

Developing Digital Literacy Skills in Our Digital World

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Introduction

With the latest technological developments, the digital world concept has emerged. Digitalization is inevitable in a world where we are intertwined with technology; we feel and use technology every day. It is one of today's needs. Thanks to digitalization, we meet our needs in many domains, including the public, health, education, and shopping. The concept of digital literacy has emerged in the digitalizing world, adding new literacy to the existing ones. Digital literacy is a dynamic process that changes depending on the situation's needs (Martin, 2006). "Digital literacy" became critical for active participation in training-education, work, and other parts of social life.

The ability to use the internet and ICT (Information and Communication Technologies) transformed into digital literacy, a new form of literacy. Digital literacy becomes a prerequisite for innovation, entrepreneurship, and creativity. Without digital literacy, citizens will fail to fully participate in society and acquire the necessary knowledge and skills to live in the 21st century (European Commission, 2003). Every



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country is trying to raise awareness of the importance of digitally empowering their youth.

Literacy

Digital literacy is an essential skill student should have today, such as reading and writing. The main difference between literacy and reading-writing is that "reading-writing is based on decoding in the alphabet system, while the concept of literacy involves meaning" (Kurudayıoğlu & Tuzel, 2010). Literacy teaches the individual the methods of acquiring and using information. In this direction, it plays a mediating role in transferring knowledge between generations (Goody, 1987).

The concept of literacy has been enriched by being used in different fields over time. Therefore, we are faced with many literacy types. Digital literacy is extensively mentioned in the literature as well. As an alternative to traditional literacy, digital literacy is essential to work and learn in the contemporary world (Churchill et al., 2008). This technology allows individuals to access, produce and share accurate and necessary information.

With the rapid development of recent e-government applications, digital literacy has gained a different dimension and created digital citizenship (Ribble, 2011). Digital citizenship is defined as individuals taking responsibility for using updated technologies (Mossberger et al., 2007). Ribble and Bailey (2007) examined digital citizenship under nine headings: Digital communication, digital safety, digital access, digital health & wellness, digital law, digital rights & responsibilities, digital commerce, digital etiquette, and digital literacy. Digital citizenship has eliminated country borders in communication and information acquisition; it has also contributed to the development of digital literacy.

What is Digital Literacy?

Digital literacy was developed with the emergence of computer use in the public sphere in the early 1980s; it was introduced into our daily lives in the 1990s and showed a significant increase after the online networked information exchange in the 2000s (Dobson & Willinsky, 2009).

The term “digital literacy” appeared in the mid-1990s to describe the changing nature of literacy via the Internet (Bawden, 2001). Lanham (1995) describes literacy in the “digital age” as “the ability to understand information no matter how it is presented.” More simply, Gilster (1997), who popularized digital literacy in his book published in 1997 with the same title, describes digital literacy as “the ability to access and use networked computer resources.” Here, Gilster underlined digital literacy's components of accessing tools and digital skills (Feerrar, 2019). The American Library Association (ALA, 2022) defines digital literacy as “the ability to use ICT requiring cognitive and technical skills, to find, evaluate, create and communicate information.”

Digital literacy is the whole of the skills that those who use the digital environment should have (Burnett & McKinley, 1998). Digital literacy is using IT to access information, share and evaluate data from different backgrounds, and create new knowledge (Tornero, 2004). Digital literacy is the ability to be successful in encounters with the electronic infrastructures and tools that make the world of the 21st century possible (Martin, 2006). Digital literacy emerges as a concept related to 21st-century skills such as information, media, and technology skills (information literacy, ICT literacy, and media literacy). Digital literacy is the skills, attitudes, and values individuals should possess to use digital tools in the 21st century.

The digital literacy acquisition process is discussed in three stages: acquisition of digital competencies, use of the competencies, and innovative digital transformation (Martin & Grudziecki, 2006). The stage of acquiring digital competencies covers the field's skills, concepts, approaches, and attitudes. The digital use phase includes using and applying digital competence in a specific area. The innovative digital

transformation stage involves possessing digital competencies and practices that allow for changes; creating a new product is related to this stage.

Despite different definitions, digital literacy, in the most general sense, is the whole of the skills that the users of the digital environment should possess (Burnett & McKinley, 1998). Like other fashionable terms, “digital literacy” has different descriptions. However, the ambiguous use of this concept will lead to misconceptions and a weakening of communication (Norton & Wiburg, 1998). According to Bawden (2008), digital literacy is a subject with confusing terminology.

Types of Digital Literacy

Educators, students, and citizens face multiple literacies in the digital age. Digital literacy is a broad concept encompassing many digital-related activity types (Martin, 2006). Moreover, digital literacy is apparently a multidisciplinary concept. Digital literacy emerges as a concept related to information technology (IT), information, technological, media, and visual literacy. Regarding content, digital literacy is broader than ICT literacy. It includes additional elements, such as media, information, and visual literacy (Martin, 2006). ICT, visual, information, and media literacy must all be balanced to create an entirely digitally literate individual (Martin, 2006). Information Literacy, Computer Literacy, Media Literacy, Communication Literacy, Visual Literacy, and Technology Literacy are the sub-disciplines of Digital Literacy (Covello, 2010, p. 4).

