

# Information and digital literacy competencies in a virtual degree

## Competencias de información y alfabetización digital en una licenciatura virtual

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### ABSTRACT

#### Keywords

Digital literacy; digital competency; curriculum; tertiary education; multimodal

The article explores the perception of undergraduate students at a public state university in Mexico, regarding their experience after completing the Multimodal Transversal Learning Unit Information and Digital Literacy. The research explores two aspects: self-perception of students regarding their level of achievement in specific digital competencies and main learning outcomes after completing the course. It also reports their assessment in five aspects: syllabus, educational resources, learning activities, coverage of the cross-cutting themes throughout the course, as well as operation of the Learning Management System and technical support. The research was quantitative, through a survey applied to 16 students in the first group that completed the curricular unit. Among the results, the following are reported: perceived levels of achievement in different competency indicators, best valued competencies, and overall assessment of the course by the students. The highest levels of achievement reported are in indicators associated with the students' daily practices interests. The lowest levels of achievement are in the areas of algorithmic understanding and the generation of original contributions and digital content.

### RESUMEN

#### Palabras clave

Alfabetización digital; competencia digital; currículo; educación superior; multimodal

*El presente artículo explora la percepción del estudiantado de nivel pregrado en una universidad pública estatal de México, en relación con su experiencia después de cursar la Unidad de Aprendizaje Transversal Multimodal Información y alfabetización digital. Se exploran dos aspectos: la autopercepción de los estudiantes conforme al nivel de alcance de sus competencias digitales y los principales aprendizajes obtenidos en el curso. Se reporta la evaluación realizada por los alumnos en cinco aspectos del curso: temario, recursos educativos, actividades de aprendizaje, cobertura de los temas transversales, así como funcionamiento de la plataforma y soporte técnico. La investigación fue cuantitativa, se aplicó una encuesta a 16 estudiantes del primer grupo que cursó la asignatura. Entre los resultados se reportan los niveles de alcance percibidos en los indicadores de la competencia, las competencias mejor valoradas y la evaluación del curso por parte del estudiantado. Los mayores niveles de alcance se ubican en indicadores asociados a sus prácticas cotidianas e intereses. Los menores niveles de alcance se sitúan en los ámbitos del pensamiento algorítmico y de la generación de aportes y contenidos digitales originales.*

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## INTRODUCTION AND CONTEXTUALIZATION

This study discusses different aspects of the first implementation of a course focused on the development of digital competencies, within an undergraduate program in virtual mode, with the interest of assessing the impact of its first application and its relevance in light of the students' perceptions. The subject in question is called Information and Digital Literacy, and is part of the repertoire of multimodal transversal learning units (UATM) created by the Autonomous University of the State of Morelos (UAEM) in Mexico, as of 2018 (UAEM, 2022).

These units, devised as generic for all bachelor's degrees, study two types of transversalities: performative and thematic (Zorrilla, 2020), i.e., they cover transversal competencies and themes. The transversal competencies are also called soft or transferable and among these are digital competencies. For their part, cross-cutting themes refer to current topics, interdisciplinary and associated with contemporary issues, often linked to the Sustainable Development Goals (United Nations, 2015).

Thus, the UATM of the UAEM were designed with the purpose of training transferable competencies based on the exploration of cross-cutting themes. They are called "multimodal" because their design proposes modal flexibility (Zorrilla and Castillo, 2016) and can be operated in different educational modalities, including face-to-face, hybrid and virtual. The UATM repertoire is composed of eleven units: four in basic academic competencies, three in digital competencies and four in basic English language competencies (see Table 1).

**Table 1.** UATM Repertoire

Núm.	Learning Unit	Available modalities	Competences
1	Strategic Learning	In-person, hybrid, or virtual	Basic Academics
2	Reading, analysis and synthesis of written texts		
3	Oral and written communication		
4	Mathematical Logical Thinking		

5	Information and digital literacy	Hybrid or Virtual	Digital
6	Online Communication & Collaboration		
7	Digital Content Creation		
8	English A1-	Virtual	Basics in English Language
9	English A1+		
10	English A2-		
11	English A2+		

Source: own elaboration with data from UAEM (2022).

The three units dedicated to digital competencies cover the first three areas of the European Framework of Digital Competences for Citizenship, DigComp 2.1 (Carretero *et al.*, 2017), of which its version 2.2 was recently published (Vuorikari *et al.*, 2022).

The aim of this study was to explore three aspects: 1) the students' perception of the digital competencies they believed they had before, during and after taking the UATM in Information and Digital Literacy, 2) the identification of what they consider their main learnings, and 3) their assessment of the different components of the course. The research sought to answer the following questions:

- What is the self-perception of the undergraduate student body in a virtual degree program regarding their level of attainment of information literacy and digital literacy competencies?
- What is the value that undergraduate students of a virtual bachelor's degree confer to the competencies developed in a subject dedicated to information and digital literacy?
- What is the valuation of the undergraduate students of a virtual bachelor's degree on the aspects that characterize the curricular and instructional design, production and implementation of the curricular unit called Information and digital literacy?

## LITERATURE REVIEW

The pandemic due to Covid-19 evidenced, more than ever, asymmetries in terms of digital competencies included in all educational levels between teachers and students (Cáceres *et al.*, 2021; Corell *et al.*, 2021; Zorrilla *et al.*, 2022).

