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Higher Education Students' Perceptions of Online Learning during COVID-19—A Comparative Study

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Abstract: The pandemic and subsequent 'lockdowns' dramatically changed the educational landscape of higher education institutions. Before-COVID-19, traditional universities had choices in pedagogical practice, which included a variety of teaching delivery modes. Overnight, a single mode of delivery became the only option for traditional higher education institutions. All services migrated to digital platforms, leading to a period of "emergency eLearning". The full impact of this sudden shift to digital platforms on all cohorts of students is still unclear. A measure of disruption to the normal student learning experience, especially for those attending traditional universities, was inevitable. Moreover, this disruption was varied depending on the University's country and the country's lockdown logistics. This international, comparative, quantitative research project investigated and explored higher education students' perceptions of emergency eLearning during the COVID-19 pandemic. Experiences of students at universities in three countries were evaluated in terms of four dimensions: (1) home learning environment, (2) engagement, (3) participation preference, and (4) impact on learning skills. The research revealed significant differences between the participating universities students' experiences. The most important differences were in the 'home learning environment', followed by 'engagement' and the perception of 'impact on learning skills'. The differences in the 'home learning environment' can be attributed to the differing economic and digital development of the surveyed countries: South Africa, Wales, and Hungary. Finally, different cultural backgrounds suggest a noticeable difference in student engagement, participation, and learning skills.

Keywords: emergency online learning; higher education teaching; COVID-19; education; student learning experience; student participation; student engagement



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1. Introduction

The emergency lockdown—imposed by most countries during the COVID-19 pandemic in 2020—has had a profound impact on all aspects of work and social interaction for everyone. Traditional higher education institutions also had to switch overnight from a predominantly face-to-face teaching mode to a fully online mode. This necessitated a fundamental change to core teaching and assessment processes.

Not only did this disruption bring about changes to the higher education landscape [1], it also severely impacted student learning experiences [2]. Since traditional modes of teaching and learning were infeasible, an era of "emergency eLearning" [3] was ushered in.

Traditional universities suddenly found themselves in direct competition with distance education universities without their having the requisite pre-existing essential infrastructure or support services to deal with the altered teaching landscape [2]. Academic staff, in many cases, had to transform their teaching material to provide content for online delivery, without the necessary training or support to do so [4]. Even assessment strategies had to be adapted for online implementation, in contrast to traditional examination halls with invigilators [5].

The lecturers found the changes the pandemic imposed challenging, but so did the students, who not only had to transition to a new mode of learning but also had to contend with many other factors that influenced their learning experience [2]. For example, some students found it difficult, or even impossible, to study at home: possibly a reflection of their socio-economic status [2]. Furthermore, since a computer (rather than a smartphone) and Internet access, was essential to access study material, this was also problematic for some students and greatly impacted their learning experience [6]. According to Guio et al. (2018), cited in Van Lancker and Parolin (2020), neither being able to study at home nor having access to a computer is a given, even in Europe, where many learners (5%) do not have an appropriate study space at home nor do they have access to the Internet (7%). In South Africa, citizens mostly access the Internet from their smartphones but data costs are prohibitively high, making their students' situations even worse [7]. Furthermore, students in all countries, who usually have to hold down jobs to support their studies, now found themselves unemployed and without funding [2].

Aristovnik et al. [8] thus call for in-depth studies to assist the educational community to understand the ways in which ways the pandemic impacted students' learning experiences to inform future teaching practices [4]. A cursory look at the research studies of 2020/2021 suggest that several comparative studies focused on comparing countries with similar cultural and economic backgrounds, with similar educational structures and educational cultures [9,10]. A large global study conducted by Aristovnik et al. [8] compares 62 countries, but does not include Hungary, South Africa, or Wales (UK).

Educational research about the student learning experience has always been an important focus area. The proliferation of the Internet, the rate of digitalisation and the rapid development of Information Communication Technologies (ICT), has provided opportunities for a range of educational delivery modes, even before the pandemic of 2020 [11–13]. Innovative educational technology tools gradually crept into education and the use of these technologies and applications resulted in a revolutionary change in pedagogy [14,15]. Soon after the emergency online remote learning was imposed in March 2020, and even as early as May 2020, research studies were published about the impact of COVID-19 on the online student learning experience. These studies considered a number of perspectives: student learning outcomes; student motivation and engagement; the importance of attitude [16]; learning platforms and related challenges [4]. A study conducted by Martinho et al. [17] investigated the sentiment of the impact of the lockdown and pandemic on students' learning experiences. However, this was from the lecturers' perspective, not from the students'. Several case studies were conducted [18–20] but these, too, focused on specific departments or modules within a university. Both qualitative [21,22] and quantitative research [8,23–26] was conducted, both in developing [27–30], and developed countries [31–33] as well as in post-communist countries [34,35].

This study presents an original comparative study of the student learning experience, from the perspective of students, across three universities from three very different countries—Hungary, a post-communist European country, South Africa, an African country which is still arguably an emerging democracy, and Wales, a country steeped in tradition with an ancient system of democracy. These countries differ in terms of their digitalisation, economic development, historical and cultural backgrounds, and COVID-19 lockdown strategies imposed by their different governments. All three universities are residential, using face-to-face tuition as the norm, but with blended learning supported in some instances.

This research highlights how these differences affected the students' online learning experience and draws on Hofstede's [36] cultural theories of "Power Distance", "Individualism", and "Avoidance", rated on two poles: low and high (see Figure 1).

