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# Construction and validation of a questionnaire on academic digital reading practices for university students in initial teacher training.

## Construcción y validación de un cuestionario sobre prácticas de lectura digital académica para estudiantado universitario de formación inicial de profesorado.

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**Abstract**

*The appropriation of academic reading and writing practices by higher education students is fundamental for the development of their professional identity in their disciplinary field. Specifically, the study focuses on investigating autonomous digital reading practices in academic contexts based on the design and validation of a questionnaire created ad hoc for students of the Bachelor's Degree in Early Childhood Education (n=503). Using a quantitative methodology with a survey method, an exploratory study of some psychometric properties of the measurement instrument was carried out. A process of operationalisation of the concepts of digital reading was carried out using five dimensions and five-point Likert-type questions, with a total of 88 items. The responses were cleaned with the IBM SPSS 26 software and an exploratory factor analysis and a semi-confirmatory factor analysis were carried out using the Factor.12 programme. The results of the analyses show that the instrument created has the reliability properties of internal consistency (Cronbach's alpha) and composite reliability (McDonald's Omega coefficient). In addition, acceptable social and ecological construct validity was found. The final questionnaire consists of four dimensions and 87 items.*

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*Keywords:* reading; digital literacy; multiple literacies; higher education; Likert scales; factor analysis.


## Resumen

*La apropiación de las prácticas de lectura y escritura académica por parte del estudiantado de educación superior es fundamental para el desarrollo de la identidad profesional de su ámbito disciplinar. En concreto, el estudio se focaliza en investigar las prácticas autónomas de lectura digital en contextos académicos a partir del diseño y validación de un cuestionario creado ad hoc para estudiantes del Grado de Educación Infantil (n=503). Mediante una metodología cuantitativa con un método de encuesta, se realiza un estudio exploratorio de algunas propiedades psicométricas del instrumento de medición. Se llevó a cabo un proceso de operacionalización de los conceptos de lectura digital mediante cinco dimensiones y preguntas de tipo Likert de cinco puntos, con un total de 88 ítems. Las respuestas se depuraron con el software IBM SPSS 26 y se procedió a realizar un análisis factorial exploratorio y un análisis factorial semiconfirmatorio mediante el programa Factor.12. Los resultados de los análisis permiten decir que el instrumento creado posee propiedades de fiabilidad de consistencia interna (alfa de Cronbach) y fiabilidad compuesta (coeficiente Omega de McDonald). Además, se constata una validez aceptable de constructo social y ecológica. El cuestionario final consta de cuatro dimensiones y 87 ítems.*


*Palabras clave:* lectura; alfabetización digital; alfabetizaciones múltiples; educación superior; escalas Likert; análisis factorial.

## Introduction and objectives

The teaching of reading and writing does not end in childhood. Learning to read and write lasts a lifetime as its complexity depends on the contexts and purposes for which it is used (Grøver et al., 2019; Tolchinsky, 2022; Uccelli et al., 2020). Thus, university life presents a series of challenges for those who are new to it, because of their own reading and writing practices, which differ for each area of knowledge (Holschuh, 2019). The appropriation of these practices promotes students' learning and participation in the written culture of their subject area (Carlino, 2020; Grøver et al., 2019). In this way, they are integrated into the professional contexts for which they are being trained and from which they will continue their civic and democratic exercise.

This study assumes that the teaching of disciplinary literacy practices is done in an explicit and situated manner (Bazerman et al., 2019). Student engagement in this learning is vitally important, however, it is not sufficient. It requires explicit mediation by teachers between the literate practices of their discipline and their students. In this way, they contribute to the transmission of knowledge and the development of their students' professional identity, teaching them to interpret and communicate the world (and the world) as specialists in their area of knowledge (Bazerman et al., 2019; Carlino, 2020; Lillis, 2019; Vygotsky, 1978). To do so, they are included in "discursive situations typical of specialised communities, according to shared purposes, meanings and values" (Carlino, 2013, p. 361-362).

## Digital reading

In this context, digital reading (DL) takes on special relevance due to the trend that exists to work with the internet and digital texts in academic and professional environments (Castells et al, 2022). The main characteristic of these texts lies in the interactivity that they promote to readers (Vázquez-Calvo and Cassany, 2022). Digital texts, diverse in their semiotic representations, through their hyperlinks lead to the web and allow direct interaction with the information found there. This is not the case with printed texts or digitised texts which, although they are also on screens, their static textualisation does not allow this type of interaction (Mills et al., 2022). Although there is still no absolute consensus on the definition of LD, several researchers agree that it integrates at least three simultaneous processes: navigation, integration and evaluation of information from multiple textualities found in digital contexts (Barzilai et al., 2018; Coiro, 2021; Salmerón et al., 2018). Therefore, LD involves navigating a vast ocean of digital information in order to select what responds to the reader's purpose. This information represented in multiple forms (hypertexts, images, videos, among others) is integrated into a coherent whole and its reliability is assessed.

Thus, Coiro (2021) presents a heuristic model of LD in order to clarify its definition and broaden its understanding. In this heuristic, LD is made up of four elements: the text, the activity, the reader and the context. The author placed texts and digital activities in the first position because of the impact they have on readers. Figure 1 shows an adaptation that simplifies this heuristic model in order to characterise reading in digital spaces.

