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Exploring Digital Literacy Skills in Social Sciences and Humanities Students

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Abstract: Digital literacy is among the mandatory abilities to any higher education level and represents a fundamental ingredient in successful professionalization. Considering the deep penetration of digital technologies in everyday life, digital literacy offers a set of transversal skills that could improve a whole area of activities, from banking operations to civic participation. However, these skills are diverse and vary according to the development of technologies and society. This study fills an important academic gap on digital literacy by placing it in a specific and well-defined context, analyzing different perspectives that involve such learning, such as predictors of digital literacy in different types of students. In addition, research increases its importance as it is being developed during the pandemic, a period characterized by accelerated technological use and sudden changes. This research used a quantitative design based on the answers to a questionnaire conducted from March 2021 to May 2021. From a methodological perspective, we tested several hypotheses using one-way analysis of variance (ANOVA) and confirmatory factor analysis (CFA) within the structural equation model (SEM). The results show that communication, critical thinking, problem-solving, and technical digital skills are more present in the case of students enrolled in social sciences, while other digital skills (i.e., creativity and information) are more prevalent in the case of humanities students. Moreover, the results showed that, except for creativity and problem-solving-related digital skills, all of the digital skills were significantly influenced by students' different levels of education.

Keywords: digital literacy; digital skills; COVID-19; education level; digital course enrolment

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1. Introduction

Due to the changes brought by the digital turn, digital literacy has become an indispensable element on the agenda of researchers and policymakers worldwide [1]. Moreover, the pandemic acted as a magnifying glass singling out regions and communities where digital access was poor or nonexistent. The sanitary crisis has made apparent both the strengths and vulnerabilities of education systems, alongside the shifting demands of stakeholders. In the present situation, when "the COVID-19 pandemic made digital technologies the lifeline for not just education but work, information, and leisure" [2], the strategic policies based on the accurate assessment of digital competencies are meaningful ways of coping with these challenges.

Having digital skills represents an essential asset nowadays as it makes it possible to access digital services and carry out numerous activities and assignments from home,

especially in times of lockdown and limited mobility. A certain level of digital skills is required in most public services, such as administration, healthcare, or higher education. In fact, most forms of employment nowadays require at least a minimum level of digital skills, and this will constitute a trend in the foreseeable future as well [3,4]. Digital literacy encompasses mandatory abilities at any higher education level and represents a fundamental ingredient in successful professionalization. Considering the deep penetration of digital media in everyday life performances, digital literacy offers a set of transversal skills that could improve a whole area of activities, from banking operations to civic participation. The possible polarized effects of using digital media (positive or negative in certain conditions, offering both opportunities and risks) strongly indicate that contemporary people must be digitally literate in a complex manner: not only in using digital tools but in selecting the right ones and interpreting them correctly [5]. Access to information is a necessary condition but not a sufficient one for acquiring knowledge. Technical skills are just a part of the skills that digital literacy encompasses; selection, critical thinking, problem-solving, and creativity are just a few examples that point out the tremendous variety and sophistication of this kind of literacy.

Digital skills will also contribute to the emergence of a better EU citizen, more democratically engaged, and with a better grasp of contemporary media cultures. As [6] shows, "academics and practitioners think that media literacy needs to be embedded within the mainstream curriculum, since small-scale media literacy projects in school are not sufficient. (. . .) Relatedly, approaches to media literacy vary significantly, which makes it hard to identify what skills and knowledge children need to be literate in the digital age". This is the reason why the European Union considers the objective of digitalization as a core one and it invests a lot of resources to achieve it. In fact, fifteen years have already passed since the European Union included digital skills among the key ingredients of lifelong learning: "this skill will become part of the educational laws of the different countries and governments, in some cases in a tentative, transversal way, while in others as the backbone of up-to-date, innovative educational policies, becoming an indispensable skill for students, teachers and citizens in general over the years" [7]. The authors enumerate no less than five theoretical models of digital literacy that have been advanced so far. Regardless of the model we choose to use, the fact of the matter is that the classical sender-receiver schema of communication has already been replaced with a non-hierarchized one, based on interconnection, flexibility, and convergence.

Even if there is an increase in the percentage of persons with digital skills in the European Union (it went up to 58% from 55% in the last six years), many people still do not possess fundamental skills [3]. In the same vein, data shows a scarcity in terms of ICT specialists, and Romania is one of the countries in which this phenomenon is widely reported by companies. Much of this is explained in terms of socio-demographic factors. They also account for the fact that Romania scores low in terms of software skills [3,8]. Along the same lines, Romania has low rates in terms of digital public services, along with Greece or Bulgaria. Romania ranks 26th out of 28 EU Member States in the 2020 Digital Economy and Society Index [3,9]. Romania manages well in terms of connectivity (11th rank), but internet use is the lowest among EU states, almost one-fifth of Romanians have yet to use the Internet. This situation is related to "the low level of basic digital skills around the country" with less than a third having "at least basic digital skills" [3,9]. Even if Romania ranks fifth as regards ICT graduates, it also has the lowest performance in the EU on digital public services and the use of internet services (see Figure 1). According to data available on Eurostat regarding students' level of digital skills (Figure 1), in the 2015–2019 period, there were significant differences between the percentages of those having basic or above basic overall digital skills in Romania and other EU countries. Romania registered the lowest percentages over the years (around 65%), the remainder up to 100% being represented by the percentages of students having low or no overall digital skills. In this context, we were interested in analyzing the digital skills of students in social science and humanities and identifying if there are any differences between the two specializations.

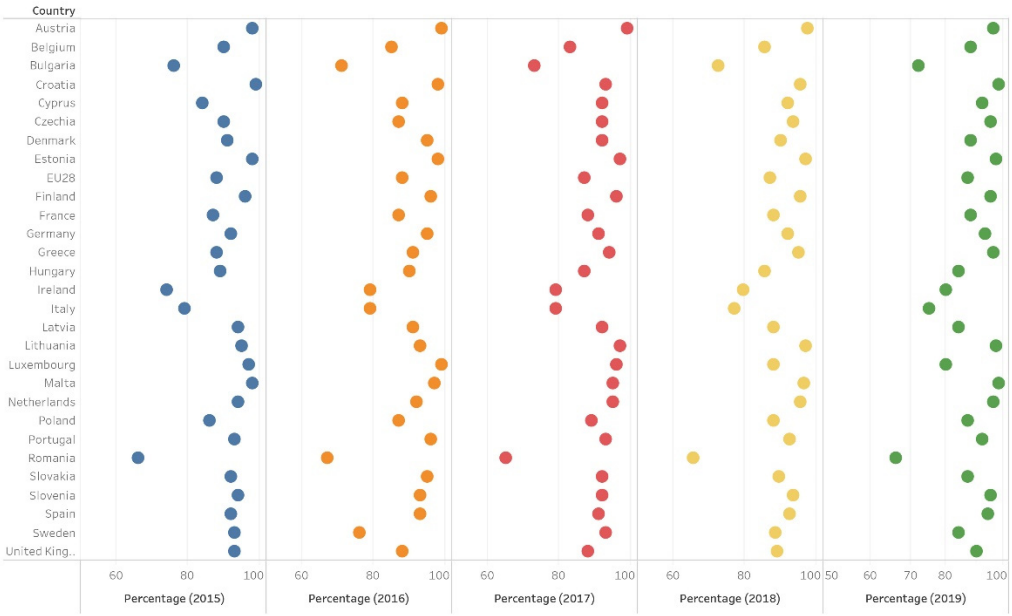

Figure 1. Percentage of students with basic or above basic overall digital skills. Source: authors' representation based on data provided by Eurostat [6].

Even if digital literacy is germane today, becoming a prerequisite for many activities, more research is needed to determine its level, understanding, or acquiring modalities for certain groups of people. Carrying out empirical analyses is vital to correctly identify these elements and to optimize both them and their relationships. Awareness of the evolving relevance of digital literacy in today's world must be paired with concrete confirmations from various factual situations. At the same time, information and communication technologies are a high-velocity territory, so the possibility of always being behind these developments is quite high. The new skills will invariably change, putting serious pressure on institutions and individuals to adopt these advances in their activities. In this vein, preparing meaningful strategies on the foundation made possible through research remains the solution to cope with this speed of changes.

On the one hand, all the above clearly shows that educational systems must adapt their curricula to the new realities in order to meet market demands. Moreover, the heavy use of digital technologies for distance learning in general, and during the COVID-19 pandemic in particular, indicates the need for enhancement of both student and teacher digital skills. It can also be argued that we should identify and support vulnerable groups that need assistance and hardware to cope with the situation. On the other hand, more research needs to be done for a more detailed account. The lack of empirical studies on Romanian students thus becomes a very serious matter.

Focusing on Romanian students, our paper aims to present a suggestive frame of digital literacy in the pandemic context. Digital literacy is inseparable from traditional literacies: if until now digital competencies were rather presumed, the pandemic acted as a test of digital proficiency for students and teachers. Thus, digital skills were needed more than ever, and not as supplemental but as a prevalent condition of carrying education further. Knowing how these students perceive the level of their digital skills in this pandemic context represents an important step towards obtaining a functional approach of literacy "in practice". In this way it is possible to assess the actual perceived level of digital literacy and to avoid a first common fallacy: "at most universities, digital literacy is either taken for granted or assumed to be an adequate level rather than being assessed, remediated, and amplified" [10]. Many students have a good or high level of personal use of technology, but other forms of using digital media (academic, professional, solving problems) must be acquired and further developed through learning. By identifying and analyzing the bases and sources of Romanian students' digital skills, we also avoid a second

fallacy: the over-estimation of students' digital abilities necessary in many domains [10]. This premise could negatively affect many students that do not have a good level of digital literacy, creating potential liabilities. Their exposure or even immersion in digital media do not guarantee that students manage the entire range of digital skills. This is the reason why the analysis of the sources of digital skills highlights whether there is congruence between formal and informal practices. Moreover, these data could be used for further research, including for constructing potential remediation strategies.

In this vein, the purpose of this paper is to examine the factors predicting university students' digital literacy and to explore differences between social science and humanities students in terms of digital skills and the sources of digital skill accumulation. Our study investigates if digital literacy is educationally constructed and what are the specifics of the elements that contribute to the acquirement of such competence. By situating digital literacy within a clear social context, this paper tries to fill a gap in the literature on digital literacy, where such empirical studies are essentially needed. It is widely acknowledged that traditional education incrementally adopts policies, curricula, and methods required for the 21st-century citizen and that many digital skills are rather acquired in informal contexts. Nevertheless, many features of digital literacy are based on knowledge and skills learned in school, in formal and controlled learning environments. The configuration and the architecture of factors that contribute to digital literacy are very diverse. That is why it is so important to conduct specific research in well-defined environments in order to comprehend the overlapping elements and mechanisms that contribute to the creation, development, and adaptation to the new competencies necessary in interpersonal, social, or work life. To distinguish between the factors involved in this process and to analyze the combination that underlies the particular practices used in a specific context represents a novelty in the research.

