REVIEW

Contemporary gaps in research on digital divide in education: a literature review

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Abstract

While computer technology permeates all spheres of life in modern society, the outcomes of using technology are different for different groups. The "digital divide" is probably one of the most undefined terms in educational research. One of the most pressing challenges is the definition of digital divide itself. Many of the contemporary research papers still focus on the gaps in access/possession of technology while this issue is not as relevant as it used to be. Most contemporary research papers simply do not even provide a definition of the construct they investigate. Those who target higher levels of the digital divide do not define the strand they focus on or use different interchangeable terms to name it. This article reviews contemporary literature critically and clarifies basic terms related to the digital divide with a specific focus on computer and information literacy. It also provides a definition of the digital divide that shifts focus from the traditional understanding of its levels and focuses on computer and information literacy as its core, as this construct encompasses all "new literacies" and is crucial for functioning and achieving outcomes in the information society.

Keywords Digital divide · Computer and information literacy · Education · Information and communication technologies

1 Introduction

The long and complicated history of modern-era computers, starting with the first electronic computer (Atanasoff-Berry Computer, or ABC) sharing many features with the modern computers' architecture [1], leads us to modern days when these technologies permeated most, if not all, human activity, especially with the influx of affordable computer devices after the year 2000 [2]. Information and communication technologies (ICT) have found their place at school and academia as well. The use of technology in formal education settings can have versatile benefits for improving teaching, learning and outcomes when aligned with the existing curriculum content. The penetration of computers and the internet in education creates more prospects for both learners and educators to collaborate in learning from virtually anywhere [3].

The outcomes from computer-assisted teaching and learning, however, may not be the same across all individual learners and institutions. Differences in the learning outcomes in computerized settings depend on different factors - personal (e.g. gender) and contextual (e.g. family, social, economic, community, etc.) [4]. One of them is the use of technology for one's own empowerment, also in school settings [5], which requires knowledge and the ability to utilize computer devices for achieving various goals. This "digital divide" was recognized at the end of the 20th century, specifically in using technologies for educational purposes [6]. Even amongst those having the ability, inequalities may exist depending on how meaningful the use is and how engaged one is [4]. That is, the gaps in the ability to use technology for learning is a rather complex and dynamic phenomenon which is hard to address, as has been recognized many times in the last 20 years. The major issue with addressing the digital divide, however, is that it is a largely undefined term, lacking sound theory, definition, and description of the concept itself [6–10]. In turn, different authors use different terms to characterize the substantive nature of the construct or its focus in their research - whether it is divide/gaps in access, skills/literacy, or outcomes. The scientific sources

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addressing the digital divide often do not even provide a definition of the construct [e.g. 3, 11–18]. In addition, when research is on specific ability aspects of the digital divide, the studies often do not clearly define them, or the terms are used interchangeably regardless of their focus and meaning, like "ICT skills", "technology skills", "ICT competences", etc. [11, e.g. 19–21].

The purpose of this paper is twofold:

1. To critically review the ambiguous and interchangeable use of different terms and definitions of concepts in modern literature related to the so-called "new skills" required to use technology successfully in an educational context; and.
2. To investigate the theoretical perspectives of the digital divide in contemporary research, its coverage, and, subsequently, determine the gaps in research on these in modern literature.

1.1 Problem statement

The "new skills" are something we hear about in the media without a reference to what is meant. Unfortunately, this also pertains to the scientific literature – the term is used without definition or even mentioning what they are. If a definition is provided, it is vague and unspecific. This is exactly the case with the publications identified for the literature review (see further) in this article. The literature review in this paper identified five articles that use the term "new skills": Oblak Črnič [22], Gerick et al. [23], Liu & Ko [24], Moreno-Morilla et al. [25], and Scherer & Siddiq [26]. Oblak Črnič [22] and Scherer & Siddiq [26] use the term "new skills" without clearly defining what they are and/ or without reference to any examples. Further, Scherer & Siddiq [26] use the term "new skillset" without explaining what it is or providing reference as to where it is defined or explained. Oblak Črnič [22] just mentions the term and refers to a paper which also does not define the new skills, just mentions the term. Gerick et al. [23] also use the term without defining it, later referring to these as "digital literacy or computer and information literacy (CIL)" [23] without explaining how or why such things would represent new skills. Liu & Ko [24] understand the new skills within the context of online reading only. Lastly, Moreno-Morilla et al. [25] also use the term "new skills" without a definition or explaining what they represent, just citing a chapter from Bryant [27] who provides just example activities, "such as massively multiplayer online games, online social networking sites, blog networks, wikis and online groups" [27]. The above examples give a clear idea of the severity of the problem with the used terminology.

The successful use of technology for different purposes is not equal across individuals and groups and is associated with many different and interrelated factors which also include the ability to use the technology. However, in addition to the ambiguous and controversial use of CIL or related items, the "digital divide" is often seen simply as a divide in the possession of computer devices and access to network resources [22, for example, as in 28, 29]. Although a distinction between the different levels of the digital divide has been made, and the higher-level (or "beyond-access") gaps have become apparent in the literature over the course of the last 20 years [6, 9, see, for example, 30], the possession and access still preoccupy opinions. The issues related with the "beyond access" digital divide include (1) inequalities in social, cultural and informational capital, as well as the resources, amplified by the use of digital media; (2) inequality of positions and power in social networks; and (3) differences in social, psychological and cultural backgrounds [6, 9]. These beyond-access issues need to be framed and addressed in a similar fashion as any other divide based on race, gender, class and nation (among other factors) because they reflect these divides in the same way [7]. This is why the old definitions of the digital divide need to be revised and aligned with the changes in the use of technology and outcomes in society and education in this regard.

The issues related to research on ICT in education are summarized in the list below. These are in hierarchical order, interrelated, where every subsequent issue depends on the previous ones:

1. The terminology for defining basic constructs related to the abilities in different aspects of the digital domain in education is not differentiated. Many of the terms are used interchangeably or as misnomers, and without theoretical background from different disciplines;

2. In research, often, no framework or systematic classification is used to name the specific ability aspect (e.g., "digital skills") a study focuses on and without positioning it in the hierarchy of other ability-related constructs that are superior or inferior to the one in scope. This also applies to even basic cognitive terms besides the ICT context like "skills", "competences" and "literacy". Often, the authors assume the meaning of the term they use is common knowledge or self-explanatory and needs no definition. Subsequently, the measurement of the construct, analysis of the data, the interpretation of the results, and the conclusions and discussions are vague and incoherent;

3. There is in fact no widely recognized framework that organizes the terminology and position of the constructs and phenomena in strict and hierarchical order to match them against the levels of ability in correspondence with the concept of digital divide;

4. The lack of theoretical clarity (see the points above) hampers the researchers to define or even decide which level of the digital divide they address through their research. In most cases, the authors do not even allude or infer which one their research is focused on;

5. The digital divide itself does not have a strict definition. Often, authors use the term without even explaining what is meant by it. Various phenomena or constructs are named as the "digital divide" unsystematically, without recognizing its different levels, assuming that the construct or phenomena in scope exhausts all of it. The ambiguity and interchangeable use of terms related to various aspects of ability (see above) also pertains to the term "digital divide" exactly due to lack of or presence of competing definitions;

6. While the digital divide is a versatile construct and without strict definition, its meaning and essence can vary depending on the context or specific area it is applied to (e.g., educational settings).

