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Students and Teachers' Need for Sustainable Education: Lessons from the Pandemic

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Abstract: The COVID-19 pandemic challenged the sustainability of higher education as millions of students were forced out of school, shifting to online learning instead of in-class education. In the Erasmus+ project, Virtual Presence in Higher Education Hybrid Learning Delivery (VIE), we were concerned with the level of readiness and the ability of higher-education students and teachers to face this changing situation. This paper reports the results of a survey which assessed the experiences that students and teachers had during the pandemic and, in particular, the development of soft skills through active learning methodologies. The project results show that there are still some unmet needs, but existing digital technologies, tools, and platforms already provide valuable solutions both for students and teachers that ensure a continuation of high-quality learning experiences.

Keywords: COVID-19; hybrid learning delivery; students' needs; teachers' needs

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1. Introduction

The World Health Organization (WHO) formally declared the pandemic on 11 March 2020. From that moment on everyone started living in a "new" way: schools, airports, gyms, restaurants, and hotels were closed, and only essential services and functions such as hospitals, pharmacies, and supermarkets remained open. Severe lockdowns forced most people to stay at home and to restrict social contact including those between teachers and students. This obstacle was overcome by pivoting to digital technologies to communicate and interact. Many educational institutions had e-learning solutions before the pandemic, which they advanced through the inclusion of videoconference technologies such as Zoom and Slack [1]. School closures went on for months, which was an opportunity to further explore online classes. When restrictions were pulled back, it provided the opportunity to explore blended educational models.

This rapid change to remote learning (estimated to have affected approximately 1.6 billion students worldwide) was a troublesome journey. Many new challenges emerged, such as the lack of computers and adequate Internet access as well as the unfamiliarity or difficulty of some students and teachers to adapt to the technology. The disruption in learning impaired, to some extent, the students' development, with younger and vulnerable students suffering more severely than their peers [2].

To overcome these obstacles, the Erasmus+ project "Virtual Presence in Higher Education Hybrid Learning Delivery" (VIE), aims to provide an interactive digital collaborative

learning platform allowing higher-education learners the ability to work in groups in real-time or asynchronously in a commonly owned digital space. VIE therefore allows for the development of soft skills, such as "Problem solving", "Analytical thinking", "Working with limited resources", "Time management", "Project management", "Creative thinking", and "Communication skills", which are frequently overlooked. In addition, active pedagogical approaches are also pursued, such as flipped classroom, project/problem-based learning, cooperative learning, gamification, design thinking, and experimental learning. As a first step, the VIE consortium tried to assess the needs, perceptions, and readiness of the students and teachers towards the use of online digital technologies and tools in pedagogical and soft-skill development.

2. Related Work

The varied responses taken by higher education (HE) institutions to the COVID-19 pandemic and its effects on teaching and learning, have already been analyzed, documented, and studied by researchers looking to capture and document the difficulties, limitations, opportunities, and solutions which have emerged. Unfortunately, the most striking evidences showed a general lack of strategical HE planning towards the online learning migration process [3,4]. In fact, most of the successful approaches were bottom-up initiatives promoted by teachers and researchers as shown next.

Morgan [5] implemented a best practices approach for remote learning during the pandemic, based on the International Society for Technology in Education (ISTE) methodology. He identified 14 critical elements for using technology for learning. This includes the importance of ensuring equity, considering the different levels of Internet access, communicating expectations clearly, and providing student-centered learning, taking particular consideration of students' motivation. The study highlighted inequalities experienced by students related to the poor implementation of online programs and systems which impact learners' concentration and increase the prevalence of depression and suicidal behaviors in the group. It thus recommends the usage of free online resources, such as virtual field trips to museums and zoos or online lessons to mitigate the pandemic's emotional toll upon students and teachers.

An Ecuadorian, Italian, and Spanish study employed a questionnaire to capture the views of students (300) and teachers (196) and to detail their move to online education [6]. Overwhelmingly, students viewed the move to online learning negatively, which was attributed to the increased workload. Teachers also struggled to adapt their pedagogical approaches to the online format.

A further study conducted in Portugal and Brazil [7], performed in-depth and semi-structured interviews on 20 students and 10 teachers from HE institutions. The interviews determined their adoption of remote education technologies utilizing a thematic analysis approach. The results showed that ICT platform usage was largely a positive experience; however, personal adaption was viewed negatively and attributed to the demand, by teachers, for students to have greater digital skills. Teachers found widespread cheating in final exams and, to overcome these issues, they reduced the testing duration and added more complex questions. Students found these approaches to be unfair, causing clashes with their teachers. A further issue identified, was absence of teacher-student interaction in labs or practice-based teaching settings as the alternatives were not viewed as conducive to learning.

A Romanian study [8] analyzed the perspective of HE students regarding their usage of eLearning platforms during the pandemic. A semi-structured online questionnaire captured 762 HE students' data. The results showed that HE institutions were not prepared for online learning, with issues mainly arising from technical resources. Teachers also lacked the communication and technical skills to adapt to teaching online.