The paper is structured as follows: in the next section, we discuss the state of the art on digital literacy and skills, with the emphasis on definitions, characteristics, typologies, and nuanced but necessary distinctions between the concepts and paradigms that share the same semantic universe of discourse. The categories and dimensions of the digital divides in relation to digital skills are explained. Digital literacy in the education sector is presented with a special emphasis on how the pandemic shapes this domain. In the light of the arguments described in the section dedicated to the literature review, we developed the hypotheses and the conceptual model of our research. The next sections describe the methodology and data, the result analysis and discussion, followed by conclusions, limitations, and directions for further research.

2. Literature Review and Development of Hypotheses

2.1. Digital Literacies and Competence

The terms "digital literacy" and "digital competence" are differently conceptualized across countries, mainly in the national curricula. For instance, Godhe [11] studied their different use in the Nordic countries and observed that in Finland the concept "digital competence" appears in combination with "multiliteracies", in Sweden the term "digital competence" is constantly used, while in Norway "digital skills" is the preferred term. In their systematic literature review of higher education, Spante et al. [12] showed that these two concepts have been used many times synonymously, and sometimes they were used to underpin each other. Moreover, the concept of digital literacy is more frequently used than that of digital competence: authors defined digital literacy by referring to research rather than to policy documents and depicted digital competence by using various types of references. In academic research "digital literacy" seems prevalent, while in policy documents, "digital competence" gained legitimacy and consistency. With respect to the correspondence between usage and geographical location, the English-speaking countries tend to use more frequently the term "digital literacy", while other European nations such as the Nordic countries or Italy tend to use the term "digital competence". Moreover, in policy-related documents dedicated to education issues, the concepts are most of the time

used interchangeably. Starting from this plethora of definitions stemming from research and practice, "an emerging classification in the EU identifies three main categories of digital skills and competence": "digital competence", "job-specific digital skills", and "digital skills for ICT professionals" [13]. Digital competence is conceived here as a synonym for digital literacy: "Digital competence: also referred to as digital literacy, encompasses a set of basic digital skills, covering information and data literacy, online communication and collaboration, digital content creation, safety and problem solving" [13]. Given this whole framework, in our paper, we use these two concepts interchangeably, as sharing a common semantic area.

We live today in a "network society" [14], with an informational economy and a raising "participatory culture" [15]. The almost instantaneous exchange of communication, capital, and data reflects and creates a new environment that has risen on a global scale. Amid such significant transformations, the citizens become highly dependent on the new standards and practices of the informational flow. In this respect, they had to learn new related skills and manage digital knowledge in order to understand and solve various private and professional issues. The demand for new competencies is visible not only at the workplace, but also as a necessary condition for taking part in social, cultural, or political life. The pervasiveness of new media into almost every aspect of our contemporary existence necessitates an "expanded concept of literacy" [16]. Since Gilster's seminal book "Digital Literacy" [17], the concept has become a very debated topic predicated on the research of computer and information literacy. It represents an ambiguous, evolutive umbrella term, with a matrix of characteristics and principles. Digital literacy is also "a condition, not a threshold and, as with all "conditions" requires maintenance and context" [18]. Digital literacy aims at developing the potential of digital technologies and required information literacy [19]. In the increasing range of digital channels, platforms, and applications, the individual must learn to effectively search, select, understand, interpret, critique, and create meaning. For instance, Martin [20] understands digital literacy as "the awareness, attitude, and ability of individuals to appropriately use digital tools and facilities to identify, access, manage, integrate, evaluate, analyze, and synthesize digital resources, construct new knowledge, create media expressions, and communicate with others, in the context of specific life situations, in order to enable constructive social action; and to reflect upon this process". Moreover, digital literacy does not refer only to individual competencies, but also to "social practices" [21–23], individual and social skills being necessary to engage adequately with digital technologies. This combination of concrete and unquantifiable skills [24,25] must be reinforced both within and outside of the educational framework in order to be successful [19]. For Rheingold [21], literacy is "skills plus community", because "solitary skills are not enough today. Literacy now means skill plus social competency in using that skill collaboratively. [. . .] What matters the most with present-day new literacies are not just the encoding and decoding skills an individual needs to know to join the community of literates but also the ability to use those skills socially, in concert with others, in an effective way" [21]. In this context, five overlapping literacies are essential today: "attention", "participation", "collaboration", "critical consumption", and "network awareness" [21]. They describe processes and not fixed things; they are part of social practice and are creatively remixed in everyday life situations.

Nowadays, it is impossible "to think about literacy in isolation from a vast array of social, technological and economic factors" [26] or to conceive it as a monolithic concept [27,28]. Thus, we better talk about "multiple literacies" or "multiliteracies" [29] for encompassing the wide range of skills that people need today to cope with various challenges, crises, and changes. Literacy is characterized by a "radical multiplicity" per se [27]. Literacies evolve over time, being socially constructed in cultural, educational, and institutional frameworks. The gaining of competencies in practice represents a major issue for education that must be relevant for contemporary life by introducing new curricula and methods. Even before the digital media, the researchers discussed the shift from orality to literacy [24], media literacy [26,30,31], visual literacy or information literacy [28],

heralding the multifariousness of this concept. New literacies "are related to an emerging and evolving mindset" [27] and include skills, social practices, strategies required by new ICT, and they are "central to full civic, economic, and personal participation in a world community" [32]. The breadth of thinking new literacies is impressive, the most explored theoretical perspectives being behavioural, cognitive, semiotic, sociocultural, critical, and feminist [33]. Moreover, different "vernacular literacies" [23,34] are observable as new multimodal and multilingual everyday practices, learned informally, in the digital era.

Frau-Meigs [35] uses the integrative term "transliteracy" for overpassing the limitations of information, media, and computer literacies and for concentrating in a meta-concept their overlapping traits, methodologies, and interdisciplinary associations. Thus, transliteracy is defined as "the ability to read, write and encode in interaction with digital tools and platforms, as well as the capacity to search, test and validate 'information' in its various shapes as understood in computer sciences (codes), in media and communication sciences (news), and in information sciences (documents)" [35].

Depending on the focus, several types of literacies are depicted [22]:

1. If we focus on language, there are print literacy, texting literacy, hypertext literacy, multimedia literacy, gaming literacy, mobile literacy, and code literacy. Print literacy remains the basis for other kinds of literacies [15], offering the mandatory abilities of reading and writing. As Leu [36] pointed out, "The Internet is a reading and literacy issue, not a technology issue". In other words, proficient communication with ICT requires both traditional and new skills. Texting literacy supposes the handling of a new linguistic register (netspeak or textspeak) in which we could rapidly communicate. Hypertext literacy refers to the ability to use the hyperlinked structure of the web to achieve or create content. Multimedia literacy recovers many meanings of the term "multimodality" [26] and acknowledges the mixed ways in which we communicate today, combining texts, audio, video, images, graphics, and so on. Gaming literacy means to deal skillfully into a game environment, perform specific tasks, interact with other users, and achieve goals. Games are not used just for fun and entertainment, but also for educative, instructive, or even therapeutical purposes. One emerging literacy is mobile literacy—a complex "macroliteracy" that incorporates many other digital abilities—and, because of the large use of mobile communication for a plethora of goals, became an "instrumental" literacy [28]. The need for a "critical mobile literacy" [28] is natural when a deep familiarity with such a medium is reached and the interrogations about its consequences are asked. Code literacy represents the ability to learn a new language and a new way of creativity—the computer language. The possibility to read or write code, to build a new application are now important skills in a digitalized world.
2. When we focus on information, we get tagging, search, information, and filtering literacies. All of them reflect an essential literacy skill set related to finding information, critically evaluating it, selecting it, and using it for various objectives. These kinds of capabilities compose a pivotal structure for the contemporary citizen that in this way can act as an experimented information gatekeeper that can differentiate between true or legitimate sources and fake ones.
3. With a focus on connections, there are personal, network, participatory and intercultural literacies. Using digital platforms and tools could be done to express ourselves and to build a powerful online identity. Being part of an online network could enhance a specific social capital and collaboration [37] and provide meaningful ways to create a "voice". In the McLuhan "global village" [38], where convergence is a functional mechanism, the cultural hybridization put together various cultures and traditions. An interculturally literate individual has the competencies necessary to understand other cultural contexts and to communicate with people across different cultures. There are essential relationships among skills, participation, empowerment, and education that construct the complex layers of connections literacies.

4. With a focus on (re)design, remix literacy represents a macroliteracy involving many kinds of literacies reworked to gain new meanings.

Doug Belshaw [39] also emphasizes that digital literacies are plural, transient, and context-dependent. Nevertheless, eight essential components of digital literacies are recurrent: 1. Cultural; 2. Cognitive; 3. Constructive; 4. Communicative; 5. Confident; 6. Creative; 7. Critical; 8. Civic. They could be organized into four skillsets: cultural, creative, constructive, and communicative; and four mind-sets: confident, cognitive, critical, and civic [40]. The cultural contexts act as "lenses" through which something is seen and understood. "Expanding minds" through openness to various modalities of communication in digital media and creating new things and ideas by remixing and editing strategies are building a more creative, critical, and confident user. The civic element recalls the opportunities for participation and the reflection upon literacy practices in correlation with social justice and civic responsibility. The power structures and the issue of social exclusion represent key questions for the last element of Belshaw's typology.

Eshet-Alkalai [41] describes a conceptual framework of digital literacy that contains five types of literacies: (a) "photo-visual literacy"; (b) "reproduction literacy"; (c) "information literacy"; (d) "branching literacy"; and (e) "socio-emotional literacy". Digital literacy is more than the possibility and ability to use digital media and devices but includes a complex plethora of cognitive, emotional, and sociological skills. People actively involved in using digital technologies solve problems in a creative manner and not only consume information in a passive way. The opportunities of digital media and the characteristics of the new audiences are just a few reasons to observe the shift from understanding digital literacy on the cognitive level to the comprehension of the sociocultural forces influencing the development of the learner [42,43].

Iordache et al. [44] tried to unravel the intricacies of this concept by analyzing 13 models of digital literacy in relation to 39 indicators organized in five categories: operational, technical, and formal; information, cognition; digital communication; digital content creation; and strategic. The results show a general overlapping of the terms literacy, skills, and competencies and a disproportionate focus on digital skills, while strategic skills are being omitted by several models. A wider perspective is needed, in which individual attributes and use to be correlated with the community and social-based approaches.

2.2. Digital Divides and Knowledge Gap

The potential of new information and communication technologies (ICTs) is not equally developed in the world. Despite the tremendous importance of digital literacy, it remains an unfulfilled aim and the "digital divides" are still active. The digital inequalities are not just a matter of access to Internet technologies, but rather a political and social problem [45,46]. If the usual meaning of the digital divide is tantamount to the inequality of access, there also exist other dimensions of its understanding. Thus, it is possible to have a "theoretical access" (physical access) to the internet and communication technologies but to not have at all the "effective access" (the knowledge and skills in order to use them effectively). The knowledge gap constitutes a critical problem that appears at this level because the technological affordance does not immediately translate into profitable or meaningful use. In this vein, there are different kinds of the digital divide and not just a single form, the divide being a moving condition and not a static one [47]. Moreover, we witness many forms of access: motivational access (the benefits and relevance of using ICTs for people), material access (the physical access to ICTs), skills access (operational, information, and strategic skills needed to use ICTs), and usage access (the diversity of applications and the usage time per person, from broadband usage to creative usage). Along with physical access, components such as literacy, educational level, and institutional structure must be considered when we discuss digital divides [48].

