INFLUENCE OF DIGITAL LITERACY AND AUDIOVISUAL MEDIA DURING THE COVID-19 PANDEMIC

LUIS ALEX VALENZUELA-ERNÁNDEZ¹, YDA FLOR CAMPOSANO-CÓRDOVA², ITALO WILE ALEJOS-PATIÑO³, GUIDO FLORES-MARIN², YOLVI OCAÑA-FERNÁNDEZ⁴, FREDDY HUGO COPAJA-ROMUTIPA⁵
¹Universidad Privada San Juan Bautista, Peru
²National University of Huancavelica, Peru
³National University Hermilio Valdizan, Peru
⁴Universidad Nacional Mayor de San Marcos, Peru
⁵Universidad César Vallejo, Peru

KEYWORDS
Digital Competencies
Digital Skills
Digital Literacy
Complex Thought
Metacognition

ABSTRACT
The work included a cross-sectional quantitative study aimed at evaluating the incidence of competencies, skills and digital literacy in complex thinking in a sample of 238 students of various cycles of the engineering specialty at a university in Lima. Four instruments were applied and submitted to the judgment of five experts. The digital literacy questionnaire was made and validated by exploratory factor analysis (Aiken’s V: 1.0, KMO test: 0.552, Cronbach’s alpha: 0.946). The instruments on digital competencies and skills and complex thinking were adapted and validated by Cronbach’s alpha (values 0.965, 0.814 and 0.941 respectively).

Received 10/08/2023
Accepted: 11/10/2023
1. Introduction

There is no doubt that advances in the technological field offer a whole series of possibilities for the integration of new technologies in academic work, which is why aspects related to digital skills, literacy and competencies have become the competencies required to face the present century (Coppari & Bagnoli, 2020; Tomczyk, 2020; Yildiz, 2020; Guzmán et al., 2017). In this regard Reis et al. (2019) stated how necessary it is to be a digitally competent individual.

The topics related to the field of digital literacy, competencies and skills are relevant and current, and are continuously changing and developing. For example, in the European case, several countries have carried out costly programs to transform the technological profile of their students; but it was not profitable since they had few significant achievements (Záhořec et al., 2020; Davenport et al., 2019; Marci & Vogel, 2018). At the same time, China was emerging to establish, at the higher education level, an integrated digital life (He & Li, 2019); but the study by Kim et al. (2018) evidenced that university students are in the transcript of whether or not they can effectively apply technological resources throughout their education despite the widespread idea that because they are digital natives they should exhibit digital fluency. Reisoglu & Çebi (2020) found a similar situation in Turkish university students, which is why they suggested the need to implement processes aimed at training in digital literacy and competencies. This situation was not alien to the Latin American location either, since some studies on the situation regarding competencies, literacy and digital skills (compared with the European digital competencies framework), have shown that there are few studies on what are the levels of digital competencies and/or skills at the higher level (Herrera et al., 2019; Moreno et al., 2018; Gutiérrez et al., 2017; Gutiérrez and Gómez, 2017; Núñez and Moreno, 2017). In the Peruvian case, the study developed by García (2019) showed that 91% of students in the area of engineering at a public university did not know basic aspects of digital skills and competencies; a fact that closely resembled that reported by Gutiérrez and Gómez (2017) in the case of students at a public university in Lima, who showed an intermediate level in the case of only basic digital competencies.

According to Gutiérrez et al. (2017), digital competencies are the set of tools, attitudes with communicational, media and information character that allow an adequate development in technological environments, which are part of a multiple and complex literacy. On the other hand, Cheicher & Melgar (2018) as well as Lordache et al. (2017) refer to digital competencies as the capabilities that enable the application of various digital knowledge and skills in different scenarios where the individual develops, which range from personal to professional. According to Buonocore et al. (2021), digital competencies are about knowing how to adequately use new digital technologies, with confidence and critical spirit, which characterize the so-called information society.