By virtue of the purpose of the curricular unit upon which this study focuses, it was necessary to focus the theoretical review on a group of competencies that have received different names, among which digital literacy (Brito, 2020) and media and information literacy (Unesco, 2021) stand out, terms that allude to "packages" of diverse competencies, which encompass knowledge, skills, values and attitudes in relation to the use of information and communication technologies, which require a permanent construction and the assumption of rights and obligations by their users.

Regarding information and digital literacy, Área and Guarro (2012) refer that it is the ability of a person to carry out his or her activities in a digital environment: search, research and analyze information, as well as generate content in different formats, and not only consume what is on the network. For Bawden (2002), digital literacy is the ability to read and understand hypertext and multimedia texts, and can be associated as a synonym for digital information literacy.

Although there are different views regarding the type of competencies required to interact responsibly and empowered with digital technologies (Área *et al.*, 2008; Carretero *et al.*, 2017; Fernández *et al.*, 2021; Law *et al.*, 2018; Matamala, 2018; Unesco, 2021; Zorrilla *et al.*, 2022), for the purposes of this article we take up the definition of the European Council expressed in 2018:

Digital competence involves the safe, critical and responsible use of digital technologies for learning, at work and for participation in society, as well as interaction with these. It includes information and data search and management, communication and collaboration, digital content creation (including programming), safety (including digital well-being and cybersecurity-related skills) and problem solving (cited by Vuorikari *et al.*, 2022, p. 3).

This definition is taken up as it is the basis of the European Framework of Digital Competences for Citizenship (DigComp) which, in turn, is the reference for the UAEM's UATM of digital competences.

Although no comprehensive studies have been identified regarding the state of development of digital competencies in Latin America, there is a variety of research (increasing since the covid-19 pandemic) that analyze the issue of digital competencies of different population groups, with special interest in educational contexts, and focus on the skills of both teachers and students. Camacho *et al.* (2015), for example, conducted a study with adult students in technology-mediated education in Mexico and

among their findings they highlight that "on the competence of information management, students expressed feeling uncertainty when handling study platforms, as well as in the use of the information of each subject, a situation they face by relying on other co-workers, and seeking feedback from teachers" (p. 22).

In another work, Saltos *et al.* (2019) point out that there is a low percentage (64%) of preparation in digital competencies among students and teachers in Latin America. They state that this constitutes an alert to the circumstances that future professionals will face for their insertion in the labor market.

Along the same lines, the literature review conducted by González *et al.* (2022), which covers the period 2001-2021, indicated that higher education teachers have a medium to low level of digital competencies. Likewise, their study points out that to overcome the existing gap, training is not enough, but rather the integration of these competencies into pedagogy and the curriculum is required, a significant conclusion for the present work, which focuses particularly on a curricular unit dedicated to digital competencies.

In general, research conducted in different population groups in Latin American countries coincide in pointing out the insufficient development of digital competencies and the need to address this deficiency through educational programs. Until now, the development of digital competencies in the university curriculum in Mexico has been nonexistent or not very visible, since universities privilege the transversal approach for the development of these and other so-called "soft" competencies.

However, in the analysis presented in the book "*Educación superior en México: resultados y relevancia para el mercado laboral*" (Higher education in Mexico: results and labor market relevance) (OCDE, 2019), it was found that the academic staff of higher education institutions consider that their main teaching role is to contribute to the acquisition of knowledge and disciplinary competencies, but not to the development of transversal competencies. This implies rethinking the training location of these competencies in the curriculum in addition to the notion of transversality, in view of which this study proposes possible ways to address the specific need to train students in digital competencies.

## METHODOLOGY

We conducted a quantitative research study, with a descriptive scope. As an instrument, we designed an online survey using the Google Forms tool, where the questionnaire was linked to the informed consent letter hosted on Google Drive.

The target population of the study included 27 students who made up the first group that took the UATM Information and Digital Literacy at UAEM, in an undergraduate level educational program (undergraduate) in virtual modality. Due to the limited size of the group, which is the only group that had taken the unit at the time of the study, the application reported here is considered as a pilot of the instrument, so it has not yet been submitted to validation by experts.

The instrument consisted of 47 items organized in the following sections:

1) General data of the participants. One of the items was the e-mail address, so the survey was not anonymous (4 items).

2) Access to technological equipment and services (4 items).

3) Self-perception regarding their digital competencies (20 items). Of the total number of items in this section, one was dedicated to each competency indicator, 18 in total; each item was configured as a double-entry matrix for the person to choose the level of attainment (basic, intermediate or advanced) in each phase of the course (before, during and after). One item was dedicated to the selection of the five indicators that the person considered most relevant in their personal development (from a menu covering the 18 indicators) and the last item in this section was an open question to express the main learning derived from the five indicators selected as most important in the previous question.

4) Assessment of course design and quality (19 items). This section was subdivided into five sections for participants to assess different aspects of the course:

(a) competencies covered in the curricular design of the course (3 items), (b) educational resources (4 items), (c) learning activities (4 items), (d) cross-cutting themes covered (3 items) and (e) platform (Moodle) used in the implementation of the course (3 items). Each item was evaluated using a Likert scale. Two open-ended questions were included at the end of this section, one to express the general opinion of the course and the other for additional comments not covered in the instrument.

