

Appropriation of digital knowledge in the training of Mexican normalist students

Apropiación de saberes digitales en la formación de estudiantes normalistas mexicanos

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ABSTRACT

Keywords

Digital knowledge;
training of teachers;
normalist students; ICT

Digital knowledge constitutes knowledge, skills and attitudes related to the use of Information and Communication Technologies (ICT) in the educational field. The training of normalist teachers requires, as a graduation profile, to strengthen the development of digital knowledge that allows them to enrich the design, development and implementation of didactic situations and sequences with the use of ICT, not only from an instrumental level, but also from a didactic perspective. This research presents the results of a quantitative, non-experimental, descriptive study, whose objective was to diagnose the appropriation of digital knowledge in the formation of Mexican normalist students. The sample consisted of 505 Mexican normal students from the states of Chihuahua, Hidalgo and Tamaulipas, who were administered a questionnaire with a Likert-type scale with 36 items distributed in 7 dimensions. Among the main findings, digital knowledge was identified with a higher score for the use of messaging services, as well as the management of different types of sizes and fonts; the lowest scores were recorded in data analysis with specialized software and the development of blogs to communicate information.

RESUMEN

Palabras clave

Saberes digitales;
formación; normalistas;
TIC

Los saberes digitales constituyen conocimientos, habilidades y actitudes relacionados con el empleo de las tecnologías de la información y la comunicación (TIC) en el ámbito educativo. La formación de los docentes normalistas requiere, como perfil de egreso, fortalecer el desarrollo de los saberes digitales que les permitan enriquecer el diseño, el desarrollo y la implementación de situaciones y secuencias didácticas con el empleo de las TIC, no solo desde un plano instrumental, sino desde una perspectiva didáctica. Esta investigación presenta los resultados de un estudio cuantitativo, no experimental, descriptivo, cuyo objetivo fue diagnosticar la apropiación de saberes digitales en la formación de estudiantes normalistas mexicanos. La muestra fue de 505 estudiantes de escuelas normales mexicanas de los estados de Chihuahua, Hidalgo y Tamaulipas, a quienes se les administró un cuestionario con escala tipo Likert con 36 ítems distribuidos en siete dimensiones. Dentro de los principales hallazgos se identifican los saberes digitales con un puntaje más alto en cuanto a la utilización de servicios de mensajería, así como el manejo de distintos tipos de tamaños y fuentes; los puntajes más bajos se registraron en el análisis de datos con software especializado y en la elaboración de blogs para comunicar información.

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INTRODUCTION

Incorporation of information and communication technologies (ICTs) in different areas of human life, mainly in the last decade, has been significant. In particular, their integration into the educational sphere in the teaching-learning process is increasingly frequent (López *et al.*, 2020; Cuevas, 2011). This phenomenon represents a challenge for both those who learn and those who train in the different educational levels and modalities (Díaz *et al.*, 2018; García, 2020), since its use is not reduced to changing the blackboard for a PowerPoint presentation, but involves transiting through various levels of ICT appropriation (Unesco, 2016): 1) integration, where the tools facilitate the presentation of content, communication and transmission of information; 2) reorientation, which consists of the use of technological tools by the teacher to organize the teaching-learning process, seeking student participation; and 3) evolution, which involves the use of technological tools from a flexible, creative and meaningful perspective (Coll and Monereo, 2008; Magallanes and Ladaga, 2013).

Unesco (2013) assures that higher education institutions need to improve the process of incorporating technological tools in educational activities, as a support for the development of conceptual, procedural and attitudinal knowledge in students, allowing them to effectively and pertinently solve the different situations they face. This also applies to the training of teacher educators in the XXI century society, because as a feature of the graduate profile, it is required to strengthen the development of digital knowledge that allows them to enrich the design, development and implementation of situations and didactic sequences with the use of ICT, not only from an instrumental level, but from a didactic perspective where these levels of appropriation are followed.