The term "computer and information literacy" (CIL) was introduced widely in 2013 with the first International Computer and Information Literacy Study (ICILS) [31]. CIL is defined as the "individual's ability to use computers to investigate, create, and communicate in order to participate effectively at home, at school, in the workplace, and in the community" [32]. ICILS 2018 defined CIL as covering four different strands. The first one (understanding computer use) includes the foundations of computer use and the computer use conventions aspects. The second strand (gathering information) includes accessing and evaluating information, and managing information aspects. The third strand refers to transforming information and creating information aspects. The fourth, and last strand refers to the sharing of information and using it responsibly and safely [32]. The succinct definition and the detailed description of the strands and aspects place CIL as an overarching term and construct, encompassing all "new skills" in contemporary literature. It covers all prerequisites to use computer devices effectively in all human activity. All strands and aspects together represent all prerequisites for effective participation at home, school, workplace, community, as well as the educational contexts where these skills are acquired [32]. Although as an overarching construct in education CIL is a decade-old, contemporary research in this area often uses different terms interchangeably with CIL like "digital literacy", "cyber literacy", "media literacy" and "computer literacy", amongst others [31]. This interchangeable use of terms can often lead to or result in a theoretical mismatch between the research purpose and the actual concept under study. In addition, the terms used interchangeably with CIL address rather narrow and limited aspects of the overarching construct CIL represents. Thus, one of the purposes of this article is to bring more clarity to the use of different terms and their place in CIL which encompasses all of them and is crucial to understanding and approaching the issue of digital divide.

1.2 Contribution to the field

The contribution of this literature review article is twofold. First, to make a better distinction between the terms used to define the "new skills" (CIL and other concepts that constitute it). The importance of the theoretical definition of CIL and similar terms in this area is crucial to make future studies more precise in their scope and purpose and, subsequently, more efficient in addressing the digital divide. Although the issue of overlapping concepts, their interchangeable use, lack of clarity, which creates confusion and misdirection, research has been recognized a long time ago as outlined in the ICILS assessment frameworks [31, 32]. However, there was no serious attempt to make distinctions between terms, clarify their concepts and meanings from the perspectives of various disciplines with a focus on education. This article bridges this gap not just by discussing the terms from different theoretical frameworks and disciplines and aspects, but also uses the results from the literature review to test the current state of affairs and point the direction for future studies in using the terminology and concepts in their frameworks for better focus and higher precision in the definition of constructs.

Second, the article provides an overview of the theoretical foundations in contemporary literature, describes the approaches and existing issues in defining the digital divide, and proposes a new definition pertinent to education. The overall outcome of this literature review article is to identify gaps in the research literature and advise directions for future research.

2 Methods

This literature review uses the latest literature sources on CIL and digital divide published within the last 10 years at the time this study began (2011–2021). This article itself is a semi-systematic (narrative) literature review [see 33] because of the aims of the paper. First, the different terms for CIL and their conceptualization used in the literature are loosely and interchangeably used by different authors from different disciplines. Second, as the research in the field has evolved gradually over the last decades, so have the terms, directions and diversity in research that make it necessary to search for an explanation on the current state of affairs. Thus, due to the divergent paths in research development on the topic within the last decades, besides the literature sources found through the literature search, older articles dating back to the beginning of 2000s will be used in the

discussion of the results against the historical background in this area.

2.1 Literature search process, databases, and results

To meet the goals of this paper, the latest relevant articles on the digital divide and the related factors and concepts were obtained through a literature search. The literature search began in February 2022 to ensure that the databases are up to date. The search terms were identified by the seminal papers on the digital divide and CIL in school education from the beginning of 2000s [5, 6, e.g. 13, 34], as well as more recent ones [e.g. 35–37] on the topics of: "digital divide", "computer literacy", "information literacy", "digital competencies", "ICT competencies", "ICT skills", "computer skills", "e-capital", "information capital" and "network capital". As the digital divide is determined by different factors, the following search terms were included as well, as identified by earlier literature (see above): "gender", "urban", "rural", "socio-demographics", and "socio-economic status". While the factors related to the digital divide can be a plethora, this article and, consequently, the literature search itself,

are limited to these base characteristics which are related and most often used in research on the topic. Only studies in English were searched for, as well as peer-reviewed content only. The time range was defined as between 2011 and 2021. The only exception was the ERIC database where the closest possible search start option was from 2013. Four databases (SpringerLink, ERIC, Sage Open and JSTOR) were used for the initial search.

The formula used in the search was as follows: ("computer literacy" OR "computer and information literacy" OR "computer literacy" OR "information literacy" OR "digital competencies" OR "digital skills" OR "ICT competencies" OR "ICT skills" OR "computer skills" OR "e-capital" OR "digital divide" OR "information capital" OR "network capital") AND (SES OR gender OR urban OR rural OR socio-demographics OR socio-economic status). The process and outcomes of each stage of the literature review are presented in Fig. 1, following the methodology proposed by Mengist, Soromessa &Legese [38]. The results were not limited to any type of academic work (i.e., just to journal articles) but were open to any type that the databases contained against the search terms.
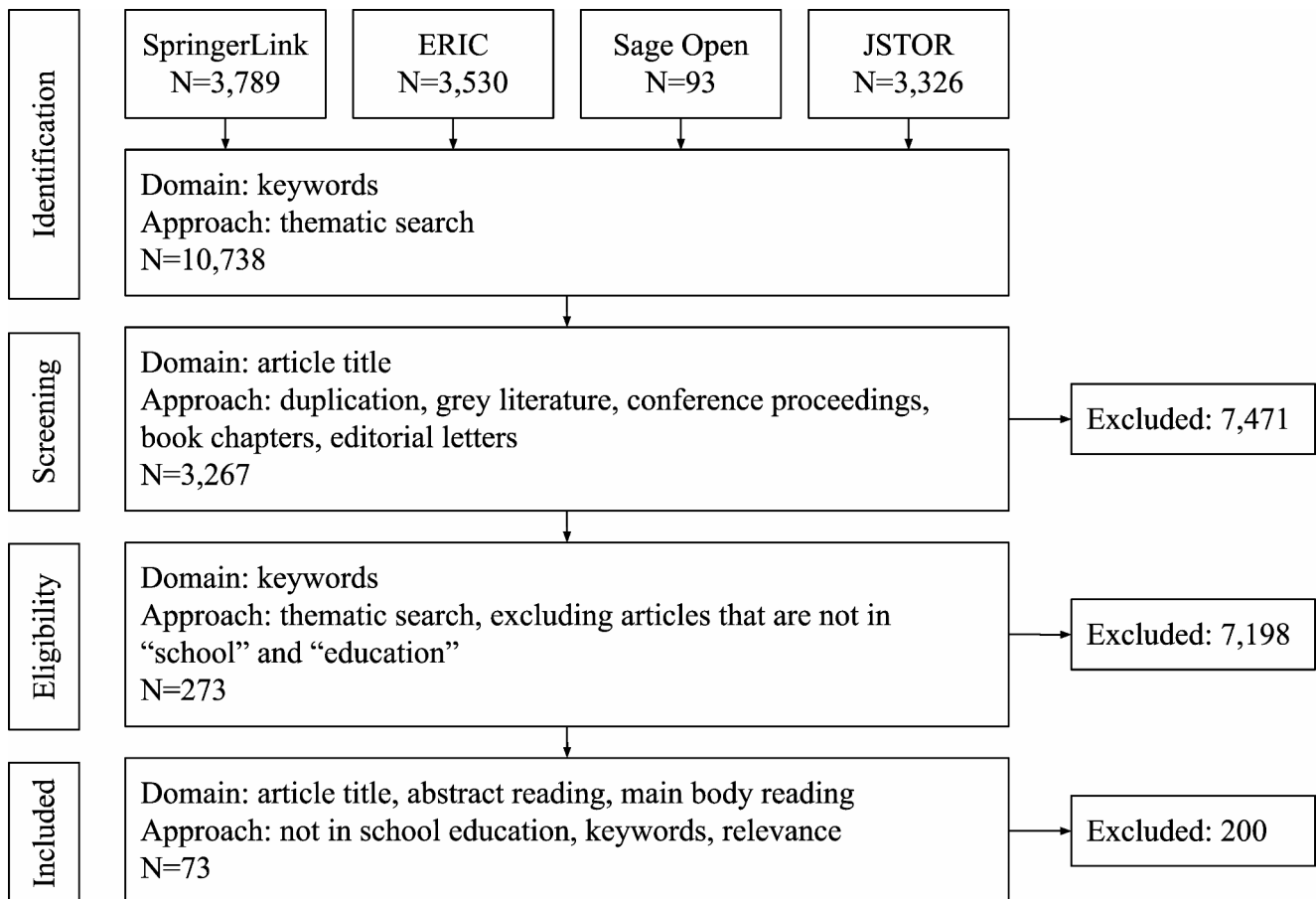