Computerization, digitization and computerization of procedures and workplaces have highlighted the need to develop digital skills in order to be able to cope with and take advantage of the constant changes (Buonocore et al., 2021). For their part Blayone et al. (2017) explained that the features of flexibility and pragmatism of digital competencies, allow diverse applications to the daily technological aspects of the individual, the same that are supported by three solid bases: (a) technical aspects, which allow the individual to be able to interact with some type of technological device, an aspect that translates as the exhibition of basic skills in being able to operate digital devices and software in a simple way, with the purpose that empowers him/her to do other activities; (b) communicational aspect, evidenced in the interaction between users in digital environments, which would also show the development of social skills that contribute to better interaction and online communication, exhibiting netiquette standards; (c) informational aspect, is that which allows the user to interact with information, showing a series of skills and strategies that allow access and understanding of information derived from digital environments.

Digital skills comprise a vast set of skills linked to digital technology oriented to the management of electronic devices such as computers and computer applications, tablets and smartphones, web domains, platforms and online services (Saleela & Kowsalya, 2021). According to Organista et al. (2017) digital skills are referred to the set of digital skills that empower the application of a series of knowledge oriented to develop or transform a certain eventuality that is required. On the other hand, Richardson & Bissell (2017) stated that digital skills enjoy a dynamic character since they are susceptible to be produced and at the same time modified in praxis. This changing or mutable feature of digital skills is explained by van Laar et al. (2019) who, in this regard, stated that the initial concept or concepts that...
defined digital skills have undergone modifications as a function of the development of new technologies.

The problem associated with the development of digital skills, exposed by Taylor et al. (2019), is embedded in the key urgencies of the industry and talent recruiters, since there was a marked shortage or gap of digital skills in these contexts; a fact that turned out to be nothing new but a dear defect in the approach that governments have to address the constant change in the industrial field, including risks and opportunities inherent to automation, including key aspects such as artificial intelligence and big data. According to van Laar et al. (2019) there is a gap between the studies in the field of computer science at university level and the main digital skills that a professional must have to enable him to perform in his field of action and thus the urgency of a greater mass of graduates with a solid background in the management of digital technologies. From this problem arises the need to develop broader studies on digital skills in order to move towards increasingly digital societies (Cortesi et al., 2020).

Digital literacy encompasses a range of competencies that enable the individual to use for employment digital devices appropriately ranging from adequate access, execution, evaluation, analysis and fusion of data, as well as the generation of new knowledge (Durrriyah & Zuhdi, 2018; Hobbs & Coiro, 2019). According to List et al. (2020) digital literacy comprises practical technical, cognitive and socioemotional skills that enable the individual to interact in digital environments. For Cote & Milliner (2018) digital literacy is a dynamic process due to its unquestionable predisposition of continuous technological development. For his part, Leaning (2019) estimated it as a vast set of competencies that empower the use of digital media, computers and information and communication technologies (ICT). On the other hand, Park et al. (2020) referred to digital literacy as the indispensable requirement for students to be able to interact in the digital context, experiencing cognitive processes to process information from such environments.

On the other hand, the ways in which students adopt a set of new technologies at the institutional level do not always reflect the intentions of the investment made or the objectives of the curriculum formulation. In the face of the aforementioned, there is the probability that those who evaluate its usefulness will do so with a certain bias; due to the fact that, regularly, digital literacy tends to be defined as a categorical classification of something that students possess or lack, rather than something they do (Alt, 2018; Hämäläinen et al., 2019; Yildis, 2020). In this regard Bhatt & MacKenzie (2019) stated that the challenge facing higher education should be oriented towards developing digital literacy practices in line with curricular and professional needs that will clarify the path towards the construction of sustainable approaches in the application of increasingly complex and powerful new technologies.