In view of this, the aim is to generate proposals that allow those who are trained as teachers to use different tools for the design of their didactic strategies, such as WebQuest, collaborative murals, wikis, forums, blogs, web pages, among others (Sansot, 2020). In this sense, the following question was posed for this research: what is the level of appropriation of digital knowledge in the education of Mexican teacher training students?

To answer this question, the opinions of teacher training students from three Mexican institutions in the states of Chihuahua, Tamaulipas and Hidalgo, in Mexico, were collected to assess the strengths and areas of opportunity in developing their training process, and how they articulate them within their activities for the identification, search and discrimination of information, communication in virtual environments, as well as the incorporation of technologies in didactic tasks they carry out with basic education students.

The objective is to diagnose, from a didactic perspective, the appropriation of digital knowledge in the initial teacher training of Mexican teacher training college students. At the same time, the following specific objectives have been proposed: 1) to establish the level of appropriation of digital knowledge; 2) to identify the items that reflect a higher and lower level of appropriation to group the main strengths and areas of opportunity, in addition to knowing the real situation of teacher training students in order to generate actions for improvement within each of the centers where they study and in the spaces of practice they perform.

REFERENCE FRAMEWORK OF DIGITAL KNOWLEDGE

International entities, such as the Organization for Economic Cooperation and Development (OECD), the United Nations Educational, Scientific and Cultural Organization (UNESCO), the National Institute of Educational Technologies and Teacher Training (INTEF), the European Computer Driving License (ECDL) and the International Society for Technology in Education (ISTE), have proposed a series of standards and indicators that people need to acquire in order to be able to perform at the highest level, the European Computer Driving Licence (ECDL) and the International Society for Technology in Education (ISTE), have put forward a series of standards and indicators that people need to acquire to perform adequately in the society of the 21st century, in the personal, work and academic spheres, to achieve better performance in their activities.

For the OECD (2015), the use of ICTs is a factor of change and economic momentum in countries, and ensures that if they invest in the development of skills of subjects for the management and use of various technological tools, they will have the necessary elements to improve their quality of life and boost the economy.

In this regard, Unesco (2019, 2016, 2016, 2013, 2008) has generated a series of ICT competency frameworks within the teaching work, which are divided into three levels: a) knowledge acquisition: that employ technologies successfully in the teaching-learning process; b) knowledge deepening: includes the use of ICT to facilitate authentic and autonomous learning; 3) knowledge creation: this level involves innovating and learning not only for life, but throughout life.

For its part, INTEF (2017) establishes the Common Framework of Digital Teaching Competence, made up of 21 competencies organized into five areas: 1) information and information literacy, 2) communication and collaboration, 3) digital content creation, 4) security, and 5) problem solving. Similarly, the ECDL (2012), a body that has worked on the competency certification process, has ten certification programs; one of the ones that has achieved the greatest impact is the International Computer Driving License (ICDL), made up of the modules: 1) ICT concepts, 2) computer use and file management, 3) word processing, 4)

spreadsheets, 5) databases, 6) electronic presentations, and 7) web searches and communication.

Finally, the American organization ISTE (2012) works along several lines related to technology and the design of standards for ICT use, which are called NETS (National Educational Technology Standards) and are oriented for teachers (NETS-T), students (NETS-S), trainers (NETS-C) and administrators (NETS-A). Among some of its performance indicators are: 1) creativity and innovation, 2) communication and collaboration, 3) research and information management, 4) critical thinking, problem solving and decision making, 5) digital citizenship and 6) ICT operation and concept.

CONCEPT OF DIGITAL KNOWLEDGE

Ramírez and Casillas (2017) propose digital knowledge as a scheme, "a graded structure of instrumental skills and theoretical knowledge of an informational and informational nature that distinguish users of information and communication technologies (ICT) according to the context in which they operate" (p. 16). In other words, they make it possible to measure what both teachers and students know about these tools and what they know how to do with them (use hardware and software, create content, etc.).