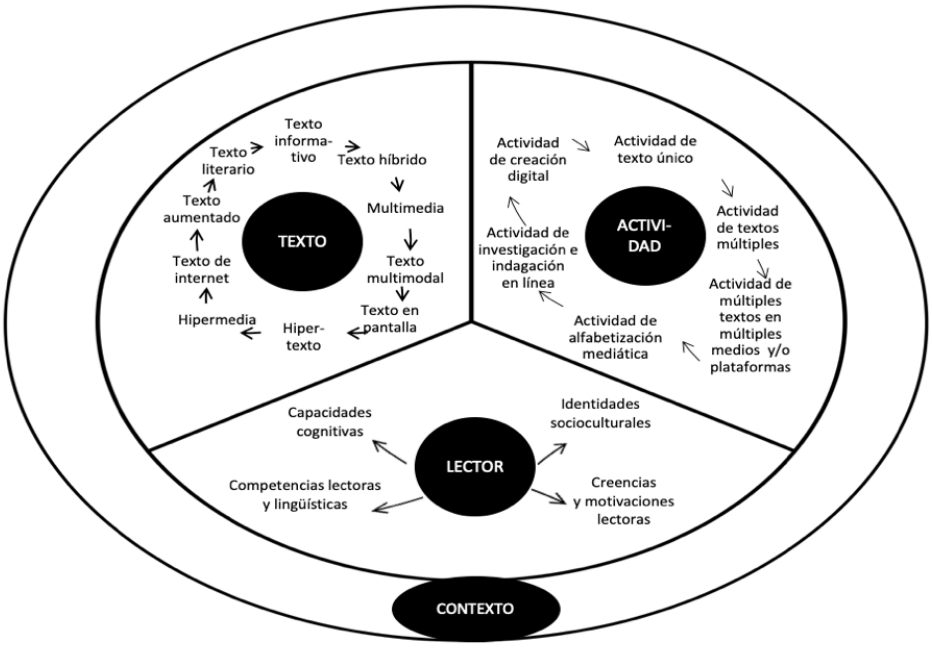


*Figure 1. Adaptation of the ML heuristic model (Coiro, 2021, p. 11).*

The four elements that are part of this heuristic model of LD (Coiro, 2021) integrate and expand one aspect of the complexity of reading in digital environments. Digital texts are varied in genre and format. They can be literary, informational, hybrid, multimedia and multimodal. And they can be found on screens, hypertexts or in augmented reality spaces. The activities these texts require range from the simplest, such as reading a single text, to the most complex, such as reading multiple texts across multiple media and/or platforms. Other, increasingly complex, activities include searching for the reliability of information and creating digital material. Readers, with their cognitive abilities, reading skills, beliefs and cultural identities, will vary as they engage with texts and reading activities, which will change according to all the elements of the context in which they are located.

## The situated study of academic digital reading practices

Researching LD practices in academic contexts (hereinafter LDA) involves approaching the study of the theory of social practices due to the interest generated by knowing how reading is used "within the framework of a specific social purpose" (Zavala, 2009, p. 23) such as teacher training. Sociocultural approaches understand that culture is manifested in the practices that, intertwined with cultural objects, are carried out by people (Vygotsky, 1978). Therefore, the study of social practices involves analysing the use of objects and their context, because these uses are reproductions or transformations of culture. In this work, the approach to reading as a social practice refers to what, how, when, where and why university students do with LDA. Along the same lines, the New Literacy Studies (NEL) assert that literate practices are influenced by the historical, social and cultural context of use (Gee, 2020; Kalman, 2022; Mills et al., 2022; Street, 1984). They thus broaden the view of reading and writing pedagogy, arguing that teaching and learning only one form of language restricts participation in a society that is increasingly globalised, culturally and linguistically diverse, and widely influenced by technologies with their multiple forms of textual representation (New London Group, 1996; Serafini and Gee, 2017).

The questionnaire presented here arises from these theoretical approaches in view of the need to know with greater precision the autonomous practices of Education students and the learning opportunities provided by their teachers with LDA. In light of this, the aim of this paper is to construct and validate an *ad hoc* questionnaire on academic digital reading practices in university initial teacher training students. Recently, some research has shown that LDA practices are different depending on the university degree specialisation (Alcocer-Vázquez and Zapata-González, 2021; Ayala, 2019; Castells et al., 2022). Moreover, in higher education there are almost no instruments that can describe the context of LDA practices in teacher education degrees. For this reason, the final questionnaire is a contribution to the field that crosses the L&D practices of pre-service teachers with their perception of teacher mediation.

## Method

The methodology used in this study is quantitative with a survey method (Hernández-Sampieri and Mendoza, 2018). It can also be considered as a study of some

psychometric properties of the creation of a measurement instrument. From the above, it follows that it is an eminently exploratory study.

## Population and Sample

The target population (N=1055) is represented by the students of the Bachelor's Degree in Early Childhood Education of the Faculty of Education of the University of Barcelona (University of Barcelona, 2022). Participants were selected by non-random selection (voluntary participation). The sample finally obtained was 503 students, obtaining an error of 3.2%, with a confidence interval of 95% and a p/q of .50.

The socio-demographic characteristics of the final sample obtained show, with respect to age, a mean of 21.07 years (SD=2.65) with a range between 18 and 35 years. Table 1 shows the distribution of students by year, with the corresponding absolute frequencies and percentages of participation, as well as the means and standard deviations of age for each year:

Table 1

*Characteristics of the sample*

| Course | No. of students | % of students | Average age (SD) |
|---|---|---|---|
| 1st year | 159 | 31.6% | 20.62 (2.37) |
| Year 2 | 153 | 30.4% | 20.53 (2.22) |
| Year 3 | 115 | 22.9% | 20.86 (2.42) |
| 4th year | 76 | 15.1% | 22.01 (2.99) |
| | 503 | 100% | 21.07 (2.65) |

The students read the research objectives and signed an online informed consent form before answering the questionnaire, in accordance with the guidelines of the Bioethics Commission of the University of Barcelona.