Components of Digital Literacy

Digital literacy components appear in the literature under concept names such as dimension, factor, component, and area. In the literature, researchers examine digital literacy by dividing it into different dimensions. According to Ng (2012), digital literacy has attitudinal, technical, cognitive, and social dimensions. According to Pérez-Escoda et al. (2019), digital literacy consists of four dimensions: learning, being

able, making/creating, and being/practicing. Pala and Basibuyuk (2020) examined digital literacy in four dimensions: information technologies, communication, safety (reliability), and problem-solving. Digital literacy is defined by ALA (2013) as using ICT to find, understand, evaluate, create and communicate digital information and emphasizes multiple components. On the other hand, Hague and Payton (2010) examined digital literacy in eight dimensions: creativity, critical thinking & evaluation, cultural & social understanding, collaboration, finding & selecting information, effective communication, e-safety, and functional skills (Figure 1).

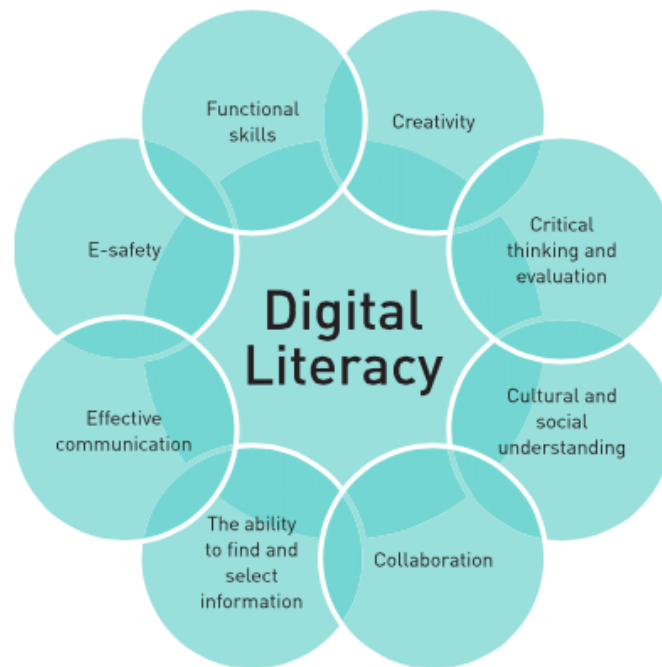


Figure 1. The components of digital literacy (Hague & Payton, 2010)

Digital Literacy Skills

Digital literacy should refer to an individual's awareness, attitude, and ability to use digital tools for communication, expression, and social action in certain life events (Goodfellow, 2011). Being digitally literate is a fundamental skill required to work and participate effectively in today's digital society. Digital literacy is the ability to

navigate inside our digital world using reading, writing, technical skills, and critical thinking. It uses technological tools such as smartphones, computers, e-readers, and more to find, evaluate and transfer information (Microsoft, 2022).

Digital technology's rapid and continuous development forces individuals to use various skills (technical, cognitive, and sociological) for the performance of tasks and problem-solving in digital environments (Eshet, 2004). According to ALA, a digitally literate individual has the following skills and uses them to establish active participation in civil society and contribute to a vibrant, informed, and engaged community (ALA, 2013).

- possesses a variety of cognitive and technical skills needed to find, understand, evaluate, create and communicate digital information in a wide variety of formats,
- uses various technologies appropriately and effectively to search and retrieve information, interpret search results, and evaluate the quality of the information obtained,
- understands the relationships between technology, lifelong learning, personal privacy, and appropriate knowledge management,
- uses these skills and appropriate technologies to communicate and collaborate with peers, colleagues, family, and sometimes the general public.

Like information literacy, digital literacy requires critical thinking and finding & using information. Moreover, it involves familiarity with digital tools and using them in collaborative, communicative ways through social engagement.

Digital literacy, which consists of many dimensions and sub-literacies, requires acquiring particular digital skills and being digitally competent. Individuals who significantly developed their digital literacy skills comprehend internet security fundamentals, such as creating strong passwords and understanding and enforcing privacy settings. Surfing through a browser, using PowerPoint, making videos,

designing slides, blogging, and familiarity with applications such as Photoshop are among the digital literacy indicators (EnglishBix, 2022).

Digital Competence

The literature shows that digital literacy and digital competence concepts are used interchangeably. However, there are differences between these two concepts. A wide range of competencies is needed to face today's complex challenges. Digital skills, sometimes called digital competencies, include the knowledge and skills to use ICT that an individual needs to achieve goals in their personal and professional life (Commission on Science and Technology for Development, 2018).

According to the OECD report (2005), competency is more than just knowledge and skills. It includes the ability to meet complex demands by leveraging and mobilizing psychosocial resources (including skills and attitudes) in a given context. Calvani et al. (2008) discussed digital competencies under three headings: technological, cognitive, and ethical. The technological dimension emphasizes the ability to solve technology-related problems; the cognitive dimension emphasizes discovering the correct and reliable sources, reading and evaluating the information, and the ethical dimension underlines having a grasp of ICT.