According to Ramírez *et al.* (2014, 2016), the measurement of this knowledge can be assessed from three perspectives: 1) perspective oriented to labor competencies: it is related to the certification of bodies such as the National Council for Standardization and Certification of Labor Competencies (Conocer), the Accrediting and Certifying Body of Labor Competencies of the State of Veracruz (Oracver) and, specifically, the Technical Labor Competency Standard (NTCL); 2) perspective oriented to commercial products, this approach is suitable for the certification of digital knowledge oriented to the use of software specific to the discipline from which one works, for example, Microsoft products; and 3) a perspective oriented towards compliance with global parameters, such as the ICT Competency Standards for Teachers (ECD-ICT) proposed by UNESCO. Digital knowledge is organized into four categories:

- 1) Digital systems management: a) know how to use devices, b) know how to manage files, c) know how to use specialized programs and information systems.
- 2) Content manipulation: a) knowing how to create and manipulate text and rich text, b) knowing how to create and manipulate data sets, c) knowing how to create and manipulate media and multimedia.

3) Communication and socialization in digital environments: a) knowing how to communicate in digital environments, b) knowing how to socialize and collaborate in digital environments.

4) Information management: a) knowing how to exercise and respect digital citizenship, b) digital literacy.

Gazca *et al.* (2020) developed a series of studies on the diagnosis of teaching competencies in digital knowledge for higher education, where they summarized the conceptual framework of references on competencies, the national perspective and the construction of a model and an instrument to assess competencies and digital knowledge.

The research on digital knowledge is deepened from different disciplines of knowledge, so Ramírez and Casillas (2021a) conducted a series of studies to recover the main knowledge according to the features, characteristics and needs of each of the disciplines.

RESEARCH ON DIGITAL LITERACY

There are different researches that analyze the digital knowledge of students. Alfredo's research (2018) in basic education levels highlights the importance of strengthening the topics of the teaching-learning process, rethinking the type of curriculum to be implemented, as well as the formative and summative activities that involve the use of technological resources for the construction of knowledge.

On their side, Gasca *et al.* (2016) conducted a diagnosis to learn about the knowledge and digital literacy of university students; based on the results, a radio program was created with which they improved their teaching-learning process and strengthened the use of digital technologies. In the same vein, Lara-Rivera and Cabero-Almenara (2021) studied the digital literacy of university professors in a Mexican institution, worked with a sample of 224 participants and identified the attitude, age and gender of the subjects as key factors to strengthen the development of this knowledge.

Among its main findings, it stands out that older teachers present more problems for the incorporation of technologies in their practices, which is directly related to the attitude to innovate, but no significant results were found regarding the gender of the subjects. In other words, it stands out that the age of the teachers contributes to the development of digital knowledge, that is, younger teachers had greater ease in the instrumental and structural management of technological tools.

Strengthening digital literacy in high school students in the 21st century is essential, since it is the level prior to higher education. For this reason, Casillas *et al.* (2020) conducted research in this context on a population of

11,000 young people in order to identify their use of ICTs. The results obtained are organized into three groups: the first, with a low command of the use of technologies, comprising 1,500 students; the second, with a medium command of technologies, comprising 3,500 students; and the third, with a high command of technologies, comprising 6,970 students.

Another study is that of Guzmán and Velázquez (2020), focused on the digital knowledge of higher education students belonging to Totonaca, Nahua, Mazatec, Popoloca, Otomi, Mixtec and some Mestizo communities. The results show an incipient incorporation of digital knowledge for the management of digital systems, the use of different technological tools and the communication process, both synchronous and asynchronous. With this in mind, a project to work on technological literacy is considered a priority.

In particular, the study by Monjelat *et al.* (2021) on the knowledge and practices with ICTs of Argentine teachers who begin their professional career is particularly noteworthy, where they identify mainly practices with the use of ICTs, but at an instrumental level and previous knowledge focused on generic skills. In view of this, the authors consider it necessary to move to a critical level in order to strengthen the role of the mediator in the construction of knowledge by students.

Similarly, the efforts of Lara Rivera and Grijalva-Verdugo (2018, 2019, 2021), authors who have conducted a series of studies on digital knowledges, stand out. In 2018 they delved into e-citizenship and university education, with descriptive and correlational research. They concluded that in nine of the ten items there were no statistically significant differences, so that the school curriculum does not have a relevant impact on the development of digital literacy.