Fig. 1 Literature review process and outcomes

As some publishers need more processing time before announcing and making the academic works available, the literature search was repeated in June 2022 to update the list using the same methodology, search terms and databases. The duplicated results from the previous search were removed. SpringerLink returned 497 new results, ERIC returned 79, JSTOR returned 377, and SAGE Open 30. The new sources were reviewed for their relevance. At the end just one new article was added to the list. The list of the 74 papers for the literature review can be found in the appendix. These consist of journal articles, books, book chapters and PhD theses.

2.2 Analysis of the literature

The 74 articles were read thoroughly with a focus on the following aspects:

1. Focus on CIL and CIL-related constructs;
2. Terminology used for CIL;
3. Theoretical foundations of digital divide.

For the first aspect, the papers were screened for CIL-related constructs the studies focus on. The studies investigate the gaps related to student performance in ICT settings.

The second aspect is related to the first one. The variety of CIL-related terminology used in these articles had to be analyzed to clarify what the authors meant by these terms when designing their research.

As the digital divide itself has been recognized as an underdefined concept both in the past [see 6, 10, for example], and in more present days as well [e.g. 4], the last aspect of the literature analysis is related to the definitions authors provide when addressing it. The definitions and understanding of the concept determine the approach and drives the research.

Table 1 CIL-related terms used in the literature

CIL-related terms	Number of sources
Abilities and skills	6
ICT skills	16
Internet skills	4
ICT/digital literacy/skills	14
ICT/digital competences	12
Information literacy/skills	6
Technology competence	3
Technological fluency/literacy	2
Digital capability	1
Digital and informational literacy	1
Computer competence	3
Computer proficiency	1
Computer literacy	4
Computer and Information Literacy (CIL)	9
Total	82

The results of this content analysis for aspects 1 and 2 from above were summarized quantitatively. In addition, for aspect 2 the terminology was reviewed, and each source was checked for providing a definition of the CIL-related construct in scope. The definitions across different papers are compared for their relevance, accuracy, and coherence with the objectives of the research undertaken. The definitions of the same constructs over different articles are compared as well. For aspect 3, the definitions of digital divide are compared for their similarities and differences, focus on specific domains, theoretical depth, content, coherence, and comprehensiveness. The results from this content analysis on the CIL-related terminology and the digital divide theory are further discussed.

3 Results

3.1 Sources' focus on and terminology for CIL-related constructs

The articles selected through the literature search were analyzed regarding the focus on CIL-related constructs and the factors related with the differences. Seven from the total of 74 articles did not have an explicit focus on any of the CIL-related constructs, but had more theoretical orientation or focus on legislation, spread or just general use of technology [18, 22, 28, 39–42]. Table 1 presents the findings on the first strand (focus on CIL-related constructs) from the remaining 67 articles. Some of the terms with greater similarity were grouped together to avoid redundancy and decrease the overall length of the table. For example, "ICT literacy" and "digital literacy" were grouped together into "ICT/digital literacy". There are, however, some deviations from this general rule. For example, "ICT/digital literacy/ skills" is a category separate from "computer literacy" because the sources falling in the former category refer to ICT or digital literacy regardless of all possible technology being considered while the sources falling in the latter refer explicitly to computers (i.e., desktops or laptops). The total number of sources (82) using each separate term is greater than the number of articles used in the literature review (67 of the articles with a focus on CIL or CIL-related constructs) because some of them use more than one term to define the CIL-related construct in focus. These terms are often used interchangeably which will be shown further. As the table shows, there are 14 groups of terms used to define the articles' focus on a CIL-related construct. The first entry in the table shows that six sources have loosely defined the construct just as "abilities and skills" without any strict reference to technology (although the sources refer to ICT), but more as general terms. The rest of the terms overlap to a

large degree, although some differences exist. For example, "digital capability" and "digital proficiency" both refer to one's capacity to use digital technology (as described by the authors), but the former term is defined as being able to use technology while the latter as how well one can use it.

"ICT skills" is the most often used term (16 articles) referring to CIL-related constructs, immediately followed by "ICT/digital literacy/skills" (14 articles) and "ICT/digital competencies" (12 articles). The fourth position is for CIL itself (nine articles), "information literacy/skills" is fifth (six articles), "internet skills" and "computer literacy" share the fifth position (four articles each). The least used terms are "technology competence" and "computer competence" (three articles each), "technological fluency/literacy" (two articles), and "digital capability", "digital and informational literacy" and "computer proficiency" (one article each).

The assessment frameworks of ICILS [31, 32] distinguish CIL from other related terms often used by researchers in their work. They also note their wide overlapping and often confusing usage, going back to the literature even before the beginning of the 21st century when the issue was recognized. The confusion and interchangeable use of these terms is still ongoing, and the present study is no exception identifying quite a number of concepts used in contemporary literature on the topic as well. Here is a short summary of the two major issues this literature review identified:

1. In 29 out of the 67 articles with a focus on CIL-related constructs multiple terms are used interchangeably when referring to the construct under study. One particular study can use multiple terms to name a single CIL-related construct and treat them as the same concept through the entire publication;

2. Many articles do not provide any definitions of the constructs. This occurs in 34 of the 67 articles with focus on CIL-related constructs.

The above issues do not appear in isolation. That is, an article can use multiple terms when referring to a CIL-related construct and, at the same time, not provide definitions or operationalize them. Such is the case of [21] who interchangeably use five different terms ("computer literacy skills", "computer literacy", "computing skills", "computer usage skills", "computer-literacy skills") without defining any of them, just mentioning different skills for operating the technology. Berger [19] provides six different terms ("media-related skills", "media literacy", "media and technology skills", "ICT skills", "ICT competence", "computer and information literacy [CIL]") with reference to the definition only for CIL from ICILS 2013, but still uses the term interchangeably with the rest throughout the article. Similarly [11], uses the terms "technology competency", "computer and information literacy skills", "digital skills", "digital literacy", "information and digital literacy",

"information and technology literacy skills", later adding the terms "information literacy" and "technological literacy" as well, providing short definitions for them, claiming they actually represent a skill [11]. However, until the end of the article it is unclear which one of the constructs they refer to, also when presenting and discussing the results. More in-depth results from the analysis of contemporary literature follow next.

Multiple papers use terms related to abilities regarding technology, such as "skills", "competences", and "literacy", and the use of "abilities" as a more general term is rare. While 32 sources refer to skills (computer, informational, digital, ICT, etc.), just three of them provide definitions. Pozas and Letzel [43] adopt the definition of "skill" as "the ability and self-efficacy to use ICT". Zhong et al., (2021) [37] adopt the term "ICT skills" as "competencies to exploit ICT potential". Both definitions are rather short and lack specificity. The definition in Pozas and Letzel [43] also includes a belief's component, and Zhong et al. [37] defines skills as competencies while the latter is a superior and more complex term than the former. In addition to these two papers, Kaarakainen et al. [14] use the terms "ICT skills", "digital skills", "ICT competencies" interchangeably. The test they composed measures ICT skills, also undefined, just briefly mentioning that "ICT skills were measured using the digital, performance-based ICT skill test" [14] which also brings the issue of operationalization.

