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The Online Teaching System as a Sustainable Way of Learning

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Abstract: The COVID-19 pandemic, in addition to the sometimes-dramatic effects in the health sector, presented a wide range of challenges for the various sectors of the national economies. This article refers to the effects of the pandemic in the university field, especially for the period of 2021 until now. The period corresponds to the end of the pandemic overlapping with the post-pandemic return to normal. Although at the beginning of the pandemic the effects seemed terrible, being widespread and long-lasting, some effects were still useful and motivational for the "real world". The effects in question are those of compulsory online teaching, so on a large scale, of all subjects from all disciplines. The authors modeled and implemented a database system that includes several types of tests to generate representative samples from the university population. In the content of the article, two such tests are exemplified for a single one-semester discipline: "Computer programming and programming languages II". The experience of the authors revealed, by comparison, practical ways to teach the theory provided in the states of functions in the real world, using exclusively the online or the mixed environment. Finally, we provide a brief conclusion and ideas for future work.

Keywords: online; e-learning; sustainable; motivation; theory; practice; COVID-19

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1. Introduction

The COVID-19 pandemic had a rapid spread throughout the globe, and left a significant mark on all the economic, social and health domains of people. The pandemic has forced people to change their way of life, to adapt and develop new ways of doing business and interacting. Among the major and visible things that the pandemic did was to accelerate the adoption of digital technologies in many sectors of economies around the globe. Before the outbreak of this pandemic, digital transformation had already been implemented at faster or slower rates in different economic sectors. In developed countries, the general pace was faster than most developing economies where the pace was slower or much slower [1,2].

Among the many different sectors affected by COVID-19 is the higher education sector. This sector is one of the most important sectors of any economy because it contributes to socio-economic development through the development of human capital, research, and the retention, development, dissemination, transmission and use of knowledge [3].

Some of the precautionary measures taken by the governments of the world to stop the rapid transmission of COVID-19 were social distancing followed by a directive to close public institutions including those of higher education, and campuses around the world [4,5]. This measure initially proved to be a big setback for the education sector in general, because classical teaching with a physical presence suddenly turned into online teaching on various platforms [6]. Online teaching and learning require digital technologies such as learning management systems (LMS), suitable computers or tablets and good internet connectivity. In Romania, most universities were familiar with this type of education (there were courses taught online for distancelearning study programs and they had implemented various

online teaching platforms at the university level). All students, almost without exception, had a laptop or desktop with an Internet connection.

Online teaching and learning in the pre-university environment in Romania was more difficult, especially in rural areas, where many children did not have access to technology and/or the Internet. With the pre-university schools not having implemented an online platform, the teachers decided by themselves, at least at the beginning, how to contact their students and which online system to use.

The main objectives of the paper are to show, first of all, that using online teaching can achieve similar results (sometimes even better) compared to classic face-to-face teaching, in terms of learning or assimilation of knowledge. Secondly, by using the online teaching system, there are additional economic and ecological benefits, making online education a possibly more sustainable choice. Thirdly, the article investigates the effectiveness of the e-learning platform proposed by Transilvania University of Brașov (https://elearning.unitbv.ro, accessed on 5 September 2022) from Romania, which is based on the Moodle platform, regarding the sustainability of student learning in a real teaching context. Fourthly, the research also has a multidisciplinary component, following whether the proposed learning method applied to the PLCP course had an impact on other subjects studied or to be studied. Thus, the research also follows a transversal approach, through different levels of study from bachelor's level to master's level.

Examples of online learning management systems in higher education in Romania include Blackboard Learn, Moodle, Google Classroom and Adobe Captivate. The outbreak of the pandemic led to an acceleration and an obligation to use the online environment in higher education. There has, thus, been a total change from the old face-to-face education practiced in most higher education institutions to online teaching and learning. While traditional classroom teaching and learning used books, chalk, blackboards and/or an overhead projector, the online mode uses digital technologies such as computers, laptops, tablets and smart phones, as well as LMS, software applications, websites, social media, etc.

Education using technology has been on the rise for the past 50 years. There are different theories related to the way of teaching so that human learning processes give maximum results, such as: multiple intelligences, behaviorism, cognitivism and constructivism, anchored instruction, innovative diffusion, and experiential learning [7–12].

This study focused on connectivism because it is the most relevant technology-influenced theory. The foundations of the theory were laid by George Siemens in 2004 [13,14]. According to Abad-Segura et al., connectivism explains the role of Internet-related technologies in creating new opportunities for teaching and learning, as well as information exchange [15].

In recent years, also due to the pandemic context, the science of learning has made significant progress in understanding the effective principles of teaching and learning. There is solid evidence and specific recommendations regarding strategies that can be used by teachers and students to maximize learning effectiveness [16,17]. Based on this research, we explored the effectiveness of several learning strategies that are embedded in an e-learning platform to improve student learning performance in a variety of subjects such as: computer programming and programming languages, technical drawing and infographics, reinforced concrete structures, special reinforced concrete structures, reinforced and prestressed concrete, metal constructions, rehabilitation of reinforced concrete and prestressed concrete structures, etc. The common strategies followed were those related to the way of designing the documentary material presented to the students, the way of designing the evaluation tests, the test exam, and the feedback.

Compared to those described above, online education has another benefit in terms of environmental sustainability. In this sense, we can mention the positive effects on the environment, e.g., if the teaching is carried out online, only a small amount of electricity is needed per hour for the operation of digital technology, i.e., computers. Compared to the classic teaching system, which also uses electricity per hour for the operation of one or more computers, overhead projectors, lights, etc., there is additional transport for teachers, especially students, which causes a lot of movement and pollution.

2. Materials and Methods

The present study investigated the effectiveness of the e-learning platform proposed by Transilvania University of Brasov (https://elearning.unitbv.ro, accessed on 5 September 2022) from Romania, which is based on the Moodle platform, in a real teaching context. As an example, the course and papers of the subject "Computer programming and programming languages II" were chosen, a subject included in the list of functions in the second year, the second semester at the Faculty of Construction within Transilvania University. A number of 20 students participated from the second year who are currently taking the courses and seminars in the classic mode, as well as a number of 24 students from the third year who passed the courses and seminars of this discipline in 2021 in the hybrid mode, i.e., the course had teaching entirely online and the seminars had physical presence at the faculty, with Romania being still in the period of the pandemic.