## Instrument

A questionnaire was constructed on the basis of Coiro's (2021) LD heuristics and Carlino's (2013, 2020) approaches to university teaching mediation in the teaching of literate practices, projecting it in this case towards LDA. The research makes it clear that the questionnaires reflect well what students see and experience in the classroom, being a useful and necessary instrument for the improvement of educational quality (González-Zamar et al., 2021; León-Carrascosa and Fernández-Díaz, 2019; Mateus et al., 2019). Furthermore, it could be said that the quickest way to access what students think, feel or do is through this type of method provided by the questionnaire technique (Ruiz-Bueno, 2021). The objectives of this questionnaire are:

- To identify the LDA practices of university students in initial teacher training in the context of their professional training.
- To describe the perception of the university students themselves on the practices of their teaching staff in relation to LDA.

Ruiz-Bueno's (2021) approach was followed to carry out the operationalisation process of the concepts of LD and teacher mediation in university contexts. Each of these concepts was divided into dimensions. Those that emerged from LD are: 1) texts, 2) supports, devices and tools, 3) activities and 4) beliefs. The fifth dimension emerged from the concept of teacher mediation: 5) teaching. The dimension Texts focuses on the various digital texts that students can use to study. The dimension Media, Devices and Tools captures the reading media, digital or analogue, together with the devices and tools such as computers, tablets, translators and online dictionaries that learners can use when studying with digital texts. The Activities dimension focuses on study activities, and searching and selecting information on the Internet. The Beliefs dimension explores learners' preferences and perceptions of LDA. Lastly, the Teaching dimension reflects the perception of the instructions received and the teaching actions of the teaching staff of their degree with respect to LDA. A scale was constructed for each dimension, so the initial questionnaire was made up of five scales corresponding to the five dimensions.

The construction of the items was based on the aforementioned theoretical contributions together with those of other research in the area of study (Alcocer-Vázquez and Zapata-González, 2021; Carlino, 2013, 2020; Coiro, 2021; Natale and Stagnaro, 2018) and interviews with students at the same grade level. Finally, the items were proposed using a five-point Likert-type rating scale (1=minimum and 5=maximum), obtaining a total of 88 items. It was designed in an on-line format using Microsoft Forms. Table 2 shows the dimensions and sub-dimensions of the first version of the questionnaire according to figure 1.

Table 2

*First version of the questionnaire*

| **Dimension/Scale** | **Sub-dimensions** |
|---|---|
| 1. Texts | Frequency of use of texts |
| 2. Supports, devices and tools | Frequency of use of devices and tools |
| | Preference for use of carriers |
| 3. Activities | Frequency of learning activities |
| | Frequency of activities for searching for information on the internet |
| | Frequency of activities for critical selection of information on the Internet |
| 4. Beliefs | Motivations |
| | Attitudes |
| | Self-assessment |
| 5. Teaching | Frequency of teaching instructions |
| | Frequency of teaching activities |

## Data collection and analysis procedure

A process of validation of the first questionnaire began with the collaboration of three university professionals knowledgeable in the subject matter of the questionnaire and three others in methodological aspects. They evaluated, using a three-point scale (1=inadequate; 2=regular; 3=adequate), all the items according to the following categories: 1) relevance to the dimension, 2) coherence of the statements, 3) syntax of the wording and 4) self-perception of the validity and reliability of the questionnaire. The level of agreement of their responses was calculated with the Fleiss Kappa coefficient (Fleiss et al., 2003), obtaining a conditional probability of rating 3 (adequate) of 86.5%.

Once the validation process of the first questionnaire had been completed, a pilot test was carried out with 80 students of the simultaneous degree in Early Childhood Education and Primary Education at the University of Barcelona. Thanks to this process, those items in which the students expressed difficulties in the wording, order of presentation, time of administration, among others, were readjusted.

The final questionnaire was administered in online format in Microsoft Forms and included the acceptance of participation and informed consent. To ensure that the greatest number of responses was obtained, the procedure used was to visit the degree classes in person, with the teacher's prior consent, explain the purpose of the research and allow time for them to answer the questionnaire on their computer or mobile phone synchronously.

Once the responses were obtained in Excel format, they were transferred to the IBM SPSS 26 software and descriptive analyses of the variables were carried out, especially those that considered the socio-demographic aspects of the respondents. The psychometric analyses were carried out using multivariate procedures, which are those that allow us to account for the structures of a data set, construct validity (Frey, 2018). The variables in this study are ordinal according to Stevens' (1946) taxonomy, but in this case they are thought to be ordered metric scale variables (Coombs, 1953). In this way it would be possible to treat such variables as interval variables (Robitzsch, 2020).

For this reason, it was decided to carry out exploratory factor analyses for each of the scales that determined the dimensions initially considered. The flow of analysis was carried out in three phases differentiated by both the type of factorisation and the statistical programme used for it. Specifically, the three phases were as follows:

**First phase:** Application of the Exploratory Factor Analysis of principal components with Varimax rotation using the IBM SPSS 26 statistical software (George and Mallery, 2019). The process followed to establish the factors of the scales was to consider, for the elimination of the items, that the factor loading was less than .30, in addition to taking into account whether or not the item was shared with more than one factor. In these cases, theoretical prevalence was always maintained as a criterion over empirical prevalence. In this phase, all the responses from the initial sample (n= 503) were considered.