The situation with "competences" (ICT, digital, technology, computer) that the articles address faces the same shortcomings as "skills" - a lack of definitions. From the 18 articles focusing on competences (ICT, digital, technology, and computer), less than a half (just eight) provide definitions. Aesaert [44] defines "ICT competence" as "a higher-order learning-process oriented competence used in complex, authentic and unpredictable situations, and is underpinned by technical and application ICT knowledge and skills" [44]. They later add that it "not only refers to the ability to locate, manage or process digital information, but also refers to more creative and expressive forms of digital media production and social online activities" [44]. Pozas and Letzel [43] adopt a definition where digital competences are understood as "the functional use of digital knowledge, skills and attitudes" [43]. This kind of definition resembles their own definition of skills which includes belief's component - self-efficacy (see above). Karpinski et al. [15] adopt the general digital competences definition as "one's ability to use computers to search for, acquire, and process information, to create content, and to communicate with others" [15] referring to ICILS 2018 [45]. However, ICILS measures CIL, not digital competences. So far ICILS made quite an effort to distinguish CIL from competences and other terms [see 32, 45]. In addition, Karpinski et al. [15] use different

other terms ("digital skills", "ICT skills", "digital competences", and "digital literacy") interchangeably throughout the article when referring to the construct in scope. They even explicitly add that "skills" and "competences" are used interchangeably without distinguishing them. Hatlevik and Christophersen [46] use "digital competence" and "digital literacy" interchangeably, binding them to a definition that claims these are "broader terms that emphasise what kind of skills, understandings, and critical reflections students are able to use" [46] without specifying any of these. They do, however, distinguish skills from competences, claiming digital skills are pertinent to the technical conditions, whereas competences and literacy are understood as equal terms. While citing several definitions, the overall focus of these is exclusively technical and on instrumental technology operational/process skills, even when it comes to producing and communicating information. Punter et al. [47] use the ICILS definition of CIL from ICILS 2013 [31] interchangeably with "computer competencies". Rambousek et al. [48] use "ICT competencies" without explicit definition, but refer to them as "ICT literacy" (also undefined) as well, and use them interchangeably. Exactly the same approach is found in Bundsgaard and Gerick [49]. Wu et al. [50] define "ICT competencies" as "basic computer skills, office software use and internet use" [50]. Finally, Falloon [51] builds an entire framework of "digital competency" where the adopted description of the term recognizes not only the knowledge on using hardware and applications, but also skills to communicate through ICT and information skills. An explicit definition of the term, however, is missing. In addition, other sources do not provide any definitions and use the "competence" terms (ICT, digital, information, technological, etc.) interchangeably with others. Such is the case with Gerick et al. [23] who use "CIL competence" and "student competence" interchangeably with "computer and information literacy (CIL)" and "digital literacy" without defining any of them.

This literature review also identified a total of 36 articles which use terms involving literacy in relation to technology. However, just one sixth of them provide some more or less strict definitions. Alghamdi and Holland [52], for example, do not provide strict definition, but quote Irish legislation for developing "digital literacy" by including programming in the curriculum to "learn core problem-solving and life-skills such as computational thinking, logic, critical thinking and strategic thinking" [52]. Jin et al. [53] define "digital literacy" as one's ability to manage and access, but also to understand and communicate, as well as evaluate and create information in a safe manner via digital technologies. The definition is focused on utilizing digital literacy for employment and entrepreneurship purposes. One of the core assumptions of their "digital literacy" definition is

that it includes competences which are variously and interchangeably referred to other constructs, such as "computer literacy", "ICT literacy", "information literacy" and even "media literacy" [53].

Dincer [54] provides multiple definitions of "computer literacy" from other authors with varying coverage of the concept, from the basic use of computers to programming and problem solving. He does provide his own definition, as "a unique domain but divided into sub-domains such as basic computer literacy, programming literacy, we want to define CL [computer literacy], taking into account these statements, as the ability to do operations relevant to his/her purpose" [54] which, admittedly, focuses on the technology, but is not very specific in terms of what the purpose is or expected outcomes are. Hatlevik et al. [55] provide multiple definitions of "ICT literacy" from different authors, adopting the one stating that it is "ability or capacity 'to solve problems of information, communication and knowledge in digital environments'" [55] which resembles the definitions of "ICT literacy" provided by other authors [see 32 for an overview]. Kim et al. [56] cite different sources' definitions of "ICT literacy" with multiple and somewhat competing formulations, but in the end it is unclear which one they adopt. Lau and Yuen [16] use an old definition from the 2007 ICT Literacy Panel which defines "ICT literacy" as "using digital technology, communication tools, and/or networks to access, manage, integrate, evaluate, and create information in order to function in a knowledge society" [16] which is almost identical to the definition of CIL in ICILS [see 31, 32]. The three dimensions of ICT literacy Lau and Yuen [16] define (information literacy [information], internet literacy [communication], and computer literacy [technology]) also cover to a large extent the CIL strands defined in ICILS [32], but goes quite beyond the essence of ICT literacy itself. Moreno-Morilla et al. [25] understand "digital and information literacy" as a combination of "digital literacy" and "information literacy". For the latter two terms they use other authors' definitions which largely overlap in terms of searching, retrieving, and processing information. Talaee and Noroozi [4] adopt the term "technological literacy" as "a set of creative and critical skills and understanding required to productively engage with technology use" [4]. They further supplement the definition, describing what it includes - wider technological literacy, information literacy, multimedia literacy, technology-mediated communication literacy, and functional literacy. The definition itself is rather vague and lacks specificity (e.g., what the creative and critical skills are), and the supplementary description of the "technological literacy" constituents does not explain the terms and their meaning.

Some sources focus on different literacies without explaining what they represent. Buabeng-Andoh and Issifu

[57] and Mansfield [58] use the term "computer literacy" without any definition. Lu and Hao [17] also use a term without defining it, but the term itself also mixes "skills" with "literacies" - "information literacy skills". Sanders and Scanlon [59] use the terms "digital literacy" without any definition. Ritzhaupt et al. [36] use the term "ICT literacy" without defining it explicitly, but only implicitly through the dimensions of their measurement instrument. Some sources even use multiple literacies interchangeably without defining any of them. Siddiq and Scherer [60] focus on "ICT literacy" but, while acknowledging the efforts to clarify the difference with many other terms, they explicitly state it is equivalent to them. No definitions, including definitions for "ICT literacy", are provided. Mitra and Dangwal [21] use the terms "computer literacy skills" and "computer literacy" interchangeably with "computing skills", "computer usage skills", "computer-literacy skills" without defining them. Bach et al. [61] and Chen [20] use "digital literacy/ies" interchangeably with other terms ("computer literacy", "ICT literacy", "information literacy", "media literacy") without any definitions. Finally, the article from Henderson [13] explores the digital divide between home and school in terms of "digital literacies" and "multiliteracies" which are undefined, but the focus is on general literacy (i.e. language) pedagogy.

3.2 Theoretical foundations of the digital divide in contemporary research

The literature review found that 30 of the 74 papers focus explicitly on the digital divide. Just 18 of these 30 papers provide definitions of the concept. Seven of these 18 papers provide definitions of the digital divide and its levels. Besides these 18, six papers provide just descriptions of the digital divide's levels without its definition. Finally, there are six papers that do not provide neither definitions nor levels. That is, 12 of the 30 papers provide research findings on a construct they do not specify.