The 27 people who took the unit in the August-December 2021 semester were invited via e-mail to respond to the online survey; of these only 16 completed it, that is, 60% of the group. The questionnaire was applied in May 2022. It should be noted that, although the instrument collects perceptions associated with different moments of the course, data collection was carried out in a single application, once the students had completed the unit.

In order to have access to the target population, authorization was requested from the director of the faculty that operates the educational

program, who gave his approval and provided the list of students with their contact information. Prior to filling out the survey, participants were provided with general information about the research project and a letter of informed consent was prepared for their review before agreeing to participate in the study. The analysis of the responses was carried out by means of descriptive statistics using Microsoft Excel.

## RESULTS

The report of results is divided into the same sections as the survey, although the first two, because they refer to the profile of those who participated, were integrated into one.

### *Profile of participants*

Of the total number of participants (16 students), with an average age of 29 years, 69% were women and 31% men; 63% worked and 37% did not. Since this is a virtual degree, it is common for most students to study and work, which was a challenge to achieve a good response rate, due to the limited time available to participate in this type of study.

In terms of technological equipment and services, almost all of the respondents answered that they have their own computer equipment and Internet access, while 44% share the equipment with a family member. Fourteen of the participants have another type of electronic device (tablet or smartphone) that they use for their academic and social activities. Table 2 summarizes the characteristics of those who responded to the survey.

**Table 2.** General data, equipment and services of the people surveyed

Number of participants	Sex		Work?		Age (average)	Do you have computer equipment?		Do you have internet access?		Do you share equipment?		Do you have another device?	
	H	M	Yes	Not		Yes	Not	Yes	Not	Yes	Not	Yes	Not
16	5	11	10	6	29	15	1	15	1	7	9	16	-

Source: own elaboration based on the data collected in the survey.



### ***Self-perception regarding digital competencies.***

For a better understanding of the results obtained, it should be noted that the course has a value of six curricular credits and consists of five hours per week, of which one is theoretical and four are practical. It can be taken as a 16-week semester course or as an eight-week intensive course. The group surveyed took the intensive program.

The syllabus is divided into three blocks that include the three competencies located in area 1 of DigComp 2.1:

- (a) Navigate, search and filter data, information and digital content.
- b) Evaluating data, information and digital content
- c) Managing data, information and digital content.

For each of these competencies, six scope indicators were identified, also derived from the DigComp 2.1 framework (see Table 3).

**Table 3.** Competencies and competency indicators covered in the syllabus of the learning unit Literacy and Digital Information

<b>Block 1. Browse, search, and filter data, information, and digital content</b>	<b>Block 2. Evaluate data, information, and digital content</b>	<b>Block 3. Data, information and digital content management</b>
1 Keyword definition (in online searches) 2 Advanced Search and Boolean Operators 3 Search for academic articles 4 Online Book Search 5 Reverse Image Search 6 News & Multimedia Search	7 News Sources and Validation Mechanisms 8 Agenda (agenda) and how it is established 9 The Emotional Factor in the Reaction to the News 10 Types of disinformation and misinformation 11 Automated mechanisms to control online information flows 12 Human mechanisms for information validation	13 Digital File Types 14 File and Folder Organization Systems 15 Cloud Storage Systems 16 File compression and decompression 17 Metadata, folksonomies and tags (hashtagging) 18 Online Content Curation

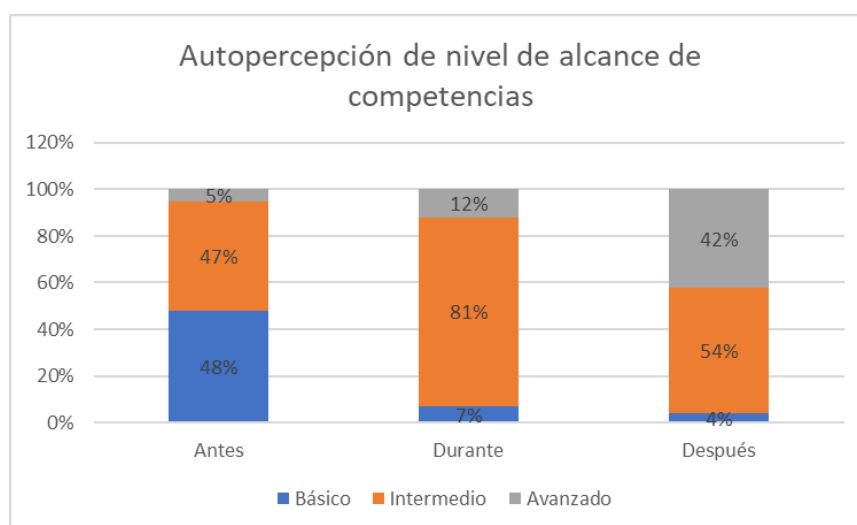
Source: own elaboration based on the analysis of the curriculum in light of the DigComp 2.1 framework.



The course consists of pieces of content focused on the competencies to be developed, which are worked on through learning activities in which the cross-cutting themes are incorporated.

To assess the students' self-perception regarding the level of their competencies before, during and after taking the UATM Information and Digital Literacy course, the 18 indicators of scope of the competencies covered by the course were used as a reference, so that in each one the participant could self-assess their degree of scope at each moment based on a scale of basic, intermediate and advanced, which corresponds to the first three levels of the reference framework (DigComp 2.1).