Digital literacy is defined as “the ability to survive in the digital age” by Eshet-Alkalai (2004). It is described by Martin and Grudziecki (2006) as individuals’ “awareness, attitude and ability” to use digital tools for communication, expression, and social action in certain life situations.

These definitions show that digital literacy and digital competence have a dynamic and multidimensional structure. In addition, digital literacy has a broader meaning than digital competence. It is widely used in international academic fields (Bayraktı, 2020).

What does today's society demands of its citizens? This demand-driven approach questions individuals’ needs to function well in society in their position, the competencies needed to find and retain a job, and the adaptive qualities required to

cope with changing technology. Competencies are essential in how individuals manage the world and help them shape it. Therefore, they are related to modern life's essential features and demands; our goals' nature, as individuals and as societies, also determines them.

Competence is essential in how individuals cope with the world and helps them shape it. Therefore, the nature of our goals, both as individuals and as societies, determine competencies, as they are related to the essential features and demands of modern life (OECD, 2005).

Digital Literacy Frameworks

The dynamic and multidimensional nature of digital literacy has made it difficult to define the concept. For this reason, researchers have developed new definitions, models, and frameworks to explain digital literacy. There are two conceptual frameworks (TPACK and SAMR) in the literature for designing digital competence programs for teacher education; they are frequently used and well supported by empirical research (Falloon, 2020).

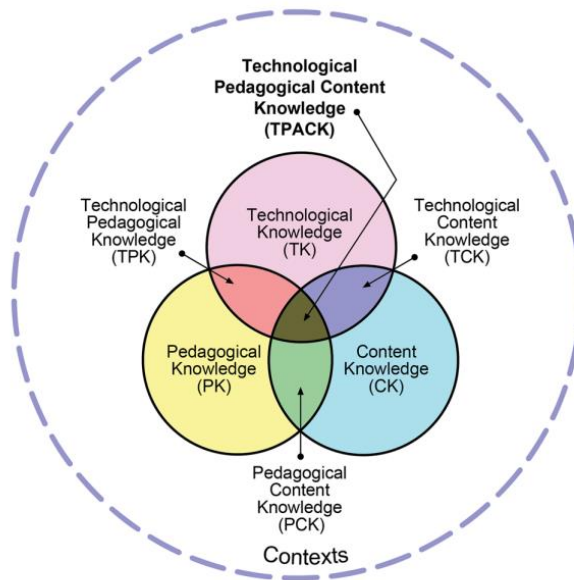


Figure 2. The TPACK framework (from Mishra and Koehler 2006) (Falloon, 2020)

The TPACK framework, developed by Mishra and Köhler (2006), is the integration and intersection of technical “know-how” (technological knowledge-TK), teaching abilities, strategies, and methods (pedagogical knowledge-PK), and “what to know” (content knowledge-CK). It is essential to create effective use of digital technology in education. The TPACK framework suggests that in developing good content, all these critical sources of knowledge (technology, pedagogy, and content) should be carefully interweaved (Figure 2).

The SAMR model includes a four-level approach for selecting, using, and evaluating technology in K-12 education (Figure 3). According to Puentedura (2006), the SAMR model is intended to be a tool through which K-12 teachers can identify and categorize their classroom technology use (Hamilton et al., 2016).

SAMR is a four-stage model representing a “spectrum” of digital technology use, ranging from substitution (old to new) to redefining learning (transformation). SAMR levels are displayed hierarchically and best interpreted as “descriptors” of the best technology used for the purpose (Puentedura, 2006).

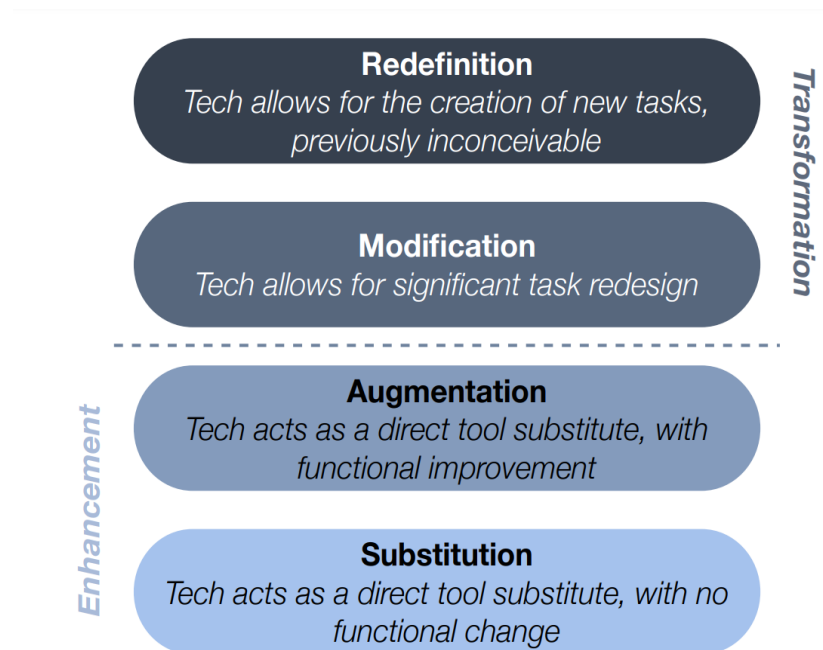


Figure 3. The SAMR model (from Puentedura 2006)

Digital Literacy Models

Various digital literacy models have been suggested to explain digital literacy. According to Pérez-Escoda et al. (2019), the proper understanding of digital literacy requires a chronologic examination of the most important models of the 21st century developing and conceptualizing this literacy. Therefore, this section will discuss five models deemed significant by Pérez-Escoda et al. (2019).