The platform offers numerous facilities, starting from the way of creating courses and enrolling students and ending with various forms of examination, grading of exams and obtaining student feedback. Through the e-learning platform of University Transilvania of Brasov, during the pandemic, both teaching and dialogue with students took place online at all courses and seminars according to the schedule. Different course or seminar materials were also uploaded through the platform. The students' examinations, either written or oral, took place online on the same platform. Students and teachers used the e-learning platform in a collaborative way, giving and receiving feedback. It was found that students who use the e-learning platform as a support in their learning process have better learning performance compared to students who learn the same content using the classical learning mode. The surveys were offered on a voluntary basis and were carried out in an interdisciplinary manner, with participants from different fields of education and at different levels of study, both at the bachelor's and at the master's level.

The results indicate that the development of a learning platform based on empirically validated strategies could help students to better regulate their learning and achieve their goals. The results also indicate that the use of the proposed platform improved the students' learning performance. It can be concluded that the platform can be effectively implemented in the teaching process as an effective means of stimulating learning. Due to the fact that from the questionnaires physically completed by the third-year students who passed the courses and seminars of this discipline in a hybrid way, there were some who had some "technical problems of sound interruption, during the online course", it can be concluded that the most efficient teaching method is the one with a physical presence, using the overhead projector connected to a computer, with the course or seminar support being transmitted on the e-learning platform.

The experimental studies were conducted on two cohorts of students. The first cohort contained 75 students (52 male and 23 female) who follow the course and the works of the discipline "Computer programming and programming languages II" (the acronym in Romanian being PLCP); the second cohort contained 63 students (45 male and 18 female) who followed, a year before, the course and the works of the same PLCP discipline. The PLCP discipline is included in the curriculum of the Department of Civil Engineering in the second year, second semester at the Faculty of Construction of the Transilvania University. In order to verify and control the results obtained from studying the students' activity, a number of 20 students (13 male and 7 female) from the first cohort (out of a total of 75 students) were physically questioned on the e-learning platform, as well as a number of 24 students (14 male and 10 female) from the second cohort (out of a total of 63 students).

The main objective of the PLCP course, contained in the course syllabus, specifies that "Students must be able to know and understand the basic concepts of computer-aided technical drawing; they will be able to develop professional drawings using established principles and methods in the field of technical drawing for constructions. Students will have CAD computer-aided design skills, they will know the most important 2D drawing commands in AutoCAD".

It is important to specify that the first cohort of 75 students are currently in their second year. They participate in this academic year, on the PLCP courses and seminars. Teaching is done face to face, as the pandemic restrictions have been completely suspended. Since it was found that the students have a better tendency to concentrate on the explanations received if they do not have to take too many notes, the courses took place in a physical format in a lecture hall. Emphasis was placed on more detailed explanations and examples were displayed on the overhead projector, the course being loaded further onto the e-leaning platform, thus being similar to the online teaching method.

The second cohort of 63 students are currently in their third year of study, and all 24 students passed the courses and seminars of the PLCP discipline in 2021, the year in which the courses and seminars took place in a hybrid way, i.e., the course was taught entirely online, and the seminars had a physical presence at the faculty, with Romania being still in the pandemic period.

Based on the answers received from students from both sets of questionnaires, the research also followed a transversal approach, through different levels of study, starting from the bachelor's level to the master's level. Thus, the article also has a multidisciplinary research component, establishing that the proposed effective learning method applied to the PLCP course had an impact on other studied disciplines.

Appendices A and B show the standard questionnaires for the two groups of students taken as a representative model. For students following the PLCP course, we have Appendix A: questionnaire 1, for students who have followed the PLCP course, we have Appendix B: questionnaire 2.

Having available documentary materials related to environmental pollution, the article could also address the sustainability component of online education.

3. Results

Below are presented the results and answers given by the students after completing the two types of questionnaires described above.

3.1. Results for Questionnaire 1—PCLP II

Following the centralization of the results and answers from questionnaire 1, Tables 1–5 and Figures 1–5 were prepared from which important data related to the objectives pursued in the article could be extracted. According to Table 1 (Figure 1), the questionnaires were completed by 13 male and 7 male students, respectively. Through table no. 1, gender of the respondent, it was analyzed whether there were major differences between male and female respondents in terms of interest in this discipline and whether or not they encountered the same problems at the time of learning.

Table 1. Gender of the respondent.

Gender	Male	Female
	13	7

Table 2. Respondents' level of programming knowledge.

Level of Programming	Advanced	Medium	Elementary	Not at All
	0	7	8	5

Table 3. The percentage of attendance at the course and at the laboratory.

Percentage of Attendance	75–100%	50–75%	25–50%	0–25%
course	15	5	0	0
laboratory	20	0	0	0

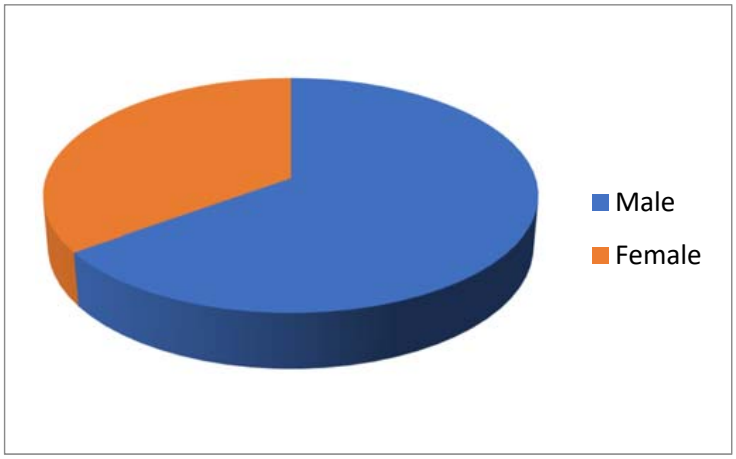

Figure 1. Gender distribution.

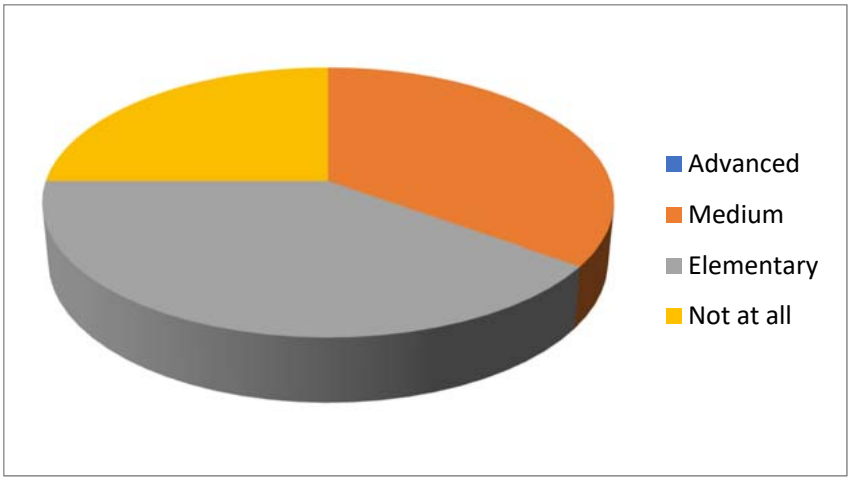

Figure 2. Programming level.