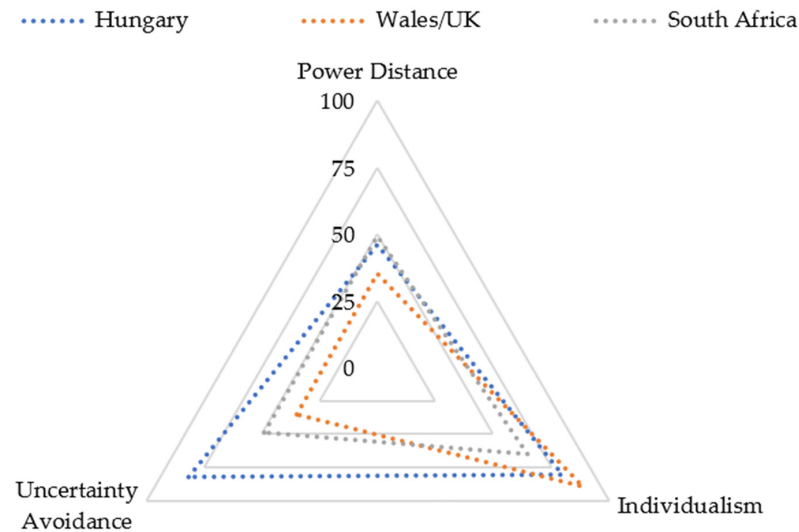


Figure 1. Cultural dimensional differences between Hungary, South Africa and Wales / UK based on Hofstede's dimensions [37], adapted by the authors.

Hofstede's 'Power Distance' cultural dimension [36] indicates the "degree to which the less powerful members of a society accept and expect that power is distributed unequally", and deals with the fact that individuals in societies are not equal, expressing the attitude of the culture towards these inequalities. Hofstede [36] defines the 'Uncertainty Avoidance' cultural dimension as "the extent to which the members of a culture feel threatened by ambiguous or unknown situations and try to avoid these", and has to do with the way that a society deals with the fact that the future can never be known, dealing with the question of whether to try to control the future or just to let it happen. The fundamental issue addressed by the 'Individualism' dimension is the degree of interdependence a society maintains among its members, which has to do with whether people's self-image is defined in terms of "I" or "we" [36].

Four dimensions of student experiences were studied: (1) home learning environment; (2) engagement; (3) participation preference and (4) impact on learning skills. The following research questions were posed:

RQ1: What digital home learning environment do students have access to?

RQ2: How did students engage in the online sessions?

RQ3: What were the student preferences for participation with the online learning platform?

RQ4: How did emergency eLearning education impact student learning skills?

The perspectives from these participating universities facilitated a comparative analysis of the student experience in the different countries, which could inform pedagogical practices in the post-pandemic period. Significant differences were found in terms of the home learning environment of students in the different countries, how engaged they were in online sessions, and their perception of how the pandemic impacted their learning skills.

The rest of the paper is organised as follows: Section 2 introduces the materials and methods used, Section 3 presents and discusses the results organised in terms of the dimensions posed, Section 4 justifies the results and finally Section 5 draws conclusions and summarizes the research as well as outlines possible future research options.

2. Materials and Methods

A self-administered questionnaire was designed to collect data from students in the three different countries. A pilot of the survey was conducted to confirm the validity

of the questionnaire, using several random students at each university and in different years of study. Some of the questions were revised after the pilot test. The Qualtrics platform offers a modern method of distributing the questionnaires to a large but specific group of respondents [38], and was thus used. The targeted respondents received the online questionnaire as a Qualtrics link in an email and were asked to spend about 10 to 15 min answering the questions. Data was collected from all three participating universities using the same questionnaire but with different links per country. The questionnaire was translated into Hungarian to facilitate ease of understanding for those participating students with Hungarian as a first language.

The researchers received ethical approval and permission from each of the respective universities to conduct the study. The questionnaire was disseminated among the respective student populations in October/November of 2020.

Quantitative analysis was conducted to reveal the similarities and differences among the three participating universities using the statistical programmes Statistical Analysis System (SAS) version 9.4 and Statistical Package for the Social Sciences (SPSS) version 25. Factor analysis—using a principal component method with a varimax rotation—was used to confirm the validity of the identified dimensions. Comparative analysis was conducted using the Chi² test to identify the significant differences in the self-reported behaviours and attitudes of students toward their online learning experience.

A decision tree using the exhaustive Chi² Automatic Interaction Detector (CHAID) splitting algorithm helped to reveal the most significant differences between the students from the three different countries. The decision tree was not used to rank the questions nor for predictive modelling, but rather to identify questions which emphasised the differences between students at the participating universities and to confirm the importance of the dimension questions. The decision tree was applied as a segmentation process [39–41] to provide a visual representation of the important questions.

2.1. Confirmation of Dimensions and Questions

Factor analysis confirmed the importance of the four identified dimensions with a significant Bartlett's Test (Chi² = 1200.554, $p = 0.000$) and a Kaiser–Meyer–Olkin (KMO) measure of 0.741, it points to a satisfactory factorisation of the dimensions [42]. The four dimensions explained 62% of the variation in the data set (see Table 1).

Table 1. Four dimensions of online learning experience—factor loadings.

Dimension	Factor Loading
Home learning environment	
I have a good learning environment at home (or where I reside)	0.659
I have the appropriate digital equipment to access the university digital environment	0.812
I am satisfied with my Internet access	0.683
Student engagement	
I miss the in-person interaction with other students	−0.809
I cannot concentrate and engage with the learning effectively when the lecture or seminar video is longer than 15 min	−0.616
I found it easy to interact with my lecturers and peers during an online lecture/seminar session	0.753
I preferred accessing the digital learning environment more than the in-person on campus learning	0.789
Participation preference	
I like to actively participate in online discussions	0.770
I always have my video on when attending an online session	0.566
I prefer to work independently	−0.494
Impact on learning skills	
The online academic education during the pandemic, helped me to become more independent as a learner	0.820
The online academic education during the pandemic, improved my digital literacy	0.801

2.2. Demographics of Participants

A total of 559 students participated in this study. After data cleaning, the information of 512 participants could be used: 240 in Hungary, 141 in Wales and 131 in South Africa (see Figure 2). The participants were mostly undergraduate students (95%) studying a wide variety of subjects, ranging from psychology to engineering. Fifty four percent were male, and 45% female; 1% did not identify with either gender. Ninety five percent of all respondents were in their 20's with a few older participants.