The stimuli and the barriers to access are complex and difficult to measure. The probable deepening of the skills divide is concerning: "motivational and physical access divides may diminish, while skills and usage divide may grow" [47]. The widespread

mobile communication seems to complicate this picture, new specific skills being demanded in this connected world. Thus, we observe a shifting of the digital divide concept from technological lack to a skills gap that produces the "participation gap", alongside concerns of "transparency" and "ethics challenges" [15]. A "second-level digital divide" is one of skills gaps [42]. DiMaggio and Hargittai [49] emphasized five dimensions along which divides may occur: technical means, the autonomy of use, use patterns, social support networks, and skill. Summarizing this development, the digital divide "has become as much an educational issue as an economic one" [22]. Digital exclusion goes beyond the socio-economic inequalities that do not represent today the sole elements responsible for this situation. The digital skills are of growing importance in terms of explaining this gap and of designing solutions to offer societal participation and autonomous use of digital media [42,50,51]. The European Commission [52] also acknowledges that "digital literacy is increasingly becoming an essential life skill and the inability to access or use ICT has effectively become a barrier to social integration and personal development". The lack of digital competence is conceived as a missing opportunity in personal, social, and work life. As Christakis and Fowler [37] also noticed, "network inequality creates and reinforces inequality of opportunity". Moreover, a "secondary digital divide" is seen in "relation to quality of use", so the ICT for lifelong learning is needed for increasing knowledge and confidence. Not only the missing infrastructure could lead to digital inequalities, but also the lacking potential of its use for empowerment, creativity, and identity management. Teaching digital literacies alongside traditional literacy skills remains a powerful tool to mitigate these disparities. Inequities are sometimes hidden, so the divides must be searched for at many levels: micro, meso, and macro, with the goal of remediating them in the learning environments [53].

2.3. Digital Skills Assessment

Several theoretical frameworks have been proposed in the specialized literature that analyze digital skills. For instance, Calvani et al. [24] grouped digital literacy into three main dimensions: technological skills (TS); cognitive skills (CS), and ethical knowledge (EK): technical skills (TS) represent the user ability to explore new technological contexts in a flexible manner; cognitive dimension (CS) encases the user ability to access, select, analyze, and critically evaluate data and information; ethical knowledge (EK) represents the users' sense of responsibility towards the imposed rights/ obligations while interacting through ICTs) [24,25]. Other authors such as Martin and Grudziecki [54] propose three levels of digital literacy development: Level 1. Digital literacy that includes skills, concepts, approaches, and attitudes; Level 2. Digital use (functional level), which refers to professional/ discipline application and Level 3. Digital transformation, a level that reflects innovation/ creativity aspects.

Jenkins et al. [15] discuss "new media literacies" in terms of cultural competencies and social skills that are developed through cooperation and networking. These are built based on traditional literacy, technical and critical analysis skills. Eleven new skills are depicted: "play"; "performance"; "simulation"; "appropriation"; "multitasking"; "distributed cognition"; "collective intelligence"; "judgment"; "transmedia navigation"; "networking"; "negotiation". All of them enter education when they are strategically learned in classrooms, providing new learning tools into an "integrated approach to media pedagogy". The greater inclusion of digital literacies across curricula represents a necessity in order to educate students adapted to their times. They do not have to be treated as an "add-on subject. Rather, we should view its introduction as a paradigm shift, one that, like multiculturalism or globalization, reshapes how we teach every existing subject" [15].

Ferrari [55] defined digital literacy as a combination of information skills, communication skills, content creation skills, safety skills, and problem-solving skills, while Helsper and Eynon [56] conceived four categories of skills: technical, social, critical, and creative skills. Van Dijk and van Deursen [42] consider skills as being crucial for the appropriation of digital technologies and for a fulfilled life in the information society. Four phases are con-

stitutive for the appropriation of new technologies: motivation, physical access, skills, and usage. They discuss six key skills divided into following categories: two medium-related skills (operational, formal) and four content-related skills (information, communication, content creation, and strategic skills). The operational skills or the "button knowledge" are related to technical abilities required to work with devices and the Internet. The formal skills are required by the formal structure of new media (menu, hyperlinks) and the main examples are browsing and navigating the Internet. Information skills refer to the important abilities of searching, selecting, and evaluating the information in new media. Communication skills are of paramount importance, too, since new media are conversational technologies with a plethora of platforms. The content creation skills allow individuals to generate content in diverse forms and formats. Strategic skills represent the ability to use digital media as a means for specific goals. As applications and interfaces are more and more interactive and intuitive, technical skills are not enough to fruitfully use digital media. Inspired by these frameworks, Van Deursen et al. [57] created a set of valid digital skills measures: operational, information navigation, social, creative, and mobile skills scales. Moreover, the most problematic skills are the information and the strategic digital skills, which can produce deeper digital divides than operational and formal skills.

Moreover, The eEurope Action Plan has at its centre the development of eLearning and eSkills, and in the "Recommendation of the European Parliament and of the Council of 18 December 2006 on key competences for lifelong learning", digital competence is one of eight essential competences enumerated: communication in the mother tongue; communication in foreign languages; mathematical competence and basic competences in science and technology; digital competence; learning to learn; social and civic competences; sense of initiative and entrepreneurship; cultural awareness and expression [58]. Digital skills, from searching to participation in collaborative networks and communities underlie the digital competence seen as "the confident and critical use of Information Society Technology (IST) for work, leisure and communication" [58]. Digital competence is not just the sum of various skills, but also includes knowledge and attitudes (critical and reflective) accompanied with the call for responsible use of technology and digital media. In Europe, digital literacy policies were constructed on three levels: 1. Access and connectivity; 2. Development of digital skills for basic use of Internet technologies; 3. Development of advanced and sustainable skills such as critical thinking, trust, and multiplatform use [52]. Digital literacy is conceived as a transversal skill necessary for personal development, employment, social inclusion, and sustainability, as The Europe 2020 Strategy advanced. Policy documents of the European Commission constantly emphasize that digital skills are essential for economic growth and for sustainable development. They increase competitiveness but also social cohesion.

DigComp 2.0 [59] presents the list of 21 competencies: browsing, searching and filtering data, information, and digital content; evaluating data, information and digital content; managing data, information and digital content; interacting through digital technologies; sharing through digital technologies; engaging in citizenship through digital technologies; collaborating through digital technologies; netiquette; managing digital identity; developing digital content; integrating and re-elaborating digital content; copyright and licenses; programming; protecting devices; protecting personal data and privacy; protecting health and well-being; protecting the environment; solving technical problems; identifying needs and technological responses; creatively using digital technologies; Identifying digital competence gaps. The European Digital Competence Framework for Citizens is complemented by the European-wide indicator "Digital skills", used to monitor the state of the digital economy and society.

Not least, as new technologies rapidly evolve, literacy acquisition is not made once for all. On the contrary, they are deictic, thus one important meta-skill of the digital era is the ability "to continuously adapt to the new literacies required by the new technologies that rapidly and continuously spread on the Internet" [32]. Very interesting insights are gained from the ways in which researchers themselves perceive their digital literacy level.

In the study conducted by Tsatsou [60] on social sciences and humanities researchers, their own evaluation of their digital literacy embeds not only technical skills but also affective experience of their processes of learning and interacting with technologies, a situation that shows the importance of user-technology interactivity besides the view of digital literacy in terms of skills.

A systematic literature review on the 21st-century skills and digital skills for workers developed by Van Laar et al. [61,62] based on an initial search of 4266 articles and a total of 154 articles after all inclusion criteria were in place, evidence that seven core skills are supported by the use of ICT: technical digital skills, information digital skills management, communication digital skills, collaboration digital skills, creativity digital skills, critical-thinking digital skills, and problem-solving digital skills. The results indicate the need for determinants such as creativity and critical thinking to be studied in the digital context, as these types of constructs are less frequently considered in digital skills analysis. Similarly, the authors found that collaboration and communication skills are underreported, and empirical data relevant to the assessment of these constructs are scarce.

2.4. Digital Literacy in Education

The use of multimodality and digital narratives, computer-supported collaborative learning, data-driven language learning, web and mobile technologies for pedagogical purposes are just a few examples of how the interplay between new media and digital literacies shapes learning environments [63]. Kalantzis and Cope [64] describe a "multiliteracies pedagogy" that should supplement what educators do through "situated practice" (hands-on experiences), "overt instruction" (explicit explained theoretical framework), "critical framing" (locating knowledge in a specific context) and "transformed practice" (transferring knowledge from one context to another). Rheingold [65] calls for a "participative pedagogy" supported by digital media and networked publics and apt to respond to the 21st century conditions [64]. Van Dijk and van Deursen [42] observed that the content-related skills must be exercised before individuals begin to use digital media.

The educational solutions are a key to digital skills that "require background knowledge, experience, practical know-how, and creativity. In many cases, they call for systematic education" [42]. Moreover, the teachers must also "develop their own digital competence" [66], a situation that increases the complexity of the actual picture. The teaching process changed consistently over time, and the educators must be properly trained to manage the skills, knowledge, and tools mandatory for the 21st century. Thus, the training programs are a legitimate need for educators, who must competently align with the current requirements.

The implementation in the curriculum of digital skills is a necessary step in harmonizing education with societal requirements [67,68]. The tensions or even discontinuities among various literacies and practices are experienced by youth that many times feel that the literacies taught in schools are not very well connected to the present times. In this respect, "youth literacies" represents a meaningful concept that tries to collect the "ways young people engage in the world using a wide array of digital, multimodal media to connect with significant people and issues throughout the world. Youth literacies are fluid, hybrid, diverse, and multiple, and include the ability to interpret and produce a wide range of communicative texts, using not only written texts but also identifying themselves through art, music, dress" [69]. Youth literacies could be consonant but also dissonant with the prevalent educational agenda from a specific country or region. This is a reason to investigate what are the sources of their skills and whether there is congruence between formal and informal practices.

From the mid-1990s, two important literacy measurement initiatives have been developed: the OECD Programme for International Student Assessment (PISA) and the International Adult Literacy Survey (IALS). The OECD strongly emphasized the affordance of digital media in acquiring a key skill of in the present day: the confidence in problem-solving for various situations. The latest PISA report entitled "21st Century Readers:

Developing literacy skills in a digital world" [2] also investigates the necessary abilities of distinguishing between true and fake news, checking facts and sources of information, detecting disinformation. When the infodemic grows, the development of high competences must be addressed urgently, so that the students should be better prepared for the present world. The report brought evidence that "education systems in which more students are taught digital skills have a higher percentage of students who can correctly distinguish facts from opinions in the PISA tasks. On average across OECD countries, 54% of students said they were trained at school to recognize whether information is biased or not" [2].