A Turkish study [9] used a focus group of 12 participants and a qualitative content analysis to interpret the results. They found that most of the participants had feelings of anxiety, boredom, and despair. Students highlighted that the platform used culminated in

a lack of communication and interactions, creating greater student isolation which affected their focus and learning. It therefore impacted their performance in relation to assignments, exams, and time management skills. To overcome these issues, students requested that teachers adopted new ways of assessment and teaching to better suit the medium.

Another study utilized a questionnaire to determine the impact of COVID-19 on parents, policy makers, students, and teachers from several countries (including Bangladesh, India, Nigeria, and Saudi Arabia) [10]. The study was completed by 200 participants, which showed that the pandemic adversely affected education through creating distraction, disruption, research capability, social isolation, and many more. To overcome these issues, technology was used by students and teachers to ensure the continuity of education and learning. This was hindered by the lack of digital skills and poor infrastructure, which runs counter-intuitively to the HE institution goal: to adopt technology to ensure the sustainability of education. The pandemic elucidated many positive outcomes from this period, such as the value of blended learning, the ability to collaborate virtually, digital literacy, and online meeting.

An Indian study [11] documented the pandemic's impact on education in the country through analyzing reports by the international and national agencies on several educational levels. It highlighted that the students and teachers were unprepared for online education, which was made more complex by the lack of connectivity. To overcome these issues, teachers provided educational resources and lessons through one or many of these mediums: Facebook, Google Meet, radio, Telegram, television, WhatsApp, YouTube, and Zoom.

This is just a small sample of the studies already published about the impact of the COVID-19 pandemic in HE. Many of them identify similar problems and difficulties for students, teachers, and educational institutions. Nevertheless, they do not consider the issues involved when soft-skills and active pedagogical approaches are considered. These should be considered as an opportunity towards innovation in these important areas of HE [12].

3. Materials and Methods

To determine the students' learning needs during the last eighteen months in the pandemic, a cross-sectional survey design study [13], employing a questionnaire, was performed over the months of November and December 2021. A survey design study was chosen due to its ability to offer sound sampling, increasing the reliability and validity of data. The online questionnaire component of which allowed remote access and completion, mitigating transmission of COVID-19. The questionnaire, located in Appendix A, asked the students to provide their experiences using digital learning tools and the methodologies employed by their teachers during the period. The goal was to better understand where the current digital learning tools fall short according to their final users. The data were collected using Google Forms which were divided into four sections:

- Background information, to profile the demographics regarding country, age, level of studies, and study area according to the Frascati manual.
- Learning and teaching approaches, focused on the perceptions of the skills and methodologies they know. This evaluated active teaching approaches, as they are deemed to be more challenging in the pandemic.
- Considerations and expectations for learning tools.
- Open comments.

The questionnaire used a 5-point discrete visual analog scale, including an extra option, namely, "Don't know" or "Don't want to rate". For instance, in case they have not used a particular tool, or they have never been taught using a particular methodology, the additional options were provided to alleviate center bias. A standardized method was therefore established, reducing students' answers to those being evaluated.

Higher education teachers' needs were evaluated from all the VIE project partner countries of Estonia, Finland, Greece, Portugal, Romania, and Spain. An analysis was then

performed utilizing the teacher's skill framework, determining digital competencies and adaptability in teaching activities.

4. Results—Students' Needs

This section shows and analyzes the results obtained from the questionnaire administered to students and the needs that can be observed from them.

4.1. Demographics

The questionnaire was completed by 269 educational students from 24 different countries. The majority of participants came from Greece—28% (76), followed by Spain—26% (70), Romania—15% (39), Portugal—9% (25), Estonia—9% (24), Finland—4% (11), and others—9% (24). The ages ranged between 18 and 54; with the mean average age of 23.3. The majority of student participants were studying towards their bachelor's degree (43.1%), followed by diploma (26.4%), and then masters (26.4%).

To categorize the student participants into their various fields of study, the Frascati manual fields of research was employed. Engineering and technology was the most studied field (55.2%); followed by social science (30.4%); humanities and arts (6.7%); natural science (5.6%), and medical and health science (2.2%). Plausibly, the distribution could be attributed to the studies entrance requirements and throughput ratios in the various fields.

4.2. Learning and Teaching Approaches

4.2.1. Soft Skill Valued

To determine the values of different soft skills, student participants rated them from 1—"Not important at all" to 5—"Very important" for their personal and professional futures. The students rated "Problem Solving" (M = 4.57, SD = 0.83), "Time management" (M = 4.34, SD = 0.94), "Communication skills" (M = 4.32, SD = 0.97), "Creative thinking" (M = 4.27, SD = 0.98), and "Analytical thinking" (M = 4.27, SD = 0.90). As they all had mean scores above 4, these skills were considered important. In contrast, "Data gathering and analysis" (M = 3.94, SD = 1.00), "Working with limited resources" (M = 3.70, SD = 1.19), and "Following systematic design processes" (M = 3.47, SD = 1.03) all attained mean scores below 4, indicating that the student participants were largely neutral regarding their values, they were therefore viewed as less important.