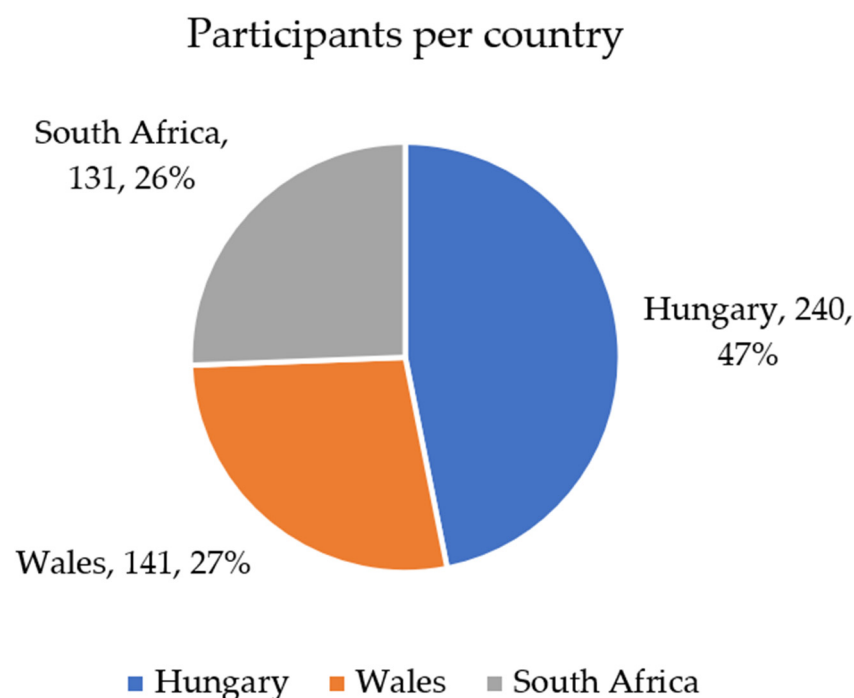


Figure 2. The number of participants from each of the countries.

Most students indicated that they were living in the country where they were studying during lockdown—97% of the Hungarian students remained in Hungary, 97% of the South African students remained in South Africa and 89% of the students studying in Wales remained in Wales. Although all the universities had students from other countries, the Welsh university had the most international participants. Students from 46 countries participated in the survey, the countries are Angola, Azerbaijan, British, China, Congo, Ethiopia, France, Ghana, Greece, Hongkong, Hungary, Indonesia, Ireland, Japan, Jordan, Kazakhstan, Kenya, Kuwait, Kyrgyzstan, Latvia, Libya, Lithuania, Malaysia, Mexico, Moldova, Mongolia, Morocco, Lesotho, Namibia, Nigeria, Norway, Poland, Portugal, Romania, Russia, Rwanda, Saudi Arabia, Slovakia, South Africa, Spain, Thailand, Turkey, Vietnam, Yemen, Zambia, Zimbabwe (46 countries).

3. Results

Sentiment analysis was used to understand which aspects of online learning the students agreed with (see Figure 3). The sentiment analysis considered all participating students' behaviour during the COVID-19 pandemic.

Most had a good learning environment at home and were satisfied with their Internet access. They did not switch their videos on when attending online sessions and struggled to concentrate and to engage with the learning environment when a lecture or seminar video lasted longer than 15 min. The majority of the participants agreed that they missed the in-person interaction and preferred face-to-face delivery. Most preferred to work independently and felt that they had become more independent and that their digital skills had improved.

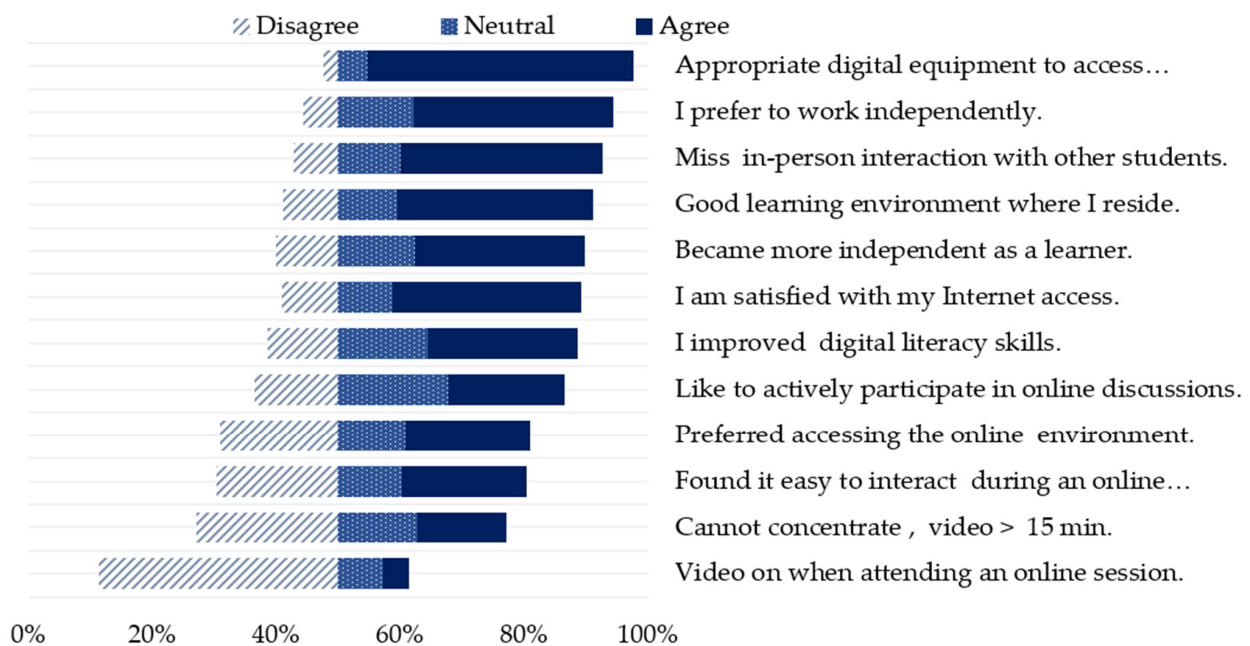


Figure 3. The student’s perceptions of their digital learning.

The comparison of the students’ self-reported behaviours, by dimension, and by country, revealed significant differences. The following reports the results in terms of the dimensions and the questions within each dimension.