The 18 papers providing definitions, however, resemble an old issue with the digital divide as a term. The initial use of the term in the late 1990s and early 2000s was associated with the possession and/or access to computer technology, i.e. to distinguish between those who have and those who do not [6]. The attention of politicians, but also researchers, towards the digital divide started to decline after the year 2000 because the policy conclusion, especially in rich and developed countries, was that due to the rapid spread of technology, the issue of the digital divide was closed [6]. Unfortunately, the perception that the digital divide is simply possession of or access to technology persists even nowadays, in the general public, political discourse and in the scientific community. Ten of these 18 papers have

definitions with a full or exclusive focus on access/possession of technology. Cruz-Jesus et al. [28], for example, use a definition from an OECD report dating back to the very dawn of the research on the topic:

> "the term 'digital divide' refers to the gap between individuals, households, businesses and geographic areas at different socio-economic levels with regard both to their opportunities to access information and communication technologies (ICTs) and to their use of the Internet for a wide variety of activities" [62].

Besides being rather dated, the definition mostly focuses on the access to ICT, just as the entire study of Cruz-Jesus et al. [28] which also looks at it through the associated costs. Similarly, Wang [63] used a definition from the 2002 ICT Literacy Panel where the digital divide is understood as "inequities among individuals who have access to technology and opportunities to learn ICT skills" [63]. At first glance this definition looks like it also goes beyond the access through the inclusion of opportunities to learn, but these are actually mentioned as a possible consequence of the access.

In a rather recent paper, Kormos and Wisdom [64] adopted a definition that understands the digital divide as "the inequality in access to technology that exists between communities due to regional and demographic differences, particularly socio-economic groups" [64]. In general, the literature search found mostly papers focusing entirely on the lowest level of the digital divide (access/possession) [28, 40–42, 59, 63–65].

Some other sources also acknowledge other gaps, although focusing mostly on the access/possession. For example, Liu [41] makes the distinction between formative (access, infrastructure and connectivity) and substantive access (interaction and engagement). However, the study focuses only on the former issue. Similarly, while Mecinas Montinel [29] does not provide an explicit definition of the digital divide, the study conducted in Mexico focuses mainly on access/possession and to some extent on skills. An additional issue in contemporary literature in this regard is the very narrow understanding of the digital divide, even when it comes just to access. For example, Hollman et al. [40] understands it just as a gap in access to broadband internet. Most of these 10 papers with the focus on access acknowledge the complexity of the digital divide, but their literature reviews do not reflect and detail it when designing their study frameworks.

Besides the papers listed above, some authors extend to other aspects of access/possession of technology. For example, Aydin [66] acknowledges the limitations of the digital divide definitions focusing simply on the possession of ICT

means and addresses it through the differences in CIL, as defined by ICILS [32], based on possession/access, experience, and demographic characteristics. Elena-Bucea et al. [39] use the same old and limited definition from OECD [62] as Cruz-Jesus et al. [28], but include social networks and demographic characteristics in their empirical model. Zhong et al. [37] understand the digital divide not just as gaps in access, but also in usage and skills. Wu et al. [50] understands it as access, competencies/ability, and motivation. Wei et al. [67] do not provide a definition of the digital divide explicitly, but mostly describe the different levels (access, capability and outcome) in an attempt to define a social-cognitive model.

On the other hand, there are six papers that do not provide definitions of the construct, but are limited to describing it just through its levels. However, in five of them even the nature of the different levels varies:

- Ritzhaupt et al. [36] - access, usage and empowerment (outcomes);
- Hohlfeld et al. [68] - with explicit focus on school settings, as school possession/access, classroom use by students and teachers to form skills, and student empowerment through technology (outcome);
- Adhikari et al. [3] - as digital access, digital capability and digital outcome;
- Kaarakainen et al. [14] - as access, skills and usage and outputs/outcomes;
- Ercikan et al. [12] - as access, frequency of use and ability.

Finally, adding to the list above, Talaee & Noroozi [4], after reviewing an entire myriad of conceptual frameworks, propose an extended framework of digital divide levels as (1) access to computers/internet; (2) skills (instrumental, informational and strategic); (3) use of computers/internet; and (4) attitudes and values. All of these are related to student home computing opportunities and risks which are at the center of their model including individual characteristics, economic, social and cultural capital [4].

4 Conclusions, discussion and recommendations

The purpose of this paper was to (1) critically review and address the ambiguity in defining the "new skills"; and (2) investigate the theoretical developments in digital divide research. The review of contemporary literature revealed that there is quite a large number of terms used for constructs related to the abilities for using ICT, as well as quite a significant variation in their intended meaning. Some of these terms overlap without clear distinction. For example, "digital capability" and "digital proficiency" both refer to

one's capacity to use digital technology, but the former term is about being able to use technology while the latter is about how well one can use it. Many sources do not even define the construct in scope. The issue has been already pointed out in the methodological literature [for example, 69]. Any research must define what it will study by (1) naming the construct; (2) defining its properties and scope; and (3) defining subdomains of its meaning [69]. It is, thus, unclear how these studies were implemented without any operationalization of the construct they investigate, what their findings represent and how valid they are. In addition, many sources use the myriad of different terms (e.g., "skills", "competence", "fluency", "proficiency" and, sometimes, "literacy") interchangeably without going in-depth into their meaning to differentiate them, drawing similarities or intersections. The issue with these terms is also that they mostly lack equivocal definitions other than the widespread intended meaning in everyday use. Most notably, the concept of skills in relation to technology appears in quite many literature sources. In its legislation papers, the European Union (EU) defines skills as "the ability and capacity to carry out processes and use the existing knowledge to achieve results" [70]. Similarly, Perez-Paredes and Sanchez-Tornel [71] define its general meaning as "any ability acquired by training or practice, allowing individuals to perform well in multifarious types of tasks" [71] and note that "a skill is an ability that is acquired through practice and by using declarative knowledge" [71]. The definitions of skills revolve around the operational/processual application of a given ability through background knowledge. An additional issue related to skills when using ICT is the differentiation and proliferation of their type which started in 1999 - instrumental/operational (working with hardware and software), structural (orientation in the structure of information), strategic (goal achievement orientation), and informational (search, select, and process computer and network information sources) [6]. This differentiation was made for "digital skills" in particular, and yet, these remain the most underdefined and confusing term in contemporary research. Further, the information skills were divided into formal and substantive more than 20 years ago [see 6 for an overview], but none of the contemporary sources address this difference, except for Liu [41] when discussing the digital divide. That is, the different skills (digital, ICT, information, etc.) that the articles focus on need to be further specified more precisely and substantiated, avoiding equal signs between them.

Schneider [72] provides an in-depth interdisciplinary theoretical overview of the term "competence", demonstrating how situational and difficult the definition of the construct is, and how dependent on the discipline it can be. Perhaps one of the most widespread and influential definitions is the one provided by the OECD: "A competence is

defined as the ability to meet individual or social demands successfully, or to carry out an activity or task" [as cited by 72]. This rather broad and technical definition focuses on the ability to perform given goal-oriented assignments. Its popularity is probably because it is also quite succinct and applicable to a wide variety of fields, including the use of ICT. As the literature has shown, very often the authors do not even define what a specific (ICT, computer, digital, etc.) competence means, or the definition is rather vague, overlapping with other constructs. Sometimes it is used interchangeably with literacy or skills.