Student participants were then requested to suggest additional soft skills and the most frequently mentioned were: "Balancing professional and personal time", "Being able to meet the special needs of children", "Critical thinking", "Learning skills", "Discipline", "Determination", "Education in values (gender violence, racism)", "Emotional intelligence", "Emotional regulation", "Flexible thinking", "Ability to work hard", "Management skills", "Intelligence", "Mental health skills", "Programming", "Resilience", "Self-control", "Social skills", "Socializing", "Giving solutions outside of the box", "Solving questions-wrong answered exercises by the students", "Take into account the socioeconomic capacities of the students", "Team work", "Web programming", "Working in a group", and "Working in multidisciplinary and multicultural environment". From those supplied, it appears that emotional management skills are a pertinent component which were overlooked.

4.2.2. Pedagogical Methodologies for the Pandemic Era

To determine which pedagogical methodology was best suited for the COVID-19 pandemic, student participants were requested to rate them from 1—"Not suited at all" to 5—"Totally suited". All the methodologies offered were active methodologies, as they are conducive to soft skill development and overcame the mobility restrictions created by the pandemic. These methodologies are ordered according to their level of suitability below, as chosen by the participants:

Project/problem-based (M = 4.19, SD = 0.94) and experimental learning (M = 4.19, SD = 1.03) were both the highest rated methodologies, indicating that the students felt that they are both suitable as pandemic approaches. This study defined project/problem

learning as the process whereby students acquire knowledge and skills through the development of projects/solutions that respond to real-life problems. In contrast, experiential learning is the process whereby learning takes place by doing.

Design thinking suitability as methodology had a mean score just below 4 (M = 3.82, SD = 1.01), indicating that the students believe that the iterative process provides greater satisfaction in attaining their needs, but this may be less well suited to teaching in the pandemic than those with a score above 4. Gamification followed closely with a (M = 3.73, SD = 1.17) suitability rating, indicating that the inclusion of game mechanics (points, badges, etc.) may be advantageous for educational settings.

Cooperative learning was viewed as a suitable methodology with a (M = 3.5, SD = 1.17) suitability rating. The cooperative learning process consists of allocating three to six people or students into specific roles and them working together to attain their collective objective. Finally, a flipped classroom attained the lowest suitability rating as a methodology score, achieving a (M = 3.2, SD = 1.22) rating. Flipped classrooms require students to read and view educational resources such as videos or documents at home. Then, in the classroom, they work on solving problems, project development, debates, and other active activities.

In addition to the mentioned methodologies, students provided the following comments which they believed could be appropriate alternatives or included in the active learning methodologies proposed:

- "*Just make a well thought through course, with clear topics, clear goals, clear steps to achieve those goals, clear learning activities, explain concepts in variety of different ways and make the assignments spread out with gradually increasing difficulty*".
- "*Currently most lecturers throw random tutorials found on the internet at you and leave it at that. Maybe a method where we could work together, could be an app, could be a method or maybe a videoconference with all of the ingredients*".
- "*Synchronous and asynchronous stakeholder communication work through various communication channels*".
- "*Typical pedagogy for on-site teaching and learning with modification for class activities*".

4.2.3. Best Learning Systems for the Pandemic

To better understand students' needs, participants were requested to evaluate which learning systems offered the best learning efficiency during the COVID-19 pandemic; this ranged from 1—"not at all" to 5—"totally". The participants believed "Online Learning Systems" (M = 3.96, SD = 0.96) were the best solution. Closely following it was "Online collaboration systems" (M = 3.78, SD = 0.94) and "Online communities" (M = 3.70, SD = 1.02). While "Massive Open Online Courses (MOOCs)" (M = 3.26, SD = 1.22) and "Mobile apps" (M = 3.31, SD = 1.11), were not favored solutions as learning systems.

The results therefore indicate that online learning systems, which are believed to create better learning, are those which facilitate collaboration and communities. These two elements should be vital components of online learning.

4.3. Learning Tools

This section focused on the tools used by students during the pandemic and the support provided.

4.3.1. Tools Currently Used

Students were asked to indicate the tools they had used or were currently using. Only 120 participants provided significant answers and the most mentioned tools were: MS Teams (34). However, its usage was mandated, resulting in some preferring other alternatives such as Google Docs and Drive (27), Zoom (18), Moodle (11), Miro (10), and Canvas (7). These tools are primarily used for the facilitation of online communication and collaboration.

