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ACCESS TO DIGITAL TECHNOLOGIES AND THE INTERNET IN HIGHER EDUCATION: VALIDATION OF A DIAGNOSTIC QUESTIONNAIRE

ABSTRACT

This work presents the process used to validate a data collection instrument in the context of the Covid-19 pandemic. The aim was to demonstrate the reliability of a questionnaire about access to digital technologies and the Internet by university students. The questionnaire construction process consisted of two stages: items were initially developed based on the objectives indicated by the Working Group, mapping the items related to “Technical Information” (INF) and “Experience” (EXP) with Digital Technologies in Education. In the second stage, the items were adjusted and divide into different sections in order to provide the respondent with one context at a time. The validity performed in the construction of the instrument indicates that the questionnaire developed is adequate to measure the latent factors of technical information. Although there was no complete invariance of the instrument for all groups of respondents, the validation conducted indicates that the instrument is relatively good for comparing the mean of latent factors in most groups.

Keywords: Questionnaire. Validation. Higher Education.

ACESSO ÀS TECNOLOGIAS DIGITAIS E À INTERNET NO ENSINO SUPERIOR: VALIDAÇÃO DE UM QUESTIONÁRIO DE DIAGNÓSTICO

RESUMO

Este trabalho apresenta o processo utilizado para validar um instrumento de coleta de dados no contexto da pandemia de Covid-19. O objetivo foi demonstrar a confiabilidade de um questionário sobre acesso às tecnologias digitais e à Internet por estudantes universitários. O processo de construção do questionário consistiu em duas etapas: os itens foram inicialmente desenvolvidos com base nos objetivos indicados pelo Grupo de Trabalho, mapeando os itens relacionados a "Informação Técnica" (INF) e "Experiência" (EXP) com Tecnologias Digitais na Educação. Na segunda etapa, os itens foram ajustados e divididos em diferentes seções a fim de fornecer ao respondente um contexto de cada vez. A validade realizada na construção do instrumento indica que o questionário desenvolvido é adequado para medir os fatores latentes das informações técnicas. Embora não tenha havido invariância completa do instrumento para todos os grupos de respondentes, a validação realizada indica que o instrumento é relativamente bom para comparar a média dos fatores latentes na maioria dos grupos.

Palavras-chave: Questionário. Validação. Ensino Superior.

ACCESO A LAS TECNOLOGÍAS DIGITALES E INTERNET EN LA EDUCACIÓN SUPERIOR: VALIDACIÓN DE UN CUESTIONARIO DE DIAGNÓSTICO

RESUMEN

Este trabajo presenta el proceso utilizado para validar un instrumento de recogida de datos en el contexto de la pandemia de Covid-19. El objetivo era demostrar la fiabilidad de un cuestionario sobre el acceso a las tecnologías digitales e Internet por parte de los estudiantes universitarios. El proceso de construcción del cuestionario consistió en dos pasos: inicialmente se desarrollaron los ítems en base a los objetivos indicados por el grupo de trabajo, mapeando los ítems relacionados con la "Información Técnica" (INF) y la "Experiencia" (EXP) con las Tecnologías Digitales en la Educación. En el segundo paso, se ajustaron los ítems y se dividieron en diferentes secciones con el fin de proporcionar al encuestado un contexto a la vez. La validez de constructo realizada en el instrumento indica que el cuestionario desarrollado es adecuado para medir los factores latentes de información técnica. Aunque no hubo una invariabilidad completa del instrumento para todos los grupos de encuestados, la validación realizada indica que el instrumento es relativamente bueno para comparar la media de los factores latentes en la mayoría de los grupos.

Palabras clave: Cuestionario. Validación. Educación Superior.

1 INTRODUCTION

In carrying out data collection procedures of an investigation, one of the indicated and more broadly used instruments is the questionnaire. However, designing a questionnaire is not a simple task, as criteria are required in its construction, validation, execution, and analysis of the collected data (SAMPIERI; COLLADO; LUCIO, 2013).

Research in Education with quantitative data has increasingly become a challenge, as thoughts and methodological directions privileging qualitative approaches with a focus on subjective data analysis are considered. However, notwithstanding, quantitative approaches seem to seek ascension, from a perspective of evidence-based education, as already developed by other areas of knowledge, for example, Medicine and Psychology. This dynamic, however, is not simple and is analyzed under controversial points of view (BITTERNCOURT, *et al*, 2011).