The use of literacy (ICT, digital, information, etc.) terms is not any clearer than with skills and competences. While the general use of the term "literacy" traditionally refers to reading and writing effectively in diverse contexts, literacy with reference to technology is understood differently. Recent definitions of "information literacy" extend the traditional definition to the ability to find information efficiently and effectively, incorporate existing information with new knowledge, but also gain understanding of the environment containing this information, as well as communicating it, and creating and sharing new information [73]. "Digital literacy", on the other hand, refers to the ability to use digital technologies in order to analyze, learn and explore, create and innovate, communicate and collaborate, research, solve problems, make decisions, use technology operations and concepts [73]. Many other definitions of "digital literacy" incorporate using digital technology for accessing, managing, using, integrating, and evaluating information to function in the knowledge society in particular [see 32]. "Web literacy" (i.e. "internet literacy") is reflective to digital literacy and is related to the traditional (paper books) literacy, but in a new environment where the learners need knowledge and understanding in order to navigate through the complex electronic environment where hypertext is divided and connected through links and other web elements, to find and use information [73]. "Computer literacy" has a narrow focus on simply operating hardware and software, and "ICT literacy" on information literacy and communication. Most definitions of "ICT literacy" revolve around the same concepts as "digital literacy" and include both operating hardware and software, and abilities to access, evaluate, manage and use information [see 32 for an overview]. There is large similarity between "computer literacy" and "digital literacy" because of the emphasis on the various digital technology devices involved [32]. Additional complication with literacy-related terminology is that authors sometimes include distinctive concepts in others. Such is the case, for example, with Alghamdi and Holland [52] who include computational thinking (CT), logic, critical thinking and strategic thinking into "digital literacy". While CT is part of the digital literacy construct [32], it is unclear to what extent

all of these rather integral concepts also belong to the concept of "digital literacy", as Alghamdi and Holland [52] do not provide any further information. Furthermore, although many of these terms [as "computer literacy", "ICT literacy", "information literacy" and even "media literacy", see 53] are related through technology, they are not equal [see 31, and 32 for an overview].

To summarize the issue with the use of CIL-related terminology in contemporary articles, the following main issues have been found:

1. Using rather old (20 or more years) definitions for core constructs that, given the development in the area, are with questionable relevance;

2. Understanding many constructs as interchangeable without taking into account their essence and coverage, as well as their intersection;

3. Providing definitions from a large variety of sources without operationalizing the construct in their own study;

4. Not providing any definitions of the constructs or their operationalization;

5. Naming a construct that actually represents a different phenomenon than the name suggests, or the rest of the literature does not support; and.

6. Accepting skills, literacy, and competence as the same cognitive constructs, using them interchangeably or simultaneously.

All this shows the need for more coherence, precision of the definitions, and match with the intended meaning of the terms to ensure correspondence with the construct under study. Further, CIL encompasses all other terms reflecting the successful use of ICT in modern society while making a distinction between them through its different strands and aspects. Moreover, as Aydin [74] points out, "CIL has to do more with computer context while ICT, beyond this, has a nature considering these technologies as basic learning instruments" [74]. That is, the focus of the terms (ICT, digital, computer, technology) is more on operational ability to use these means while CIL is more on content and ability to use it for personal growth through the technology. Thus, another recommendation is to use CIL as an overarching term when addressing the digital divide, as this construct covers all others which, as a whole, represent higher level ability than the separate parts. The same applies to the ability terms (skill, competence, etc.) - the term "literacy" has clear definitions that reflect and incorporate all others. That is, CIL is an overarching term representing the entire spectrum, unless the research is strictly focused on just one strand or aspect. If the latter is the case, then this must be specified explicitly with strict definitions.

Most of the issues mentioned above (2, 3, 4, 5, 6), however, pertain to a problem discovered a long time ago that still persists – the so called "jingle-jangle fallacies" [75]

which occupy a large part of the work of the American psychologist Herbert Marsh. Although the jingle-jangle fallacies were first identified around the first quarter of the 20th century [76], they can often be seen in modern research literature as well, as found in this literature review. The jingle-jangle fallacies appear when a study uses the same or similar labels to denote the measurement of different constructs (jingle fallacy) or when it uses different labels to measure the same or similar constructs (jangle fallacy) [75, 76]. Often, researchers use conceptually similar measures with different operationalizations to suit different research (e.g. on competence perceptions vs. self-efficacy), as to serve their own purpose [76]. The problem is not just within the narrow scope of this publication, but it extend to other fields as well as, for example, psychology and its different branches, and education at large [75]. One highly likely reason for the occurrence of jingle-jangle fallacies is that some researchers in different disciplines tend to put their focus on the measures they prefer without paying enough attention on how or even whether the construct in scope is different from other similar constructs [76]. The consequences of jingle-jangle fallacies do not pertain just to the definition of the constructs themselves but have implications at each stage and level of a study. The major implications for research, but also for practice, are that (1) research is built on foggy conceptual foundation [77]; (2) formulating biased hypotheses that will lack evidence to support them or the evidence will be biased [76]; (3) there are serious implications for measurement [77]; (4) there is a loss of information [78]; (5) makes deriving recommendations for practice and intervention difficult [77]; (6) poor communication of the results [77, 78]; and, finally, (7) limits educational applicability [77].

More than 30 years ago, Marsh [75] called for a more critical evaluation of the interpretation of measures using a construct validity approach. To avoid the jingle-jangle fallacies, researchers need to conduct studies on construct validity [76]. Preliminary support for the construct validity is provided by finding that items have the same loads on a factor scale, but this approach provides little support for interpretations on a particular label assigned to the construct by the instrument developer or by the one who will place the label when using a particular scale [75, 76]. Thus, "researchers should apply confirmatory factor analysis (CFA) and structural equation models (SEMs) to evaluate the structural, predictive, convergent, and discriminant validity of different motivation measures" [76]. Although the citation is on motivational measures, the approach can, and should, be extended to any domain. Another strategy which is helpful for the purpose of this article and the issues described above is to provide an effective definition by avoiding the arbitrary assemble of components, but to define the concepts on the basis of structural and functional element covariation. This also allows for empirical scrutiny of the usefulness of adding additional components and, ultimately, reach a definition of a construct that can be used in empirical research [77].

The issue discussed above does not pertain to just the construct being measured, but to the entire general and overall framework of the digital divide. Addressing the digital divide depends on the constructs that it encompasses. The term digital divide is also often used arbitrarily and without even defining what it stands for. Probably the first mention of the digital divide definition issue was made by Warschauer in 2001 [as cited by 79] who states that it "is one of the most discussed social phenomena of our era. It is also one of the most unclear and confusing" [79]. This observation was shared by van Dijk [6], amongst many others: "Among the shortcomings of digital divide research are its lack of theory, conceptual definition, interdisciplinary approach, qualitative research and longitudinal research" [6]. It is not even certain who introduced the term [6] and what was the intended meaning when it first appeared in the mid-1990s, and officially used for the first time in a report from the US Department of Commerce's National Telecommunications and Information Administration (NTIA) in 1999. Even the authors of the NTIA report are not certain where they encountered the term for the first time [79]. This literature review has found that most of the contemporary research papers have exclusive focus on possession/access, and just a handful aim to address the digital divide on higher levels. This technological determinism (everything can be solved through a technological approach) dates back to the beginning of 21st century when access was the main obstacle, but this approach lasted even further [6]. More than 10 years ago, Epstein et al. [30] noted that understanding that access was the issue of the digital divide was reinforced by the NTIA reports which claimed that besides the spread of ICT, at least in the United States, the rates of internet use remained uneven. Even earlier, 20 years ago, Livingstone [80] stated that research must move beyond the access and examine the nature of use and its quality, the social and cultural conditions, as well as the personal meaning. Thus, the preoccupation with access/possession in newer research is unexplainable, as the issue of access/possession of ICT and internet connection has gradually become much less of a problem. Even in 2013 ICILS found that 96–100% of eighth graders across the participating countries were studying at schools with internet access. The percentages of eighth graders having access to computer-based information sources were the same [81]. The data from ICILS 2018 show that on average 95% of the eighth graders in the participating countries have one or more laptops or desktop computers at home, 85% have at least one tablet e-reader and 95% have