Thereafter they provided other tools for specific purposes: Discord, Slack, and Google Meet for group communications; Socrative and Kahoot for interactive assessments; Trello

for group tasks management; etc. They also mentioned many more specific tools which, in some cases, come from informal learning. It was of interest to note that Anki, Anydesk, Aroba, Blackboard, Brilliant, Brightspace, Codepen, Crash Course, Docebo, Duolingo, eClass, Edmodo, Figma, Flinga, Freecodecamp, Genially, GeoGedora, GitHub, Hackerrank, Howspace, Jamboard, Linkedin, Live, Matlab, MathOverflow, Menti, Moovi, Multisim, Mural, Nearpod, Notion, Padlet, Platzi, Programmiz, Quizzlet, Skype, Stack Exchange, Stack Overflow, TeamViewer, Udemy, Viber, and WebEx were listed.

Visual Studio Code and Wolfram Alpha were mentioned only once, and students utilized two or more tools at a time. The extensive list indicates that students were able to utilize many different tools to support their learning needs, either individually or in groups. This gives us reason to believe that the students are aware of their needs and the tools available to facilitate learning.

4.3.2. Suitability of Current Tools Used

To determine the suitability of the current tools used, the student participants were requested to say if they believed that the proposed tools facilitated achieving the learning goals. Overwhelming, 47% of the participants reported that the current tools were "Maybe" suitable for the achievement of learning goals. However, 34% of the participants were "Satisfied with the tools", with the remaining 19% indicating that they were "Unsuitable". The students' responses can be attributed to their varied experiences, related to either the number of countries, the academic institutions, or both, in which they are situated.

4.3.3. Most Valuable Characteristic of Tools

To determine the most valuable features of the various learning tools, participants were requested to rate features from 1—"Not important" to 5—"Very important".

The most valuable characteristic was "Easily accessible" ($M = 4.38$, $SD = 0.90$), followed by "Easy to use" ($M = 4.34$, $SD = 0.93$), and "Compatible" ($M = 4.29$, $SD = 0.87$), showing that students place importance on the tool's accessibility and intuitiveness. This indicates that students want tool learning time to be reduced.

Students' requirement for an "Interactive" tool was also important ($M = 4.28$, $SD = 0.90$), indicating that they wanted to have a relationship with the system. It is thus unsurprising that the students wanted a "Collaborative" tool ($M = 4.07$, $SD = 0.96$), showing their need for connectivity to work with their peers. It was, however, startling to see that students did not value "Aesthetics" ($M = 3.55$, $SD = 1.15$). While, "Asynchronous" was provided the lowest rating ($M = 3.43$, $SD = 1.15$), which can be attributed to students' unfamiliarity with the characteristic as one of the students mentioned: "Didn't understand some options".

4.3.4. Most Relevant Functionalities

Students were requested to rate the functionalities of learning tools and the three highest rated tool functionalities were "Online Collaboration" ($M = 4.09$, $SD = 0.97$), "Sharing of ideas" ($M = 4.09$, $SD = 0.89$), and "Management and prioritization of tasks" ($M = 4.08$, $SD = 0.95$). This was followed by "Modularity" ($M = 3.94$, $SD = 0.94$) and "Supported brainstorming" ($M = 3.88$, $SD = 0.96$) tool functionalities. "Synthesizing by building on each other's ideas . . . " ($M = 3.79$, $SD = 1.05$), "Commonly owned digital workspace" ($M = 3.76$, $SD = 0.97$), and "Taking notes on a common virtual blackboard . . . " ($M = 3.70$, $SD = 1.13$) followed. "Avatar presence" ($M = 3.03$, $SD = 1.25$) obtained the lowest rating, as it is not a common functionality in traditional learning tools. It is, however, an important social component even in learning tools, especially in VR [14].

The students added other functionalities to the list, such as: "Ability to combine other existing tools", "Assessment", "Chat", "Easy access to basic materials" and "An overview of tasks ahead to keep in one place", "Give the users the ability to customize their working space", "Work on pre-saved exercises", "Shared calendars", "Synchronous communication" and "Video conference". Some of these proposals are common in collaboration-oriented tools, such as chat, synchronous communication, and videoconferencing. Other function-

alities are more focused on having control and awareness of what students and teachers must do, as well as how and when they want to do it: "Easy access to basic materials", "An overview of tasks ahead to keep in one place", "Give the users the ability to customize their working space", "Work on pre-saved exercises", and "Shared calendars".

4.3.5. Learning Tool Preference of Easy to Use or Many Functions

Of the student participants, 25.6% (scoring "5" and "Many functions", Figure 1) believed that a learning tool should preferably offer many functions. Only a fraction of a percentage less (25.2%) of students believed that "Easy to use" was more important (scoring "2" and "Easy to use", Figure 1). However, 49.2% of the student participants remained centered, indicating that they prefer a balance between the two. The tendency line indicates a linear relationship, and thus no preference to either "Many functions" or "Easy to use" was evident (Figure 1).