For this investigation, validation is the ability to exactly measure what is proposed (LINDEMAN, 1974). In this sense, the validation process of the instrument developed by the researchers aimed to check and analyze the proposed items to be able to measure what was proposed, to identify the relationship of Internet access of students from a Higher Education Institution (HEI) and students' experience with Digital Technologies in Education.

This research takes place at a singular moment for humanity when no historical record shows the phenomenon of a pandemic caused by the SARS-CoV-2 virus, which causes the disease called Covid-19. Because of the pandemic, the World Health Organization (WHO) has recommended social distancing as a strategy to combat the spread of the virus. Faced with this phenomenon, with the determination of social distancing, daycare centers, schools, colleges, and universities around the world have suspended their face-to-face classes, and some of them substituted the face-to-face activities with remote or distance learning activities.

In the university this research was developed, the calendar of classes was suspended, and a Working Group was formed to:

I - promote discussion and articulation with the stakeholders of the Federal University of Alagoas (UFAL) to support fundraising and planning aimed at implementing and systematizing educational actions mediated by digital technologies; and

II - promote the articulation with the Campi and Academic Units to institutionalize up to 40% of the teaching hours of the undergraduate courses, focused on distance learning (UNIVERSIDADE FEDERAL DE ALAGOAS, 2020).

One of the actions carried out by the Working group was to identify the profile of the HEI students concerning their familiarity and access to digital technologies in Education. The collected data is expected to reveal the student profile, allowing the discussion and planning of effective actions, analyzing the possibility (or not) of substituting face-to-face on-campus classes with distance learning in the percentage of 40% of the teaching hours, as indicated by the Ordinance. No. 1,428, of December 28, 2018, from the Ministry of Education in Brazil (BRASIL, 2018).

For the data collection, as the HEI did not have concrete data on this topic, and, to the best of our knowledge, there was no instrument designed and validated for this specific purpose, a group of researchers from the Working group constructed, validated and applied a new instrument to understand the access to Digital Technologies and the Internet by higher education students. The problem addressed in this study and reported in this article focuses on the construction and validation of the instrument so that it can be objective, validated, and reliable.

2 RELATED STUDIES

In the study Validation of the EFFECT questionnaire for competency-based clinical teaching in residency training in Lithuania (VAIŽGĖLIENĖ; PADAIGA RASTENYTĖ *et al*, 2017), the validation of a questionnaire that aimed to assess the quality of clinical teaching in-home training is presented. Composed of 58 items in 7 domains, the items could be scored using the Likert Scale, similar to some of the instrument's items we have developed. The authors used Cronbach's alpha to assess internal consistency and reliability. Some frailties in the participants' recruitment were significant, which caused the researchers to indicate that they will need to revalidate the instrument.

In the study Transcultural Validation within the English Scope of the Questionnaire Evaluation of Variables Moderating Style of Teaching in Higher Education. C.E.M.E.D.E.P.U., the authors (OCHANDO, 2017) also used the validation methodology of judges and Cronbach's Alpha. The initial objective of the validation started with the translation of the questionnaire, observing cultural issues, and how they could influence the instrument validity. After the methodological procedures, they concluded that in the

process of translation and back-translation, the results were positive, and the translations required minor modifications. In the validation by the expert judges, they observed that the participation was extremely productive and satisfactory because no professor found questions that needed to be changed to be understood.

In the investigation Knowledge and food practices questionnaire: construction and validation (DA SILVA; PICCOLI; PELLANDA, 2020), the authors present a significant methodology when validating an instrument to be used with children. It is observed that, methodologically, it was Content validity, with the analysis of two groups of judges. The analysis by the two groups was performed sequentially to verify the items of the instrument. The first group of experts indicated some changes. After the instrument was reorganized, it was analyzed by the second group of judges. Another methodological approach was to carry out a pilot test with a group of 40 children, to identify possible difficulties the children could find to respond, as well as to assess the behavior, mediate the time of application, monitor the triggered feelings, etc. These elements were analyzed and a new version of the instrument was developed, and a re-test was conducted with the same children. In addition to these content, pilot and retest analysis, procedures for internal consistency and validity were also performed based on the responses of 453 children, using Cronbach's alpha.