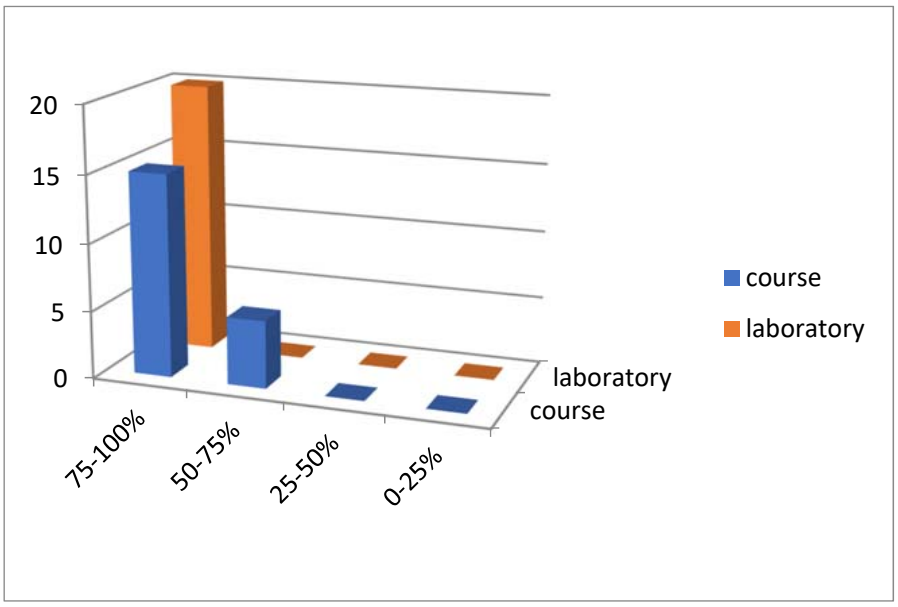

Figure 3. The percentage of attendance at the course and at the laboratory.

Table 4. The usefulness of the course for other disciplines.

Very Much	A Lot	A Little	Not at All	I Do Not Know
6	11	2	0	1

Table 5. Usefulness of the course after graduation.

Very Much	A Lot	A Little	Not at All	I Do Not Know
10	10	0	0	1

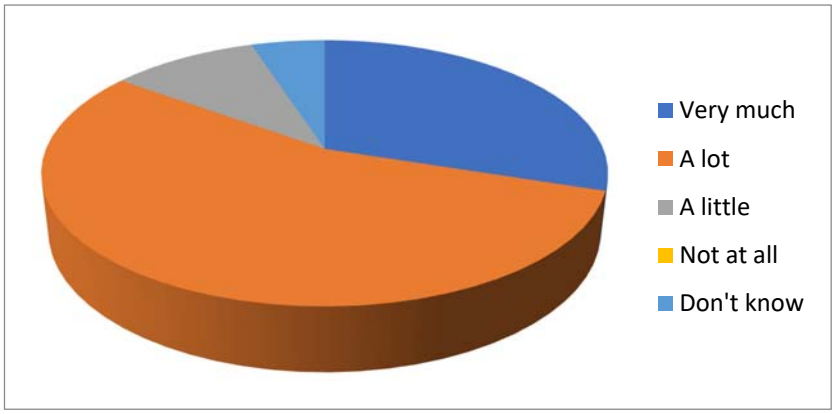

Figure 4. Course usefulness for other disciplines.

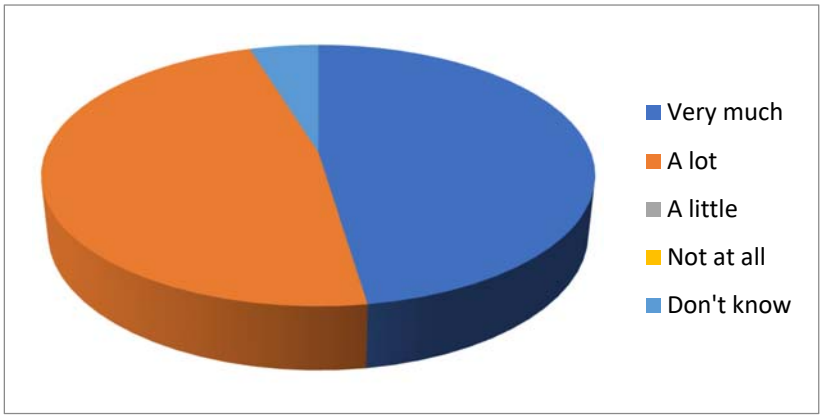

Figure 5. Course usefulness after graduation.

From Table 2 (Figure 2), we can see the level of programming knowledge of the respondents. We notice that no student has an advanced theoretical base before starting the course, but most of them have elementary and average programming knowledge. We can deduce that the students will be interested in deepening their knowledge of programming and will be able to keep up with the explanations that will be taught both in the theoretical and the practical part.

The PCLP discipline was also chosen for the reason that, regardless of the online or face-to-face teaching method, it is necessary to use the computer. From the question "In what proportion do you think you will participate in the course/laboratory hours?" the students understood that in this discipline the digital technique will be used, and from their answers, the vast majority will participate in the course and in the works. From this, it can be deduced that the students have a great willingness to use software and digital technology. Table 3 (Figure 3) shows the percentage of participation in the course, respectively, in the laboratory, anticipated by the students. When the actual attendance was

checked, it was found that it was a little higher, so the students anticipated very well the participation in the class or laboratory hours.

From the questions "Do you think this course will be useful for other disciplines?" and "Do you think the discipline will be useful to you after you graduate?", the respondents interest in the general curriculum of the study program chosen at the beginning of the education cycle was followed, that is, if they knew and understand the functions of the subjects taught or those that will be taught. From the answers received, it was concluded that most of the students knew very well and had studied the university curriculum provided by the faculty. Table 4 (Figure 4) summarizes the students' answers to the fourth question from the questionnaire, and Table 5 (Figure 5) presents the students' answers to the fifth question from the questionnaire.

The question "What difficulties do you think you will encounter?" from questionnaire 1, corroborating the questions "What difficulties did you encounter during the lessons?" and "What problems did you face in laboratory classes?" from questionnaire 2 is of particular importance in the context of this article, because from this question, it was possible to draw important conclusions related to the two classical methods of face-to-face teaching compared to online. The answers to the question were: "technical difficulties"—three students, "keeping certain tasks"—five students, "too little information from the teaching staff"—one student, "insufficient interest on my part"—one student, " lack of knowledge of the English language"—one student, "difficulties in programming and solving assignments"—two students, "complexity of the program"—one student, "too many new things"—one student, "mistakes when entering data"—one student, and "there will be no difficulties"—six students.