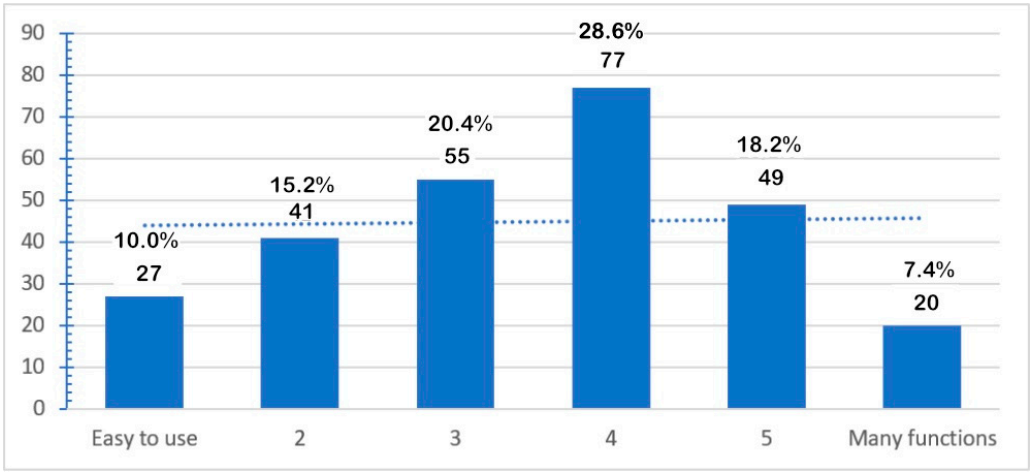

Figure 1. Easy to use or many functions.

4.3.6. Learning Tool Preference of Predefined or Personalization

The majority of students preferred tool personalization (45.7%), followed by 38.7% who, instead, favored a more balanced approach between tool personalization and predefinition (Figure 2). The tendency line indicates a linear relationship, with a preference towards personalization.

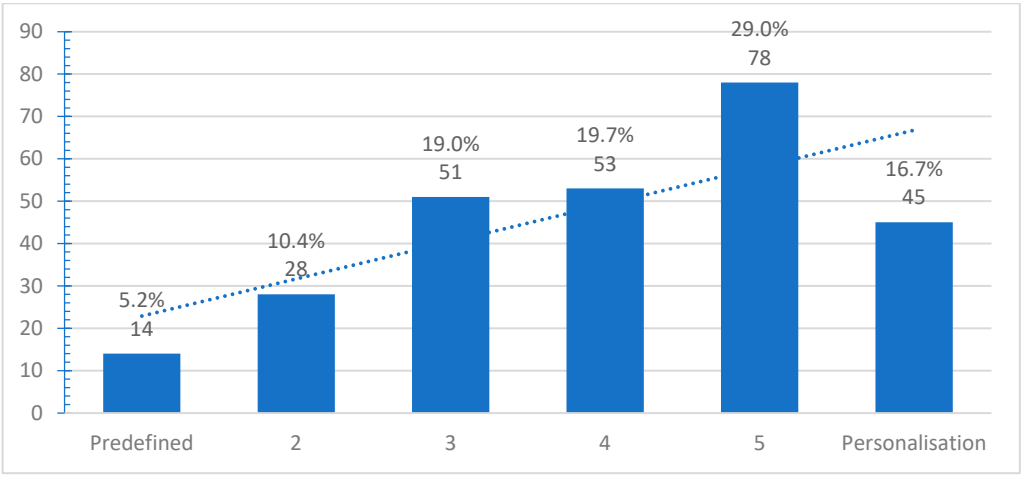

Figure 2. Predefined or personalization.

4.4. General Feedback

The last section of the questionnaire was an optional free space to give additional comments: "*Google Drive has a good platform for group projects because it lets you comment on the work and everyone included can edit*", "*Many great tools for specific productivity and collaboration tasks are already available, there is no need to invent another behemoth of an environment that is expensive, takes long time to make, complicated and probably won't work properly, the question is how to combine the tools already available*", "*Online education doesn't provide the things that are necessary for real learning; the student has to work almost self-taught, and the teachers are not so involved because they delegate their functions to different websites and programs*".

5. Results—Teachers' Needs

Managing a distance learning class requires a different set of skills than doing so in a face-to-face scenario, especially when employing an active pedagogy. Teachers therefore need to keep their own competence up to date, in order that they can impart it upon their students. Students with digital competence will therefore be more readily able to advance their knowledge and skills, when utilizing digital resources. Thus, enabling students to be better prepared for the future labor market. Some students however may require additional support and orientation due infrastructural or financial inequalities.

Teachers can employ several frameworks to ensure students develop competences and skills:

The Teacher Digital Competence (TDC) framework devised by Falloon [15], draws upon Technological Pedagogical Content Knowledge (TPACK) framework and extends it to provide a holistic solution. This framework asserts that teachers should integrate their own knowledge and pedagogical understanding to increase the student's competence of technology [16].

Falloon's [15] framework recognizes key components for teachers as personal-ethical and personal-professional competencies. The teaching of personal-ethical competencies provides students the ability to "*access and use digital resources in a sustainable, safe and ethical way*" [15] (p. 2460). The aim is therefore to teach students how to be good "digital citizens" when working on devices/platforms/resources, which includes the ability to ensure their own wellbeing, mental health, and digital and personal safety. This therefore helps them to negate predatory behaviors, and physical and psychological problems.