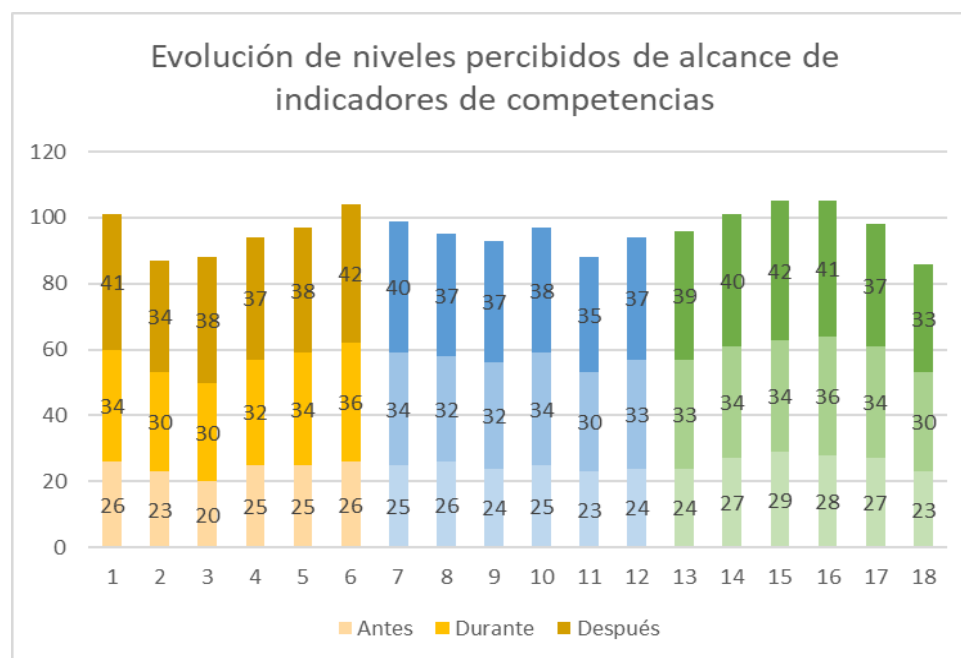
In general, before the course, 48% of the participants self-assessed themselves at a basic level, 47% at an intermediate level and 5% at an advanced level. During the course the self-perception of basic level decreased to 7%, intermediate level increased to 81% and advanced level increased to 12%. After the course, the self-perception of the basic level decreased to 4%, the intermediate level decreased to 54% and the advanced level reached 42% (see graph 1).



**Graph 1.** Self-perception of levels of competence attainment.  
Source: own elaboration based on the data collected in the survey.

As can be seen in Graph 1, in terms of the students' self-perception, their progress in the acquisition and development of competencies was favorable. In order to assess the evolution perceived by the group in their achievement of the indicators throughout the course in a more detailed way, a quantification of these was made, assigning one point to the levels selected as "basic", two points to "intermediate" and three to "advanced".

In the first block of competencies (yellow) in graph 2, it can be seen that the highest levels of reach are located in the indicators: 1) Definition of key words, and 6) Searching for news and multimedia; both had, equally, the highest scores before taking the course. The indicator with the lowest reach was 2) Advanced search and Boolean operators, which also had a low score in the pre-course phase.



**Graph 2.** Evolution of perceived levels of achievement of competency indicators.

Source: own elaboration based on the data collected in the survey.

In the second block (blue), the highest levels of reach relate to the indicators: 7) News sources and validation mechanisms, and 10) Types of disinformation and misinformation. As in the first block, it can be seen that the highest reach is registered in indicators that had the highest scores before taking the course. The lowest level of scope is recorded in indicator 11) Automated mechanisms to control online information flows, which also had the lowest initial score in the block.

Finally, in the third block (green), the indicators with the greatest scope are 15) Cloud storage systems, and 16) File compression and decompression, just as in the first two blocks, were the ones that registered the highest scores before taking the course. The indicator with the lowest range was 18) Online content curation, which also registered the lowest starting score.

In the same section of self-perception of digital competencies, students were asked to select the five indicators of scope of the competencies they considered most significant in their learning process, where the selection of six indicators predominated (see Figure 1).



**Figure 1.** Value attributed to competency indicators.  
Source: own elaboration based on the data collected in the survey.

Table 4 shows in detail the main learning perceived by the students in these six indicators, to which they attributed greater importance in their educational process.