Subsequently, in 2019 they analyzed the knowledge to produce digital content in a Mexican higher education institution. In a sample of 346 students, they had high results in the production of digital content; however, there are statistically significant differences in the management of data and software, i.e., despite being common in the creation of content, there is no broad mastery in the management of computer programs and data.

In 2021 they investigated digital literacy in teachers in training in a Mexican school located in Baja California Sur. With a sample of 119 subjects, the main finding was the importance of revising the curriculum, so that it favors the implementation of digital knowledge at first in an instrumental way, and later from a pedagogical perspective that allows enriching the teaching-learning process with students.

METHODOLOGY

Design and context of the research

The study corresponds to a quantitative research, with a non-experimental, sectional design (Artavia-Medrano and Gurdián-Fernández, 2021), which was carried out in three Mexican teacher training institutions located in the states of Chihuahua, Hidalgo and Tamaulipas, Mexico. These institutions are working on a study plan and program based on the 1995-2000 Educational Development Program at the federal level, which analyzes the evolution and needs of teacher training institutions and highlights the Program for the Transformation and Academic Strengthening of Teacher Training Colleges at the federal level.

Participants

There were 505 students from these Mexican teacher training schools: 177 from Chihuahua (35%), 73 from Hidalgo (14.5%) and 255 from Tamaulipas (50.5%), with an age range of 17 to 41 years and an average of 21 years ($SD = 3.23$ years), that is, 74.9% female and 25.1% male. The type of sampling was non-probabilistic and the subjects were invited to participate by e-mail. As part of the ethical considerations, anonymity and confidentiality were guaranteed at all times, as well as the use of the information for exclusively academic purposes.

Technique and instrument

The technique used was the survey, defined by Archenti (2012) as a method of data production that allows inquiring about different topics. As an instrument, the questionnaire proposed by Ramírez and Casillas (2021b) was adapted to identify the appropriation of digital knowledge in initial teacher training, composed of 36 five-point Likert scale items (5 = always, 4 = almost always, 3 = sometimes, 2 = rarely, and 1 = never), and three general information items: gender, age and state where the teacher training school is located.

For the validation of the instrument, expert judgment was used with the participation of fifteen research professors from different national and international universities who handle the use of ICTs as a line of generation and application of knowledge. As a result of the observations and recommendations, the corresponding adjustments were made to the questionnaire for its subsequent administration to the sample. Table 1 presents a description of the seven digital knowledge used as dimensions of the questionnaire.

Table 1. Description of the digital knowledge of the questionnaire

Digital know-how	Description
Create and Manipulate Text and Rich Text	It includes the combination of knowledge and skills around the use of word processing programs and other tools for digital content
Create and manipulate datasets	It requires the use of a series of tools that allow the collection, analysis and visualization of data of different natures, in addition to the organization of the information collected
Create and manipulate media	It corresponds to the reproduction, production, editing and integration of media in a multimedia product, and its distribution in various digital media
Communicating in digital environments	It includes knowledge, skills and attitudes regarding the exchange of messages and information in general, between one or more recipients in synchronous or asynchronous digital media
Socialize and collaborate in digital environments	It encompasses the dissemination of information and socialization in digital media in the daily practice of the discipline, so it includes interactions between students and teachers, and the use of classroom and collaboration tools
Digital Literacy	It states that students should be able to analyze, discriminate, and select information according to localized sources, as well as to use local and online tools to search for and integrate information in different formats into their academic work
Exercising and respecting digital citizenship	It recognises respect for intellectual property, rules or norms of behaviour and the proper use of technology, including the use of citation styles and references, the control of plagiarism and knowledge of the academic consequences of plagiarism

Source: Authors' own elaboration adapted from Ramírez and Casillas (2021).