The competencies proposed by the European framework for the Digital Competence of Educators (DigCompEdu) has six levels of proficiency ranging from the most basic, being A1, to the most advanced, being C2 [17].

The next section analyzes teacher needs, to develop active pedagogical methodologies. This is achieved through the operationalization of the frameworks with the DigCompEdu framework being used as the main guide.

5.1. Digital Resources

Teachers need to be able to work with digital resources [17]:

- Selecting digital resources requires teachers to be able to identify the most appropriate digital resource for teaching and learning. It is pertinent to determine the context of the learning, the reliability of the information, its licensing, and the teaching setting.
- Creating and modifying digital resources initially requires a certain level of competence or training on digital resources and their relevant licenses [17–19]. Once these have been established, the relevant resources can be adapted, modified, and redistributed. This results in the creation of more educational resources and tools which can be tailored to enable learning.
- Managing, protecting, and sharing digital resources ensures that the quality of the information being shared or used remains of a high quality and scientific in nature. This also means that resources should be correctly cited [17–19]. This requires teachers to be able to constructively criticize content, a competence which requires fostering, while offering transparency where the resources are obtained and their robustness [18,19]. It

is additionally pertinent that privacy and intellectual rights are ensured when working with sensitive data or resources.

5.2. Knowledge Development

Knowledge development occurs when content has been gleaned from the relevant sources and determined to be valuable. It is then transformed into information and passed on to the students as knowledge. This requires skills to utilize the relevant remote learning solutions and utilize the intended lesson plan [20,21].

5.3. Socio-Emotional Skills

The development of an active pedagogical methodology requires autonomy and leadership from the students in the performance of activities. This requires the following skills:

- Engagement. To foster students' engagement, teachers should employ digital resources and technologies to build students' interest in the relevant knowledge area, stimulating learning, competence, motivation, and reflection [17–19,22]. The engagement can also assist students to disconnect from the complex situation which surrounds them, offering them a reprieve [18,19,22].
- Empathy. To offer students' an empathic space where they are offered support and encouragement, teachers must create a remote learning environment which fosters empathy, compassion, and understanding. This offers a space for students to develop their ability to connect with their teachers and peers, reinforcing their connection to the society in which they live [19–21]
- Emotional intelligence. Social distancing has created an obstacle for the development of students' emotional intelligence; remote education offers them the ability to safely engage with the world around them. This offers them a connection to their world and develops their emotional intelligence [21,23].

5.4. Assessment

Assessments are a key component of the educational process, requiring teachers to appropriately manage them. This process is more complex and demanding in blended environments, requiring teachers to have the following competences [6]:

- Analyzing evidence. Student data should be collected for greater insight into their behaviors. The analysis will help highlight which students require support as well as where their strengths and weaknesses are. The results will additionally help educators to be informed of what teaching and learning activities provide the best outcomes for the relevant student group and activity [17].
- Provide appropriate feedback and planning using the collected teaching, digital interaction, and assessment data to help identify areas where educators can intervene. Enhanced student feedback is important when the communications among teachers and learners is restricted.

5.5. Student Support

Students have different levels of competency in the use of new technologies. Teachers should be able to identify students' capabilities and support students in developing the following competences:

- Information and media literacy. In order that they can more accurately determine the credibility and reliability of data. They will therefore be able to structure and organize data and information to develop their own digital content, which draws upon credible sources [17].
- Student peer-to-peer support. Remote learning educational environments allow students to collaborate, chat, play, and learn with their peers. This is a vital part of the educational process. Remote educational solutions allow social learning to take place

safely and remotely, and students should be aware of these possibilities and take advantage of them [22,23].

- Student-to-teacher communication. Remote education allows teachers and students to have a communication channel to provide guidance, empathy, feedback, and support [22,23]. Nevertheless, students do not make adequate use of these facilities.

5.6. Teacher Support

Teachers all have different levels of competency with the use of new technologies and in many cases, they may need support and guidance. Teachers should be able to provide such help to each other regarding the following aspects:

- Device support. Teachers must be offered support and training on how to use the devices provided to them. This includes an online service on how to overcome obstacles in the development of content. This need will be decreased through digital literacy [22,23].
- Peer-to-peer support. Teachers, through the formation of a peer-to-peer network, should be able to guide each other through the obstacles they have faced with the usage of the technologies and resources [19,22]. The same technologies facilitate the development of a collaborative environment [17]. This doubles as a socioemotional support framework [19,22].

6. Discussion

The rapid change to remote learning, brought on by the pandemic, was demanding and came with numerous new challenges. For example, the lack of computers and Internet access [5,10], the unfamiliarity or difficulty for some teachers to engage with the required technology [6], the difficulty of students to adapt to a new form of learning [5], etc. Therefore, the disruption in learning affected students' development, with younger and vulnerable students suffering more severely than their peers [5]. This becomes more complex due to the uncertainty surrounding the pandemic [2].