The related works mentioned above target validating instruments in different contexts. To the best of our knowledge, there is no validated instrument to measure the access of higher education students to digital technologies and the Internet, as proposed in this paper.

3 MATERIALS AND METHODS

The method used for the construction and validation of the questionnaire as a data collection instrument started from the principle of commitment to the criticism and reliability required for knowledge production. In view of the final objectives to be reached with collecting the questionnaire data, the definition of educational policies required a careful structuring, with procedures already consolidated in the literature.

The construction process consisted of two steps: initially, the questionnaire items were prepared based on the objectives indicated by the Working group, mapping the items related to “Technical Information” (INF) that affect access to Digital Technologies and “Experience” (EXP) with Digital Technologies in Education by several HEI students. In the

second step, the researchers adjusted the items and divided them into different sections to provide the respondent with one context at a time, which we consider positive to prevent the respondent from confusing the questions with the different contexts of the investigation. The items were also finally defined as questions and answers on a 5-point Likert scale, in which the central point was of indifference to the question, while the extreme ends reflected extreme agreement and disagreement and the intermediate points referred to partial agreement and disagreement.

The validation processes of a data collection instrument can follow different paths, as indicated by different authors (MONDADORI; LADEIRA, 2007; SPERLING; COSER; CARDOSO, 2018; RAYMUNDO, 2009; PASQUALI, 1998). For this study, as shown in Table 1, four procedures were used, which do not exclude each other, but when combined, they present greater rigor.

Table 1: Instrument validation scheme

Characteristic	Tipo	Procedure/techniques
Validity	Content	Questionnaire submitted to judges
	Construct	Exploratory Factor Analysis Confirmatory Factor Analysis
Invariance	Equivalence	Multi-group Confirmatory Factor Analysis
Reliability	Internal Consistency	Cronbach's Alpha

Source: the authors (2020)

One of the ways to search for content validity, performed from Kappa coefficient is the Delphi technique. The technique consists of judging the instrument by judges with extensive experience in the subject (BELLUCCI JÚNIOR, 2012). In this study, the instrument was sent to 6 judges, with the objective of analyzing the questionnaire from its content. The judges were experts in the field of education with relevant activities in the development of research in Education and Educational technologies.

We performed an Exploratory Factor Analysis (EFA) (BARENDSE; OORT; TIMMERMAN, 2015; WATKINS, 2018) to explore the relationship across the proposed items, identifying the instrument's structure, defined by correlation patterns in the item responses and the latent variables or factors that define the dimensions of the instrument. In addition, we performed Confirmatory Factor Analysis (CFA) (BROWN, 2006) to verify whether the identified latent factors can be summarized according to the theoretical model which based the items developed or some standard model that assumes standard covariance or correlations across the items and the identified latent factors. The theoretical

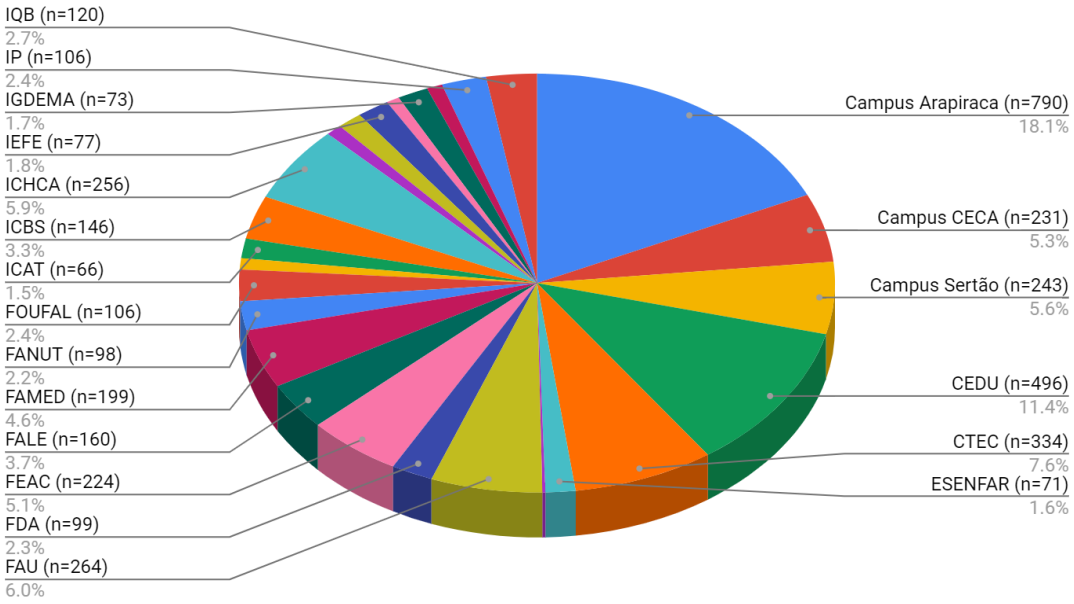
model corresponds to the initial mapping defined by the Working group during the construction process of the instrument.