3.1. Analysis of the Dimensions

3.1.1. Home Learning Environment

The learning experience of students during COVID-19 was assessed with three questions, referring to (1) good learning environment, (2) quality of the Internet access, and (3) the appropriate digital equipment to access the Learning Management System (LMS) (See Figure 4). The analysis revealed no significant differences regarding Internet access. The ‘learning environment’ and ‘appropriate digital equipment to access the LMS’, will be considered next.

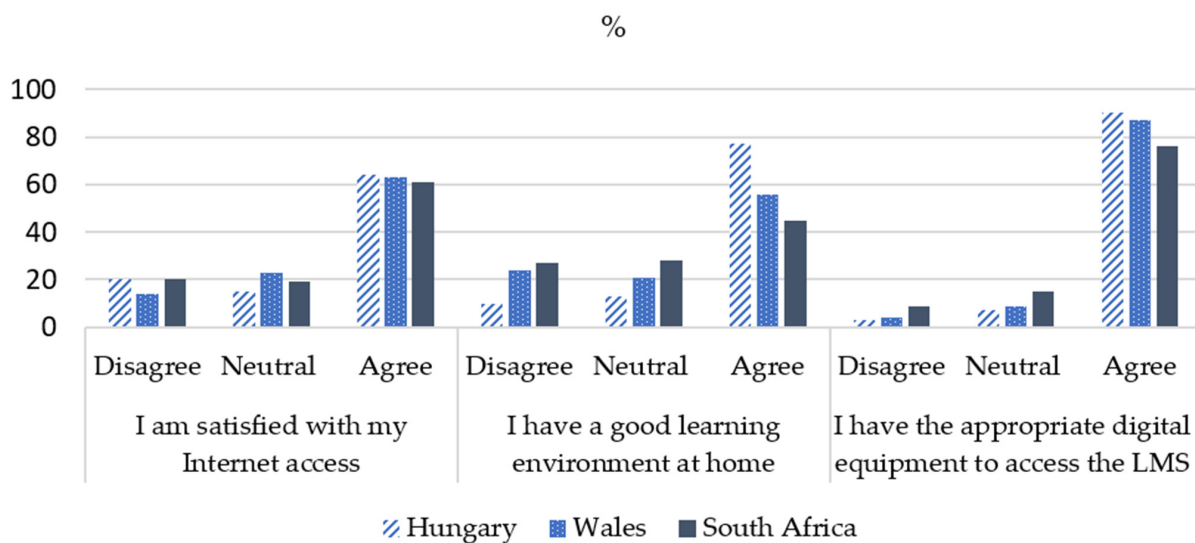


Figure 4. Home learning environment, by participating country.

The majority of all the students (63%) were satisfied with their home learning environment, but students studying in Hungary considered theirs to be “good”, as compared to students from the other two countries ($\chi^2 = 65.56$ and $p < 0.0001$). For all pairwise

comparisons within a row of each innermost sub-table Bonferroni correction was used—see Table 2 which presents the significant differences by participating university.

Table 2. Comparison of home learning environment.

Comparisons of Column Proportions		Group		
		Hungary (A)	Wales (B)	South Africa (C)
I have a good learning environment at home (or where I reside)	Disagree		A (0.001)	A (0.000)
	Neutral			A (0.001)
	Agree	B (0.000) C (0.000)		

Significance level < 0.05.

The letters used for each group (Hungary-A, Wales-B, South Africa-C) indicate the significant differences and compares the responses by group. For example, students in Hungary agreed significantly more with the statement “I have a good learning environment at home” than students in Wales and South Africa. The results are based on two-sided tests. For each significant pair, the key of the category with the smaller column proportion appears in the category with the larger column proportion.

Most participating students, in all three countries (86%), felt that they had appropriate digital equipment to access the University’s digital environment ($\text{Chi}^2 = 56.68$ and $p < 0.0001$). A significant difference was found between the different universities’ students (see column proportion comparisons in Table A1 in Appendix A).

3.1.2. Student Engagement

When analysing student engagement with online education, significant differences were found (see Figure 5). The participating students studying in Hungary (53%) preferred the digital learning environment to in-person on-campus learning. In contrast, the participating students studying in South Africa (31%) and Wales (25%) preferred face-to-face teaching ($\text{Chi}^2 = 55.77$ and $p < 0.0001$).

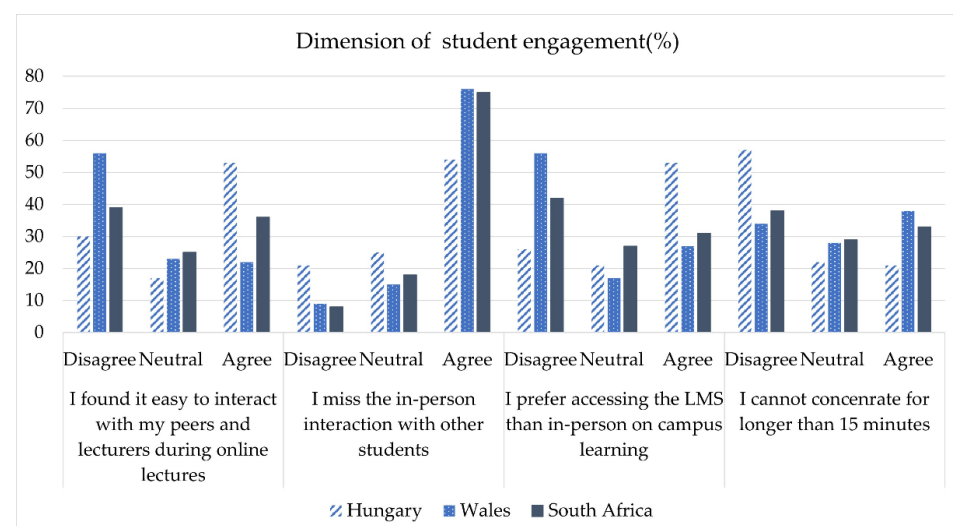


Figure 5. Student Engagement by participating country.

Students in the Welsh and South African universities significantly disagreed with the statement “I preferred accessing the digital learning environment more than the in-person on campus learning”, as compared to the students in Hungary (Table A2 in Appendix A).