2.5. The COVID Pandemic Context and Digital Skills

The pandemic of COVID 19 and the SARS-CoV-2 virus (Severe Acute Respiratory Syndrome Coronavirus 2) high transmission rate [70] has changed how we live and interact socially, where even social distance has become mandatory at times. Thus, we are in the midst of a time of significant changes in understanding and interpreting the different areas of life. Education is no exception, and the way we teach and learn is undergoing substantial changes [71]. The migration from the educational environment to collaborative learning environments and high technological use was already underway before the pandemic, which accelerated the process. The experiences developed have already proven that technology has facilitated the management of autonomy with the active participation of students in online educational spaces. However, access to technologies and knowing how to use them is different from digital competence, which depends on a set of knowledge, skills, and attitudes [72].

During the pandemic, online emergency remote education had to be widely adopted by educational institutions of all levels [71,73,74]. This abrupt change in how education is delivered demonstrated how much the learning experience needed to be enhanced for a new context [75,76]. Online emergency remote education has been an experiment in all areas [77]. Thus, educators and managers have perceived successful learning experiences and others less so. The educational landscape and its perspectives and ways of teaching will need to renew and reposition itself [71]. Education must become more flexible, where the student has more independence and autonomy, using educational technologies. This personalization can benefit from the experience taking place on a global scale, blending the strengths and weaknesses learned from online emergency teaching.

This context of increased use of digital technologies has further increased the importance of digital literacy to face the challenges caused by the pandemic [78,79]. Adopting the digital process is one of the challenges for educational institutions, which need to improve their students' digital skills. Such competencies are essential for students to benefit from the multiple options of the digital context, such as social media, video streaming, MOOCs, and the Internet of Things. These technologies can promote autonomous learning and improve performance in more learning activities [78,80]. However, learners' autonomy depends on their ability and willingness to make choices independently, complemented by the cultural background and educational culture [81]. Thus, "digital scholarship" represents the efforts of the digital university towards openness and orientation to social and work changes [82].

Following the arguments mentioned above and available in the existing literature, we developed the following conceptual model (Figure 2) and hypotheses:

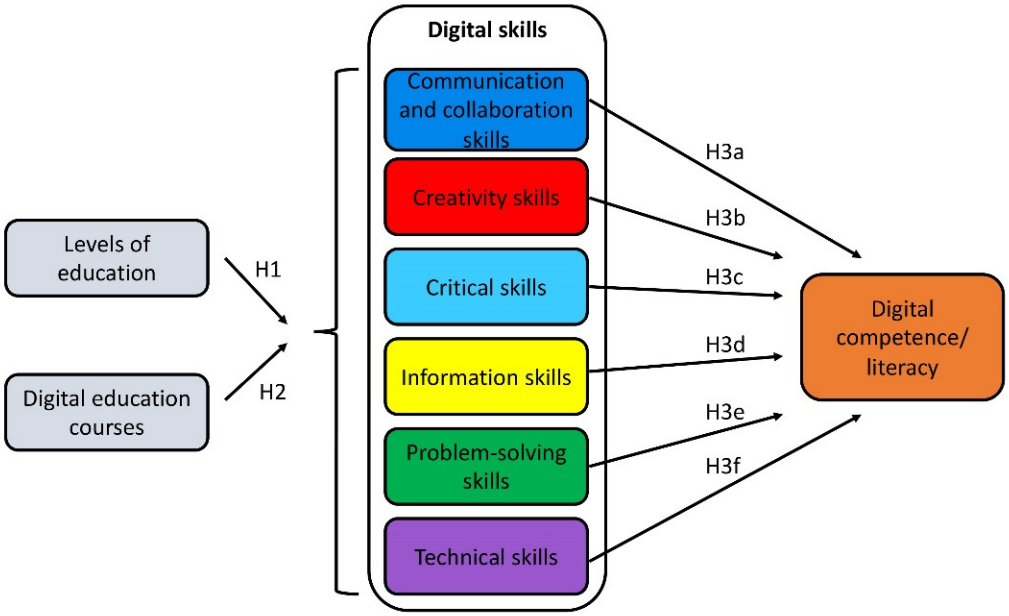

Figure 2. Conceptual model regarding digital skills, digital education, and digital competence/literacy. Source: authors' contribution.

Hypothesis 1 (H1). *We hypothesize that students' reported level of digital skills is significantly influenced by their education level.*

Hypothesis 2 (H2). *We hypothesize that students' reported level of digital skills is significantly influenced by their digital course enrolment.*

Hypothesis 3 (H3). *We hypothesize that there is a positive relationship between students' reported level of digital skills and digital competence/literacy.*

Hypothesis 3 (H3a). *Communication skills are positively related to digital competence/literacy.*

Hypothesis 3 (H3b). *Creativity skills are positively related to digital competence/literacy.*

Hypothesis 3 (H3c). *Critical-thinking skills are positively related to digital competence/literacy.*

Hypothesis 3 (H3d). *Information skills are positively related to digital competence/literacy.*

Hypothesis 3 (H3e). *Problem-solving skills are positively related to digital competence/literacy.*

Hypothesis 3 (H3f). *Technical skills and digital competence have a positive relationship.*

3. Methods and Data

3.1. Study Design and Data Analysis

Our study aims to investigate the relationships between students' reported level of digital skills and the sources of digital skill accumulation: education level and digital course enrolment in the new and specific situation created by the pandemic context. We further expand the analysis by including six digital skills perceptions: communication digital skills, creativity digital skills, critical-thinking digital skills, information digital skills, problem-solving digital skills, technical digital skills. We expect that the identified digital skills will be positively related to digital competence/literacy latent construct.

We opted for an online design due to the pandemic related restrictions and collected data during the second semester (March–May) of 2021 academic year through survey questionnaires administered to university students from four major faculties of the "Alexandru Ioan Cuza" University of Iasi, Romania: Faculty of Economics and Business Administration; Faculty of Philosophy and Social-Political Sciences, Faculty of Letters, and Faculty of Orthodox Theology. The students were grouped according to their field of education into two categories: social sciences and humanities. The questionnaire was structured into three

sections: in the first section we included questions regarding students' digital skills, in the second section we considered questions evaluating the students' perception of several directions of action that need to be pursued in order to achieve a development strategy in education, and in the third section we capture the respondent's profile (socio-demographic characteristics: e.g., age, gender) and the sources of digital skills accumulation (e.g., educational level and digital education courses enrolment). For this paper, we used the questions from the first and third sections of the questionnaire, as presented in Table 1. Moreover, Appendix A comprises the question items used in the study and the constructs developed based on them. The questionnaire was distributed to respondents using different educational platforms (e.g., TEAMS, ZOOM, and others).

For a better understating of the study goals and outcomes, on the first page of the questionnaire, we provided a short description of our work and the participants' right to quit the survey at any time. Moreover, they were provided with the option "I do not want to respond". Moreover, in order to assure the anonymity of the respondents, no personal identification data have been collected and they were informed about the possibility to withdraw at any time from the study, with no repercussions.

To analyze the influence of the sources of digital skills accumulation on the various types of digital skills, we performed the one-way analysis of variance (ANOVA). One-way ANOVA is a parametric test that compares the means of three or more independent groups in order to determine whether there is statistical evidence that the associated population means are significantly different [83]. Giving that ANOVA is included in the category of parametric analysis methods, the performing of the analysis will be done after defining the distribution of the recruitment population. Thus, normality, independence, and equal variance of the samples must be satisfied for ANOVA. In this way, the processes of verification on whether the samples were extracted independently from each other, Levene's test for determining whether homogeneity of variance was satisfied, and Shapiro-Wilk or Kolmogorov test for determining whether normality was satisfied must be conducted prior to deriving the ANOVA results [84]. We studied if there were significant differences among the scores of each type of digital skill based on the level of education and the enrolment in a digital education course.

In addition, in order to study the relationship between digital skills and digital competence, we applied confirmatory factor analysis (CFA) within the structural equation model (SEM). SEM is the integration between two statistical concepts, namely, the concept of factor analysis belonging to the measurement model and the concept of regression through the structural model.

One of the major advantages of SEM over traditional multivariate techniques is that it facilitates the estimation of latent (unobserved) variables via observed variables [85]. In our case, the latent variable is represented by the digital literacy of the students, while the observed variables are the following: communication digital skills, creativity digital skills, critical-thinking digital skills, information digital skills, problem-solving digital skills, and technical digital skills.

In the study, digital literacy was represented as a latent variable and was studied in relation to each of the digital skills considered both at the level of the total number of students and at the level of each of the two faculties. Confirmatory factor analysis (CFA) is the measurement part of SEM, is a statistical technique that is used in order to verify the factor structure of a set of observed variables, allowing to test the hypothesis that a relationship between observed variables and their underlying latent constructs exists. In this study, the CFA is subjected to maximum likelihood estimate (MLE) and run by means of the STATA, version 13. The CFA was applied both on the level of the total number of students and on the level of each specialization field (i.e., social sciences and humanities). For evaluating the model fit, we determined the following goodness-of-fit indices: root mean square error of approximation (RMSEA), standardized root mean square residual (SRMR), comparative fit index (CFI), and Tucker–Lewis index (TLI). RMSEA is a parsimony-adjusted index whose values closer to 0 represent a good fit. SRMR represents

the square root of the difference between the residuals of the sample covariance matrix and the hypothesized model. A value of SRMR below the cut-off of 0.08 means a good fit for the model. CFI and TLI measure whether the model fits the data better than a more restricted baseline model. These two indices vary from 0 to 1, a value greater than 0.90 indicating a good fit. According to the rule of thumb, if the values of most indices respect the suggested values in terms of lower/higher limits (i.e., SRMR and RMSEA $\leq$ 0.08; CFI and TLI $\geq$ 0.90), then the estimated models are well-fitted [86,87].

Table 1. Description of the variables.