internet access at home [82]. That is to say that the spread of technology is rather high already, although some differences in access may exist between the student school and home [20], i.e. home-school access divide. This does not mean that access/possession of technology is a negligible issue. Availability of technology is the prerequisite for using it, this is why all models of the digital divide have it at the base level. However, having access to technology does not mean one is capable of using it or will use it for personal growth, which concerns the higher levels of the digital divide. Those building arguments solely on access inevitably fall into the binary approach (i.e. having or not having) trap which is a narrow and simplistic way of framing the digital divide [7]. A decade ago, Ritzhaupt et al. [36] noted that "Yet little is known and understood about how students use ICT resources, how well they use these resources, and whether they can use these resources for their own empowerment". Similarly, it is stressed that research shall "explain the chain of effects from the digital access divide through the digital capability divide to the digital outcome divide" [67]. This literature review shows that not much has been done in this direction over the last decade. In addition, the access to technology itself is not equal around the world and it may be an issue for some nations, but not for others. Access can be an issue in Mexico [see 29], but not in Central European countries [see 28]. While the availability of access is important, its quality matters as well [29]. Still, Cruz-Jesus et al. (2012) identify two dimensions of digital divide: (1) infrastructure and adoption by population; and (2) e-business and cost. However, as Kim and Kim [34] note, "inequality in the information society is fundamentally different from that of industrial society". When it comes to learning, it is important to distinguish formative (lack of devices, connectivity, and infrastructure) and substantive (lack of meaningful ICT interaction and engagement). The latter is the one that affects the learning experience and outcomes [41]. Given all this, further research on the digital divide in education shall have a more prominent focus on the higher levels of the digital divide and less on access/possession of technology. This transition can happen if the view on possession and access shifts from the limited and oversimplified understanding of economic capital [as seen in 28] to the higher levels of inequalities it is related to through Bourdieu's theory of capital (economic, social and cultural) [4]. Currently, there is disappointingly low interest towards human and cultural capital as factors in contemporary research. There are just three papers that emphasize the importance of cultural capital for the digital divide and provide an overview of its impact [4, 18, 22]. Similarly, just one paper [61] discusses the role of human capital in the context of digital divide. This is surprising because previous research has identified the digital divide issues (especially those beyond access) as

rooted in human (as well as in cultural) capital a long time ago [see 6, 9]. Only Talaee and Noroozi [4] make a serious theoretical attempt to build a new model of the digital divide where they add a fourth level - attitudes and values - that is looked through the lens of individual characteristics, economic capital, social capital, and cultural capital. This kind of multidimensional approach has been proposed a long time ago [see 7 for an overview]. A serious empirical attempt to include these factors in a quantitative study was made by Weber and Becker [18] and Talaee and Noroozi [4] only. These forms of capital are important factors in research on the digital divide since traditional, "old", differences in resources and capital are amplified by the new technologies through the possession/access to information which can be seen as a commodity, but depend on the ability to process which, in turn, is unequal within society [6]. In this regard, contemporary literature rarely discusses the consequences of the digital divide. There are just three papers that focus specifically on digital inequalities as a social phenomenon (outcome) in society [22, 28, 29], but these focus on the access issue, again. Some papers discuss the results of these inequalities as social, economic and (beyond access) digital exclusion [22, 28, 29, 39, 41, 59, 61]. Sanders and Scanlon [59] even discuss the digital divide as a human rights issue, but their focus is only on the access to broadband internet connection as related to different factors (income, education, rurality, and race and ethnicity). Some more research and elaboration on the consequences of the digital divide, apart from access, is needed since ICT use is a social action and is shaped by social contexts, along with individual factors [4].

The greatest difficulty in providing a definition of the digital divide, as well as a common framework for addressing it, is probably described best by Epstein et al. (2011): the focus depends on the field (IT, sociology, education, etc.). Although the definitions center around inequality, the question asked more than 15 years ago "What inequality does the digital divide concept refer to?" [6] still remains unanswered. Back then it was acknowledged that the digital divide lacks definition, conceptual elaboration and that "filling this gap is an urgent task" [6], and that even basic terms and concepts are improperly defined. The most likely reason for the lack of progress is that "different social groups may be more effectively addressed using different conceptualizations of the digital divide, depending on the desired outcome" [30]. Thus, after reviewing contemporary and past literature, this paper attempts to provide a digital divide definition pertinent to education. It considers the three levels identified by other authors decades ago, as well as in contemporary literature, but in a different way:

The digital divide represents inequalities in CIL due to differences in (1) quality access to technology and information; (2) abilities to use technology to acquire, process and use information; (3) personal and social characteristics (including background, motivation, beliefs, and demographic); (4) economic, social and cultural capital; which impede achieving educational and greater social functioning and outcomes related to personal growth.

There are a few things to note in the proposed definition. First, the focus is on CIL, as this is what was identified as definitive for successful functioning in education and society (including economy later in life). That is, the digital divide is understood as a CIL divide with reference to the outcomes. Second, access to technology and abilities to operate it, as well as processing information are not levels, but factors that the divide depends upon. That is, the definition focuses on the outcomes which have been traditionally defined as the highest level of the digital divide and shifts away from the first and second which are now used as factors explaining the highest one. This shift is necessary because technology and its use have already permeated through modern society deep enough, and so the focus shall be on the outcome, not the prerequisites which nowadays have been largely met. Third, the entire definition, its components, and the outcome deviate from the binary approach (have or have not) and understand the divide as a spectrum where different individuals (or groups) are positioned at different points on the continuum. To summarize the entire text in this section so far in one sentence, "Good concepts need solid definitions to operate" [83] but, unfortunately, research on abilities in the digital domain and on the digital divide does not seem to be there yet.

It needs to be noted that the article is focused on just two strands of the digital technology in education – ability and digital divide with focus on ability. These are just two of the constructs pertinent to education. This study has identified a lack of coherence in defining basic terms in these two aspects. The issue, however, is not pertinent to these two only. Such issues can be seen in other areas where the digital world and education meet, and this can further elucidate and support this paper's concerns and help recognize the value of conceptual understanding in research on the digital divide and its versatile nature. For instance, besides the role of education to provide knowledge and abilities, it is also crucial to prepare the youth to be full members of society and their community, i.e. civic education [84]. Beyond the political dimension, civics is about a broad range of experiences in daily life as community member or a citizen, including the environment where activities take place, the fundamental views on self and others and the vast interplay of ideas and experiences about the world. When factors change, civics must respond [85]. More importantly, it also is about the understanding of the responsibilities and rights of citizens as in traditional civics in the so called "infosphere" and includes ethical issues arising from the technology due to the changes in self-understanding resulting in behavioral changes or challenges [84]. Thus, in the digital age, it is important to explore the issues brought by the digital technologies in civics and finding a way to address them in pedagogy in the areas of civics and ethics, as ICT is among the most influential factors affecting the ontological function in the infosphere. There is a strong relationship between ontology and ethics. Thus, civics in the digital age must account for this relationship, as education itself must develop responses in this regard [84]. Digital civics are not about the application of technology in the civic space. Instead, digital civics must consider how the civic concepts apply in the digital revolution. This requires philosophical awareness to suit the civic life in the digital environment. This would engage students with conceptual ideas, but also will provide the grounds to understand the constantly changing world. Putting the technological means in the classrooms will not constitute digital civics education or any other kind of digital pedagogy. The shift in thinking in civics about the digital space on civic issues, however, will. In doing this, teachers must make it clear that both the offline and online environments are ontologically continuous [84, 85]. However, literature on digital civics on technological interventions or the political power of engagement through technology often mistakenly addresses topics like "community informatics" instead of digital civics [85].