To question 7, "What is the main reason why you will participate in the course?", the following answers were received: "to learn how to use the program by attending the course—9 answers", "to better deepen the knowledge of programming—5 answers", "curiosity—2 answers", "the desire to accumulate as much as possible a lot of knowledge—3 answers", "the desire to surpass myself—1 answer", "to learn a new programming language—1 answer", "it is part of the education curriculum—1 answer", and "because it is widely used in the field of civil engineering—1 answer".

To question 8, "What is the main reason why you will participate in the laboratory classes?", the following answers were received: "to learn how to use the program by participating in the laboratory—4 answers", "to practice the knowledge learned in the course—11 answers", "to pass the exam—1 answer", and "to better deepen the knowledge of programming—6 answers".

To question 9, "What are your expectations from this course?", the following answers were received: "Promoting the exam—4 answers", "I have no expectations—3 answers", "to understand the use of the program—6 answers", "to deepen the knowledge of programming—4 answers", and "accumulation of knowledge in the field of civil engineering 4 answers".

To question 10, "What concepts do you think will be taught in the course?", the following answers were received: "notions about the technical language—2 answers, "notions about programming in AutoCAD—11 answers", "notions specific to the field of civil engineering—5 answers, and "I do not know—2 answers".

3.2. Results for Questionnaire 2—PCLP II

Following the centralization of the results and answers from questionnaire 2, the following data were obtained.

The questionnaires were completed by 14 male students, and by 10 female students (Table 6, Figure 6). From question no. 1, "Gender of the respondent" was followed if there were major differences between the male and female respondents in terms of interest in this discipline and whether or not they encountered the same problems at the time of learning.

Table 6. Gender of the respondent.

Gender	Male	Female
	14	10

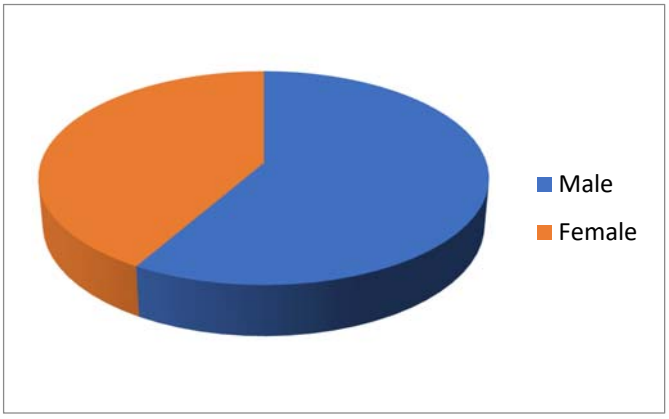

Figure 6. Gender distribution.

To the question "Did you enjoy the Computer Programming and Programming Languages II course and laboratory?", we aimed to see if the respondents did not have a theoretical basis for programming before the start of the course (Table 7, Figure 7).

Table 7. Appreciation of the quality of the teaching method of the respective course of the programming laboratory and computer programming languages II.

	Very Much	Much	Neutral	A Little	Not at All
course	11	7	5	0	1
laboratory	11	6	6	0	1

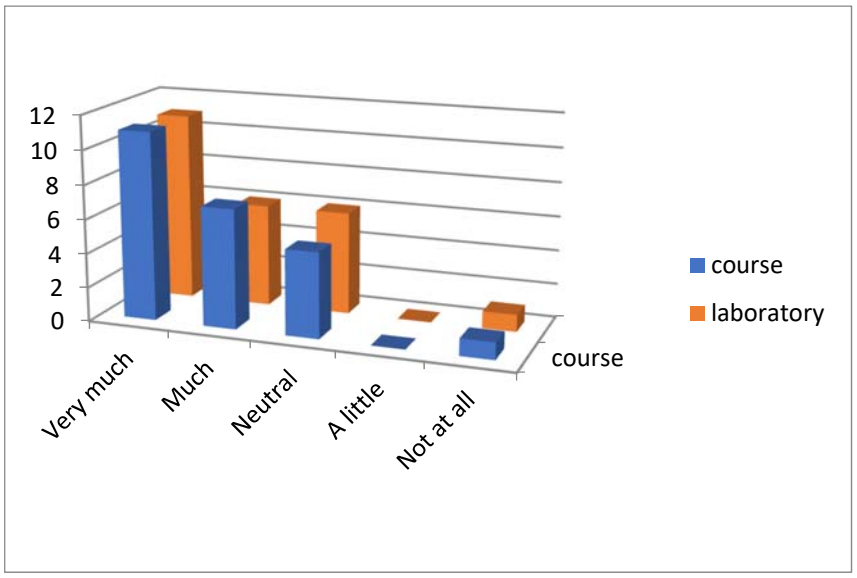

Figure 7. The percentage of attendance at the course and at the laboratory.

The PCLP discipline was also chosen for the reason that regardless of the online or face-to-face teaching method, use of a computer is needed. From the question "Do you think the discipline was/is/will be useful for other subjects?", most students answered yes (23 students answered yes, 1 student was not sure about the answer, and no student

answered no). This question was corroborated with the following: "If you answered "yes" to question 3, do you remember one/several subjects?".

To question 4, the following answers were received: "Reinforced and prestressed concrete—14 students", "Communication roads—2 students", "Wood—8 students", "Civil constructions—15 students", "Projects of specialized courses—3 students", and "Technical drawing and infographics—1 student". From the answers received, it was concluded that most students have studied and know the university curriculum provided by the faculty.

According to the answers to question 5, "Did you participate in the course/laboratory classes?" it can be seen in Table 8, or Figure 8 that the vast majority of students participated in the proportion of over 50% of both courses and papers. The increased interest in this discipline was also due to the fact that digital technology was exclusively used. It was thus deduced that students have a great availability and are interested in using software and digital technology.

Table 8. The percentage of attendance at the course and at the laboratory.