Digital literacy is useful in education. As stated by Eryansyah et al. (2019) digital literacy empowers students to be able to employ and generate digital products and also to be able to interact with wider audiences of other digital readers and writers. On the other hand, Cote & Milliner (2018) stated that, if we want to assess the level of digital literacy in university students, this process must be consistent with the context in which they develop, in order to be able to assimilate the diversity of factors in which they develop such as connectivity, accessibility, technological support, among others.

According to Spante et al. (2018) in the last twenty years the concepts related to digital literacy have been increasing and at the same time tend to be increasingly controversial, particularly in the focus of policies on what types of skills and knowledge individuals should acquire in the knowledge society (List, 2019; Reis et al., 2019). For his part Watt (2019) mentioned that the praxis of digital literacy needed to fully interact nowadays tends to follow a growing process as the progressive advancement of digital technologies takes place. But, what currently comprises what is referred to digital technologies? According to Mercader & Gairín (2020) as well as Liu et al. (2020), mentioned that digital technologies comprise the set of devices, including hardware and software, that facilitate communication and access, generation, transmission and storage of information and knowledge in digital environments.

The notion of complex thinking developed by Edgar Morin is the most congruent reference that allows understanding the complexity of the world, due to the need for a logical complexity capable of integrating the complementarities that are necessary to describe the various dimensions of the world and the dynamic interaction between them as a complex whole (Teixeira et al., 2019). Thus Morin (2009) defines it as a web of events, decisions, actions, probabilities that are part of the phenomenological world. On the other hand, Gonzáles (2019) expressed it as a philosophical position that by its nature is related to the educational task in addition to being malleable in its appreciation.
development and interpretation. For his part, Peña (2018) considered that complex thinking leads to multidimensional knowledge allowing the concatenation of various disciplinary domains, once fragmented by the so-called disintegrative thinking. In turn, Restrepo (2017) stated that complex thinking helps to perceive reality in a flexible way in addition to assimilating new ideas and facing stages of uncertainty. According to Martínez et al. (2019) it is a process aimed at solving contextual problems, connecting different types of knowledge with creativity, critical thinking, systemic analysis and metacognition, in addition to empowering control over cognitive and cognitive facts.

According to Bustamante et al. (2018) the transcendence of complex thinking lies in the great usefulness of being able to be applied in the experiences of university students since they reflect the three basic principles of complex thinking: dialogic, recursive and hologrammatic. Under such premise, Delgado (2019) expressed that Morinian complex thinking serves as a basis for generating viable alternatives with which to question reality and think about it from a perspective of social and educational praxis, of a free character, since it is a concrete strategy that catalyzes being able to explore and generate knowledge.

There is currently a tendency to promote complex thinking in educational systems (Tobón & Luna, 2021; Servín, 2020; Álvarez et al., 2019; González et al., 2018; Llanga et al., 2018; Techataweewan & Prasertsin, 2018). In addition, there is a need to develop instruments or evaluation systems to observe and/or measure complex thinking, according to the conceptual perspective developed by Edgar Morín and Mathew Lipman, considering the most relevant notions in the field of higher education (Álvarez et al., 2019; Silva & Iturra, 2021; Velducea et al., 2019) especially in the area of engineering (Faustino et al., 2017; Serna & Serna, 2017). Currently, it is not known at what level engineering students are in relation to aspects referred to competencies, literacy and digital skills, as well as complex thinking; therefore, it is desired to know what is the incidence of literacy, skills and digital competencies in the complex thinking of engineering students? If this dilemma persists, there is a risk that the quality of the training of professionals will be affected with respect to their insertion in the labor market; therefore, the aim of this work was focused on determining the level of incidence of digital literacy, skills and competencies on the complex thinking of engineering students.

2. Development of the research

The present non-experimental study with a cross-sectional criterion, framed under the positivist paradigm, quantitative and substantive in nature, used the hypothetical-deductive method with an explanatory level.