**Second phase: The** results obtained in the first phase were triangulated using random samples of 60% of the original sample for the four scales corresponding to the four dimensions explored, following the resampling technique using the IBM SPSS 26 programme. This was carried out using the free software Factor.12 (Ferrando et al., 2022; Lorenzo-Seva and Ferrando, 2013). To obtain the factors, the unweighted robust least squares (RULS) method was used with a rotation to achieve the simplicity of the factor: Robust Promin (Lorenzo-Seva and Ferrando, 2019). In addition, this software provides a

semi-confirmatory factor analysis delivering fit indices of the measurement model obtained: Root Mean Square Error of Approximation (RMSEA), Non-Normed Fit Index (NNFI), Comparative Fit Index (CFI), Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI) (Lorenzo-Seva and Ferrando, 2013).

**Third phase.** It consisted of the calculation of two types of reliability for each triangulated scale, Cronbach's alpha coefficient and McDonald's Omega coefficient.

## Results

The factor analyses for each of the five initial scales proposed remained at four, since in the first exploratory factor analyses of the first phase it was found that the fit of the items was much better if scale 1 (Texts) and scale 2 (Supports, devices and tools) were considered. In order to present the results, the scale and its final fit results will be presented after the three phases of analysis described above have been applied. Next, each of the scales will be presented with their corresponding items and the weights or loadings of each one in the factors obtained.

It is specified that the adequacy for factor analysis is fulfilled, since all the scales respond to the Barlett's test of sphericity (with statistical significance $p<.05$), the KMO test (with values above .65) and the MSA test with values above .50 (Lorenzo, Seva and Ferrando, 2021). It should be noted that when using the RULS method, it is not necessary that the premise of multivariate normal distribution is met (multivariate normality does not occur in any of the scales).

**Scale 1 and 2: Texts, media, devices and tools**. This scale is composed of 25 items and has been validated with the responses of 319 students obtained by randomly resampling 60% of the total sample (n=503). Table 3 shows how the exploratory factor analysis provides eight factors to the scale structure with an explained variance of 58.09%. Table 4 shows the relationship of items. All eight factors show adequate composite reliability with scores above .70. Furthermore, the entire scale as a whole has an internal consistency, Cronbach's alpha, above .70 and a 95% confidence interval between .710 and .775 alpha (table 5).

Table 3

*Exploratory factor analysis of the scale Texts, media, devices and tools*

| | **Factor loadings** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Items** | **Fac. 1** | **Fac. 2** | **Fac. 3** | **Fac. 4** | **Fac. 5** | **Fac. 6** | **Fac. 7** | **Fac. 8** |
| V2 | .786 | | | | | | | |
| V3 | .327 | | | | | | | |
| V8 | .310 | | | | | | | |
| V1 | -.306 | .302 | | | | | | |
| V11 | | .740 | | | | | | |
| V12 | | .503 | | | | | | |
| V21 | | | .553 | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| V22 | | | .612 | | | | | |
| V23 | | | .782 | | | | | |
| V13 | | | .303 | | | | | |
| | | | | | | | | |
| V15 | | | | .490 | | | | |
| V16 | | | | .749 | | | | |
| V17 | | | | .627 | | | | |
| V18 | | | | .609 | | | | |
| V19 | | | | .464 | | | | |
| V20 | | | | .617 | | | | |
| V25 | | | | .541 | | | | |
| | | | | | | | | |
| V9 | | | | | .707 | | | |
| V10 | | | | | .780 | | | |
| | | | | | | | | |
| V4 | | | | | | .314 | | |
| V5 | | | | | | .646 | | |
| | | | | | | | | |
| V14 | | | | | | | .645 | |
| V24 | | | | | | | .372 | |
| | | | | | | | | |
| V6 | | | | | | | | .681 |
| V7 | | | | | | | | .751 |

Table 4

*List of items of the scale Texts, media, devices and tools (table 3)*

| |
|---|
| V1_Desktop computer; V2_Laptop **computer**; **V3_Mobile**; V4_Tablet; **V5_E-reader**; V6_Online translator; V7_Online dictionary; **V8_Cloud** storage **platforms**; **V9_Reading** on paper; **V10_Reading** on screens; **V11_Chats** or public forums; **V12_Blogs**; V13_Search **engines** (Google, Yahoo, etc.); V14_Databases (Dialnet, Google Scholar, etc.); **V15_Facebook**; **V16_Instagram**; **V17_Twitch**; **V18_Whatsapp**; **V19_Telegram**; **V20_Twitter**; V21_Video **platforms** (YouTube, Vimeo, etc.); V22_Picture **platforms** (Google Images, Pinterest, etc.); **V23_Slides** (Power point, Canva, etc.); V24_E-books; **V25_Podcasts**. |

Table 5

*Reliability of scale Texts, media, devices and tools*

| | **Fac.1** | **Fac.2** | **Fac.3** | **Fac.4** | **Fac.5** | **Fac.6** | **Fac.7** | **Fac.8** |
|---|---|---|---|---|---|---|---|---|
| **Composite reliability (ω) ordinal** | .819 | .820 | .877 | .919 | .860 | .737 | .782 | .846 |
| **Reliability Cronbach's alpha (α) scale** | | | .743 | | | Confidence interval (95%) .710 ± .775 | | |

Table 6 shows the statistics corresponding to the model fit (semi-confirmatory factor analysis of the eight factors) which confirm the adequacy of the factor structure found since the RMSA statistics are lower than .030 and the rest are higher than .90.