Variable	Code	Description	No. of Items (Scale)
		Digital skills	
Communication and collaboration digital skills	Comm_ Collab_skills	The students' ability to transmit information using digital environments and to share online content and media made by them or others and to collaborate with peers. Communication and Collaboration skills consists of six items, with answers evaluated on a five-point Likert scale (1 = strongly disagree; 5 = strongly agree).	6 (1–5)
Creativity digital skills	Creativity_ skills	The students' ability to create content by converting information into new knowledge. Creativity skills consists of six items, with answers evaluated on a five-point Likert scale (1 = strongly disagree; 5 = strongly agree).	6 (1–5)
Critical thinking digital skills	Critical_skills	The students' ability to think reflectively and judge skilfully the incoming online information and provide them with a safe, permanent and an easily accessible tool as well as a physical environment and, also, to formulate their own point of view. Critical_skills consist of five items, with answers evaluated on a five-point Likert scale (1 = strongly disagree; 5 = strongly agree).	5 (1–5)
Information digital skills	Information_ skills	The students' ability to search, evaluate and organize digital information. Information_skills was assessed using six questions from the questionnaire, where the respondents were evaluated on a five-point Likert scale (1 = strongly disagree; 5 = strongly agree).	6 (1–5)
Problem-solving digital skills	Problem-solving _skills	The students' ability to find solutions for the problems or to formulate strategies to determine the best solutions for them. Problem-solving skills consists of six items, with answers evaluated using a five-point Likert scale.	6 (1–5)
Technical digital skills	Technical_ skills	The students' ability to continuously adapt to new technologies. Technical_skills construct consists of nine items, with answers evaluated using a five-point Likert scale.	9 (1–5)
		Socio-demographic variables	
Age	Age	A numerical variable where the respondent was asked to provide their age (in years). The variable was coded into three categories: 1 = 18–20 years old; 2 = 21–24 years old; 3 = 25 and over.	1 (1–3)
Gender	Gender	Gender of the respondents. A variable which takes the value "0" when the respondent's gender is male, and the value "1" when the respondent's gender is female;	1 (0–1)
Faculty field type	Faculty	A categorical variable representing the respondent's fields of education: 1 = social sciences and 2 = humanities.	1 (1–2)
Levels of education	Levels of education	A categorical variable representing the respondent's education level in which the student accumulated digital skills. The question was defined as a multiple-answers one, having the following three categories: 1 = Primary, 2 = Secondary and 3 = Tertiary and all the possible combination in-between.	1 (1–6)
Digital education courses	Digital education course enrolment	Enrolment at digital skills training courses. A dichotomous variable taking the value "1" if the respondent answers affirmatively to the question and "0" otherwise	1 (0–1)

Source: authors' calculations based on the Stata statistical analysis software.

In order to determine the sources of students' digital skills accumulation, we took into consideration the following variables:

Levels of education, a categorical variable that was constructed based on a multiple-answer question. The respondents were asked to indicate in which type of education system they have accumulated their digital skills. The categorical variable representing the respondents' source of digital accumulation has the value 1 for "primary education" (the respondents who mentioned only primary school as the source of digital skills accumulation); 2 for "secondary education"(the respondents who answered that only secondary

school was important in this aspect), 3 for " tertiary education" (containing the respondents who mentioned only tertiary school), and between 4 and 6, for all the combinations in-between (4 = the ones who considered both primary and secondary school education were the sources for their digital skills; 5 = comprising the respondents who mentioned secondary and tertiary school as the source of their digital skills accumulation and 6 = the respondents who considered all of three levels of school as important in accumulating their digital skills).

Digital education courses enrolment. The students were asked to specify if they have taken digital skills training courses. The variable used in the study was named "Digital education course enrolment". A dichotomous variable taking the value "1" if the respondent answers affirmatively to the question and "0" otherwise.

3.2. Digital Skills Measures

In the first section of the questionnaire, we included 38 items in order to assess the respondents' digital skills. In including the selected digital skills, we started from Van Laar et al. [61,62] meta-analysis, which was conducted using Scopus, Web of Science, and PsycINFO databases and aimed at synthesizing the relevant academic literature concerned with 21st-century skills and digital skills. The study provided seven core skills supported by the use of ICT: technical digital skills, information digital skills management, communication digital skills, collaboration digital skills, creativity digital skills, critical-thinking digital skills, and problem-solving digital skills. For each type of digital skill, we considered several items measured using a five-point Likert scale ranging from 1 = "strongly disagree" to 5 = "strongly agree".

In order to verify the reliability of the multi-item scales, we performed a Cronbach Alpha-based internal consistency analysis. For exploratory studies, values between 0.60 and 0.70 are considered acceptable [86]. The value of Cronbach Alpha corresponding to each of the six types of digital skills was higher than 0.70, offering, in this way, good reliability of the scales (Table 2). In addition, to further verify the composite reliability, we computed the value of McDonald's Omega for each of the six types of digital skills. Similar to Cronbach Alpha, the values of McDonald's Omega must be higher than 0.70 and the results indicate that this criterion is accomplished for all the constructs.

Table 2. Results of reliability and validity tests.

Variable	Cronbach's Alpha	McDonald's Omega	AVE	Correlation Coefficients					
				1.	2.	3.	4.	5.	6.
1. Comm_Collab_skills	0.829	0.825	0.661	[0.813] [a]					
2. Creativity_skills	0.812	0.811	0.660	0.572 ***	[0.812]				
3. Critical_skills	0.780	0.780	0.592	0.639 ***	0.412 ***	[0.769]			
4. Information_skills	0.702	0.700	0.549	0.514 ***	0.417 ***	0.547 ***	[0.741]		
5. Problem-solving_skills	0.821	0.827	0.543	0.568 ***	0.465 ***	0.605 ***	0.511 ***	[0.737]	
6. Technical_skills	0.754	0.747	0.502	0.607 ***	0.547 ***	0.592 ***	0.552 ***	0.632 ***	[0.709]

Notes: *** $p < 0.01$ (2-tailed); [a] The data in the diagonal square brackets are the square root of the AVE value for each variable.

In Table 2 were included also results regarding the convergent and discriminant validity. The convergent validity was measured through average variance extracted (AVE) and, in order to assure the convergence of the constructs, the values have to be higher than 0.50. Based on the values of AVE for each of the six constructs, the discriminant validity can be measured by calculating the square root of AVE values. If in the inter-correlation matrix, the value obtained is higher than the ones on the corresponding column and row, then the idea of discriminant validity is achieved. Given these criteria, in the case of each construct, results from Table 2 reveal that both convergent validity and divergent validity are accomplished.

Further, we will present separately each type of digital skills:

Communication and collaboration digital skills. These skills describe the students' ability to efficiently communicate using digital tools/ instruments such as email, social networks, and instant messaging services and to collaborate with their peers. To measure this digital skills category, we used six items developed, starting from Al Khateeb [88] methodology (e.g., "I actively use a wide range of communication tools (e-mail, chat, SMS, instant messaging, blogs, micro-blogs, social networks) for online communication"; "I pass or share knowledge with others online (e.g., via social networking tools or in online communities.)"; "I can communicate with others using Skype, WhatsApp, Messenger, etc., or using basic features (e.g., voice messaging, SMS, text exchange)"; "I can use advanced features of several communication tools (e.g., using Skype and sharing files)"; "I can use collaboration tools (e.g., project management software, online spreadsheets) and help edit documents/files created and shared by others (One Drive, Google Drive, Dropbox, etc.)"; "I know I can use online services (e.g., e-banking, e-governments, e-hospitals, online payment, etc.)".

Creativity digital skills. This construct refers to the students' ability to create digital content based on their ideas and experiences. Creativity was measured with six items adapted after van Deursen et al. [89] and Al Khateeb [88] (e.g., van Deursen et al. [89]: "I know how to create something new from existing online images, music or video."; from Al Khateeb [88]: e.g., "I can create simple digital content (e.g., text, tables, images, audio files) in at least one format using digital tools."). Additional items include: "I pass on or share knowledge with others online (e.g., via social networking tools or in online communities)"; "I am confident about writing/creating content on a blog, website or forum"; "I would feel confident putting writing/video/image content I have created online"; "I can use tools for creating webpages or blogs"; "I can create complex, multimedia content in different formats, using a variety of digital tools and environments".

Critical thinking digital skills. It reflects the students' ability to think reflectively and judge skilfully the incoming online information and, also, to formulate their own point of view. This digital skill shows the students' ability to filter and extract valuable information, and provide them with a safe, permanent and an easily accessible tool as well as a physical environment. *Critical thinking digital skills* construct was measured with two items adapted after van Deursen et al. [89] and Al Khateeb [88] and four items developed by the authors (e.g., "I know that on internet not all the information is reliable", and "I know how to check different sources and evaluate online content."; "I know how to identify and extract specific information in sources like social media."). This type of digital skill was evaluated using a five-point Likert scale (scale 1 = strongly disagree; 5 = strongly agree).

Information digital skills. These skills refer to students' ability to identify, select, and organize digital information. This type of skill was measured using six items starting from Al Khateeb [88] methodology (e.g., "I can save or store files or content and retrieve them once saved or stored."; "I classify the information in a methodological way using folders. I make backups of information or files I have stored."; "I can use advanced search strategies to find reliable information on the internet (such as using web feeds (like RSS))"; "I use some filters when searching to compare and assess the reliability of the information I find"; "I can assess the validity and credibility of information using a range of criteria"; and "I can save information found on the internet indifferent formats. I can use cloud information storage services"). The respondents were evaluated using a five-point Likert scale (1 = strongly disagree; 5 = strongly agree).

Problem-solving digital skills. This type of digital skill refers to the students' ability to deal with problematic situations which may appear in the digital environment. To measure problem-solving digital skills, we used six items adapted from Al Khateeb [88] (e.g., "I can solve almost all problems that arise when using digital technologies"; "I use different passwords to access equipment, devices, and digital services and I modify them on a periodic basis"; I can take basic steps to protect my devices (e.g., using anti-viruses and passwords)"; "I have installed security programs on the device(s) that I use to access

the Internet (e.g., antivirus, firewall)"; "I know how to react if my computer is infected by a virus. I can configure or modify the firewall and security settings of my digital devices"; "I find support when a technical problem occurs or when using a new program").

Technical digital skills. These skills describe the students' ability to face the challenges related to technology. This type of digital skills was evaluated through nine items: two adapted from van Deursen et al. [89] methodology, five from the methodology developed by Al Khateeb [88], and two developed by the authors starting from the literature (e.g., "I regularly update my digital skills. I am aware of my limits and try to fill my gaps"; "I am aware of new technological developments; I understand how new tools work."; "I can bookmark a website and I can download/upload files"; "I can complete online forms";" I can apply basic formatting (e.g., insert footnotes, charts, tables) to the content I or others have produced";" I know how to import data into specific programs and tools (e.g., STATA, SPSS, Eviews, MonkeyLearn, Aylien, Google Cloud NLP API, Amazon Comprehend, Brandwatch, RapidMiner, MeaningCloud)"; "I know how to do simple data processing in specific programs and tools (e.g., STATA, SPSS, Eviews, MonkeyLearn, Aylien, Google Cloud NLPAPI, Amazon Comprehend, Brandwatch, RapidMiner, MeaningCloud)"; "I know how to reference and reuse content covered by copyright" and "I can choose the right tool, device, application, software or service to solve (non-technical) problems".

In the study, constructs for each type of digital skill were created by calculating the average of the responses for the items referring to them. For instance, the scores for the construct regarding the communication skills were defined as the average of the response' values obtained at the 6 items referring to the type of digital skill. Similarly, we define all the constructs used in the analysis.

3.3. Sample and Data

First, the questionnaire was pretested in order to check the understanding of the items and to validate the scales. The pilot study was sent to a small sample comprise of 25 students during online classes. We performed different reliability tests in order to validate the constructs, and to define the final version of the survey.

In order to perform our analysis, we extracted a random sample by using the university's database. We have randomly selected 1000 students, out of which only 301 were willing to participate in the survey. The total number of observations reached 282 valid responses, the percentage of complete responses being of 93.68%. From these observations, we eliminated 23 because, in some of the responses for the variables of interest, there were data missing, which could have impacted the accuracy of the results. Thus, the final number of observations considered in the database was of 259 students.