**Table 4.** The learning that students value the most

Indicator	Number of times selected	What learning do students value the most?
3) Search for academic articles	11	<ul style="list-style-type: none"> <li>• Know how to search for academic articles in order to have reliable information</li> <li>• Learn how to use the academic search engines offered through the internet</li> <li>• Improve knowledge for information search</li> <li>• It is of great help to use reliable sources</li> <li>• Have the facility to know how technology is advancing more and more and must know how to search for it</li> <li>• Learn how to search for articles with reliable information</li> <li>• Learn that there are specialized search engines to find academic articles and thus obtain accurate information</li> </ul>
15) Cloud Storage Systems	10	<ul style="list-style-type: none"> <li>• How to safeguard our information in the cloud, so as not to fill the memory of our devices</li> <li>• Understand the use, management and utilization of storage clouds</li> <li>• Save information in the cloud and share links for school and work activities</li> <li>• Save and keep my files and images safer on trusted systems</li> <li>• How to save critical information</li> </ul>
1) Keyword definition	9	<ul style="list-style-type: none"> <li>• Know how to select keywords to make an assertive search</li> <li>• Select keywords to search for scholarly information from trusted sources</li> <li>• Learn how to spot keywords</li> <li>• More targeted search</li> <li>• Learn how to find more appropriate and useful information</li> <li>• Search faster and more appropriate to the topic</li> <li>• Learn how to remove generic words in searches to improve results</li> </ul>
13) Digital File Types	9	<ul style="list-style-type: none"> <li>• New knowledge in file types, expanding the use of digital tolos</li> <li>• Learn how to identify the different types of files and use them according to their characteristics</li> <li>• Learn how to identify the different types of files and use them according to their characteristics</li> </ul>

10) Types of disinformation and misinformation	6	<ul style="list-style-type: none"> <li>• Know how to differentiate the different types of apocryphal information that exist on the internet</li> <li>• Learn that everything that is online can be uploaded by anyone, so you have to check the sources correctly, that they are reliable, to use reliable information</li> </ul>
16) File compression and decompression	6	<ul style="list-style-type: none"> <li>• To upload files that are smaller</li> <li>• Save files that generate little space in memory or on digital devices</li> </ul>

Source: own elaboration based on the data collected in the survey.

### ***Course design and quality***

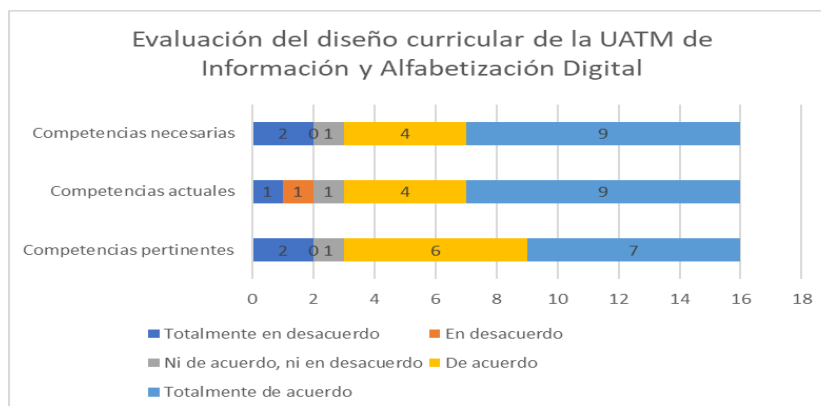
In this section we analyze the results of the last section of the survey, where students evaluated the design and quality of the UATM in Information and Digital Literacy.

For the design and production of the UATM, a knowledgeable teacher was involved, who has knowledge and expertise in the topics of information and digital literacy. In addition, two instructional designers, a multimedia team for the creation of educational resources and a person from the technical support area were involved for the assembly and online implementation in Moodle. The course took four months to develop.

Regarding the design and quality of the course, students were asked to evaluate the following aspects: a) Competencies covered in the curricular design, b) Resources (content pieces), c) Learning activities (design, quantity and effort required), d) Approach to cross-cutting themes throughout the course, and e) Operation of the platform and technical support. The results in each of these dimensions are presented below:

#### **a) Competencies covered in the curricular design**

As can be seen in Graph 3, if the ratings of Strongly Agree and Agree are combined, thirteen of the 16 participants consider that the competencies covered in the course are necessary, current and germane.

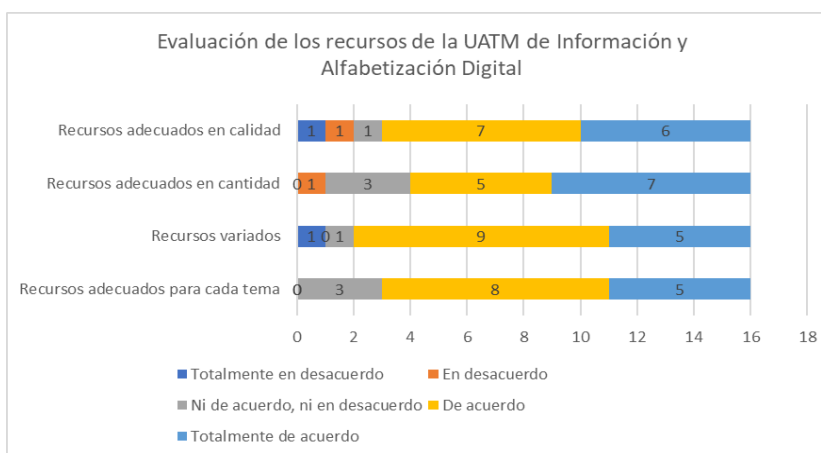


**Graph 3.** Evaluation of the curricular design of the UATM of Information and Digital Literacy.

Source: own elaboration based on the data collected in the survey.

### b) Evaluation of the educational resources (content pieces)

Graph 4 shows that, in the four aspects evaluated in relation to the resources provided, if the responses Strongly Agree and Agree are added, the item with the highest score is variety, with fourteen favorable responses out of 16, followed by quality (13) and appropriateness to the topic (13). Quantity was the item with the lowest number of favorable responses (12). In all four items there is a majority of responses giving a favorable rating to the resources. It should be noted that in order to triangulate these responses, the UATM was reviewed on the platform (e-observation) and it was found that the resources are indeed varied (texts, videos, infographics, among others) and that their quantity and quality are sufficient.