P21Model, Partnership on 21st-Century Skills (2002)

In the P21 Model (Figure 3), there are different areas such as basic subjects, learning and innovation skills, information, media and technology skills, life and career skills (Partnership for 21st-Century Skills, 2009). Digital literacy, on the other hand, emerges as a concept related to 21st century skills such as information, media and technology skills (information literacy, information and communication technologies literacy and media literacy).

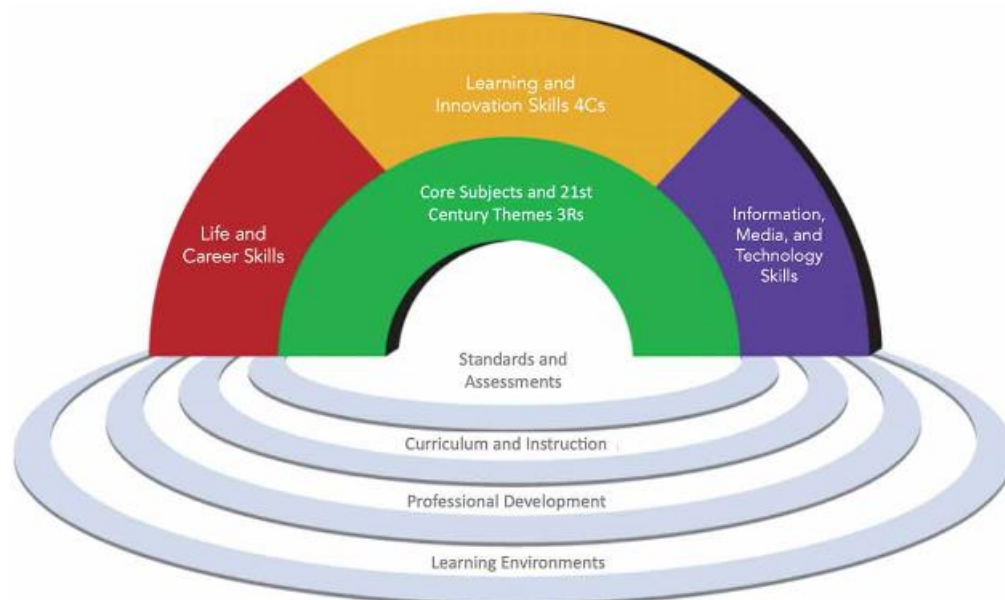


Figure 3. P21 model of digital literacy (Partnership for 21st Century Skills, 2009)

Krumsvik's Model (2008)

The researcher Krumsvik (2008) developed this digital literacy model in the context of Norwegian education policy. Digital literacy has been introduced at all educational levels and subjects of compulsory education to promote the development of this literacy in Norway. The model highlights four essential skills in achieving digital literacy: basic digital skills, didactic-ICT competence, learning strategies, and digital literacy (Krumsvik, 2011). (Figure 4).

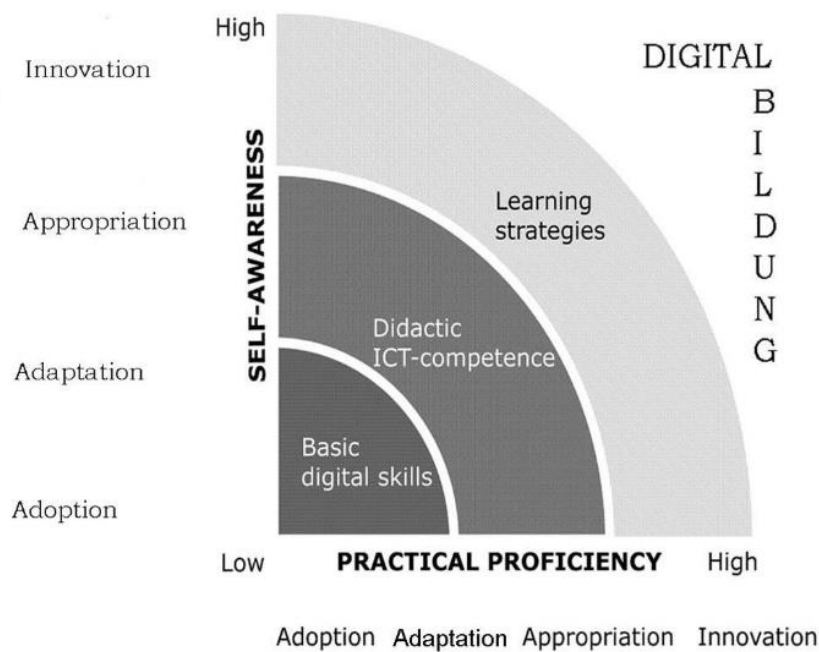


Figure 4. Krumsvik's (2008) digital literacy model

DIGCOMP Model (2011) and Digcompedu Model (2017)

DIGCOMP project had a single purpose, creating a European frame of reference for understanding and developing digital competence. It included three goals for this purpose. These are identifying digital competence (knowledge, skills, and attitudes) required to be digitally competents, identifying digital competency areas and other existing frameworks, suggesting a strategy for using and developing digital

competence at different levels. The model called DigCompEdu consists of Professional Engagement, Digital Resources, Teaching and Learning, Assessment, Empowering Learners, and Facilitating Learners' Digital Competence (Figure 5).