The sample consists of N = 259 students, out of which 150 students were enrolled in social sciences (57.9% of the total sample) and 109 students (42.1% of the total sample) in humanities. The overall sample was predominantly female (69.1%, 30.9% males), and the vast majority being aged between 18 and 20 years, 92 (35.5%) or between 21 and 24 years, 116 (44.8%). Sample descriptives are presented in Table 3.

Table 3. Frequency distribution for our sample (n = 259).

Variable	Category	Frequency	Percentage (%)
Gender	Female	179	69.1
	Male	80	30.9
Age	18–20	92	35.5
	21–24	116	44.8
	25+	51	19.7
Faculty	Social sciences	150	57.9
	Humanities	109	42.1

Source: authors' calculations based on the Stata statistical analysis software.

4. Results of the Research

This section provides the descriptive statistics for the variables considered in the analysis. In order to validate our hypotheses, we present the main results regarding the influence of the sources of digital skills accumulation on each type of the digital skills and the relationship between digital skills and digital competence/literacy.

4.1. Descriptive Statistics

Figures 3 and 4 reveal the categories and their frequencies in the total sample for variables referring to the sources of digital skills accumulation. Regarding the level of education (Figure 3), we can observe that the vast majority of the respondents claimed that the digital skills were accumulated mostly in both secondary and tertiary levels of education (78, equivalent to 30.11%) or in secondary education (70, equivalent to 27.02%), while few accumulated these skills just in the primary (8, equivalent to 3.08%) or in both primary and secondary (22, equivalent to 8.49%) levels of education. Concerning the enrolment in digital courses (Figure 4), most of the students declared that they did not attend such courses in the past (204, equivalent to 78.76%).

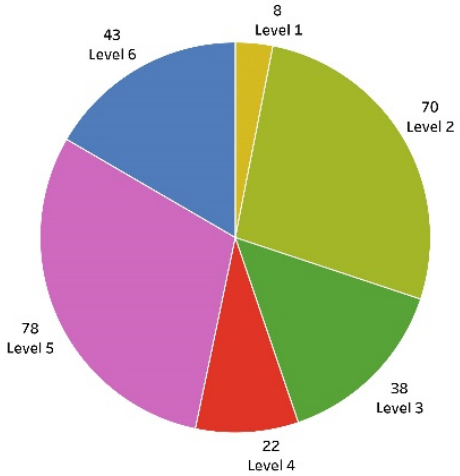

Figure 3. Distribution for Level of education, Source: authors' calculations.

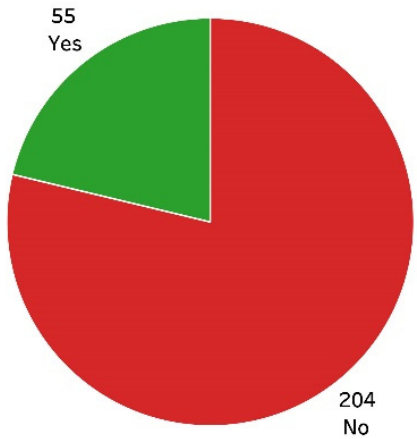

Figure 4. Distribution for digital courses enrolment, Source: authors' calculations.

Table 4 shows the descriptive statistics for each type of digital skills. As it can be seen, the interval of variation is between 1 = representing the lowest score for a certain digital skill, and 5 = representing the highest score for the same digital skill.

Table 4. Descriptive statistics of the variables measuring digital skills.

Variable	N	Min	Max	Mean	Std. dev.	Skewness	Kurtosis
Comm_Colab_skills	259	1	5	4.438	0.620	−1.993	6.814
Creativity_skills	259	1	5	3.637	0.811	−0.305	0.004
Critical_skills	259	1	5	4.402	0.586	−1.449	3.662
Information_skills	259	1	5	3.890	0.629	−0.639	0.867
Problem-solving_skills	259	1	5	3.906	0.817	−0.432	−0.494
Technical_skills	259	1	5	3.627	0.598	−0.027	0.117

Source: authors' calculations based on Stata statistical analysis software.

The digital skills which registered the highest scores were communication and collaboration skills and critical thinking skills with mean values higher than 4.4 (4.438 and 4.402, respectively). In contrast, the ones with the lowest scores were creativity skills and technical skills, which registered values around 3.6 (3.637 and 3.627, respectively). The negative values regarding coefficients of skewness revealed asymmetrical distributions at the level of all types of digital skills.

4.2. Sources of Digital Skills Accumulation

In Figures 3 and 4, for each of the levels of education (or any possible combination between them) and for digital course enrolment, indicated by the respondents as a source of the accumulation of the digital skills, are presented the average scores obtained for each of the digital skills analyzed: communication and collaboration digital skills (blue color), creativity digital skills (red color), critical thinking digital skills (blue color), information digital skills (yellow color), problem-solving digital skills (green color) and technical digital skills (purple color).

The results show that the students who declared primary level of education as the single source of their digital skills accumulation registered the lowest scores for all the digital skills considered (3.604 for communication and collaboration digital skills, 2.960 for creativity digital skills, 3.700 for critical thinking digital skills, 2.959 for information digital skills, 3.188 for problem-solving digital skills, and 2.986 for technical digital skills), while for the ones who mentioned secondary or tertiary levels of education, the highest scores were identified (4.573 for communication and collaboration digital skills, 3.919 for creativity digital skills, 4.454 for critical thinking digital skills, and 4.043 for problem-solving skills in the secondary level of education; 3.961 for information skills and 3.666 for technical skills in the tertiary level of education) (Figure 5).

In terms of the digital skills scores depending on the digital education course enrolment, we can observe that the students who declared that participated to such courses had higher scores than the ones who did not (i.e., 4.585 versus 4.372 for communication and collaboration digital skills, 3.873 versus 3.553 for creativity digital skills, 4.527 versus 4.359 for critical thinking digital skills, 4.124 versus 3.835 for information digital skills, 4.091 versus 3.837 for problem-solving digital skills, and 3.784 versus 3.560 for technical digital skills). (Figure 6).

In addition, among the digital skills, it can be observed that, regardless of the level of education or digital courses enrolment, the ones with the highest average scores are related to communication and collaboration and critical thinking digital skills, while the ones with the lowest average scores are referring to creativity and technical digital skills.

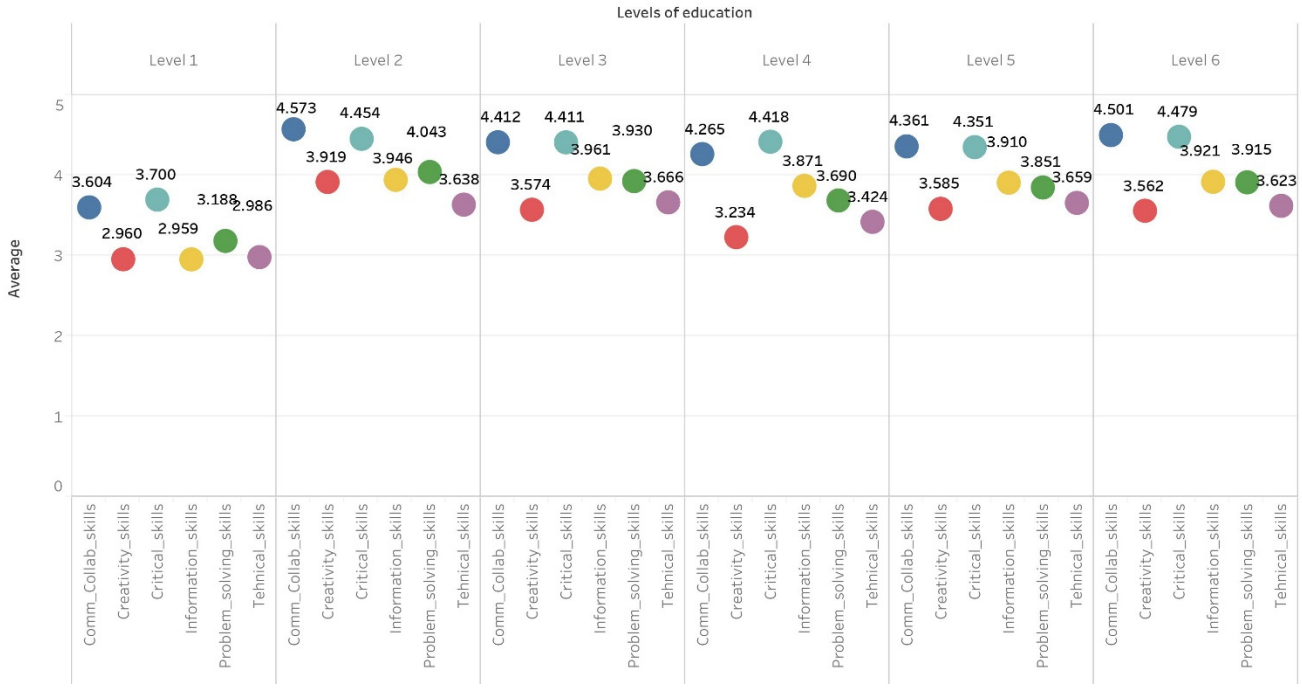

Figure 5. Scores of digital skills based on the level of education. Source: authors' calculations.

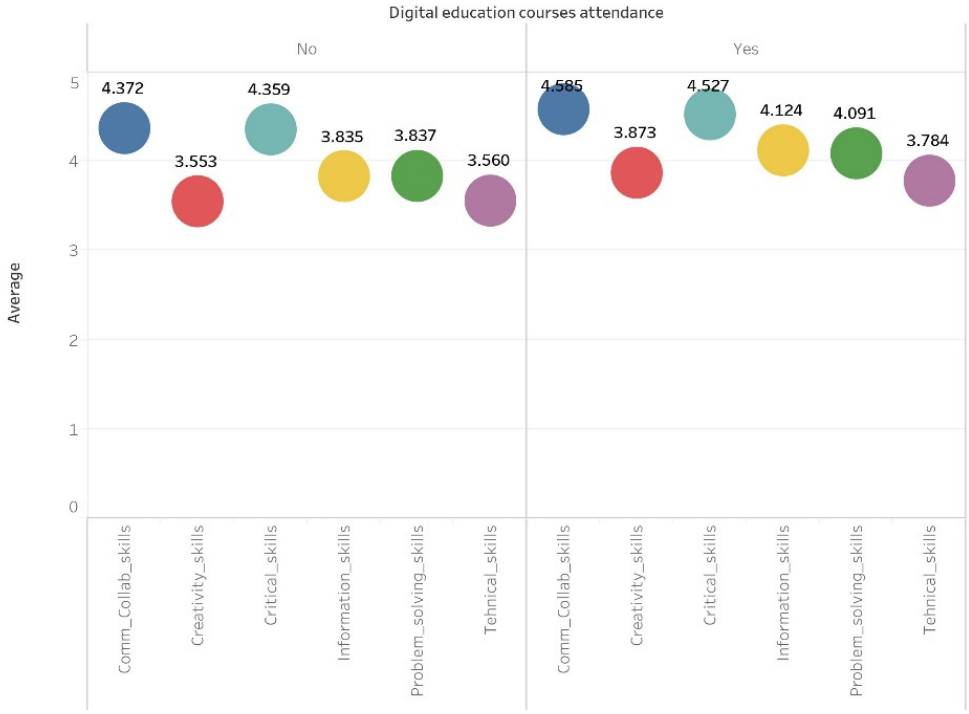

Figure 6. Scores of digital skills based on digital education course enrolment, Source: authors' calculations.