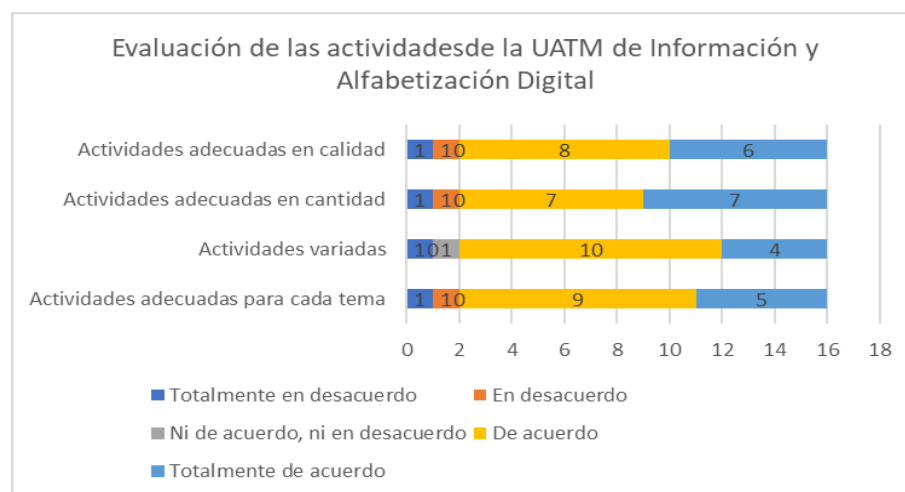
**Graph 4.** Evaluation of the UATM's Information and Digital Literacy resources.

Source: own elaboration based on the data collected in the survey.

### c) Assessment of learning activities

The results of the learning activities (their design, quantity and effort required to carry them out) are shown in graph 5. If the responses Strongly Agree and Agree in the four items are added, fourteen of 16 participants rated the activities contained in the course positively. The items with the highest ratings are quantity and quality of activities, followed by appropriateness and variety.

As in the case of the content pieces, from e-observation it was recorded that the course has 27 learning activities, including exercises, reflections, practices, presentations and gallery. On average, students perform between three and four activities per week, although it should be remembered that this subject was operated in an intensive scheme over eight weeks, so that, in a semester operation of 16 weeks, the average number of weekly activities is reduced by half.



**Graph 5.** Evaluation of the activities of the UATM of Information and Digital Literacy.

Source: own elaboration based on the data collected in the survey.

### d) Assessment of the approach to cross-cutting issues

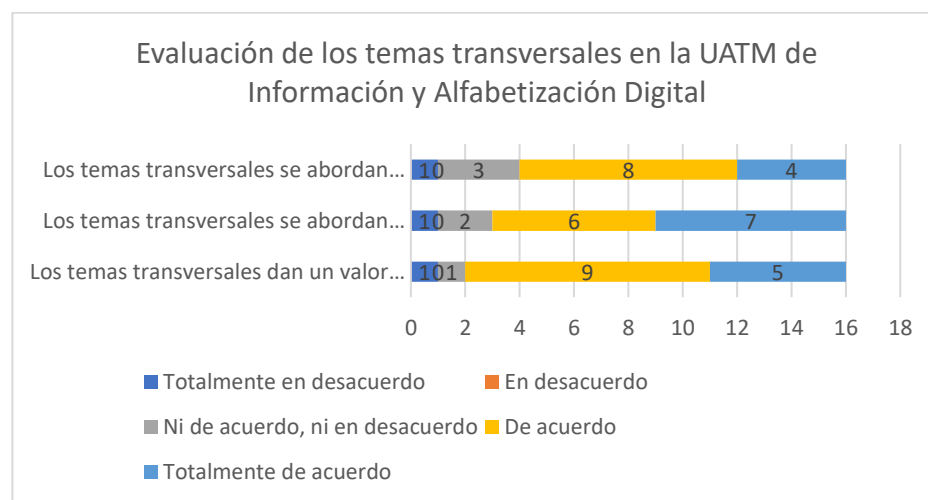
Regarding the inclusion of cross-cutting themes in the UATM evaluated, it is possible to specify that, according to the UAEM university model (2011), transversality is the "inclusion in the curriculum of content that crosses and enriches disciplinary learning and is applicable in various contexts" (p. 32). Among the cross-cutting themes contemplated in the university model, and taken up by the UATM, are the following: sustainability, diversity and multiculturalism (including cultural exchange), human,



social and peoples' rights, self-care, and university ethos and national culture.

It is necessary to specify that these topics are not limiting, since the university model itself states that they are dynamic and circumstantial. Therefore, for the design of the UATM, "gender equity" and "entrepreneurship" were added. The university model (2011) establishes that the inclusion of cross-cutting themes in the curriculum can be done through different strategies: 1) in existing disciplinary curricular content, 2) by creating specific curricular units -as is the case of the UATM-, and 3) by incorporating formal, non-formal and informal extracurricular activities and training in the labor field.