High-income countries were better able to cope with the disruption of face-to-face learning. On the contrary, lower-income countries were in more need of infrastructure [10] and connectivity improvements, increased learning opportunities, and better protection measures for students in vulnerable situations. In this sense, government policy and financial support was critical in diminishing the negative impact of the COVID-19 pandemic and sustaining the functions of higher education institutions during this troubled and difficult phase. The governments had to intervene to make sure that every student had the same possibilities and opportunities to learn, having to take additional measures, such as providing computers or access to the Internet for students that were not able to afford the equipment. This can be seen in the way that the Indian government used a multi-channel approach to ensure that the continuation of learning was supported [11].

Technology was not the only condition for effective remote learning, as it is context dependent. For example, an engaged student requires intrinsic motivation, and technology effectiveness as well as contextual factors such as the home environment [23]. More support and guidelines are needed to help the faculty and staff members in the transition to online teaching, learning, and research. Teachers and students must adapt to moving classes online. This requires teachers to employ methods to create a curriculum for better teaching environments to fulfill student needs. This is reinforced by the calls for active pedagogies and soft-skill development seen in the study's result section. This, at the same time, offers a solution to the problems highlighted by Brazilian and Portuguese students [7] and teachers, relating to exam cheating, duration, and complexity of the questions.

To sum up, for successful remote learning to take place, three elements need to be achieved: teachers' effectiveness, suitable technology, and engaged students. Teachers must have a high level of knowledge of content development, and they must be skilled in the usage of digital learning platforms and resources. They must be able to adapt their teaching practices to suit the education needs of remote students. On the other hand, the

students' digital literacy could hamper the students' remote learning process [6], thus creating a barrier for education. Upskilling of both teachers and students is incremental and should not be rushed to avoid hesitancy or rejection of the process. Students' cognitive and emotional skills will develop from the feedback and motivation provided by teachers, when working with the system [23]. On the positive side, online education caters for students that are introverted learners. They normally want to participate but are often too shy to express their ideas in front of their friends. Through online tools they can be more confident to share their ideas and participate in their classroom discussion.

Learning in the virtual space also allows us to explore active learning possibilities such as problem-based learning (PBL) and other active pedagogies. PBL uses complex, real-world issues as the classroom's subject matter, encouraging students to develop problem-solving skills and learn concepts instead of just absorbing facts. Through this methodology, students can exchange experience, acquire information, discuss, and receive feedback. In addition, educators and supervisors can involve themselves and acquire information about how the courses are perceived, how teaching and supervision can improve, and which perspectives need to be addressed further. The increment of the interaction between the students and the teacher is based on an instructional and organizational design that develops the interaction.

The development of debate skills in the context of online learning is made possible for collaborative construction work using online communication tools. In this process, students develop metacognitive analytical skills [24,25]. Thus, flexibility and the principle of knowledge-building are a central dimension in these online educational contexts that are based on a constructivist perspective of learning [26] (p. 147). This provides many opportunities for interaction and decision-making, as well as easy access to knowledge and learning as a social and collaborative process [27]. It also implies the active participation and involvement of students, promoting social and cognitive interactions between students and teachers [28]. The teacher has the task of guiding the acquisition of information and the construction of knowledge, as well as generating a social environment that facilitates critical thinking [29]. The feeling of belonging to the learning community can be assumed to be a predictor of student performance, as it makes it possible to share information and experiences in a reflective and critical way [30,31]. These results are also due to the continued support that teachers provide to students when carrying out the proposed activities [32].

7. Conclusions

One of the greatest challenges in the COVID-19 era is the seamless continuation of learning in formal higher education contexts. The forced digital transformation profoundly changed the teaching and learning settings, bringing forth new opportunities, but also challenges that have become more evident and more difficult to address during the COVID-19 pandemic. Here, the sudden shift towards a 100% digital teaching and learning setting, followed by blended educational models mixing virtual interaction with physical presence, had a significant impact on performance and efficiency. The uncertainty introduced by the pandemic highlighted the need for developing alternative, hybrid educational models that facilitate virtual interaction to complement physical presence.

Educational digital technologies have shown to be useful in the new scenarios to support a variety of pedagogical approaches, also active and project-based ones. Indeed, they have been gaining ground as complementary learning tools even before the current pandemic. Nowadays, blended learning models may combine face-to-face with distance learning delivery and the flexibility to adapt the ratio of in-class to distance offerings provides an avenue of growth in the future. Educational activities may include formal instruction sessions, access to educational content, in-class group collaboration, home projects, receiving effective feedback, maintaining open lines of communication with educators and peers, and more. Some of these activities may be supported by traditional learning management systems that allow the delivery of multimedia content, including

text, images, and video, and the submission and grading of projects. However, traditional learning management systems fail to engage students in highly interactive teamwork that simulates classroom group collaboration. Through most available digital learning platforms, students can review content or communicate through asynchronous services such as forums or chats. However, these cannot effectively replace face-to-face collaboration due to the time lag between posts, responses, and reactions. Similarly, student supervision, monitoring, assessment, and support are the main issues where teachers need help to improve the efficiency of the learning process. These are the challenges that the VIE project wants to tackle. Additionally, the study of the needs, perceptions, and preparedness of the students and teachers clearly showed that the consortium is on the right track towards the creation of conditions to improve that efficiency.