The research suggests that the participating students in Hungary (53%) found it easier to interact with their lecturers and peers during online lecture seminar sessions whereas students from Wales disagreed (55%), and in South Africa, the students were not

as conclusive about this statement, with approximately similar proportions agreeing and disagreeing. ($\text{Chi}^2 = 50.64$ and $p < 0.0001$). For significance see Table A3 in Appendix A.

Both Welsh and South African students missed the in-person interaction with other students more than the Hungarian students did ($\text{Chi}^2 = 31.87$ and $p < 0.0001$). Table A4 depicts the significant differences (see Appendix A).

The Hungarian students disagreed more (57%) with the statement “I cannot concentrate and engage with the learning effectively when the lecture or seminar video is longer than 15 min long” with 34% of the Welsh and 38% of the South Africans disagreeing with the statement ($\text{Chi}^2 = 27.05$ and $p = 0.0007$), see Figure 5. Hence, the majority of the participating students studying in Hungary felt that they could concentrate for longer than 15 min (see Table A5 in Appendix A).

3.1.3. Participation Preference

This dimension compared opinions about participation in the online learning environment. Most students (77%) did not always have their video camera on when attending an online session ($\text{Chi}^2 = 44.93$ and $p < 0.0001$). Table A6 (in Appendix A) shows these significant differences between the students from the three universities.

Most students (64%), in all three countries, indicated that they preferred to work independently ($\text{Chi}^2 = 8.34$ and $p = 0.4006$) (see Figure 6). Thirty seven percent of the participants agreed that they liked to participate in online discussions, and 36% felt neutral about it ($\text{Chi}^2 = 8.91$ and $p = 0.3502$). No significant differences could be found between the respondents, by university.

Dimension of preference of student participation (%)

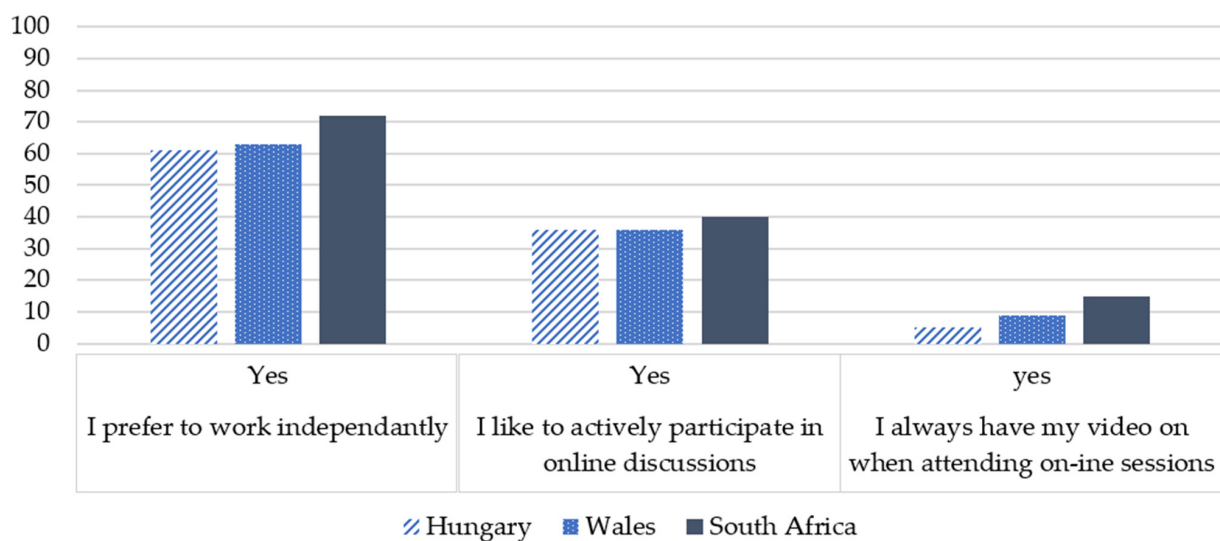


Figure 6. Participation preference.

3.1.4. Impact on Student Learning Skills

This dimension considered how or whether the digital and learning skills of students developed during the COVID-19 pandemic. The students studying in South Africa (71%) felt more strongly that “The online academic education during the pandemic, helped me to become more independent as a learner” while half (52%) of the participating students studying in Wales and 48% of the participating students studying in Hungary (see Figure 7) indicated so ($\text{Chi}^2 = 40.13$ and $p < 0.0001$). Table A7 in Appendix A depicts the pairwise comparison.

More students in the South African university (68%) agreed that “The online academic education during the pandemic improved my digital literacy”, while only 50% of the Welsh and 37% of the Hungarian students indicated this ($\text{Chi}^2 = 61.75$ and $p < 0.0001$). The pairwise

comparison can be seen in Table A8 in Appendix A, which shows the significant differences between the three universities.

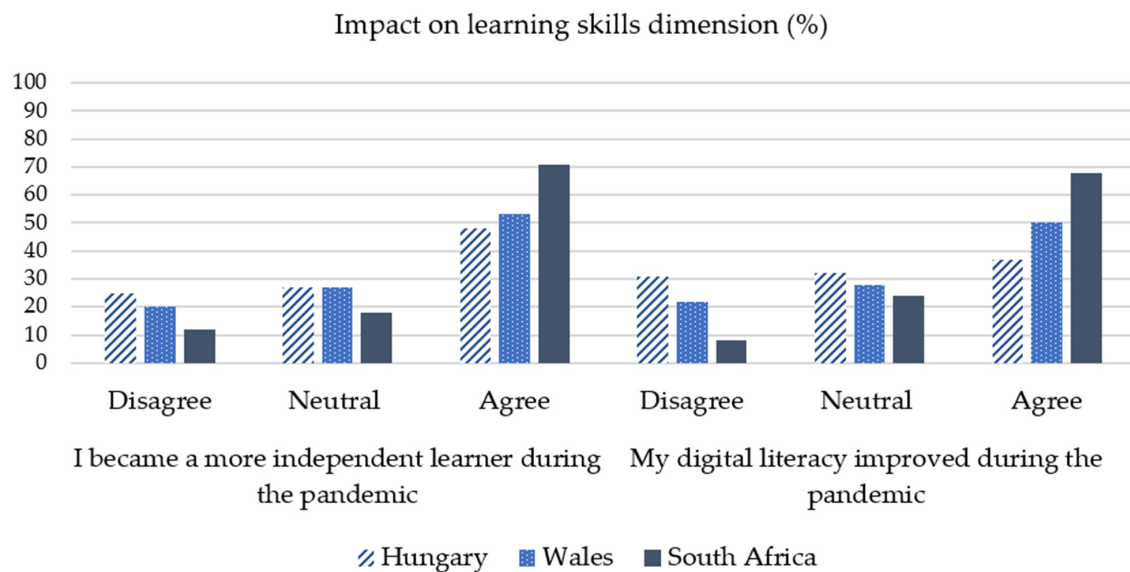


Figure 7. Impact on learning skills by participating country.