The evaluation made by the students surveyed regarding the coverage of cross-cutting themes throughout the course can be seen in graph 6, where, in the accumulated responses Totally agree and Agree, there were fourteen of 16 participants who affirm that the cross-cutting themes add value to the course, thirteen who consider that they are sufficiently analyzed and twelve who think that they are covered in a superficial manner. At this point it is possible to observe that these last two answers are contradictory; one would think that those who think that the topics are sufficiently covered would not agree that they are superficially analyzed.



**Graph 6.** Evaluation of cross-cutting themes in the UATM of Information and Digital Literacy.

Source: own elaboration based on the data collected in the survey.

### e) Platform operation and technical support

The UATM was implemented through the Moodle platform, so it was also considered necessary to know the students' perception regarding the functioning of the platform and the attention they received from technical support. The results are shown in graph 7. Of these, if the responses Strongly Agree and Agree are added, thirteen out of 16 participants consider the technical support service adequate, twelve think that the Moodle communication tools are sufficient and eleven perceive that Moodle worked correctly.

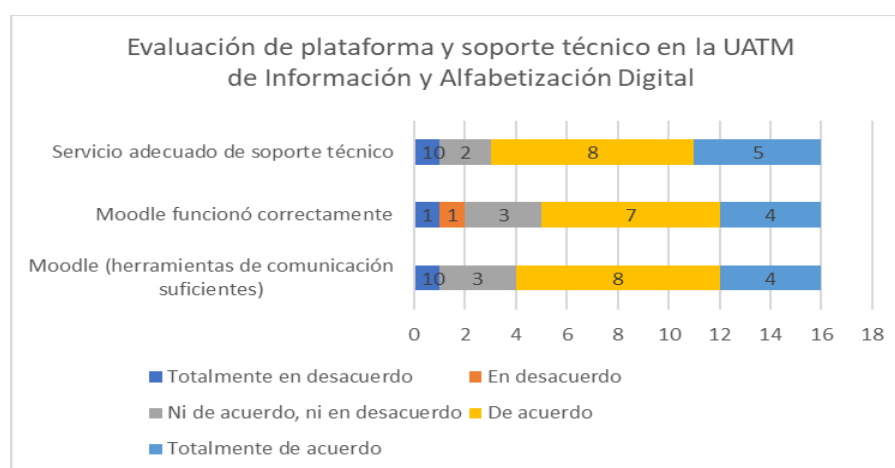
## DISCUSSION

### *Participants' profile*

Table 2 shows that there is a ratio in the sample of two women for every male participant, while almost two thirds of those who responded work, which is consistent with the usual profile of people who enroll in online programs. Likewise, the average age (29 years) is higher than the average age in face-to-face degree programs. Another evident aspect is that most of them have access to computer equipment and Internet connection, which is consistent with the usual profile of those who study online.

### Self-perception regarding digital competencies

As mentioned above, one of the questions posed in this study was: what is the self-perception of undergraduate students in a virtual degree program regarding their level of information and digital literacy competencies? Below, we discuss the results presented in Graph 2, which answer this first question.



**Graph 7.** Evaluation of platform and technical support at the UATM of Information and Digital Literacy.

Source: own elaboration based on the data collected in the survey.

In the indicators of block 1, which relate to the competency of "navigating, searching and filtering data, information and digital content" of the DigComp 2.1 framework, it is interesting to note that, of the different types of searches seen in the course (articles, books, news and multimedia), the one with the greatest scope was the third one, which in general is the least related to academic content, that is, the most developed competencies are those associated with activities of searching for current information and consumption of audiovisual content.

The above is consistent with different studies on the practices of Internet users. The National Survey on Availability and Use of Information Technologies in Households (ENDUTIH, by its acronym in Spanish) (INEGI, 2022) reports that the main activities carried out by internet users in 2021 were communicating (93.8%), searching for information (89.9%) and accessing social networks (89.8%). The same study states that the most used applications in mobile telephony were: instant messaging (90.8%), audio and video content (77.8%) and social networks (76.3%).

In Spain, the figures are similar: of the top five Internet activities, the second is reading news (75.4%), the fourth is listening to music (61.4%) and the fifth is watching movies (57.7%) (AIMC, 2022).

In contrast, the indicator with the lowest reach is linked to the functionality of search engines, which in turn is related to what some call "algorithmic thinking" and is associated with logical-mathematical reasoning.

In the indicators of block two, corresponding to the competence "evaluate data, information and digital content" of the DigComp 2.1 framework, it was found that in general the self-perception of students is favorable in terms of identifying reliable sources of information.

This is consistent with the study by García Lara *et al.* (2021), who conducted a systematic research review from 2010-2020 related to assessing the attitude of young university students towards the so-called 'fake news'. From the 243 articles reviewed, it can be inferred that young university students have a high capacity to detect fake news; likewise, among the practices they propose to mitigate the impact of disinformation, information literacy stands out.

Regarding the indicator with the smallest scope, "automated mechanisms to control online information flows", it is also related to algorithmic thinking, as in the first block.

In the indicators of block three, which correspond to the competency "data, information and digital content management" of the DigComp 2.1

framework, specifically the indicator that registered the lowest extent was 18) Online content curation, which by the very content of this competency area is the only one that is directly related to a proactive attitude of the user, since curation implies adding value to the information that is searched and organized.