Table 6

*Semi-confirmatory factor analysis. Fit statistics of the scale Texts, media, devices and tools*

| | **RMSA** | ***NNFI*** | **IFC** | ***GFI*** | ***AGFI*** |
|---|---|---|---|---|---|
| **SCALE 1 model (8 factors)** | <.001 | 1.048 | .999 | .993 | .983 |

The table of specifications for the scale Texts, media, devices and tools with the factors associated with the corresponding items is available in Appendix A.

**Scale 3: Activities**. This scale is composed of 21 items and has been validated with the responses of 293 students obtained by random resampling. Table 7 shows the composition of the scale structure in seven factors with an explained variance of 66.48%. Table 8 contains the ratio of items. The statistics obtain an adequate composite reliability for each factor, above .70. Overall, a Cronbach's alpha of .759 with a confidence interval (95%) between .727 and .78 is obtained (Table 9).

Table 7

*Exploratory factor analysis of the Activities scale*

| | **Factor loadings** | | | | | | |
|---|---|---|---|---|---|---|---|
| **Items** | **Fac. 1** | **Fac. 2** | **Fac. 3** | **Fac. 4** | **Fac. 5** | **Fac. 6** | **Fac. 7** |
| V10 | .854 | | | | | | |
| V11 | .498 | | | | | | |
| V12 | | .665 | | | | | |
| V13 | | 1.066 | | | | | |
| V14 | | .742 | | | | | |
| V15 | | .418 | .350 | | | | |
| V17 | | | .638 | | | | |
| V18 | | | .852 | | | | |
| V19 | | | .840 | | | | |
| V21 | | | .453 | | | | |
| V4 | | | | .373 | | | |
| V5 | | | | .832 | | | |
| V6 | | | | .314 | | | |
| V20 | -.303 | | | .619 | | | |
| V1 | | | | | -.550 | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| V2 | | | | | .746 | | |
| V3 | | | | | .414 | | |
| V7 | .328 | | | | | .667 | |
| V8 | | | | | | .617 | |
| V16 | .311 | | | | | | .429 |
| V9 | | | | | | | .341 |

Table 8

*List of items of the Activities scale (table 7)*

**V1_Take** notes on paper; **V2_Take** notes in a word processor; **V3_Highlight** with colours the relevant information of the texts in digital format; **V4_ Define** in advance the site where you will start the search for information according to what you want to find; **V5_** Define in advance the format in which you want to find the information (PDF, JPG, etc.); V6_ Use Boolean operators; V7_ Change the site where you have searched for information, because its results have not satisfied your search purposes; V8_ Redefine the search by changing the key words); **V6_Use** Boolean operators; V7_Change the site where you have searched for information, because its results have not satisfied your search purposes; V8_Redefine the search by changing keywords or language, if you do not find what you need; **V9_Complement** the information found on the Internet with other web pages or sources; **V10_Relate** the content found with the search topic; **V11_The** writing and spelling of the written text; **V12_The** design of the page (colours, typography, etc.**V13_The** presence of images; **V14_The** presence of videos; V15_The presence of hyperlinks; **V16_The** information found is among the first results of the search engine; **V17_The** date of publication; **V18_The** author or institution supporting the information; **V19_The** support of the information in other bibliographic sources; **V20_The** format of the document (PDF, DOC, etc.); **V21_The** information is in a scientific journal.

Table 9

*Reliability of the scale Activities*

| | Fac.1 | Fac.2 | Fac.3 | Fac.4 | Fac.5 | Fac.6 | Fac.7 |
|---|---|---|---|---|---|---|---|
| **Composite reliability (ω) ordinal** | .900 | .995 | .942 | .884 | .838 | .843 | .715 |
| **Reliability Cronbach's alpha (α) scale** | | .759 | | | Confidence interval (95%) .727 ± .788 | | |

With respect to the semi-confirmation of the factors (table 10), the analysis carried out indicates that there is adequacy of fit (RMSA slightly above .030 and the rest of the indices above .90).

Table 10

*Semiconfirmatory factor analysis. Fit statistics of the Activities scale*

| | RMSA | *NNFI* | IFC | *GFI* | *AGFI* |
|---|---|---|---|---|---|
| **SCALE 3 model (7 factors)** | .033 | 1.048 | .999 | .993 | .983 |

Appendix B contains the Activities scale specification table with the factors associated with the corresponding items.

**Scale 4: Beliefs**. This scale is composed of 13 items and has been validated with the responses of 293 students obtained by random resampling. Table 11 shows the composition of the scale structure in four factors with an explained variance of 60.19%. Table 12 shows the ratio of items. The statistics obtain an adequate composite reliability for each factor, above .81. Overall, a lower reliability is obtained, a Cronbach's alpha of .670, with a confidence interval (95%) between .727 and .78 (table 13).