The population consisted of 621 students of both genders with ages fluctuating between 18 and 30 years, from a private university in Lima belonging to all academic cycles of the specialty. The sample size and type was calculated by stratified sampling, yielding a total of 238 students as shown in Table 1.

<table>
<thead>
<tr>
<th>Cycle of studies</th>
<th>Population (N)</th>
<th>%</th>
<th>Sample (n)</th>
<th>K=N/n</th>
</tr>
</thead>
<tbody>
<tr>
<td>(I) First</td>
<td>98</td>
<td>15.78</td>
<td>38</td>
<td>3</td>
</tr>
<tr>
<td>(II) Second</td>
<td>85</td>
<td>13.68</td>
<td>33</td>
<td>3</td>
</tr>
<tr>
<td>(III) Third</td>
<td>87</td>
<td>14</td>
<td>33</td>
<td>3</td>
</tr>
<tr>
<td>(IV) Fourth</td>
<td>60</td>
<td>9.66</td>
<td>23</td>
<td>3</td>
</tr>
<tr>
<td>(V) Fifth</td>
<td>59</td>
<td>9.50</td>
<td>22</td>
<td>3</td>
</tr>
<tr>
<td>(VI) Sixth</td>
<td>64</td>
<td>10.31</td>
<td>25</td>
<td>3</td>
</tr>
<tr>
<td>(VII) Seventh</td>
<td>42</td>
<td>6.76</td>
<td>16</td>
<td>3</td>
</tr>
<tr>
<td>(VIII) Eighth</td>
<td>46</td>
<td>7.41</td>
<td>17</td>
<td>3</td>
</tr>
<tr>
<td>(IX) Ninth</td>
<td>44</td>
<td>7.10</td>
<td>17</td>
<td>3</td>
</tr>
<tr>
<td>(X) Tenth</td>
<td>36</td>
<td>5.79</td>
<td>14</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>621</strong></td>
<td><strong>100</strong></td>
<td><strong>238</strong></td>
<td></td>
</tr>
</tbody>
</table>

Source: Authors
In the data collection technique, the survey was used and for this purpose four questionnaires were used: digital skills: Digital Skills Questionnaire (thirty items) by Organista et al. (2017), digital literacy (twenty-nine items), digital competencies: Digital Competencies 2.0 Questionnaire (forty-two items) by Castillo et al. (2017) and complex thinking: Complex-21 Scale (twenty-one items) by Tobón and Luna (2021); which were submitted to the judgment of five experts to determine the content validity by means of Aiken's V, which generated a value of 1. The reliability of the instruments was performed by applying a pilot test to a group of thirty individuals with similar traits equivalent to the sample. Reliability was evaluated by Cronbach's alpha with results of .946 (digital literacy), .965 (digital skills), .814 (digital competencies) and .941 (complex thinking).

In order to have a tool adapted to the reality of the study, the digital literacy questionnaire was developed, consisting of twenty-nine items, which was subjected to construct validity, which was estimated by exploratory factor analysis, generating a variance value of 78.008 and by the KMO test a value of .552 (sig. .000) was obtained. Regarding the rotated component, it is worth mentioning that all the items obtained a value higher than 0.500, thus consolidating the suitability of the instrument used. On the other hand, the value for Barlett’s test of sphericity (Chi2 = 784.309, gl = 406, sig = 0.000) supports that the factorial model used was adequate for the research.

On the other hand, all the questionnaires were provided through a single Google Forms form, separated into sections, which was disseminated through e-mail accounts to the participants or WhatsApp messages. All the data collected in the Google cloud, generated by the answers provided, were downloaded into an MS Excel spreadsheet that served as a matrix file, which was used to carry out the statistical research using IBM SPSS version 26. The inferential analysis was performed by means of ordinal logistic regression to determine the level of dependence of the complex thinking variable on the digital literacy, skills and competencies of engineering students.