As regards the impact of these sources of digital skills accumulation on each type of digital skill, the results of ANOVA (Table 5) show several significant influences. In order to assure the representativeness of these results, we previously validated the hypotheses of normality, independence, and equal variance at the level of the samples.

Table 5. Results of ANOVA test for each type of digital skills.

Variable	Levels of Education		Digital Education Course Enrolment	
	F Statistic	Sig	F Statistic	Sig
Comm_Collab_skills	2.565	0.028	5.371	0.021
Creativity_skills	0.936	0.458	7.682	0.006
Critical_skills	2.491	0.032	3.391	0.067
Information_skills	2.096	0.066	11.351	0.001
Problem-solving_skills	1.000	0.418	4.754	0.030
Technical_skills	1.700	0.135	7.093	0.008

Source: authors' calculations.

Regarding digital skills accumulation according to the educational level, we can observe that all of the skills are significantly influenced for a significance level between 5% and 15%, except creativity digital skills and problem-solving digital skills, partially validating Hypothesis 1. In the case of digital education course enrolment, its impact is significant for all of the digital skills analysed, considering a risk of 1% for creativity, information and technical skills; 5% for communication and collaboration and problem-solving skills; and 10% for critical thinking skills, confirming Hypothesis 2**.**

4.3. Digital Literacy Skills

The average scores of digital skills differ among students' faculty types. Figure 7 emphasizes these differences, offering more details on the average scores registered at the level of each type of digital skill, both on the total database and on the level of each faculty type: social sciences and humanities.

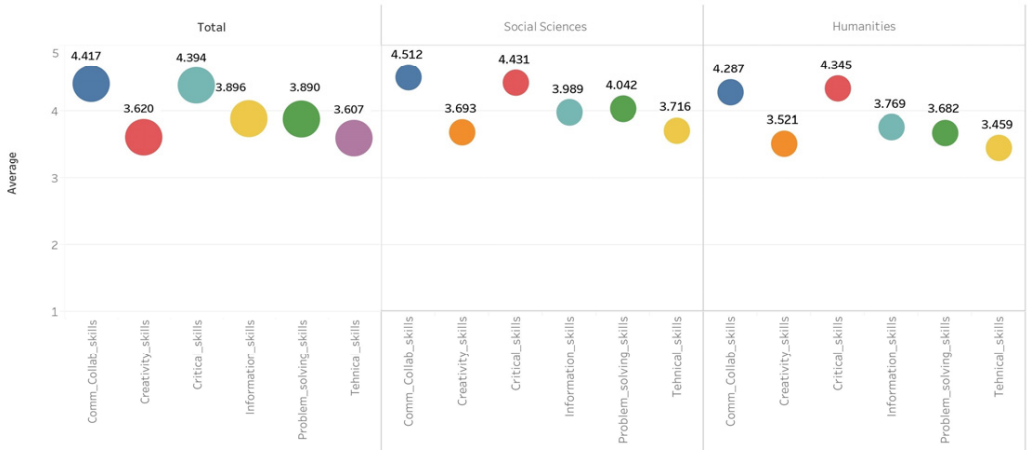

Figure 7. The average scores for each type of digital skills on total sample and on each faculty. Source: authors' calculations.

The results indicate higher mean scores for students in social sciences than from those enrolled in humanities 4.512 versus 4.287 for communication and collaboration digital skills, 3.693 versus 3.521 for creativity digital skills, 4.431 versus 4.345 for critical thinking digital skills, 3.989 versus 3.769 for information digital skills, 4.042 versus 3.682 for problem-solving digital skills, and 3.716 versus 3.459 for technical digital skills.

Further, we will consider the relationship between digital literacy and each of the digital skills analyzed, both on the total sample and on each faculty type using CFA within SEM (Figures 8–10).

Taking into consideration the different number of items included in the observed variables, the standardized processing of original data is required. The estimated path coefficients depict the effects among variables. The exogenous latent variable, digital literacy, is measured by the observed variables (communication and collaboration digital

skills, creativity digital skills, critical thinking digital skills, information digital skills, problem-solving digital skills, and technical digital skills).

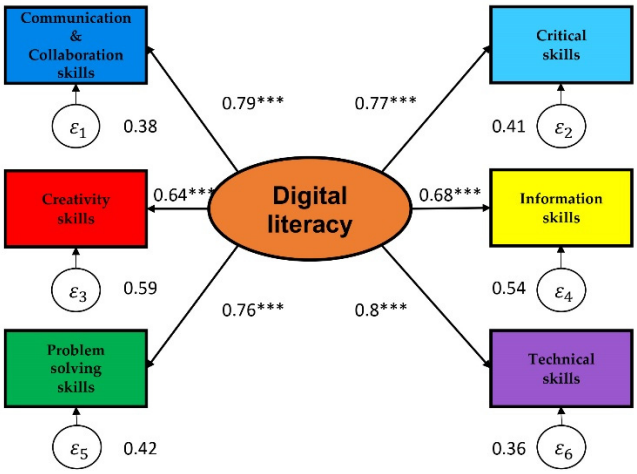

Figure 8. Relationship between digital literacy and digital skills: total sample. *** shows the statistical significance of the regression coefficient at 1%. Source: authors 'calculations based on Stata statistical analysis software.

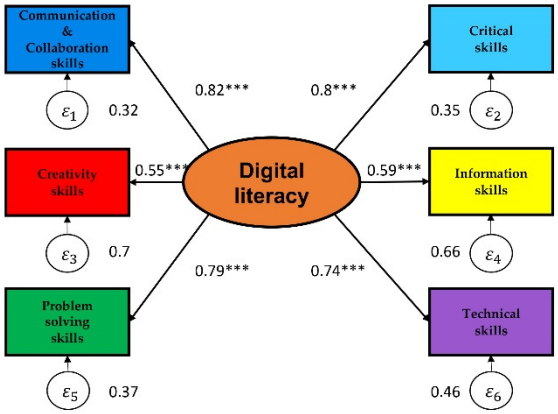

Figure 9. The relationship between digital literacy and digital skills: social sciences students. *** shows the statistical significance of the regression coefficient at 1%. Source: authors' calculations based on Stata statistical analysis software.

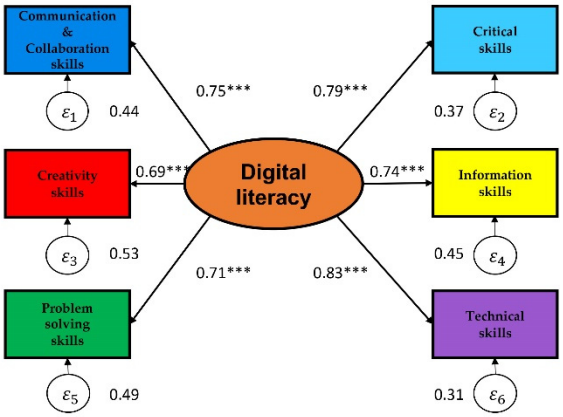

Figure 10. The relationship between digital literacy and digital skills: humanities students. *** shows the statistical significance of the regression coefficient at 1%. Source: authors' calculations based on Stata statistical analysis software.

In Table 6 several results are included of modeling for the total sample, social sciences students, and humanities respondents.

Table 6. Loadings of the measurement model.

Latent Variable	Measurement Variables	Total		Social Sciences		Humanities		Hypothesis—Result
		Std. Estimates	R^2	Std. Estimates	R^2	Std. Estimates	R^2	
Digital literacy	Comm_Collab skills	0.788 ***	0.621	0.824 ***	0.678	0.749 ***	0.561	H3a—Supported
	Creativity skills	0.640 ***	0.410	0.550 ***	0.303	0.687 ***	0.473	H3b —Supported
	Critical skills	0.768 ***	0.590	0.803 ***	0.645	0.792 ***	0.627	H3c —Supported
	Information skills	0.678 ***	0.460	0.587 ***	0.344	0.743 ***	0.553	H3d —Supported
	Problem-solving skills	0.759 ***	0.576	0.791 ***	0.626	0.714 ***	0.509	H3e —Supported
	Technical skills	0.799 ***	0.639	0.735 ***	0.680	0.828 ***	0.675	H3f —Supported
	Overall		0.886		0.885		0.892	

Source: authors' calculations based on Stata statistical analysis software. Note: *** shows the statistical significance of the regression coefficient at 1%.

As it can be observed from Figures 8–10 and Table 6, standardized estimates indicate a significant relationship between digital literacy and each of the digital skills considered, at the total sample level and at the level of each field of education. There are several empirical views on the standardized estimate of the factor loadings. Generally, values of at least 0.3 and greater than 0.5 are interpreted as good, while values greater than 0.7 are interpreted as very good [90]. In the total sample and on the social sciences and humanities levels, all the values of these estimates are higher than 0.7, except the ones for creativity digital skills and Information digital skills ranging between 0.5 and 0.69.

The values for R^2 indicate the size of the variation explained by the latent variable for a certain observed variable (i.e., digital skills). Results revealed a percentage ranging between 41 and 63 in the total sample, the lowest percentages of variation explained by digital literacy being observed in the case of creativity digital skills (41%) and information digital skills (46%), while the highest being noticed in the case of communication and collaboration digital skills (62.1%) and technical digital skills (63.9%). Concerning the differences between the two specializations, it could be emphasized that communication and collaboration digital skills, critical thinking digital skills, problem-solving digital skills, and technical digital skills are explained to a larger extent by digital literacy/competence in the case of social sciences, while the other digital skills (i.e., creativity digital skills and information digital skills) are better explained in the case of humanities. Overall, digital skills are explained, on average, to a percentage of 88% by digital literacy, thus validating Hypotheses 3, and H3a–H3f.

The goodness-of-fit is an indication of whether the established SEM reflects the data situation well, a poor goodness-of-fit rendering the results unreliable. Therefore, model evaluation through the goodness-of-fit indices is an important aspect of SEM modeling.

The goodness-of-fit indices presented in Table 7 revealed that the models estimated within the SEM framework are well-fitted, the values of RMSEA and SRMR being lower or equal to 0.08, except the case of humanities, and the values of CFI and TLI being higher than 0.90. In the case of humanities, it was observed a value of 0.13 for RMSEA; still, the model can be validated because the other three indices respect the suggested values.

Table 7. Evaluation of the structural model.