Table 11

*Exploratory Factor Analysis of the Beliefs scale*

| Factor loadings | | | | |
|---|---|---|---|---|
| **Items** | **Fac. 1** | **Fac. 2** | **Fac. 3** | **Fac. 4** |
| V1 | .942 | | | |
| V2 | .923 | | | |
| V7 | | .646 | | |
| V8 | | .672 | | |
| V3 | | .391 | | |
| V4 | | .348 | | |
| V10 | | .335 | | |
| V13 | | .430 | | .332 |

| | | |
|---|---|---|
| V5 | .677 | |
| V6 | .623 | |
| V9 | | .444 |
| V11 | | <.30 |
| V12 | | 1.001 |

Table 12

*List of items of the Beliefs scale (table 11)*

**V1_I can** access from anywhere; **V2_I can** access at any time; V3_It allows **me** to do other things at the same time, such as listening to music, chatting with friends, etc.; V4_There are hyperlinks that allow me to access other websites; **V5_It is** provided by the university; **V6_It is** done by other people nearby; **V7_** It is faster than reading printed material, as I can search for keywords that allow me to read only what interests me; **V8_** If I find something interesting I can quickly share it with my classmates and vice versa; **V9_** I can trust all the information I find on the internet; **V10_** It allows me to access other people's academic work; **V11_** Printed books are outdated; **V12_** I am always clear where to look for the information I need on the internet; **V13_ I have** a good learning experience with reading academic texts on the internet.

Table 13

*Reliability of the Beliefs scale*

| | **Fac.1** | **Fac.2** | **Fac.3** | **Fac.4** |
|---|---|---|---|---|
| **Composite reliability (ω) ordinal** | .964 | .865 | .825 | .98 |
| **Reliability Cronbach's alpha (α) scale** | .670 | | Confidence Interval (95%) .626 ± .711 | |

With respect to the semi-confirmation of the factors (table 14), the analysis indicates that the fit is slightly lower in the case of the RMSA statistic (above .30), although the rest of the indices are above .90. It was considered appropriate to maintain the structure taking into account the theoretical rather than the statistical sense.

Table 14

*Semiconfirmatory factor analysis. Fit statistics of the Beliefs scale*

| | **RMSA** | ***NNFI*** | **IFC** | ***GFI*** | ***AGFI*** |
|---|---|---|---|---|---|
| **SCALE 4 model (4 factors)** | .051 | 0.951 | .980 | .986 | .915 |

Appendix C contains the specification table for the Beliefs scale with the factors associated with the corresponding items.

**Scale 5: Teaching**. This scale is composed of 28 items and has been validated with the responses of 293 students obtained by random resampling. Table 15 shows the composition of the scale structure in seven factors with an explained variance of 63.36%. Table 16 contains the relationship of items. Item V1 was eliminated as it had a loading of less than .30. The statistics obtain an adequate composite reliability for each factor, above .85. Overall, a Cronbach's alpha of .888 is obtained with a confidence interval (95%) between .865 and .95 (Table 17).

Table 15

*Exploratory Factor Analysis of the Teaching scale*

| | **Factor loadings** | | | | | | |
|---|---|---|---|---|---|---|---|
| **Items** | **Fac. 1** | **Fac. 2** | **Fac. 3** | **Fac. 4** | **Fac. 5** | **Fac. 6** | **Fac. 7** |
| V22 | .723 | | | | | | |
| V11 | .738 | | | | | | |
| V7 | .676 | | | | | | |
| V5 | .501 | | | | | | |
| | | | | | | | |
| V14 | | .770 | | | | | |
| V15 | | .691 | | | | | |
| V16 | | .783 | | | | | |
| V17 | | .449 | | | | | |
| | | | | | | | |
| V18 | .483 | | .585 | | | | |
| V19 | | | .615 | | | | |
| V20 | .388 | | .604 | | | | |
| V21 | | | <.30 | | | | |
| | | | | | | | |
| V25 | | | | .599 | | .478 | |
| V3 | | | | .428 | | | |
| V4 | | | | .674 | | | |
| | | | | | | | |
| V2 | -.394 | | | | .476 | | |
| V9 | | | | | .394 | | |
| V10 | | | | | .419 | | |
| V12 | | | | | .754 | | |
| V13 | | | | | .671 | | |
| | | | | | | | |
| V23 | | | | | | .720 | |
| V24 | | | | | | .882 | |
| V26 | | | | | | .810 | |
| V27 | | | | | | .821 | |
| V28 | | | | | | .588 | |
| V8 | | | | | | .324 | |
| | | | | | | | |
| V6 | | | | | | | .998 |

Table 16

*List of items of the Teaching scale (table 15)*

| |
|---|
| **V1_** Reading teaching material about didactic experiences in Early Childhood Education classes; **V2_ Reading** bibliographical reference texts (scientific articles, book chapters, etc.); **V3_** Searching for printed books in the library (stories, illustrated albums, textbooks, etc.) **V4_** Searching for information on websites; **V5_** Searching for information on social networks; **V6_** Searching for information on videos; **V7_Searching for** information on audios (e.g. podcasts); **V8_ Planning** the search for information on the Internet. For example, establishing, beforehand, key words, publication dates, etc.);<br>**V9_** Discuss, share or present what you have read through the virtual classroom forum or other online resources; **V10_Systematise** the key ideas of a reading in a video;<br>**V11_Systematise** the key ideas of a reading in an audio note; **V12_Systematise** what has been read through a summary; **V13_Systematise** what has been read through a graphic organiser or scheme; **V14_** Intervene, before reading a digital text, with an explanation or activity that helps comprehension; **V15_** Intervene, during the reading of a digital text, with an explanation or activity that helps comprehension; **V16_ Intervene**, at the end of reading a digital text, with an explanation or activity that helps comprehension; **V17_** Present concepts using written text and images (images that give meaning to the concept, not decorative images); **V18_ Present** concepts using only images (without written text); **V19_** Present concepts using tables, diagrams, etc.**V20_** Present concepts using infographics; V21_ Present concepts using videos; **V22_** Present concepts using audio resources (e.g. podcasts); **V23_** Provide criteria for searching for information on the internet;<br>**V24_** Guiding the use of search engines such as Google; **V25_** Guiding the search for information in databases; **V26_** Guiding the evaluation of information found on the internet; **V27_** Guiding the use of tools that favour academic digital reading (online translators, online dictionaries, etc.); **V28_** Guiding the organisation of digital reading material in the cloud. |