The decision on the number of items for each dimension of the questionnaire was made by the research team for validation by experts, who expressed their opinion in terms of qualitative observations and

emphasized aspects that would contribute to improving the wording and clarity of the items, in addition to assessing their relevance in terms of each dimension. Table 2 shows the number of items included for each digital knowledge, the object of measurement of the questionnaire.

Table 2. Number of items included in the questionnaire for each dimension

Dimensión	Digital know-how	Number of items
1	Create and Manipulate Text and Rich Text	8
2	Create and manipulate datasets	5
3	Create and manipulate media	5
4	Communicating in digital environments	4
5	Socialize and collaborate in digital environments	5
6	Digital Literacy	5
7	Exercising and respecting digital citizenship	4

Cronbach's alpha was used as a measure of internal consistency (Cronbach, 1951), based on the covariances between items. The value $\alpha = .948$ was obtained, which is considered optimal. After analyzing that it was not necessary to eliminate any item because it did not maximize the alpha, we proceeded to keep the 36 items in the questionnaire for the rest of the analyses.

Data collection and analysis

For data collection and analysis, a Google Forms questionnaire was designed and sent to the participants by e-mail. In this, special care was taken to present the objective of the research, the informed consent and the announcement of confidentiality of the information. To process the information, the information matrix of the questionnaire was exported in

Excel, and subsequently analyzed through different descriptive and multivariate statistical techniques, using SPSS software (IBM Corp, 2017).

RESULTS

Factor analysis is the technique par excellence used to identify the underlying structure of the items of a test, that is, to explore the set of latent variables or common factors that explain the responses to these items (Lloret-Segura *et al.*, 2014); therefore, it is a technique used to obtain evidence of validity regarding the internal structure of the test (Martínez *et al.*, 2006).

For compliance with the requirements of factor analysis, the correlation matrix was determined, which showed a practically null determinant. The KaiserMeyer-Olkin index (KMO) of sampling adequacy was calculated and a value of .938 was obtained, as well as Bartlett's test of sphericity ($\chi^2 = 11726.79$, $gl = 630$, $p < .001$). As for the total variance explained by the seven factors, a value of 59.206% was reached, as shown in Table 3.

Table 3. Total Variance Explained

Factor	Initial eigenvalues			Load Extraction Sums Squared		
	Total	% Variance	Cumulative %	Total	% Variance	Cumulative %
1	13.425	37.292	37.292	13.035	36.210	36.210
2	3.472	9.644	46.936	3.123	8.674	44.883
3	1.822	5.062	51.998	1.418	3.938	48.821
4	1.649	4.581	56.579	1.239	3.443	52.264
5	1.367	3.797	60.376	.976	2.710	54.974
6	1.294	3.595	63.972	.889	2.470	57.443
7	1.100	3.057	67.028	.635	1.763	59.206

Note: Principal axis factorization was used as the method of varimax extraction and rotation.

To diagnose the level of appropriation of digital knowledge, the mean and standard deviation are presented for each item of each of the dimensions of the instrument that correspond to this knowledge.

Table 4 shows high levels of appropriation in dimension 1 of the questionnaire, with particular attention to item 11, referring to the use of commands for text management, which has a lower mean than the rest and the highest standard deviation in this dimension, so it is considered important to incorporate spaces in the training of students to increase the proper use of commands for text management. In general, the percentages are high: the highest mean was the use of different font sizes and types ($n = 4.73$). There is a difference of 0.74 between the highest and the lowest mean.

Table 4. Levels of appropriation of knowing how to create and manipulate text and rich text

Utterance	Stocking	Standard deviation
it5: Formatting to text, italics, bold, and underlining	4.57	.706
it6: Using Different Font Sizes and Types	4.73	.592
it7: Inserting Images, Diagrams, Diagrams, and Links	4.68	.601
it8: Create, download and edit documents online	4.37	.843
it9: Changing Format Types, Defragmentation, and Manipulation	4.09	.990

it10: Inserting Symbols in Text	4.26	.943
it11: Using Commands for Text Handling	3.99	1.044
it12: Creating Tables of Contents and Bibliography	4.30	.919

Source: Authors' own elaboration, with estimates made from the SPSS software (2017).