Percentage of Attendance	75–100%	50–75%	25–50%	0–25%
course	14	7	1	2
laboratory	18	4	2	0

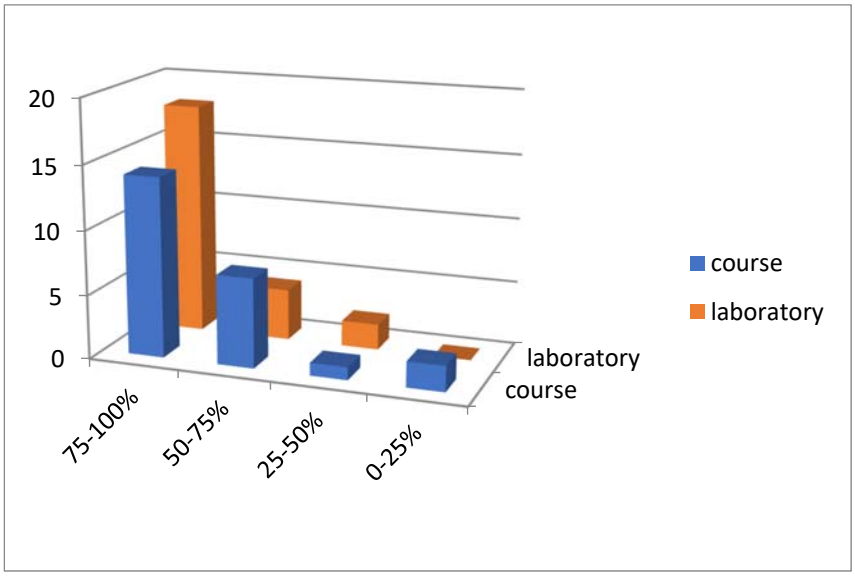

Figure 8. The percentage of attendance at the course and at the laboratory.

From the questions "Did the course meet your expectations?" and "Did the laboratory meet your expectations?", the respondents' interest in the general curriculum of the study program chosen at the beginning of the education cycle was followed. After completing and passing the final assessment, it was observed that the discipline approached the expectations that the students had (Table 9, Figure 9). The conclusion was drawn that most of the students were not negatively affected by online teaching.

Table 9. The level of fulfillment of the respondents' expectations regarding the course and the laboratory.

	Yes	Partially	Not at All
course	17	6	1
laboratory	16	7	1

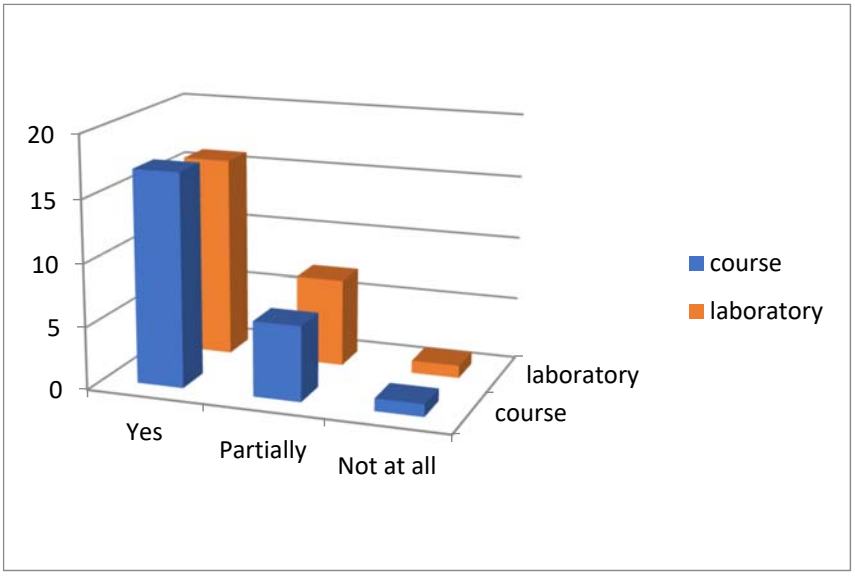

Figure 9. The level of fulfillment of expectations.

Questions 8 ("What difficulties did you encounter during the course classes?") and 9 ("What problems did you encounter in laboratory classes?") present a particular importance in the context of this article, because from these questions, it was possible to draw important conclusions related to the online teaching method (course) compared to the face-to-face teaching method (laboratory). The answers to question 8 were: "There were no problems—17", "Solving specific problems simultaneously with following the course—2", "Technical problems with sound interruption—1", "Specific disadvantages of the online environment—2", "schedule—1", and "Not understanding the use of some commands—1". The answers to question 9 were: "There were no problems—13", "Small differences between the information received from the laboratory compared to that from the course—1", "The laboratory period was too static and monotonous—1", "There were not sufficiently exemplified some commands explained in the course—2", "timetable—1", "Misunderstanding of the scale representation of the drawings—1", "The calculators in the laboratory are old—1", and "Too few explanations—6".

To question 10, "What was the main reason why you attended the course classes?", the following answers were received: "the discipline was interesting—3 answers", "the teacher taught properly—2 answers", "for the enrichment of knowledge—18 answers, and "presents in class—1 answer".

To question 11, "What was the main reason why you attended the laboratory classes?", the following answers were received: "the discipline was interesting—1 answer, "The teacher taught properly—1 answer", "For the enrichment of knowledge—18 answers", "Present—2 answers", "For the priority assignments that were reflected in the final grade—2 answers", and "It was a mandatory condition for entering the exam—1 answer".

To question 12, "How confident are you in programming—designing a structure?", the following answers were received: "I gained more experience—6 answers", "I still need help from the teacher—10 answers", "very confident—3 answers", and "I still have a lot to learn—5 answers".

To question 13, "Which part of the course do you think was the most useful for you?", the following answers were received: "the part when the office programs were also used—2 answers", "the second part of the course related to the technical notions specific to Civil Engineering—5 answers", "the first part of the course when they were taught basic commands—5 answers", "practical exercises—4 answers", "using offset and array commands—1 answer", and "the whole course—9 answers".

4. Discussion

COVID-19 has left an unmistakable mark on the world stage. It has changed the global socio-economic landscape, forcing each person to adapt and accept new ways of life, concerns, business, learning, etc.

Education, be it pre-university or especially university education, is a very important sector of an economy, especially because it includes a very large number of people. In this sector, work that requires physical presence can be replaced, at least partially, with online work from home.

In the online mode compared to the classic teaching mode, the professor–student interaction increased more, and the explanations were more elaborate. The students focused more on the explanations they received; they did not have to take too many notes, because the course support already existed on the platform. There were situations when the teachers' presentation was recorded, with the students declaring that it was enough for them to listen to the recording a few times and thus prepare for the exam.

The relevance of the effects of examination on learning has been highlighted by a lot of studies in the field. Many of these studies have indicated that practice testing of a subset of information also influences memory for other related, untested information [18,19].

During the pandemic, in most subjects, the examination was written in the form of a grid test, compared to the classic written examination, where three or more subjects proposed by the teacher were developed. The scoring accuracy of the evaluation proved to be slightly higher in grid tests compared to classical testing. However, if we talk about the overall learning of the subject by the student, classical testing proves to be more effective. In the case of the oral examination, although apparently similar, the face-to-face oral examination with safety is more effective than the online one.