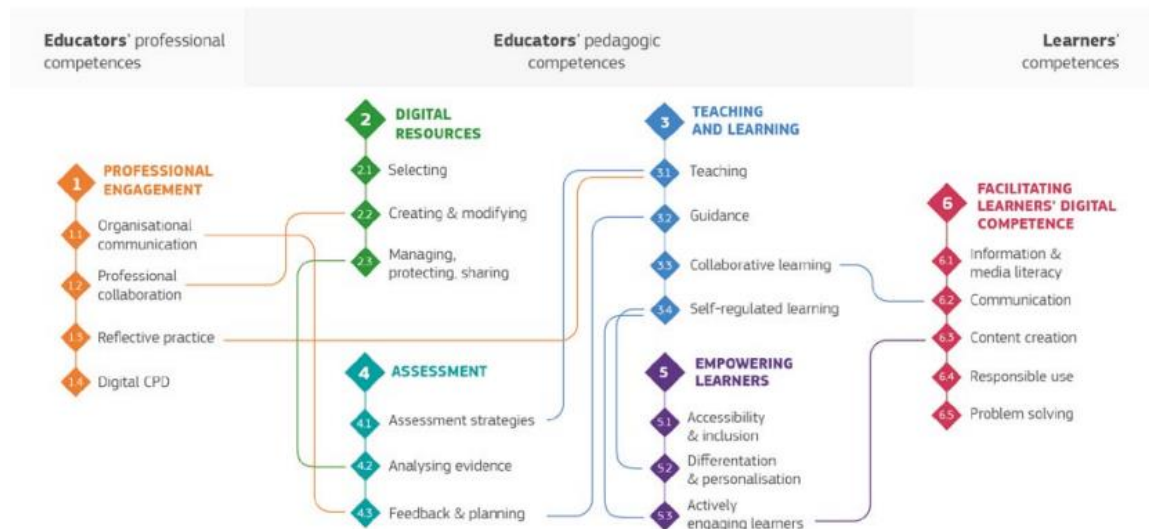


Figure 5. The DigCompEdu Framework (Redecker, 2017)

ISTE Standards (2009)

ISTE (International Society for Technology in Education) is the largest public, non-profit organization whose mission is to educate teachers and students worldwide in learning and education standards appropriate for the digital age. These standards (Figure 6) have five competence areas (International Society for Technology in Education (NETS-A, 2009).

- Facilitating and encouraging creativity and learning in students
- Designing & developing assessments and learning experiences suitable for the digital age
- Adapting the characteristic work and education of the digital age
- Promoting and exemplifying responsibility and digital citizenship
- Being committed to professional growth and leadership



Figure 6. ISTE standards (International Society for Technology in Education (NETS-A), 2009).

ISTE standards for educators includes a framework that determines teacher skills, abilities, and behaviors in seven areas (continuous personal learning, digital leadership, digital citizenship, digital collaboration, digital learning environment designer, effective digital learning facilitator, and digital data analyst) considered as the key to teacher digital literacy (ISTE, 2017).

JISC Model (2009)

The model that JISC suggested in the UK is a theoretical study that aims to apply the existing literature to teaching practices by analyzing all required literacies (information, media, technology) and students' characteristics and capacities in a changing environment.

This study formed the basis of the Professionalism in the Digital Environment (PRIDE) Project. The PRIDE Project was applied in academia to university students who develop competence areas that each profession needs. These areas were presented as a pyramid with a constructivist philosophy (Pérez-Escoda et al., 2019). The pyramid model (Figure 7) comprises access and awareness, skills, practices, and identity steps (Sharpe & Beetham, 2010).



Figure 7. “Pyramid model” of the digital literacy development model (Sharpe & Beetham, 2010)

After examining these five development models of digital literacy, a new model was developed by integrating the dimensions, areas and competencies of the other five models (Pérez-Escoda et al., 2019). (Figure 8).