But what is digital civics if it is not about the application of technology in the civic space? Clements [86] provided a long-standing definition of digital civics as "the study of the rights and responsibilities of citizens who inhabit the infosphere and access the world digitally". Although this definition stood for a long time, later in 2023 Clements [87] admits that even the overarching concept and model of digital civics can be accommodating, it also has vulnerabilities, as "it requires a further degree of consideration, problematisation, interpretation, and adaptation in order to function" [87]. Clements [87] also recognizes the large amount of work that remains to be done on the level of the model digital civics represents, and as well as on the conceptual level, where lack of strong definitions of basic (non-digital) terms like "community" and "membership" is a major obstacle [87] as this work has also suggested (see the discussion on basic terms like "skills" "competences", etc.). This is extremely important as, along the lines of this article, "A misunderstood concept of digital civics will lead to a failure in formulating digital citizenship activities that bring about the circumstances requisite for a stable society"

[85]. These issues in digital civics probably can be expected because, as Clements herself admits, digital civics is a new conception of civics, currently establishing itself, that needs to be grounded in a theoretically informed framework [85]. This, however, does not explain the current state of affairs in research on the digital divide (the focus of this paper) where issues were recognized nearly 30 years ago which is enough time to take account of many of the issues presented here.

In this regard, it needs to be noted that abilities related to the digital environment in the case of digital civics are only assistive in shaping digital civics as an outcome. The important points for digital literacy regarding digital civics are ethics, awareness of historical antecedents, and the notions of remaking the civics education. These are in addition to an understanding of the core content of philosophy of information [84]. Digital civics "encompasses various dimensions of ethical and responsible behaviour in online contexts" [85]. Understanding how our views of the world are altered by using technologies and how the subsequent reactions take shape by the changing ideas and beliefs, shifts the thinking and understanding of the digital challenges as philosophical, not as technological issues. "Thus, when the pedagogical focus is placed onto the ideas, and not the technology, we are reminded that we can acquire useful lessons for the digital age from many sources, including texts written long before many of our present-day technological innovations were created" [86]. Practices for successful digital citizenship, must involve not just information literacy (as opinioned by many), but also "supporting conceptual structures that help us achieve philosophical understanding and wisdom" [88] because although living in an information age civic efforts must be underpinned through engagement with an intellectual rigor. Otherwise we will not live in an age of wisdom [88].

The previous discussion clearly shows that besides the issues in focus of this paper there are, apparently, issues in other, traditional domains in education (and probably beyond) where digital technologies come into play. Apparently, we have an issue when traditional domains of research and education meet the digital world on a conceptual level, on levels of theoretical modeling, but, more congruently even at the most basic ones – of naming and defining things (terminology).

Similar to research on digital civics, research on the digital divide needs to acknowledge the environmental dimension of this construct from a philosophical point of view, as outlined by Luciano Floridi. The digital divide has a vertical dimension due to the sudden shift for humankind from beings who submit to nature, to beings who construct new realities and tailor them to their own needs, while inventing the future for themselves. This comes with enormous moral responsibility. The digital divide can also be expressed in terms of a horizontal gap within humanity. This gap does not have geographical, political, social, or linguistic dimensions, but is embodied in the infosphere. People from different locations, social class, economic status, etc., may all inhabit the infosphere, but in a different way, depending on their position on these variables, with some being insiders and others being outsiders [89, 90]. These are serious issues in the emerging information age, as summarized by Floridi [89]:

> ...the [digital divide] reshapes the social map because it occurs between individuals rather than countries or whole societies, between the computer literate and the computer illiterate (e-analphabetism), between the information rich and the information poor, whatever their nationality and neighborhood. The [digital divide] abolishes space and time constraints but creates new technological barriers between insiders and outsiders.

The underestimation of the digital divide may let it widen, exacerbating other issues in society. More importantly, no significant problem is in isolation, as in global context the interactions and systemic synergies are escalating: "no crucial issue can be solved without considering the whole system of relations in which it is embedded" [89]. This means that the digital divide is an issue that disempowers, discriminates and creates dependency, it can become a new form of colonialism [89, 90]. As such, the digital divide is a new challenge of ethics, information ethics. Old solutions to ethical problems, however, cannot be our only coping tool with this challenge, as technologies "are not only tools, but also vehicles of affordances, values and interpretations of the surrounding reality, like hermeneutic devices" [89], they are ethically charged. Ethical problems in the infosphere can be best understood as environmental problems that include education and capacity building, preservation, dissemination and quality control, reliability, free information flow and security, technical support, and many more as part of the environment [89]. As it is an issue that affects more on an individual than on a social level, the approach should be bottom-up, employing an environmental approach [89]. From this perspective, the gaps will not be reducible to distance between rich and developing countries, as the issue cuts across societies [90]. Thus, there should be increasing responsibility for different agents.

Just as other revolutions, the information revolution is a dramatic one. Thus, there is a risk of being in serious trouble if we do not recognize that we are not constructing a new environment just for here and now, but for generations to come [90]. Thus, conceptual issues need to be taken as the next call to both researchers and policy makers. It is vital

that the issues this article has raised regarding the digital divide are equally considered and become part of this call. A call to stop and think, but also to rethink, about future developments in defining what the digital divide is, what does it depend on, what are the definitions of the basic concepts that constitute it? Because without this being done, all efforts in bridging the digital divide may remain just an exercise in futility that can lead to ineffective educational and, more generally, social policies.

5 Limitations

As any research has its limitations, this study has too. It is a conceptual study and many of the literature sources and the additional literature used in this article are also conceptual studies. As such, they may have lower reliability and validity and some level of subjectivity and bias that are difficult, if at all possible, to estimate. However, conceptual analysis covers different issues related to the concepts, as well as the relationship between the concepts and measurements [83], as seen from the sources from Fraillon and his colleagues [31, 32, 45, 81] where the concepts are tested empirically. Further, conceptual studies play the role of "ladder of abstraction" in classification [83], as shown by the review of basic general terms (i.e. outside of the digital context), as "skill", "competence", "literacy", etc. Also, conceptual studies provide typologies in research designs and explanations [83], as shown by ranking the different terms related to abilities and the levels of digital divide (also in the newly formulated definition in this article). Lastly, conceptual studies have the power for treating category mistakes and pitfalls [83]. It is important to remember that many of the issues in this paper pertain to the philosophy of information and "Philosophy, now understood as the study or science of open questions and their answers, becomes primarily a form of conceptual design" [91]. Although conceptual studies may use different language which may lead to problems mentioned above, it is the responsibility of the researcher to align the narrative and the language to avoid going further into the pitfall of jingle-jangle fallacies. As for the jingle-jangle fallacies themselves, the article already made recommendations using Marsh's [75, 76] (establish construct validity, use SEM) and Pekrun's [77] (provide an effective definition by avoiding arbitrary assemble of components, define the concepts on the base of structural and functional element covariation) strategies on how to avoid them. These strategies can help avoid the frequent criticism that the discussion of concepts is just an "attention-directing" approach to new questions and research puzzles, and that there are too many cases of conceptual pitfalls. Then, more rigorous conceptual analysis will be made a priority [83].

Declarations

Competing interests The authors declare no competing interests.

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