The feedback had the quality, on the one hand, of directly understanding the students' problems related to their learning ability, observing the portions of the course where the subject was understood and learned adequately or, on the contrary, observing the portions of the course where the subject was not understood and/or the course was not explained well enough. Feedback also has the quality of improving learning by revealing to students what they know and what they do not know, and at the same time is a strategy for increasing metacognition—our understanding of our own learning process. Furthermore, the implementation of feedback in practice tests is strongly recommended because studies show that this association protects against errors and perseveration when frequently answering incorrectly on practice tests.

4.1. Discussions Related to the Effects of the Pandemic on Education

One of the most significant effects of the pandemic has been the acceleration of the use of digital technologies in many areas of the global economy. In the higher education sector, the closure of all faculties and campuses put an end to face-to-face teaching. To continue teaching and learning, however, required the most rapid change yet seen in this field. There has been a sudden shift to online learning, which is mainly based on digital technologies [20].

In this sense, universities had to promote an innovative type of teaching, encouraging employees to take risks and learn from their mistakes. Technology, in addition to being a tool for school reform, has also become a critical, necessary component [21,22].

COVID-19 has had a huge impact on teachers around the world, causing a "big shift online". This has accelerated existing trends towards distance work, online delivery and collaboration, thereby facilitating the opportunity for higher education to embrace digital transformation [23]. The pandemic, on the other hand, has drawn attention to the continuation of the "digital divide", which exists both between and within countries and institutions, increasing existing disproportions [24].

Various researchers have studied and formulated different theories related to the way of teaching so that human learning processes give maximum results [7–10]. Some of these theories are: multiple intelligences, behaviorism, cognitivism and constructivism, and

various theories related to educational technology have been developed from them [11]. Examples of theories related to educational technology include connectivism, anchored instruction, innovative diffusion, and experiential learning [12].

Connectivism theory promotes the use of search engines and social networks by students so that they can explore the world while interacting with other people, strangers, during the learning process [25]. In addition, the theory is anchored on the understanding that online peer networks, such as social media sites and online platforms, are indispensable in e-learning experiences [26,27]. The theory of connectivism is centered on the fact that students can obtain new learning materials updated frequently and choose acceptable resources. In addition, the theory frees students from outdated cognitive practices of acquiring knowledge by receiving instruction, study, and experience and channels them to allow technology to become part of their internal learning process [13,14].

Among the above theories, this study focused on connectivism because it is the most relevant theory influenced by technology. The foundations of the theory were laid by George Siemens in 2004, who described it as a new learning theory heavily influenced by technology [13,14]. Currently, the theory of connectivism is considered the theory of the digital age. According to Abad-Segura et al. [15], connectivism offers a new perspective on what is needed to facilitate online education in an ever-evolving digital world. The theory explains the role of Internet-related technologies in creating new opportunities for teaching and learning, as well as information exchange.

The COVID-19 pandemic, but also the dynamics of society and the way of learning of current students, has led to a new way of teaching, namely the one based predominantly on online activity. Building intelligent learning environments supported by e-learning platforms has become an important research objective in the field of education nowadays.

Students are considered to be active participants in teaching and learning and not recipients of information. Through network connections, they can obtain, engage and share information [28]. Unlike traditional learning, learning in the era of digital transformation is established individually or socially by students supported by various ideas [20]. Within the connectivism theory, effective learning is supported by the possibilities of connecting to the Internet and technological resources of each individual student. Therefore, higher education institutions should ensure that students can access the Internet and have appropriate gadgets to enable them to participate meaningfully in teaching and learning supported by educational technologies.

Despite the disadvantages, COVID-19 has shown that online education, if used effectively, can open up new possibilities. The transition to online learning can help to equalize the learning conditions and possibilities [29]. The shift to online learning can help expand access to quality education, allowing students to learn anywhere anytime and even learn from experts around the world. Online learning can help widen access and act as an equalizer. Learners at remote universities can have access to leading researchers, educators, and resources that are not available to them on a daily basis [4].

After the relatively long and difficult period of accommodation with the effects of the pandemic, educational results also gradually recovered, eventually equaling the pre-pandemic ones.

4.2. Discussions Related to the Effects of the Pandemic on Environmental Sustainability

This paper refers to the sustainability of the environment in the context of online courses having various positive effects. Online teaching leads to a low carbon footprint because the electricity consumed by digital technology per hour is insignificant. On the other hand, in the case of classically taught courses with physical presence, the transport for teachers and students must be added to the carbon footprint, which causes a lot of movement, agglomeration, stress and pollution. Humanity is currently going through difficult times in terms of global health or climate change issues. In this context, online teaching is a good compromise to keep students and teachers safe and healthy, thus contributing to the reduction in costs in health systems.

According to a UN report in the lockdown periods of 2020, in the midst of the pandemic, global air pollution has been reduced to an unprecedented level throughout the world. Small pollutant particles PM 2.5, largely responsible for various diseases, have decreased on average by up to 40%, according to the report of the International Meteorological Organization on air quality and climate. The document compared air quality in 2020 with data obtained in 2015 and 2019, showing that the level of hazardous particulate matter emitted from burning fuel has sometimes been reduced by as much as 70% in many urban areas. Unfortunately, the decrease recorded in 2020 was too short-lived, once the pandemic restrictions were cancelled, and the increased level of dangerous particles returned [30,31]

Air pollution is a major risk factor for human health around the globe, contributing to reduced life expectancy. The short period of low level of polluting particles did not have a visible impact on people's health.

Bucharest is the third busiest city in Europe. Employees in Bucharest lose an average of 1.5 h per day traveling to and from work. The average distance between home and work is almost 11 km, so the average rush hour speed is about 14 km per hour. Employees use either personal or company cars, public transport or other alternative means [32,33].

Approximately a quarter of the employees declare that they are dissatisfied with the services, restaurants or leisure facilities in the area where they carry out their activity at the workplace. Moreover, approximately half of the employees believe that the offer of facilities should be improved.

In the job selection process, the most important criteria taken into account are the salary, the job description and the benefits package. In fourth place among these criteria is the flexibility of the work schedule, which also includes the possibility of working from home or online.

The time spent in traffic is also reflected in the desire of the employees in choosing the workplace. Thus, if they could choose where to work, 45% of employees would spend time at the office, 35% would like to work from home, 10% would work from a co-working space, and the remaining 10% from employees would work from an unconventional space, such as a cafe or food court. The average age of the respondents was 34 years; 92 percent of them have a higher education degree or are still students [32].

So for more than half of the employees, especially for the young ones, online work is a desirable, convenient and sustainable solution.

The education sector, having a very large number of employees as well as children, is an economic sector in which online work from home is sustainable.