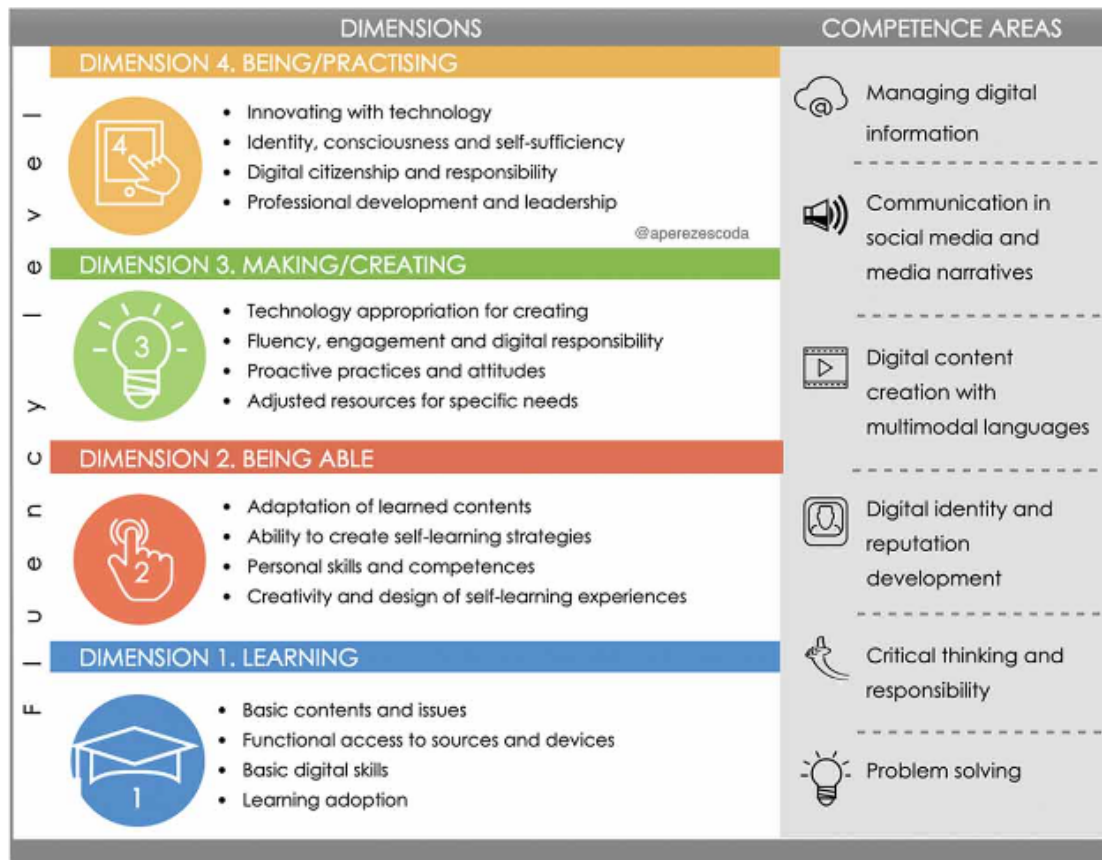


Figure 8. Dimensions of digital literacy, based on the five models
(Pérez-Escoda et al., 2019)

These four dimensions (learning, being able, making/creating, being/practicing) will allow the development of six competence areas at different levels. Their levels depend on the citizen's or student's dimension.

Apart from these models, there are different models called digital literacy or digital competence models developed by different researchers to explain digital literacy with all its dimensions. These are:

- The digital competency model developed by Calvani et al. (2009) handled digital competency in three dimensions: cognitive, ethical, and technological.
- In the digital literacy model developed by Chetty et al. (2017), five disciplines (information literacy, computer literacy, media literacy, communication

literacy, and technology literacy) and three perspectives (technical, cognitive, and ethical) broadly outline a framework that can be adopted to evaluate and measure digital literacy's conceptual components.

- The digital and media literacy model developed by Hobbs (2010) determines the basic competencies of digital and media literacy: access, analysis & evaluation, creation, reflection, and behavior.
- In the digital literacy model developed by Ng (2012), digital literacy arises from three intersecting dimensions: (i) technical, (ii) cognitive, and (iii) social-emotional.
- In Hague and Payton's (2010) digital literacy model, digital literacy is the skill, knowledge, and understanding that enables critical, creative, distinctive, and safe practices while dealing with digital technologies in all areas of life. It may be helpful to think of digital literacy as a structure having several interrelated components or dimensions. On the other hand, Hague and Payton (2010) examined digital literacy in eight dimensions: creativity, critical thinking & evaluation, cultural & social understanding, collaboration, finding & selecting information, effective communication, e-safety, and functional skills.
- The DigEuLit project, which aims to establish a definition and framework for digital literacy, developed by Martin (2009), suggested a participation model consisting of digital competencies (I), digital uses (II), and digital transformation (III) stages (Martin, 2006). Digital literacy can be talked about only in stages II or III.
- The Digital Competence Building Blocks model developed by Janssen et al. (2012) gathered 95 experts from various fields to establish a common ground on the knowledge, skills, and attitudes that constitute digital competence. The research results show that experts see digital competence as a collection of knowledge, skills, and attitudes related to various objectives domains and levels.

Digital Literacy in Education

In the past, libraries used to mediate access to information, but today television, computers, and mobile devices serve this function. At this point, it is vital for individuals to filter the information they encounter and to distinguish between true and false information.

Education, which includes the learning and teaching process, is an area where digital settings are used. Digital technologies are used in this field. For this reason, digital literacy is needed more than before in education. It is impossible to separate digital literacy from the realities of daily life, including school and other aspects of education. Students, teachers, and parents rely on the internet to get their needed information. As digital literacy permeates every aspect of daily life, it is recommended that teachers of all grade levels (from pre-school to university) promote digital literacy in the classroom.