3. Results

Regarding digital competencies, more than half of the students (51.3%) identified with the medium level. This was in line with Suárez et al. (2020) regarding expectations about digital competencies in students from different universities in the country, as they mentioned that they found significant differences between students from the capital and the provinces. On the other hand, the students who identified themselves with the high level (25.6%) could be due, among others, to what was exposed by Kim et al. (2018) who in this regard stated that the previous digital experience of university students usually has a significant influence on digital competence.

Regarding digital skills, half of the students (50.8%) identified themselves with a medium level, followed by low (25.6%) and high (23.5%) levels with a barely significant difference (2.1%). Said result equated to that exposed by Avitia and Uriarte (2017) about digital skills in Mexican students in the engineering area, as they reported that there was a medium level. On the other hand, the value obtained can be supported by what was expressed by Emosda & Annisa (2020) who stated that the development of digital skills is directly linked to the continuous use of digital technologies which is a frequent issue for the generation of the so-called digital natives. Regarding digital literacy, a considerable number of students were located in the medium level (54.2%), which together with those who identified with a high level (21%), is slightly below the value reported by Emosda & Annisa (2020) of 58% for the same level analyzed. The above consolidates the idea that, due to the area of study in which they develop, together with the demand, conditions the students to an acceptable handling of aspects referred to digital literacy. The above is corroborated by Salado et al. (2019) who stated that the university is the gravitational axis of knowledge specialization and, due to technological development, they need to have skills related to digital literacy. To endorse the stated arguments, it should be kept in mind that there is no constant regarding the results for different researches, since according to List (2019) it is held that, although the students’ own beliefs about the development of digital literacy can have a profound impact on their behaviors, under learning situations that require digital literacy, such beliefs have been underestimated in the literature.

Regarding complex thinking, slightly less than half (48.3%) of students were at the medium level, followed by high (27.7%) and low (23.9). The results found are distant from what Oseda et al. (2019) reported about complex thinking of systems engineering students; finding that the intermediate level of
complex thinking had 64%, confirming that a significant effect occurred in the development of aspects of complex thinking in the aforementioned students.

**Table 2.** Fitting the model of the incidence of digital literacy, skills and competencies on complex thinking in engineering students.

<table>
<thead>
<tr>
<th>Model</th>
<th>Log likelihood -2</th>
<th>Chi2</th>
<th>gl</th>
<th>sig.</th>
<th>Pseudo R2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept only</td>
<td>402,385</td>
<td></td>
<td></td>
<td></td>
<td>Cox &amp; Snell .799</td>
</tr>
<tr>
<td>Final</td>
<td>20,476</td>
<td>381,909</td>
<td>6</td>
<td>.000</td>
<td>Nagelkerke .911</td>
</tr>
</tbody>
</table>

Source: Authors

According to the data presented in Table 2, the significance weighting (0.000) supported the relationship between the variables. From this, it was concluded that competencies, skills and digital literacy had an impact on the complex thinking of engineering students. In addition, through the estimated regression model, the quality of the adjustment of the pre-established value in the model was obtained according to the data found. In this regard, the contrastation by likelihood ratio supported that the proposed model was significant ($X^2=381.909; p< 0.05$), which allows accepting the validity of the fit of the proposed model. In addition, the value of the pseudo R2 factor of Nagelkerke (0.911) supported that 91.1% referred to competencies, skills and digital literacy had an impact on the complex thinking of engineering students.

**Table 3.** Parameter estimates explaining the incidence of digital literacy, skills and competencies in complex thinking.