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Appendix A

VIE Questionnaire for students

Background information:

Country: _____

Age: _____

Level of studies:

O Diploma
O Bachelors
O Masters
O PhD
O Other . . . _____

Study Area (Frascati manual fields of research):

O Natural Sciences
O Engineering and Technology
O Medical and Health Sciences
O Agricultural and Veterinary Sciences
O Social Sciences
O Humanities and Arts

Learning and teaching approaches:

Do you think that the current tools used in education during pandemic era allow you to achieve your learning goals?

O Yes
O Maybe
O No
O Other . . . _____

Indicate the importance of the following skills for your future professional and personal life (from 1—not important at all to 5—very important)

	Not Important				**Very Important**	**Don't Know/ No Answer**
Problem solving	1	2	3	4	5	NA
Analytical thinking	1	2	3	4	5	NA
Data gathering and analysis	1	2	3	4	5	NA
Following systematic design processes	1	2	3	4	5	NA
Designing and evaluating alternative interventions towards solving a problem	1	2	3	4	5	NA
Implementing and assessing the effectiveness of a solution	1	2	3	4	5	NA
Working with limited resources	1	2	3	4	5	NA
Time management	1	2	3	4	5	NA
Project management	1	2	3	4	5	NA
Creative thinking	1	2	3	4	5	NA
Communication skills	1	2	3	4	5	NA

Would you like to add a skill to the list?

_____

Which of the following pedagogical methodologies would be suited to learn in pandemic era? (From 1—not suited at all to 5—totally suited)

	Not Suited at All				**Totally Suited**	**Don't Know/ No Answer**
Flipped Classroom: Students study primary educational materials at home and, then, worked on in the classroom.	1	2	3	4	5	NA
Project/Problem-Based Learning: students acquire knowledge and skills through the development of projects/solutions that respond to real-life problems.	1	2	3	4	5	NA
Cooperative Learning: in formation of groups of 3–6 people, each member has a role and they reach the objectives by interaction and work in a coordinated manner.	1	2	3	4	5	NA
Gamification: The integration of game mechanics and dynamics (points, badges, etc.) in different environments such as education.	1	2	3	4	5	NA
Design Thinking: a method to solve problems and satisfy the needs of clients in an iterative manner.	1	2	3	4	5	NA
Experiential learning: learning by doing	1	2	3	4	5	NA

Would you like to add a method to the list?

_____

Which of the learning systems enable the best kind of learning during the pandemic era? (1–not at all to 5 totally)

	Not at All				Totally	Don't Know/ No Answer
MOOC's (massive open online courses)	1	2	3	4	5	NA
Mobile apps	1	2	3	4	5	NA
Online communities	1	2	3	4	5	NA
Online collaboration systems	1	2	3	4	5	NA
Simulation and games	1	2	3	4	5	NA
Online learning systems	1	2	3	4	5	NA

Expectations for a learning tool

VIE project aims to provide a solution for online and offline learning in the pandemic era. Therefore, we would like to know what are your needs/expectations for skills development.

Your expectations for a learning tool:

	Not Important				Very Important
Interactive	1	2	3	4	5
Collaborative	1	2	3	4	5
Asynchronous	1	2	3	4	5
Easily accessible	1	2	3	4	5
Easy to use	1	2	3	4	5
Aesthetical	1	2	3	4	5
Compatible	1	2	3	4	5

The needs of functionality for a learning tool:

	Not Important				Very Important
Online collaboration	1	2	3	4	5
Commonly owned digital workspace	1	2	3	4	5
Design oriented	1	2	3	4	5
Supported brainstorming	1	2	3	4	5
Synthesizing by building on each other's ideas	1	2	3	4	5
Synthesizing by building on each other's ideas	1	2	3	4	5
Taking notes on a common virtual blackboard	1	2	3	4	5
Avatar presence	1	2	3	4	5
Sharing of ideas	1	2	3	4	5
Modularity—combining ideas for a solution	1	2	3	4	5
Management and prioritization of tasks	1	2	3	4	5

Would you like to add a functionality?

_____

What do you prefer from a learning tool? Easy to use vs. many functions

Easy to use	1	2	3	4	5	6	Many functions

What do you prefer from a learning tool? Predefined or personalisation

Predefined functionality for ease of use	1	2	3	4	5	6	Personalisation/ customisation

Name some online collaborative learning tools that you are using

_____

Feedback

Thank you for your contribution! If you have any comments or recommendations, you are very welcome to leave them below.
Any other comments of questions?

_____

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