3.2. Features Shaping the Participating University Student Groups

A decision tree method was used to identify the separating questions of the dimensions that indicate the important differences between the student groups from the three universities (see Figure 8). Each dimension is represented by at least one identified question of importance, with two dimensions identifying two questions of importance per dimension.

During the tree development, only the questions where significant differences were detected were added as independent variables. The decision tree algorithm was run having either of the three countries as a target variable, which resulted in very similar trees. The criteria used were the splitting node significance level was set to $\alpha = 0.05$, the minimum number of cases in the parent node was set to 30 while that of the child node was set to 10 as the number of students in South Africa was relatively low and the goal was to gain a decision tree with sufficient depth. The maximum tree depth was set to 5 to gain as many significant splitting variables as possible.

The level 1 splitting of the tree identified “the good learning environment” as a significant difference among the students from the different universities and assigned students in South Africa to the dissatisfied, neutral group. The satisfied group is the group of students from the participating Hungarian university while participating students from the Welsh university were rather satisfied in this question and did not determine a segment.

At level 2, two separating learning experiences differentiate the students from these three universities namely, the practice of “having the video on during the online session” and the “improvement of digital literacy”.

At level 3, the leftmost leaf was split further. The question of “digital literacy” was also significant in the group which did not turn on the video camera, namely the group dominated by the students in Hungary. In this case, two further segments were defined, separated by “how easy students find to interact with the lecturers and peers”, and whether students “prefer digital learning environment or in-person on campus learning”.

The Decision tree analysis identified six-dimension questions of importance:

- Home learning environment: I have a good learning environment at home (or where I reside).
- Engagement: (1) I found it easy to interact with my lectures and peers during an online lecture/seminar session; (2) I preferred accessing the digital learning environment more than the in-person on campus learning.

- Participation Preference: I always have my video on when attending an online session.
- Impact on learning skills: (1) The online academic education during the pandemic improved my digital literacy; (2) the online academic education during the pandemic helped me to become more independent as a learner.

Each dimension is represented by at least one identified question of importance, with two dimensions identifying two questions of importance.

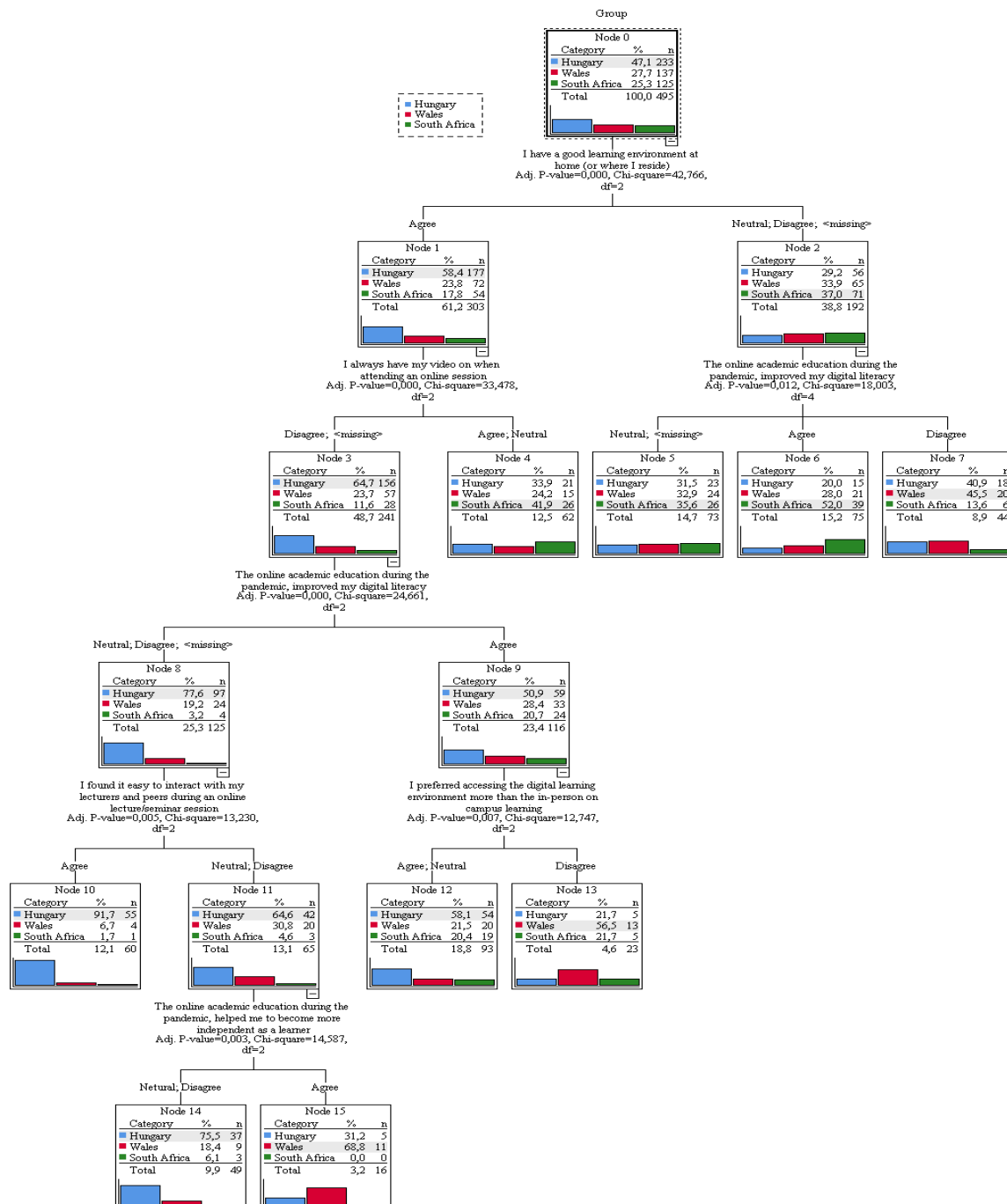


Figure 8. Decision Tree to identify the strongest separating variables.