Table 17

*Reliability of the Teaching scale*

| | Fac.1 | Fac.2 | Fac.3 | Fac.4 | Fac.5 | Fac.6 | Fac.7 |
|---|---|---|---|---|---|---|---|
| **Composite reliability (ω) ordinal** | .928 | .918 | .851 | .872 | .901 | .953 | 1.00 |
| **Reliability Cronbach's alpha (α) scale** | | .888 | | | Confidence interval (95%) .865 ± .895 | | |

With respect to the semi-confirmation of the factors (table 18), the analysis carried out indicates that it has a very good level of fit (RMSA below .030 and the rest of the indices above .90).

Table 18

*Semi-confirmatory factor analysis. Fit statistics of the Teaching scale*

| | **RMSA** | ***NNFI*** | **IFC** | ***GFI*** | ***AGFI*** |
|---|---|---|---|---|---|
| **SCALE 5 model (7 factors)** | .013 | 0.997 | .999 | .988 | .964 |

The table of specifications of the Teaching scale with the factors associated to the corresponding items is available in Appendix D.

## Discussion and conclusions

As has been demonstrated throughout this research, it can be concluded that the initial objective - to construct and validate an *ad hoc* questionnaire on academic digital reading practices in university students in initial teacher training - has been achieved. As has been seen in the results and thanks to the semi-confirmatory analysis carried out, it has been possible to confirm an acceptable adjustment of the factorisation carried out in each of the scales by means of the indices used in each of them: RMSA, NNFI, CFI, GFI, AGFI. Another relevant aspect of the results obtained is that the reliability coefficients used for the different scales could also be considered within the limits of acceptability. In short, from a psychometric point of view and taking into account what has been carried out on the scales, it could be said that the dimensional structure has been verified considering the three phases of analysis.

All the scales analysed presented good construct validity thanks to the exploratory and semi-confirmatory factor analysis of the factorisation carried out. As demonstrated, the fit indices were in acceptable ranges for all scales, with the exception of the Beliefs scale where the theoretical basis supported by other studies prevailed (Alcocer-Vázquez and Zapata-González, 2021; Natale and Stagnaro, 2018). In addition, it is likely that it was affected by the low number of items, only 13. It should be noted that in this study the psychometric aspects of the instrument, such as validity and reliability, have been complemented by other types of validation that are sometimes omitted. In this sense, the contributions of Krippendorff (2013) and Bronfenbrenner (1977) on three types of validity that are considered relevant to this study have been included. Firstly, face validity, which aims to see intuitively what is valid, true, sensible or plausible, carried out in the first phase of validation and inter-judge reliability. In addition, a social validity considering the social uses, the creation of opinion or debates in the community in which they can be derived. In this particular case, of students as opinion formers. Finally, the instrument has an ecological validity because "it is carried out in a natural environment and with everyday objects and activities" (Bronfenbrenner, 1977, p. 515). In this sense, thanks to the instrument, valid and reliable information has been obtained in order to assess the type of LDA practices of the future teachers.

Consequently, the instrument can provide an excellent tool for detecting levels as well as concreteness of prospective teachers' LDA practices. Moreover, it serves a dual function. On the one hand, as an initial detection of students' LDA practices, on the basis of which teachers can design concrete intervention proposals adjusted to reality for each dimension of the instrument. Secondly, with an evaluative purpose in order to find out the changes produced in university students after the teachers' intervention.

The instrument makes it possible to become aware of the relevant role that university teachers play in the academic context of each area in relation to being mediators of the acquisition of the culture of that disciplinary area by students (Carlino, 2013, 2020). A future line of research consists of applying the validated questionnaire to other teacher training degrees in order to obtain a diagnosis from which to draw didactic actions in relation to the dimensions investigated. The final version of the questionnaire can be found at the following link: https://doi.org/10.6084/m9.figshare.22015214.v1 (Abarzúa et al., 2023).

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## Appendix A.

***Table of dimension/scale specifications Texts, media, devices and tools***

| Subdimension | Factorisation | Items |
|---|---|---|
| Frequency of use of texts<br><br>Frequency of use of devices and tools<br><br>Preference for use of carriers | Factor 1: Devices for everyday use | Laptop computer |
| | | Mobile |
| | | Cloud storage platforms (One Drive, Dropbox, Google Drive, etc.) |
| | Factor 2: Disused devices and texts | Desktop computer |
| | | Public chats or forums |
| | | Blogs |
| | Factor 3: Multimodal texts | Video platforms (YouTube, Vimeo, etc.) |
| | | Image platforms (Google Images, Pinterest, etc.) |
| | | Slides (Power point, Canva, Prezi, etc.) |
| | | Search engines (Google, Yahoo, etc.) |
| | Factor 4: Social media | Facebook |
| | | Instagram |
| | | Twitch |
| | | Whatsapp |
| | | Telegram |
| | | Twitter |
| | | Podcasts |
| | Factor 5: Supports | Read on paper |
| | | Read on screens |
| | Factor 6: Limited-use devices | Tablet |
| | | E-reader |
| | Factor 7: Digitised texts | Databases (Dialnet, Google Scholar, Scopus, etc.) |
| | | E-books |
| | Factor 8: Tools | Online dictionary |
| | | Online translator |