<table>
<thead>
<tr>
<th>Threshold</th>
<th>Estimate</th>
<th>Error</th>
<th>Wald</th>
<th>gl</th>
<th>Sig.</th>
<th>95% confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower limit</td>
</tr>
<tr>
<td>Thought_complex = 1</td>
<td>-28,567</td>
<td>1,806</td>
<td>250,158</td>
<td>1</td>
<td>.000</td>
<td>-32,107</td>
</tr>
<tr>
<td>Thought_complex = 2</td>
<td>-21,354</td>
<td>1,427</td>
<td>223,955</td>
<td>1</td>
<td>.000</td>
<td>-24,150</td>
</tr>
<tr>
<td>[Digital_literacy=1]</td>
<td>-1,172</td>
<td>1,025</td>
<td>1,310</td>
<td>1</td>
<td>.252</td>
<td>-3,180</td>
</tr>
<tr>
<td>[Digital_literacy=2]</td>
<td>-0.949</td>
<td>.847</td>
<td>1,255</td>
<td>1</td>
<td>.263</td>
<td>-2.610</td>
</tr>
<tr>
<td>Digital literacy_digital_literacy=3</td>
<td>0a</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td></td>
</tr>
<tr>
<td>[Digital_skills=1]</td>
<td>-1,110</td>
<td>1,847</td>
<td>.361</td>
<td>1</td>
<td>.548</td>
<td>-4,731</td>
</tr>
<tr>
<td>[Digital_skills=2]</td>
<td>-1,382</td>
<td>1,205</td>
<td>1,316</td>
<td>1</td>
<td>.251</td>
<td>-3,743</td>
</tr>
<tr>
<td>[Digital_skills=3]</td>
<td>0a</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td></td>
</tr>
</tbody>
</table>

Source: Authors
As exhibited in Table 3, it could be established that digital competencies had a greater incidence on the complex thinking of engineering students, due to the result of the Wald test value of 273.230 (p=0.000).

**Table 4.** Goodness of fit of the incidence of digital literacy, skills and competencies in complex thinking.

<table>
<thead>
<tr>
<th></th>
<th>Chi2</th>
<th>gl</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson</td>
<td>2,366</td>
<td>26</td>
<td>1,000</td>
</tr>
<tr>
<td>Deviation</td>
<td>2,900</td>
<td>26</td>
<td>1,000</td>
</tr>
</tbody>
</table>

Source: Authors

According to what is shown in Table 4, the deviation value (2.900), had a p > 0.05 (1.000) demonstrating that the proposed regression model that posits competencies, skills and digital literacy impacted complex thinking, proved to be valid and approved.

The inferential analysis allowed corroborating the incidence of competencies, skills and digital literacy in the complex thinking of the engineering students evaluated, at the ratio of the Nagelkerke factor value of 0.911 and the deviation of 1.000 allowed verifying the validity of the incidence. On the other hand, the weight of the Wald coefficient of 273.230 (sig. = 0.000) allows establishing that, of the variables analyzed, it was digital competencies that had the greatest incidence on students’ complex thinking, followed by literacy and digital skills with Wald coefficient values of 1.310 and 0.361 respectively.

On the above, Kim et al. (2018) evaluated the impact of digital experiences on the digital competencies of nearly four hundred university students establishing that the levels of previous digital experiences significantly influenced the students’ perceived digital competencies and with it the predisposition to the use of digital technologies. They also noted that digital competencies and attitudes were mediated by their learning agility, i.e. the occurrence of Morinian complex thinking was evidenced since it showed an affinity of students in their ability to learn continuously and the willingness to apply the acquired knowledge to the solution of problems in their academic life.

4. Conclusions

In this regard, the level of incidence of digital competencies on complex thinking was highly significant, due to the context in which the students had to develop, conditioning them to a constant use and interaction with technological devices, greater connectivity time either synchronously or asynchronously, use of applications, programs, email including social networks (Facebook, WhatsApp, among others) in addition to the development of the work that materialized in these contexts. All the above mentioned increases the identification of students with digital competences. In addition, at this juncture and due to the characteristics of the engineering area, aspects such as metacognition, problem solving, critical and systemic analysis together with creativity tend to be reconsidered in the students’ work.
References


Influence of Digital Literacy and Audiovisual Media During the Covid-19 Pandemic