While digital technologies keep their impact on research, teaching & learning, digital literacy programs are developed and expanded in colleges and universities, enabling students to critically use and consume digital tools and create various content (Feerrar, 2019). Developing a vision of a digitally literate university will form a basis for institutional strategies, policies, and processes, flourishing digital literacy (Jisc, 2015).

In short, many researchers suggested different descriptions, frameworks, and models to explain digital literacy. Digital literacy is a broad, complex, dynamic and multidimensional issue. Like classical literacy, it is a tool for all citizens to establish interaction between the individual and society. It creates and shares meaning through which actions are directed, social patterns evolve and change, and social order advances. Whatever the name, the society we live in now is infused with digital, and it is necessary to relate to digital to establish a relationship with this society (Martin, 2009). In the digital world, digital literacy skills and competencies are essential for academic success. 21st-century students can indeed be digital natives. However, this does not mean that they will always use their digital literacy skills for learning. Individuals should be given opportunities to maintain their digital literacy for a

lifetime. In this context, individuals should be provided with environments to develop their digital literacy skills, strategies, policies, and practices should be set, and support services should be offered.

References

- American Library Association (ALA) (2022). Digital literacy. Retrieved from <https://literacy.ala.org/digital-literacy/>
- American Library Association. (2013). Digital Literacy, Libraries, and Public Policy: Report of the Office for Information Technology Policy's Digital Literacy Task Force.
- Bawden, D. (2001), Information and digital literacies: A review of concepts. *Journal of Documentation*, 57(2), 218-259. <https://doi.org/10.1108/EUM0000000007083>
- Bawden, D. (2008). Origins and concepts of digital literacy. In C. Lankshear & M. Knobel (Eds.), *Digital literacies: Concepts, policies, and practices* (pp. 15–32). New York, NY: Peter Lang.
- Bayrakcı, S. (2020). Digital literacy as a whole of digital competences: Scale development study. Doctoral dissertation, Marmara University, İstanbul/Turkey.
- Burnett, K., & McKinley, E. G. (1998). Modelling information seeking. *Interacting with computers*, 10(3), 285-302.
- Calvani, A., Cartelli, A., Fini, A. & Ranieri, M. (2008). Models and Instruments for assessing Digital Competence at School. *Journal of e-Learning and Knowledge Society*, 4(3), 183-193. Italian e-Learning Association.
- Calvani, A., Fini, A. & Ranieri, M. (2009). Valutare la competenza digitale. Modelli teorici e strumenti applicativi. *Italian Journal of Educational Technology*, 17(3), 39-46.
- Chetty, K., Qigui, L., Gcora, N., Josie, J., Wenwei, L., & Fang, C. (2018). Bridging the digital divide: measuring digital literacy. *Economics: The Open-Access, Open-Assessment E-Journal*, 12(1), 1–20. [http:// dx.doi.org/10.5018/economics-ejournal.ja.2018-23](http://dx.doi.org/10.5018/economics-ejournal.ja.2018-23).

- Churchill, N., & Ping, L.Ç., & Oakley, G., & Churchill, D. (2008). Digital storytelling and digital literacy learning. International Conference on Information Communication 51 Technologies in Education, Island.
- Commission on Science and Technology for Development. (2018). Building digital competencies to benefit from existing and emerging technologies, with a special focus on gender and youth dimensions (Report of the Secretary General E/CN.16/2018/3). United Nations. https://unctad.org/system/files/officialdocument/ecn162018d3_en.pdf
- Covello, S. (2010). A Review of Digital Literacy Assessment Instruments. Syracuse University, School of Education.
- Dobson, T., & Willinsky, J. (2009). Digital literacy. *The Cambridge Handbook of Literacy*, David Olson, Nancy Torrance (ed.), p. 286-312. Cambridge: Cambridge University Press,
- EnglishBix (2022). Digital and technology literacy skills with examples. <https://www.englishbix.com/digital-and-technology-literacy-skills/>
- Eshet, Y. (2004). Digital Literacy: A Conceptual Framework for Survival Skills in the Digital era. *Journal of Educational Multimedia and Hypermedia*, 13(1), 93-106. Norfolk, VA: Association for the Advancement of Computing in Education (AACE). <https://www.learntechlib.org/primary/p/4793/>.
- Eshet-Alkalai, Y. (2004). Digital literacy: A conceptual framework for survival skills in the digital era. *Journal of Educational Multimedia and Hypermedia*, 93-106.
- European Commission. (2003). *E-learning: better elearning for europe*. Office for Official Publications of the European Communities.
- Falloon, G. (2020). From digital literacy to digital competence: the teacher digital competency (TDC) framework. *Education Tech Research Dev*, 68, 2449–2472. <https://doi.org/10.1007/s11423-020-09767-4>
- Feerrar, J. (2019). Development of a framework for digital literacy. *Reference Services Review*, 47(2), 91-105. <https://doi.org/10.1108/RSR-01-2019-0002>