4. Discussion

Several studies have been conducted [2,5,21,30,43] to understand and investigate the impact of the COVID-19 pandemic on higher education. This study compared the perceptions of higher education students about the impact of COVID-19 on their student

learning experience in universities from three different countries. The findings in terms of the research questions are presented next.

RQ1: *What digital home learning environment did students have access to?*

Arnou et al. argue that access to a good digital home learning environment is key to enhancing students' online experiences [44]. Our study's findings suggest that there was no significant difference in digital home learning environment. Participating students from all three universities were satisfied with their access to digital equipment, their access to the Internet, and their home learning environment. In general, the Hungarian students were more satisfied with their home learning environment.

A great digital divide exists in the South African society: most of the population live below the poverty line, with the country being one of the most unequal in the world [45]. The cost of internet access is considered expensive as compared to other countries. Affordability is thus a challenge, and people with high incomes are likely to report using the Internet more than those with lower incomes [46]. Despite this, almost half of the participating South African students indicated that they had a good digital learning environment at home. Individual participating university responses to the COVID-19 pandemic were quite different and contextualized to the needs of the students, which suggests an explanation for this outcome. For example, all participating South African students were issued with laptops, where required, purchased via the university, and credited to their student account, with free but limited data packages. Some students were given laptops as a bursary. Appropriate access to digital equipment and access to the Internet for home learning was therefore provided.

It is interesting to note that even though students indicated that they had a good learning environment at home, they did not always switch on their videos. In South Africa, this could be explained by the limited bandwidth and degradation of Internet access when video cameras were activated. It does not explain this behaviour by students in the other two participating universities.

RQ2: *How did students engage in the online sessions?*

University students are heterogeneous [47]. The student population of the Welsh participating university is a case in point, where a large proportion of the student population is not from Wales but from countries within the UK: England, Scotland, and Ireland, as well as internationally. Students from different races, culture, and affluence attend the South African university. The significant differences among the attitude of students in the online environment might be explained by this cultural diversity. Although the participating universities are not homogenous entities, the student responses from the different universities to the question "*I prefer online learning to face-to-face learning*", and the question "*I miss the in-person interaction with other students*" compares well with the differences depicted in Figure 1 (adapted from [37]), except in the case of the Welsh students.

Significantly more of the Hungarians preferred the online mode of study, more so than the South African students, which compares well with the '*Individualism*' dimension for Hungary and South Africa as countries. The Welsh students however, preferred the 'face to face' mode of study, which is an interesting contradiction to the Hofstede dimension of "*Individualism*". The impact of the change to a totally new learning management system for the Welsh students just before the lockdown period could be a contributing factor. Another factor could be that the number of participating students from Hungary in the age range 20–30 was considerably higher than the number of participating students from Wales and South Africa, who were comparatively younger. The influence of students' age and hence, experience, could have impacted responses to the question about their preferences.

A study conducted by Almaiah et al. [21] suggests that 'Culture' is one of the critical factors that affect the usage of e-learning systems. It is therefore important, when trying to understand student experiences of online learning, that the cultural aspect be acknowledged.

Hofstede [36] suggests that societies that present with a large degree of '*Power Distance*' accept what the hierarchy imposes. In societies with low '*Power Distance*', reasons for

inequalities are sought. Our results showed that participating Hungarian students found it easier to interact with their lecturers and peers during online lecture seminar sessions than students from Wales and South Africa.

The 'Uncertainty Avoidance' cultural dimension can be used to explain the responses from the participating Hungarian students when asked the question "*I find it easy to interact with my lecturers and peers during the online lectures or seminar sessions*", as the majority of these students agreed with this statement. The South African and Welsh students disagreed and were uncertain about this. The combination of the lower level of 'Uncertainty Avoidance', and higher level of Individualism suggests a more flexible attitude to emerging and changing environments and encourages creativity and innovation [36].

The Hungarian students agreed that they could concentrate and engage with the learning effectively when the lecture or seminar video was longer than 15 min. The Welsh and South African students disagreed with this statement. Research indicates that the average adult attention span is 8 s, and that videos under 5 min will generally garner the most user engagement [48]. Anderson (2014), cited in [49] indicates that "*... the length of a TED talk—18 min—is one of the key reasons behind the format's success, indicating that this length of time is long enough to be serious and short enough to hold people's attention*".

The Welsh and South African students preferred face-to-face teaching and learning. The results of this study are similar to a study conducted by Besser et al. [50], who found that traditional face-to-face learning was generally preferred to online learning. It is interesting to note that the participating students from the Hungarian university preferred the online learning mode of teaching.

RQ3: *What were the student preferences for participation with the online learning platform?*

The country comparison, with respect to their preferences related to having their video camera on during an online session, was found to be significant, with all the participating students preferring not to have their video cameras on. This could also be explained by the Hofstede [36] 'Individualism' dimension for these three countries, with slightly more of the participating students from Wales and Hungary (with higher Hofstede individualism scores, see Figure 1) preferring not to switch on their video cameras.

RQ4: *How did emergency eLearning education impact student learning skills?*

This research suggests significant differences. The majority of the South African participants indicated that the emergency eLearning education during the pandemic improved their independent learning skills, while only half of the participants from Wales, and less than half of the participants from Hungary agreed that: "*The online academic education during the pandemic, helped me to become more independent as a learner*". Here, again, Hofstede's [36] 'Individualism' cultural dimension could be explanatory, as South Africa is generally considered less individualistic than Wales and Hungary (see Figure 1). The emergency eLearning provided these students with the opportunity to improve their independent learning skills.