5. Conclusions

COVID-19 has left an indelible mark across the globe. It has changed the socio-economic situation around the world and forced people to adapt and embrace new ways of doing business as well as new ways of living. One of the major things this pandemic has done is accelerate the adoption of digital technologies in many sectors of economies around the globe. In the higher education sector, with the closure of all educational spaces, it suddenly stopped face-to-face teaching and learning for a long period of time. This automatically called for the most rapid change ever seen in this sector, namely the shift to online teaching and learning.

This article sought to explore and identify the "good parts" of the digital transformation imposed by COVID-19 for higher education institutions. The secondary data obtained from the analysis of the specialized literature were used to achieve the objective of the study.

As a general vector for comparing the online mode to the classic teaching mode, the significant increase in the interaction between the professor and the students was found, the explanations could have been better elaborated. Thus, the students could concentrate more on the explanations received, not having to take too many notes, having the ability to download the course from the platform at any time. There were situations when the teachers' presentation was recorded, the students declaring that it was enough for them to listen to the recording a few times and thus prepare for the exam.

There were students who, wanting to know more, turned to the bibliographic references suggested by the teacher or to various tutorials found on the Internet. This confirmed the connectivism theory described in the "discussions" chapter.

After analyzing and comparing the answers between the male and female respondents regarding the interest in the exemplified discipline, respectively, the problems encountered at the time of learning, no significant differences were recorded.

The feedback had the quality, on the one hand, of directly understanding the students' problems related to their learning ability, observing the portions of the course where the subject was understood and learned adequately or on the contrary, observing the portions of the course where the subject was not understood and/or the course was not explained well enough. Feedback also had the quality of improving the way of learning by revealing to students what they know and what they do not know and, at the same time, it is a strategy for increasing our own learning process. Furthermore, the implementation of feedback in practice tests is strongly recommended because studies show that this association protects against perseveration errors when students answer practice tests incorrectly.

Online teaching has a low carbon footprint by eliminating the need for transport for teachers and students, thus reducing traffic congestion, especially at peak hours. Online teaching thus contributes to keeping students and teachers in a healthier and safer environment.

The limitations of the study are that it relied on secondary sources of data to answer the research questions, such as literature reviews and content analysis. In future research, the primary data obtained from interviews with several teachers, respectively, with some leaders of higher education, will have to be used.

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Institutional Review Board Statement: Ethical review and approval was waived for this study due to the fact that the Ethics Committee of our institution does not require such approval. Moreover, the students gave their verbal consent for this study before starting to complete the questionnaire. As mentioned in the article, completing the questionnaire was not mandatory and was anonymous. We also reaffirm the fact that only about a third of the students agreed to participate in the survey, which is also specified in the article: "To check and control the results obtained after studying the students' activity, a number of 20 students (13 men and 7 women) from the first cohort (out of a total of 75 students) were physically surveyed on the e-learning platform, respectively, a number of 24 students (14 men and 10 women) from the second cohort (out of a total of 63 students)".

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A. Questionnaire 1—PCLP II

Please complete the following survey related to the course and papers of the subject "Computer programming and programming languages II", subject included in the list of functions in the second year, the second semester at the Faculty of Construction of the Transilvania University of Brașov. The survey is anonymous, no identification data is requested. By completing this survey you will help improve the course.

1. Gender of the respondent:

☐ Male ☐ Female

2. What programming knowledge do you have?

☐ Advance

☐ Media
☐ Basics
☐ Not at all

3. In what proportion do you think you will participate in the course/laboratory hours?

Course:	Laboratory:
☐ 0–25%	☐ 0–25%
☐ 25–50%	☐ 25–50%
☐ 50–75%	☐ 50–75%
☐ 75–100%	☐ 75–100%

4. Do you think this course will help you in other disciplines?
☐ Very much
☐ A lot
☐ Little bit
☐ Not at all
☐ I do not know

5. Do you think the discipline will be useful to you after you graduate?
☐ Very much
☐ A lot
☐ Little bit
☐ Not at all
☐ I do not know

6. What difficulties do you think you will encounter?
7. What is the main reason why you will participate in the course?
8. What is the main reason why you will attend the laboratory classes?
9. What are your expectations from this course?
10. What concepts do you think will be taught in the course?

Appendix B. Questionnaire 2—PCLP II

Please complete the following survey related to the course and papers of the subject "Computer programming and programming languages II", subject included in the list of functions in the second year, the second semester at the Faculty of Construction of the Transilvania University of Brașov. The survey is anonymous, no identification data is requested. By completing this survey you will help improve the course.

1. Gender of the respondent:
☐ Male ☐ Female

2. Did you enjoy the "Computer Programming and Programming Languages II" course and laboratory?

Course:	Laboratory:
☐ Very much	☐ Very much 11
☐ Many	☐ Many 6
☐ Neutral	☐ Neutral 6
☐ Little	☐ Little
☐ Not at all	☐ Not at all 1

3. Do you think that the discipline was/is/will be useful for other disciplines?
☐ Yes ☐ I don't know ☐ No

4. If you answered "yes" to question 3, do you remember one/several subjects?
Reinforced and prestressed concrete 14, Roads of communication 2, Wood 8, Civil constructions 15, Specialized course projects, Technical drawing and infographics,

5. Did you participate in the course/laboratory classes?

Course:	Laboratory:
☐ 0–25%	☐ 0–25%
☐ 25–50%	☐ 25–50%
☐ 50–75%	☐ 50–75%
☐ 75–100%	☐ 75–100%

6. Did the course meet your expectations?
☐ Yes ☐ Partly ☐ Not at all
7. Did the laboratory meet your expectations?
☐ Yes ☐ Partly ☐ Not at all
8. What difficulties did you encounter during the course classes?
9. What problems did you encounter in the laboratory classes?
10. What was the main reason why you attended the course classes?
11. What was the main reason why you attended the laboratory classes?
12. How confident are you in programming–designing a structure?
13. Which part of the course do you think was the most useful for you?