The above is also consistent with other studies that show that, despite the possibilities offered by Web 2.0, and in particular social networks, for the development of a more democratic and participatory infosphere where consumers have the possibility of participating by generating content or at least adding value to the content generated by other users, several studies show that audiences continue to be mostly made up of consumers where those who produce are a minority (Arribas *et al.*, 2019; Barredo *et al.*, 2018; Chu, 2010).

The second research question was: what is the value that undergraduate students of a virtual bachelor's degree confer to the competencies developed in a subject dedicated to information and digital literacy? Regarding the perceived usefulness of the competencies analyzed by the unit, it is interesting to note that of the six indicators selected by a greater number of people (see Table 4), four are repeated with those that obtained a perception of greater scope: 1) Definition of keywords (for online searches), 10) Types of disinformation and misinformation, 15) Cloud storage systems, and 16) Compression and decompression of files.

Of these four selected indicators, two (15 and 16) are related to better management of their devices' memories, through additional space in the cloud and file compression, which evidences the limitations of their equipment and the need they present to develop competencies that respond to this situation.

Regarding the other two selected indicators that score high in scope perception, the definition of keywords is emphasized throughout the course as the key to all other searches, so it is understandable that it is considered a fundamental learning process. Prioritizing the indicator associated with discerning between reliable and unreliable information agrees with the findings of Garcia *et al.* (2021).

It should be noted that the other two indicators selected as important in their personal development, in contrast, are among those with the lowest perceived scope in their respective blocks: 3) Searching for academic articles and 13) Types of digital files. This reflects that, despite having a low starting point and a modest scope, students value positively the progress registered in these indicators. On the same line, it can be underlined that the search for academic articles departs from the social and leisure practices that prevail among young university students, which reflects the awareness of the need and importance of developing, in addition, competencies related to their academic activity.

The interest in digital file types could reflect at least a first, estimated approach to algorithmic thinking which, as seen above, is common to several low-scope indicators.

### ***Course design and quality***

With regard to the third question, we asked ourselves: what is the assessment of undergraduate students of a virtual bachelor's degree on the aspects that characterize the curricular and instructional design, production and implementation of the curricular unit called Information and Digital Literacy? Although the different assessed aspects received positive evaluations in general, the best evaluated aspect was the coverage of competencies covered by the course, that is, the curricular design, which, as noted, is in line with the DigComp 2.1 framework. The evaluation of educational resources and learning activities was similar, reflecting a balance in the quality of both components of the course. The aspects with slightly less favorable evaluations were the incorporation of cross-cutting themes, where contradictory responses were recorded, pointing to the need to revise two items, and the performance of the platform, which, although well evaluated, did not receive comparatively high scores as high as the most highly rated items in this section of the survey.

### **CONCLUSIONS**

At the UAEM, it was considered that incorporating content for the training of digital competencies into the curriculum and doing so following the European Framework of Digital Competencies for Citizenship (DigComp 2.1), was a promising way to develop competencies in students that would allow them to perform favorably in their future life and occupation, according to international standards.

One concern that was raised at the beginning, when the UATM project was presented, especially regarding digital competencies for citizenship, was that, students, being "digital natives", already had these competencies.

Although the implementation of only one of the three learning units dedicated to digital competencies, in a single program and in a single group, is a miniscule glimpse of its potential, it can be glimpsed that the students' perception after taking it is one of achievement, with respect to progress in their mastery of the different indicators of the competencies' scope. In this sense, most of them perceive that they start with a level of achievement between basic and intermediate, achieving at the end a level that ranges between intermediate and advanced.

It is noted that the highest levels of reach are located in indicators associated with the daily practices of students and their interests. Likewise, the lowest levels of scope are found in the areas of algorithmic thinking and the generation of original digital contributions and contents.

The first of the two aforementioned is closely related to logical-mathematical thinking, which in turn is an area of low performance in Mexico, according to standardized tests. The second is a finding that coincides with the literature that demystifies the idea that all young people today produce content and add value to the information available on the Internet.

Similarly, it is clear that respondents perceive their areas of opportunity in the field of information and digital literacy skills, and value them as necessary, current and relevant. Particularly noteworthy is their assessment of the indicators of types of disinformation and misinformation, as well as the search for academic articles, reflecting an awareness of the need to acquire and develop critical thinking and academic skills, beyond those associated merely with online leisure.

The general evaluation on the quality and relevance of the curricular unit is favorable, although it is necessary to continue the analysis of other implementations in different educational programs and in a 16-week semester scheme. Likewise, it is necessary to evaluate the implementation of the other UATM, in order to comprehensively measure their impact and potential. In view of the above, it is considered that the UATM model in the UAEM is a possible route for universities to offer a scaffolding to teachers and students for the acquisition and development of digital competencies for life and work.

In closing, we point out some limitations of this study that are important to consider: the small number of participants and their particular profile, as they are students of an online degree with an average age higher than that of students in the face-to-face mode, who at the same time are presumably located with a greater development of digital competencies.

Another limitation is that the three moments of the perception of the level of attainment were collected after having completed the unit, making it more convenient to self-assess these levels at the indicated moments, for greater precision in the measurement. Finally, like many other studies on digital competencies, this one is based on self-perception (Buckingham *et al.*, 2005), so ethnographic studies or measurement of competencies based on portfolios of evidence or other types of evaluations are necessary.

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