Appropriation levels shown in Table 5 could be considered intermediate; the lowest value is for item 15, which refers to data analysis using specialized software. It is notorious that in this dimension there are high values of standard deviation, which shows the variability in the information provided in this knowledge. When analyzing the level of appropriation of the creation and manipulation of data, it is evident to strengthen in the students the use of office tools such as Excel, and specialized programs for the analysis of both quantitative and qualitative data that allow them to go deeper into the reflection of the findings obtained.

Table 5. Levels of appropriation of knowing how to create and manipulate datasets

Utterance	Stocking	Standard deviation
it13: Importing and exporting data from other tools to Excel	3.40	1.286
it14: Data Analysis Using Excel	3.17	1.294
it15: Data Analysis Using Specialized Software	2.64	1.414

it16: Presentation of data using graphs and audio-visual aids	3.40	1.243
it17: Handling Complex Data and Its Metadata	3.01	1.414

Source: Authors' own elaboration, with estimates made from the SPSS software (2017).

Table 6 shows high appropriation levels in dimension three of the questionnaire, where the highest values obtained are for items 18 and 19, focused on the use of multimedia content, rather than its actual creation. Therefore, it is necessary not only to emphasize the importance of searching, identifying and selecting materials to incorporate them into their classes, but also to create their own resources in different digital formats.

Table 6. Levels of appropriation of knowing how to create and manipulate multimedia content

Utterance	Stocking	Standard deviation
it18: Multimedia recognition as an element to reinforce learning	4.44	.819
it19: A Critical Look at Image, Audio and Video Materials	4.47	.804
it20: Creating Audios and Videos for Learning	4.07	1.034
it21: Consideration of Aesthetic Elements for Multimedia Crafting	4.22	1.012
it22: Managing Devices for Multimedia Playback	4.43	.854

Source: Authors' own elaboration, with estimates made from SPSS software (2017)

In Table 7, the highest mean is for item 24, which highlights the use of messaging services, which is one of the activities with which students and teachers are most familiar; however, it is a task within the subjects taught in teacher training colleges: to strengthen the management and use of educational platforms for the development of the teaching-learning process.

Table 7. Levels of appropriation of knowing how to communicate in digital environments

Utterance	Stocking	Standard deviation
it24: Using courier services	4.84	.457
it25: Using Video Calls	4.33	.916
it26: Use of social networks as a means of communication with teachers and classmates	4.43	1.000
it27: Management and use of educational platforms	4.31	.929

Source: Authors' own elaboration, with estimates made from the SPSS software (2017).

With regard to knowing how to socialize and collaborate in digital environments, Table 8 shows a low level of appropriation in item 28, development of blogs to communicate information, which presents a high standard deviation as evidence of the variability of the responses. The use of Wikipedia for collaborative work (item 29) and commenting on publications (item 31) show an intermediate level, with high standard deviations.

Table 8. Levels of appropriation of knowing how to socialize and collaborate in digital environments

Utterance	Stocking	Standard deviation
it28: Creating blogs to communicate information	2.86	1.410
it29: Using Wikipedia	3.12	1.426
it30: Indication of "Likes" on a Post	4.16	1.083
it31: Comments on posts from classmates and teachers	3.60	1.324
it32: Participation in group activities using technological tools	4.12	1.078

Source: Authors' own elaboration, with estimates made from the Jamovi software (2022).

Table 9 shows intermediate-high values in digital literacy, that is, the capacity developed by students to interact with information, their effective search, analysis and reflection of resources, as well as assertive communication. The highest value is presented in item 33, on the use of information search engines. It is advisable that students get to know the various journals specialized in educational sciences, as they are a resource to deepen in different topics, as well as a possible space for the presentation of their research results.

Table 9. Levels of appropriation of digital literacy

Utterance	Stocking	Standard deviation
it33: Use of basic and specialized search engines	4.17	.951
it34: Reading Specialized Journals	3.59	1.137

it35: Consultation of websites of national and international organizations	3.82	1.140
it36: Specialized Database Review	3.60	1.213
it37: Discriminating Information Effectively and Efficiently	3.73	1.213

Source: Authors' own elaboration, with estimates made from the SPSS software (2017).