- Gilster, P. (1997). *Digital literacy*. Wiley, New York, NY
- Goodfellow, R. (2011). Literacy, literacies and the digital in higher education. *Teaching in Higher Education*, 16(1), 131-144.
- Goody, J. (1987). *The Interface between the Written and the Oral*. Cambridge University Press.
- Hague, C., & Payton, S. (2010). Digital literacy across the curriculum. UK: Futurelab.
- Hamilton, E. R., Rosenberg, J. M., & Akcaoglu, M. (2016). The substitution augmentation modification redefinition (SAMR) model: A critical review and suggestions for its use. *TechTrends*, 60(5), 433-441.
- Hobbs, R. (2010). Digital and media literacy: A plan of action. Washington, DC: The Aspen Institute.
- International Society for Technology in Education NETS-A (2009). NETS for Administrators 2009. <http://www.iste.org/standards/iste-standards/standards-for-administrators>
- International Society for Technology in Education. (2017). ISTE standards for educators. Washington, DC: International Society for Technology in Education.
- Janssen, J., Stoyanov, S., Ferrari, A., Punie, Y., Pannekeet, K., & Sloep, P. (2013). Experts' views on digital competence: Commonalities and differences. *Computers & Education*, 68, 473-481.
- Jisc, (2015). DL themes. <https://www.webarchive.org.uk/wayback/en/archive/20151003125117/http://jiscdesignstudio.pbworks.com/w/page/53896713/DL%20themes>
- Krumsvik, R. (2008). The emerging digital literacy among teachers in Norway. The story of one digital literate teacher. In R. Koboyashi (Ed.), *New educational technology* (pp. 105–155). New York, NY: Nova Science Publishers, Inc
- Krumsvik, R. J. (2011). Digital competence in the Norwegian teacher education and schools. *Högre utbildning*, 1(1), 39-51.

- Kurudayıoğlu, M., & Tuzel, S. (2010). The types of literacy of the 21st century, changing text comprehension and Turkish teaching. *Journal of Turkology Research*, (28), 283-298.
- Lanham, R. A. (1995). Digital literacy. *Scientific American*, 273(3), 198-200.
- Martin, A. (2006). A European framework for digital literacy. *Nordic Journal of Digital Literacy*, 1(2), 151-161.
- Martin, A. (2009). Digital literacy for the third age: Sustaining identity in an uncertain world. *ELearning Papers*, 12, 1-15.
- Martin, A., & Grudziecki, J. (2006). DigEuLit: Concepts and tools for digital literacy development. *Innovation in Teaching and Learning in Information and Computer Sciences*, 5(4), 249-267.
- Microsoft, (2022). Digital literacy? <https://www.microsoft.com/en-us/digital-literacy#:~:text=Digital%20literacy%20is%20the%20ability,%2C%20evaluate%2C%20and%20communicate%20information.>
- Mishra, P., & Koehler, M. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, 6, 1017–1054
- Mossberger, K., Tolbert, C. J., & McNeal, R. S. (2007). *Digital citizenship: The Internet, society, and participation*. Cambridge, MA: MIT Press.
- Ng, W. (2012). Can we teach digital natives digital literacy?. *Computers & Education*, 59(3), 1065-1078.
- Norton, P., & Wiburg, K.M. (1998). *Teaching with technology*. New York: Harcourt Brace.
- Organisation of Economic Co-operation and Development (OECD). (2005). The definition and selection of key competencies. <https://www.oecd.org/pisa/definition-selection-key-competencies-summary.pdf>

- Pala, Ş. M., & Basıbuyuk, A. (2020). The investigation of digital literacy of fifth grade secondary school students. *Cumhuriyet International Journal of Education*, 9(3), 897-921.
- Partnership for 21st Century Skills. (2009). P21 framework definitions. Retrieved from <https://bit.ly/1nir7Vs>
- Pérez-Escoda, A., García-Ruiz, R., & Aguaded, I. (2019). Dimensions of digital literacy based on five models of development/Dimensiones de la alfabetización digital a partir de cinco modelos de desarrollo. *Cultura y educación*, 31(2), 232-266.
- Puentedura, R. (2006). Transformation, technology and education: A model for technology and transformation. http://hippasus.com/resources/tte/puentedura_tte.pdf.
- Redecker, C. (2017). European Framework for the Digital Competence of Educators. Luxembourg: Publications Office of the European Union. <https://doi.org/10.2760/159770>.
- Ribble, M. & Bailey, G. (2007). Digital citizenship in schools. Washington, DC: “International Society for Technology in Education”.
- Ribble, M. (2011). Digital Citizenship in Schools. The International Society for Technology in Education (ISTE).
- Sharpe, R. & Beetham, H. (2010). Understanding students’ uses of technology for learning: Towards creative appropriation. In Sharpe, R., Beetham, H. & De Freitas, S. (Eds.), *Rethinking Learning for a Digital Age: How Learners are Shaping Their Experiences*, Abingdon: Routledge, pp. 85- 99.
- Tornero, J. P. (2004). Promoting digital literacy: Final report (EAC/76/03). Understanding digital literacy. Gabinete de Comunicación y Educación, Universidad Autónoma de Barcelona.

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