Fit Statistics	Total	Social Sciences	Humanities
RMSEA	0.08	0.05	0.13
CFI	0.98	0.99	0.95
TLI	0.96	0.98	0.91
SRMR	0.03	0.03	0.04

Source: authors' calculations based on Stata statistical analysis software.

Our results are in line with the ones obtained by authors such as [60–62], emphasizing the importance of studying the digital skills not at the general level, but at the particular one, decomposing them in several types (i.e., communication digital skills, creativity digital skills, critical-thinking digital skills, information digital skills, problem-solving digital skills, technical digital skills). Moreover, as Tsatsou [60] mentioned on his study on digital skills of social sciences and humanities researchers, the evaluation of digital literacy embeds not only technical skills, but also affective experience of the processes of learning and interacting with technologies, showing the importance of user-technology interactivity besides the view of digital literacy in terms of skills, especially in the present context of the COVID pandemic.

5. Discussion

This paper focused on students' digital skills perception and on the sources of digital skills accumulation. As Pangrazio [91] points out, more often than not being successful as a young person is linked to digital literacy. Those who do not keep the pace have serious issues in terms of both the job market and personal interactions. Moreover, although plenty of definitions circulates in academia [12], their focus is either on technical expertise, critical skills, or both. As Buckingham [92,93] noticed, in the context of growing media convergence, there is a need to broaden the perspective on literacy to overpass the binary approaches in media opportunities and risks. Skills and competencies remain at the core of this reconceptualization, with the call for extending the conceptual framework and the educational configuration. Nevertheless, we could not obtain a critical and functional perspective if we did not know, through empirical studies, the actual sources of digital skills and the perceived level of literacy of specific categories of people. In this vein, our study put these alignments to work in the case of Romanian students in the particular context created by the pandemic. Six digital skills were analyzed (communication and collaboration digital skills, creativity digital skills, critical-thinking digital skills, digital information skills, problem-solving digital skills, digital technical skills), alongside two crucial sources of digital skills accumulation: educational level and digital course enrolment.

In achieving the aim of the paper, we developed a questionnaire which was applied among the students from four major faculties of the "Alexandru Ioan Cuza" University of Iasi, Romania: Faculty of Economics and Business Administration; Faculty of Philosophy and Social-Political Sciences, Faculty of Letters, and Faculty of Orthodox Theology. In the questionnaire we included items regarding students' digital skills, also capturing the sources of digital skills accumulation (e.g., educational level and digital education courses enrolment) and the respondent's profile (socio-demographic characteristics: e.g., age, gender). In order to assess the students' digital skills, starting from the meta-analysis of Van Laar et el. [61,62], we included 38 items covering six core skills developed by using ICT: communication and collaboration digital skills, creativity digital skills, critical-thinking digital skills, information digital skills, problem-solving digital skills, and technical digital skills.

Further, we performed a one-way analysis of variance (ANOVA) in order to analyze if there were significant differences among the scores of each type of digital skill based on the two sources of digital skills accumulation: the level of education and the enrolment in a digital education course. The results showed that, except creativity and problem-solving digital skills, all of the digital skills were significantly influenced by the levels of education at which students accumulated them. Moreover, in the case of enrolment taking a digital education course, there was a significant impact on all the digital skills.

In order to study the digital skills-digital literacy nexus, we grouped the students according to their field of education in two categories (i.e., social sciences and humanities) for observing if there are any significant differences between them. This relationship was studied by applying confirmatory factor analysis (CFA) within the structural equation model (SEM). We considered digital literacy as a latent variable and studied it in relation to each digital skill separately. The standardized estimates indicated a significant relationship

between digital literacy and each of the digital skills considered, for the total sample as well as for each field of education.

Based on the results obtained, we can draw the following main conclusions. First of all, we demonstrate that the accumulation of digital competences took place mainly at secondary or higher levels of education, and not at primary education. The results revealed that students who declared basic education as the only source of accumulation of digital skills recorded the lowest scores for all digital skills considered, while for those who mentioned high school and/or higher education, the highest scores were identified. This has some implications for the need for greater focus on developing initiatives at high school and higher education. Moreover, digital education courses are effective options for increasing digital skills. Most students declared not having taken digital education courses, however, students who declared having taken such courses had higher grades than those who did not. Besides the above arguments, we can state that there is clear heterogeneity in the levels of digital skills by indicator among students. The results show that communication, critical thinking, problem-solving, and technical digital skills are more present in the case of students enrolled in social sciences specializations, while the other digital skills (i.e., creativity and information) are more to the fore in the case of Humanities enrolled students. This shows the complexity of adapting course curricula to new realities to meet market demands.

Theoretical and practical implications are manyfold. Firstly, even if digital abilities are generally seen as essential for the future, many worries come precisely from the skills area: 26% of Eurobarometer' respondents expressed serious concerns about "the difficulty of learning new digital skills in order to take an active part in society" [94,95]. The concerns related to acquiring new digital skills are directly proportional to age, so it became clear that a good foundation for digital literacy must be constructed in the youth. If the aged people think that acquiring new digital skills represents a hard task, the younger respondents expressed that their troubles are situated in disconnecting from the online and in creating an equilibrium between online and offline. We observe again the complexity of digital literacy layers and the constant need of evaluating concrete situations. By analyzing students' digital skills, we placed our research in a nodal framework both theoretically and practically. Secondly, the level of digital skills that specific demographics have remains critical information that must be ongoingly updated. Our paper contributes to this effort of filling the gap between the theoretical interpretations of the digital skills concept and the perceived level of their use and importance in various contexts. Students who master digital literacy are not just more prepared for online learning, coping better with the pandemic, or being more employable, but they also develop a consistent advantage by becoming lifelong learners and participative citizens. Thirdly, our findings revealed that some digital skills are more used than others, depending on faculty specialization. Thus, a set of improvements and strategies could be further developed considering the different specializations, too. Besides the digital foundational skills, it is vital to develop the full potential of digital literacy. Innovative initiatives could find in our study a basis for diagnosis and a starting point for practical programs or remediation plans. Fourthly, our research raises awareness of the importance of the perception of digital literacy and points out the real sources of acquiring digital skills. The relevance of education in this process implies conceiving more innovative curricula with a special emphasis on digital literacy.

6. Conclusions and Directions for Further Research

The digital skills necessary for the current context of high use of information and communication technology in all areas are acquired in formal and informal contexts. Traditional education incrementally adopts the policies, curricula, and methods young people need. The formal and controlled learning environment contributes significantly to the knowledge and skills required for digital literacy. However, these knowledge and skills are diverse and vary according to the development of technologies and society. This study fills an important academic gap on digital literacy by placing digital literacy in a specific

and well-defined context, analyzing different perspectives that involve this learning, such as predictors of digital literacy in different types of students. In addition, the research increases its importance when being developed during a pandemic period, of accelerated technological use, and with sudden changes being implemented.

Our results do not go without limitations. First, we used student responses from four major faculties of Romania, which can cause potential sampling bias; only six digital skills were considered as antecedents of digital competence/literacy, which offers a limited perspective of the complex interactions between the constructs. Second, our assessment is cross-sectional, not allowing us to capture how these constructs relate to each other from an evolutionary perspective. In this context, some suggestions for future research are presented: (i) carry out similar surveys across other contexts and regions; (ii) use complementary methodologies, both quantitative and qualitative, that can deepen the results; (iii) design longitudinal assessments to see an evolution of the students' perception regarding digital literacy and digital skills; (iv) include additional variables to measure the factors that influence the accumulation of digital literacy and digital competences.

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

Appendix A. Constructs and Question Items

Dimension	Questions
Communication and Collaboration digital skills	
	"I can communicate with others using Skype, WhatsApp, Messenger, etc. or using basic features (e.g., voice messaging, SMS, text exchange)". "I can use advanced features of several communication tools (e.g., using Skype and sharing files) ". "I actively use a wide range of communication tools (e-mail, SMS, instant messaging, blogs, social networks) for online communication". "I can use collaboration tools (e.g., project management software, online spreadsheets) and help edit documents / files created and shared by others (One Drive, Google Drive, Dropbox, etc.) ". "I know I can use online services (e.g., e-banking, e-governments, e-hospitals, online payment etc.) ". "I pass on or share knowledge with others online (e.g., via social networking tools or in online communities) ".

Dimension	Questions
Creativity digital skills	
	"I know how to create/edit something new from existing online images, music or video". "I am confident about writing/ create content on a blog, website or forum". "I would feel confident putting writing/video/image content I have created online". "I can create digital content (e.g., text, tables, images, audio, video files) in at least one format using digital tools". "I can use tools for creating webpages or blogs". "I can create complex, multimedia content in different formats, using a variety of digital tools and environments".
Critical thinking digital skills	
	"I know when I should and shouldn't share information online and which kind of information". "I know how to extract/highlight fundamental concepts and references in the text". "I know how to identify and extract specific information in sources like social media". "I am aware that my credentials (username/password) can be stolen. I know I should not reveal private information online". "I know that on internet not all information is reliable and I know how to check different sources and evaluated online content".
Information digital skills	
	"I can use advanced search strategies to find reliable information on the internet (such as using web feeds (like RSS)) ". "I use some filters when searching to compare and assess the reliability of the information I find". "I can assess the validity and credibility of information using a range of criteria". "I can save or store files or content and retrieve them once saved or stored". "I classify the information in a methodical way using folders. I make backups of information or files I have stored". "I can save information found on the internet indifferent formats. I can use cloud information storage services".
Problem-solving digital skills	
	"I can take basic steps to protect my devices (e.g., using anti-viruses and passwords) ". "I have installed security programmes on the device(s) that I use to access the Internet (e.g., antivirus, firewall) ". "I use different passwords to access equipment, devices and digital services and I modify them on a periodic basis". "I know how to react if my computer is infected by a virus. I can configure or modify the firewall and security settings of my digital devices". "I find support when a technical problem occurs or when using a new program". "I can solve most of the more frequent problems that arise when using digital technologies".
Technical digital skills	
	"I can bookmark a website and I can download/upload files". "I can complete online forms". "I can apply basic formatting (e.g., insert footnotes, charts, tables) to the content I or others have produced". "I know how to import data into a specific programs and tools (e.g., STATA, SPSS, Eviews, MonkeyLearn, Aylien, Google Cloud NLP API, Amazon Comprehend, Brandwatch, RapidMiner, MeaningCloud) ". "I know how to do simple data processing in specific programs and tools (e.g., STATA, SPSS, Eviews, MonkeyLearn, Aylien, Google Cloud NLPAPI, Amazon Comprehend, Brandwatch, RapidMiner, MeaningCloud) ". "I know how to reference and reuse content covered by copyright". "I can choose the right tool, device, application, software or service to solve (non-technical) problems". "I am aware of new technological developments. I understand how new tools work". "I regularly update my technical digital skills. I am aware of my limits and try to fill my gaps".

Dimension	Questions
Digital skills accumulation	
Levels of education	Please mention in which education system you have accumulated digital skills.
Digital education course attendance	Please mention if you have taken digital skills training courses.
Socio-demographic	
Age	Please mention age (in years)
Gender	Gender
Faculty	Faculty

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