It is interesting to note that more South Africans agreed that "*The online academic education during the pandemic, improved my digital literacy*", but only half of the Welsh and even fewer of the participating Hungarian students indicated this. The policy responses from the participating universities to address the challenges and impact of the pandemic on their emergency provision of education, were different.

The response from each of the universities reflected the educational needs of the students. For example, in South Africa, a majority of the students normally only have access to digital equipment at their university. This university responded by subsidising each student who did not have the necessary resources with a purchased and discounted laptop and free, but limited data bundles were included in the package deal provided to these students. Mobile Service Providers in South Africa also allowed students to access the university websites free of charge.

Even so, many of these students had to learn different and new digital skills even though access to digital resources might not have been an issue. This can be explained by the Digital Intelligence Index (DII) of a country. This index refers to the country's "*...*

economy's digital trajectory as a function of two factors: its current state of digitalization, and its pace of digitalization over time" [51]. According to this index, the United Kingdom is currently digitally advanced, but the pace of advancement is showing signs of slowing. Furthermore, this index suggests that Hungary, as well as South Africa, has significant challenges in terms of their digitisation, and its slow development, which is in keeping with the participating university's emergency educational response.

Students who did not have a good learning environment at home were not always convinced that their digital literacy had improved. The participating students from South Africa dominated in their perception of their digital literacy being improved or were neutral. However, on the contrary, participants from Wales did not consider their digital literacy skills to have improved.

The question of "digital literacy" was also significant in the group that did not turn on the video camera, namely the group dominated by Hungarian students. In this case, two further segments were defined, separated by "how easy students find to interact with the lecturers and peers", and whether students "prefer digital learning environment or in-person on campus learning". Students from the participating Welsh University dominated the group that prefers in-person on-campus learning while the Hungarian group preferred the digital learning environment. At the same time, students studying in Wales who did not find it easy to interact with the lecturers and their peers during the online sessions, became more independent learners.

5. Concluding Remarks and Future Work

A comprehensive comparison of the students from the three participating universities helped the authors to expose the dimensions of difference. The dimension-related questions helped to explain the different perceptions of students' experiences of the emergency online learning during the COVID-19 'lockdown' and explored different attitudes and self-reported behaviours.

This study provides insights which can inform university authorities and academic researchers. It will help to manage the challenges of online learning and the necessary factors that need to be taken into consideration to ensure an optimal student experience. Based on the results from this study, several suggestions can be made to influence future pedagogical approaches to university teaching:

1. The younger students preferred face-to-face teaching and found it difficult to engage with lecturers and peers online, which may suggest that blended learning could be introduced later in students' academic studies.
2. There were significant differences between the responses from the participating universities within the three countries, in terms of how students experienced the online learning environment. This depended on how the country responded to the pandemic crisis, the support provided to students, and the resources made available. It is clearly important to understand the digital requirements of students, as well as the challenges of their home study environments, and to provide access to study spaces to those not privileged enough to have appropriate home learning spaces.
3. The development of the online study content requires careful consideration to ensure that the study sessions incorporate enough activities to keep students engaged.
4. Opportunities should be created for developing digital, information and academic skills early on in University careers, so that students learn to become independent learners.

Limitations relate to the restricted sample of students and the fact that only one university in each country participated. This research could be expanded to include more universities from the original participating countries as well as universities from other countries.

The next phase of this research study investigates the question of equitable access to digital technologies and the perceptions of risk of cyber security and safety and related student behaviours when conducting their online learning.

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Appendix A

Table A1. Comparison of appropriate digital equipment.

Comparisons of Column Proportions		Group		
		Hungary (A)	Wales (B)	South Africa (C)
I have the appropriate digital equipment to access the university digital environment	Disagree Neutral Agree	C (0.001)		A (0.022)

Significance level < 0.05.

Table A2. Participation Preference.

Comparisons of Column Proportions		Group		
		Hungary (A)	Wales (B)	South Africa (C)
I preferred accessing the digital learning environment more than the in-person on campus learning	Disagree Neutral Agree	B (0.000) C (0.000)	A (0.000)	A (0.005)

Significance level < 0.05.

Table A3. Ease of interaction during online session.

Comparisons of Column Proportions		Group		
		Hungary (A)	Wales (B)	South Africa (C)
I found it easy to interact with my lecturers and peers during online lecture/seminar sessions	Disagree Neutral Agree	B (0.000) C (0.007)	A (0.000) C (0.021)	B (0.036)

Significance level < 0.05.

Table A4. Preference of in-person interaction with peer students.

Comparisons of Column Proportions		Group		
		Hungary (A)	Wales (B)	South Africa (C)
I miss the in-person interaction with other students	Disagree	B (0.008)		
	Neutral	C (0.004)		
	Agree		A(0.000)	A(0.001)
Significance level < 0.05.				

Table A5. Comparison of concentration on videos longer than 15 min.

Comparisons of Column Proportions		Group		
		Hungary (A)	Wales (B)	South Africa (C)
I cannot concentrate and engage with the learning effectively when the lecture or seminar video is longer than 15 min	Disagree	B (0.000)		
	Neutral	C (0.004)		
	Agree		A (0.002)	
Significance level < 0.05.				

Table A6. Comparison of whether students have their video on during an online session.

Comparisons of Column Proportions		Group		
		Hungary (A)	Wales (B)	South Africa (C)
I always have my video on when attending an online session	Disagree	C (0.000)	C (0.002)	
	Neutral			A (0.000)
	Agree			B (0.014) A (0.003)
Significance level < 0.05.				

Table A7. Comparison of how independent students could become as learners.

Comparisons of Column Proportions		Group		
		Hungary (A)	Wales (B)	South Africa (C)
The online academic education during the pandemic, helped me to become more independent as a learner	Disagree	C (0.014)		
	Neutral			
	Agree			A (0.000) B (0.011)
Significance level < 0.05.				

Table A8. Comparison of how students perceive their digital literacy improvement.

Comparisons of Column Proportions		Group		
		Hungary (A)	Wales (B)	South Africa (C)
The online academic education during the pandemic, improved my digital literacy	Disagree	C (0.000)	C (0.004)	
	Neutral			
	Agree		A (0.036)	A (0.000) B (0.011)
Significance level < 0.05.				

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