References

1. Rashid, S.; Yadav, S. Impact of COVID-19 Pandemic on Higher Education and Research. *Indian J. Hum. Dev.* **2020**, *14*, 340–343. [CrossRef]
2. Ziyadin, S.; Suieubayeva, S.; Utegenova, A. Digital Transformation in Business. In *Digital Age: Chances, Challenges and Future*; ISCDTE: Lisboa, Portugal, 2019.
3. Weeden, K.A.; Cornwell, B. The small-world network of college classes: Implications for epidemic spread on a university campus. *Sociol. Sci.* **2020**, *7*, 222–241. [CrossRef]
4. Mhlanga, D.; Denhere, V.; Moloi, T. COVID-19 and the Key Digital Transformation Lessons for Higher Education Institutions in South Africa. *Educ. Sci.* **2022**, *12*, 464. [CrossRef]
5. Marinoni, G.; Land, H.; Jensen, T. The Impact of COVID-19 on Higher Education around the World, IAU Global Survey. Report, International Association of Universities. 2020. Available online: https://www.uniss.it/sites/default/files/news/iau_covid19_and_he_survey_report_final_may_2020.pdf (accessed on 25 July 2022).
6. Toquero, C.M. Challenges and Opportunities for Higher Education amid the COVID-19 Pandemic: The Philippine Context. *Pedagog. Res.* **2020**, *5*, em0063. [CrossRef]
7. Wright, D.B. A framework for research on education with technology. *Front. Educ.* **2018**, *3*, 21. [CrossRef]
8. Agarwal, P.K.; Roediger, H.L. Lessons for learning: How cognitive psychology informs classroom practice. *Phi Delta Kappan* **2018**, *100*, 8–12. [CrossRef]
9. Butler, A.C.; Roediger, H.L. Feedback enhances the positive effects and reduces the negative effects of multiple-choice testing. *Mem. Cogn.* **2008**, *36*, 604–616. [CrossRef]
10. Chan, J.C.K. The concept of distinctiveness in memory research. In *Distinctiveness and Memory*; Oxford University Press: Oxford, UK, 2006; pp. 3–25. [CrossRef]
11. Ouyang, J.R.; Stanley, N. Theories and research in educational technology and distance learning instruction through blackboard. *Univers. J. Educ. Res.* **2014**, *2*, 161–172. [CrossRef]
12. Cohen, L.; Manion, L.; Morrision, K. *Research Methods in Education*, 5th ed.; Routledge Falmer: London, UK, 2000.
13. Siemens, G. Connectivism: A Learning Theory for the Digital Age. Elearnspace. 2004. Available online: https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.1089.2000&rep=rep1&type=pdf (accessed on 25 July 2022).
14. Fiore, A.M. Connectivism: A Learning Theory for the Digital Age. 2018. Available online: https://focusedusolutions.com/2018/12/22/connectivism/ (accessed on 25 July 2022).
15. Abad-Segura, E.; González-Zamar, M.D.; Infante-Moro, J.C.; García, G.R. Sustainable Management of Digital Transformation in Higher Education: Global Research Trends. *Sustainability* **2020**, *12*, 2107. [CrossRef]
16. Clinton, V.; Alibali, M.W.; Nathan, M.J. Learning about posterior probability: Do diagrams and elaborative interrogation help? *J. Exp. Educ.* **2016**, *84*, 579–599. [CrossRef]
17. Cohen, J. Things I have learned (so far). *Am. Psychol.* **1990**, *45*, 1304–1312. [CrossRef]
18. Chan, J.C.K.; McDermott, K.B.; Roediger, H.L. Retrieval-induced facilitation: Initially nontested material can benefit from prior testing of related material. *J. Exp. Psychol. Gen.* **2006**, *135*, 553–571. [CrossRef]
19. Cranney, J.; Ahn, M.; McKinnon, R.; Morris, S.; Watts, K. The testing effect, collaborative learning, and retrieval-induced facilitation in a classroom setting. *Eur. J. Cogn. Psychol.* **2009**, *21*, 6919–6940. [CrossRef]
20. Pokhrel, S.; Chhetri, R.A. Literature Review on Impact of COVID-19 Pandemic on Teaching and Learning. *High. Educ. Future* **2021**, *8*, 133–141. [CrossRef]
21. Said, G.R.E. How Did the COVID-19 Pandemic Affect Higher Education Learning Experience? An Empirical Investigation of Learners' Academic Performance at a University in a Developing Country. *Adv. Hum. Comput. Interact.* **2021**, *2021*, 6649524.
22. Hodges, C.; Moore, S.; Lockee, B.; Trust, T.; Bond, A. The Difference between Emergency Remote Teaching and Online Learning. Educause Review. 2020. Available online: https://er.educause.edu/articles/2020/3/the-difference-between-emergency-remote-teaching-and-online-learning (accessed on 25 July 2022).
23. Garzon, A.E.; Martínez, T.S.; Ortega, M.J.L.; Marin-Marin, J.A.; Gomez Garcia, G. Teacher training in lifelong learning—The importance of digital competence in the encouragement of teaching innovation. *Sustainability* **2020**, *12*, 2852. [CrossRef]
24. Alenezi, M. Deep Dive into Digital Transformation in Higher Education Institutions. *Educ. Sci.* **2021**, *11*, 770. [CrossRef]

25. Anderson, I. Identifying different learning styles to enhance the learning experience. *Nurs. Stand.* **2016**, *31*, 53–63. [CrossRef]
26. Tomczyk, Ł. Declared and real level of digital skills of future teaching staff. *Educ. Sci.* **2021**, *11*, 619. [CrossRef]
27. Antón-Sancho, Á.; Vergara, D.; Lamas-Álvarez, V.E.; Fernández-Arias, P. Digital content creation tools: American university. teachers' perception. *Appl. Sci.* **2021**, *11*, 11649. [CrossRef]
28. Duke, B.; Harper, G.; Johnston, M. Connectivism as a digital Age learning theory. *Int. HETL Rev.* **2013**, *2013*, 4–13.
29. Allen, I.E.; Seaman, J. *Online Nation: Five Years of Growth in Online Learning*; Sloan Consortium: Newburyport, MA, USA, 2007.
30. Dumitru, A. Raport ONU: Poluarea Aerului la Nivel Global S-a Redus la Un Nivel FăRă Precedent îN Perioada de Lockdown Din 2020 Digi 24 2021. Available online: https://www.digi24.ro/stiri/sci-tech/natura-si-mediu/raport-onu-poluarea-aerului-la-nivel-global-s-a-redus-la-un-nivel-fara-precedent-in-perioada-de-lockdown-din-2020-1656327 (accessed on 25 July 2022).
31. Ciupala, L.; Deaconu, A.; Spridon, D. IDW map builder and statistics of air pollution in Brașov. In *Bulletin of the Transilvania University of Brasov. Series III: Mathematics and Computer Science*; Transilvania University Press: Brasov, Romania, 2019; Volume 1, pp. 247–256.
32. Bucharest Employees Spend 46 Minutes on Average from home to Office Romania Insider, Ro. 2019. Available online: https://www.romania-insider.com/bucharest-employees-commute-time (accessed on 25 July 2022).
33. Dragan, A. Employees in Bucharest Lose 1.5 Hours Per Day on Their Work Commute Business Review, Ro. 2019. Available online: https://business-review.eu/business/employees-in-bucharest-lose-1-5-hours-per-day-on-their-work-commute-202991 (accessed on 25 July 2022).