Table 10 shows high levels of appropriation in the items that make up the knowledge to exercise and respect digital citizenship, that is, the set of conceptual, procedural and attitudinal knowledge that allows students to access, retrieve, understand, evaluate, use and share information, by using various tools in a critical manner. It is noteworthy that the different items included in this table are above value 4.

Table 10. Levels of appropriation of knowing how to exercise and respect digital citizenship

Utterance	Stocking	Standard deviation
it38: Using APA Format	4.02	.961
it39: Considering the Risks of Sharing Personal Information on the Internet	4.53	.776
it40: Publishing content on social networks and digital spaces trying not to harm third parties	4.35	1.093
it41: Respect for copyright in every work submitted	4.52	.779

Source: Authors' own elaboration, with estimates made from the SPSS software (2017).

DISCUSSION

The study presented here is valuable and relevant, since it makes a diagnosis of teacher training students and contrasts with the results of another research, such as that of García (2020), who analyzes knowledge and teaching skills in distance and digital education, which allows linking the graduation profile of a teacher training student with the professional profile required by a teacher in his or her professional practice through the performance of activities such as teaching, research and management.

Likewise, it is consistent with the main findings of Grijalva-Verdugo and Lara-Rivera (2019, 2021), regarding the high knowledge of students for the production of digital content, and the management of databases as an area of opportunity, since the lowest item in this study was the one corresponding to data analysis using specialized software, with a result of 2.64.

CONCLUSIONS

To measure the appropriation level of digital knowledge in the sample, an adaptation of an instrument developed by Ramírez and Casillas (2021b) was used, in addition to a validation by means of expert criteria and a reliability analysis, using Cronbach's alpha as a measure of internal consistency, which gave a value of $\alpha = .948$, considered optimal. The instrument developed has the conditions required to perform a factor analysis and seven factors were identified that explained 59.21% of the total variance; in particular, the first factor managed to explain 37.29% of the variance. The 36 items that make up the questionnaire present high factor loadings (above 0.30).

As for establishing the appropriation level in the different digital knowledge presented in the first objective of this research, it is observed that the highest values in the sample are given in the use of messaging services (item 24) and the use of different sizes and types of sources (item 6); while the lowest values are found in data analysis using specialized qualitative software (item 15) and the development of blogs to communicate information (item 28). It is questioned whether the daily use could be a factor for which the knowledge of messaging programs is higher than that of specialized software.

In spite of the fact that almost all the items achieved an average higher than 3.0 (average considered as a theoretical value), it should be noted that the highest levels are found in the items on the use of technology as a tool, while the lowest values are in the analysis and creation of content.

In relation to the second objective, which was aimed at identifying the items that reflect a higher and lower appropriation level in order to, in this way, group the main strengths and areas of opportunity that allow us to

know the real situation of teacher training students, it is concluded that the highest degree of incorporation is reflected in the category level of appropriation: knowing how to communicate in digital environments (item 24) and use of messaging services, with an average of 4.84, in the appropriation level: knowing how to create and manipulate text and rich text (item 6) and the use of different font sizes and types, with an average of 4.73 (item 7), insertion of images, diagrams, schemes and links with an average of 4.68.

On the other hand, lowest appropriation levels are found in knowing how to create and manipulate data sets: data analysis using specialized software (item 15) with a mean of 2.64; knowing how to socialize and collaborate in digital environments (item 28) and the creation of blogs to communicate information, with a mean of 2.86 and, finally, knowing how to create and manipulate data sets (item 17) and management of complex data and their metadata.

Based on the results presented in this research, it is proper that teacher training institutions incorporate workshops in which students deepen their knowledge in the use of technological tools, as well as in the levels of appropriation, mainly those that refer to the manipulation of contents, their communication and socialization in multimedia environments, so that they incorporate activities in the design of didactic situations and strategies and apply them in their practice spaces.

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