## Appendix B.

***Table of dimension/scale specifications Activities***

| Subdimension | Factorisation | Items |
|---|---|---|
| Frequency of learning activities<br><br>Frequency of activities for searching for information on the internet<br><br>Frequency of activities for critical selection of information on the Internet | Factor 1: Attention to formal and substantive aspects of drafting | The relationship of the content to the theme |
| | | Writing and spelling |
| | Factor 2: Care in multimodal criteria | The design of the page (colours, typography, etc.) |
| | | The presence of images |
| | | The presence of videos |
| | | The presence of hyperlinks |
| | Factor 3: Attention formal academic criteria | The date of publication |
| | | The author or the institution behind the information |
| | | Supporting information in other bibliographic sources |
| | | The information is in a scientific journal |
| | Factor 4: Planning activities | Define in advance where you will start your search for information based on what you want to find. |
| | | Define in advance the format in which you want to find the information (e.g. PDF, JPG, etc.). |
| | | Using Boolean operators |
| | | The format of the document (PDF, DOC, PPT, etc.) |
| | Factor 5: Study activities | You take notes on paper |
| | | You take notes in a word processor (Word, Pages, etc.). |
| | | You highlight with colours the relevant information of the texts in digital format. |
| | Factor 6: Resolution activities | Change the site where you have searched for information, because its results have not satisfied your search intentions |
| | | Refine your search by changing keywords or language, if you don't find what you need. |

| | | |
|---|---|---|
| | Factor 7:<br>Focus on initial criteria for information search | The information found is among the first results of the search engine. |
| | | Complement the information found on the internet with other websites or sources. |

**Appendix C.**
***Table of dimension/scale specifications Beliefs***

| Subdimension | Factorisation | Items |
|---|---|---|
| Motivations<br><br>Attitudes<br><br>Self-assessment | Factor 1: Access possibilities | I can access from anywhere |
| | | I can access at any time |
| | Factor 2: Navigation experiences | It is faster than reading printed material, as I can search for key words that allow me to read only what I am interested in. |
| | | If I find something interesting, I can quickly share it with my classmates and vice versa. |
| | | It allows me to do other things at the same time, like listening to music, chatting with friends, etc. |
| | | There are hyperlinks that allow me to access other websites |
| | | It gives me access to other people's academic work |
| | | I have a good learning experience with reading academic texts on the internet. |
| | Factor 3: External influences | Enabled by the university |
| | | It is done by other people close to them |
| | Factor 4: Information consumption | I can rely on all the information I find on the internet. |
| | | Printed books are old-fashioned now |
| | | It is always clear to me where to look for the information I need on the internet. |

**Appendix D.**
***Table of specifications of the dimension/scale Teaching***

| Subdimension | Factorisation | Items |
|---|---|---|
| Frequency of teaching instructions<br><br>Frequency of teaching activities | Factor 1: Activities with audio and social media | Present concepts using audio resources (e.g. podcasts). |
| | | Systematising the key ideas of a reading in an audio note |
| | | Searching for information in audios (e.g. podcasts) |
| | | Search for information on social networks |
| | Factor 2: Mediation and conceptualisation with digital texts | Intervene, before reading a digital text, with an explanation or activity that helps comprehension. |
| | | Intervene, during the reading of a digital text, with an explanation or activity that helps comprehension. |
| | | Intervene, at the end of the reading of a digital text, with an explanation or activity that helps in comprehension |
| | | Present concepts using written text and images (images that make sense of the concept, not decorative images). |
| | Factor 3: Conceptualisation | Present concepts using only images (no written text). |
| | | Presenting concepts using only tables, diagrams, etc. |
| | | Presenting concepts using only infographics |
| | | Presenting concepts using only videos |
| | Factor 4: Search for information | Guiding the search for information in databases such as Dialnet or Google Scholar. |
| | | Look for printed books in the library (stories, picture books, text books, etc.). |
| | | Search for information on websites |

| | | |
|---|---|---|
| | Factor 5: Comprehension activities | Read bibliographic reference texts (scientific articles, book chapters, etc.). |
| | | Discuss, share or present what you have read through the virtual classroom forum or other online resources. |
| | | Systematising the key ideas from a reading in a video |
| | | Systematise what you have read through a summary. |
| | | Systematise what you have read through a graphic organiser or outline. |
| | Factor 6: Professional digital activities | To provide criteria for searching for information on the internet |
| | | Targeting the use of search engines such as Google |
| | | Guiding the evaluation of information found on the internet |
| | | Guiding the use of tools that favour academic digital reading (online translators, online dictionaries, etc.). |
| | | Guiding the organisation of digital reading material in the cloud (One Drive, Dropbox, Google Drive, etc.). |
| | | Plan the search for information on the Internet. For example, establishing, in advance, keywords, publication dates, etc.). |
| | | Read teaching material about teaching experiences in pre-school and/or primary school classes. |
| | Factor 7: Video activities | Searching for information in videos (YouTube, Vimeo, etc.) |