Multi-group Confirmatory Factor Analysis (MGCFA) (FRENCH; FINCH, 2008; KINE, 2015) is the technique used to assess the instrument's invariance, defined as equivalence of measurement parameters of the latent factors in different population groups for which the instrument was developed. The equivalence of the measurement parameters determines whether the items are interpreted in a conceptually similar way by respondents who represent different groups. Violations of invariance can affect the significant interpretation of the measurement of latent factors and their covariance or correlations. If statistical equivalence is found in the responses, comparisons across latent factors are possible.

Finally, Cronbach's alpha coefficient (SPERLING; COSER; CARDOSO, 2018) was used to assess the internal consistency of the instrument's dimensions, thus determining its reliability, assuming a statistical significance p-value of 0.05. For this analysis and the previous ones regarding the instrument validation, we used the software R version 3.3.1 (RCORE, 2016), with the Lavaan packages version 0.5-23 (ROSSEL 2012), and the software package Psych version 1.9.12 (REVELLE, 2017) - the R scripts of the validation are available at: https://github.com/geiser/2020-validation-QATeDI.

Data collection for instrument validation occurred in two concurrent steps. In one step, doctoral students in Education answered the questionnaire to carry out the analysis and validation of the instrument's constructs, and in another step, students from undergraduate courses (bachelor's and licensing degrees), as well as master's and doctorate, answered the questionnaire online. This research sample was defined as non-probabilistic Vieira (2017), and the calculation to define the sample considered a 95% confidence level, 5% margin of error, and the studied population, the total of students enrolled at the HEI. For this purpose, the 2018 higher education census, available on the institution's website, was used as information, indicating 29,725 students enrolled in technical, undergraduate and graduate courses. From this calculation, the investigation was based on the minimum collection of 379 participants.

Fig. 1: Distribution of respondents by academic unit



Source: research data (2020).

However, 4,372 responses were collected and, to validate the instrument through the EFA / CFA, MGFA and Cronbach's alpha, we used 4,369 responses, three responses were excluded, considered as careless responses because of a consecutive sequence of identical responses. When the length of identical responses is over two-thirds of the number of items, the response was considered as careless. The sample of n = 4,369 analyzed in this investigation is distributed by academic unit as shown in Figure 1.

Respondents in this sample were enrolled in undergraduate, master's and doctoral courses. Of the 4,369 respondents, 154 (3.52%) are enrolled in distance learning courses and 4,215 (96.48%) in face-to-face on-campus courses.

4 RESULTS NA DISCUSSION

4.1 Judges' analysis

The submission to the judges allowed to identify the need for reformulating three of the eighteen proposed questions, granting all of them with the same construct in the alternatives, thus preventing the induction of answers. The judges also indicated the order reorganization of the questions, combining them according to categories (Identification; Technical Information - Devices; Technical Information - Internet at Home; Technical Information - Internet on Mobile / Smartphone; Technical Information - Internet at Work; Technical Information - Internet at the HEI; Experiences with Digital Technologies and Distance Learning). As a final result, the 24 items detailed in Appendix 1 were defined.

4.2 Exploratory (EFA) and Confirmatory (CFA) Factor Analysis

Prior to the factor analysis to determine the structure of the instrument, with the n=4369 responses, we performed item screening. Using descriptive statistics and the Kaiser-Meyer-Olkin (KMO) test (KAISER, 1974), the screening was carried out to eliminate items that cannot be attributed to any latent factor. According to Table 2, the screening showed no need to eliminate any item because the general MSA measure (Measure Sampling Adequacy) of the KMO test was 0.76 (median) and none of the items had an unacceptable level (<0.50s).

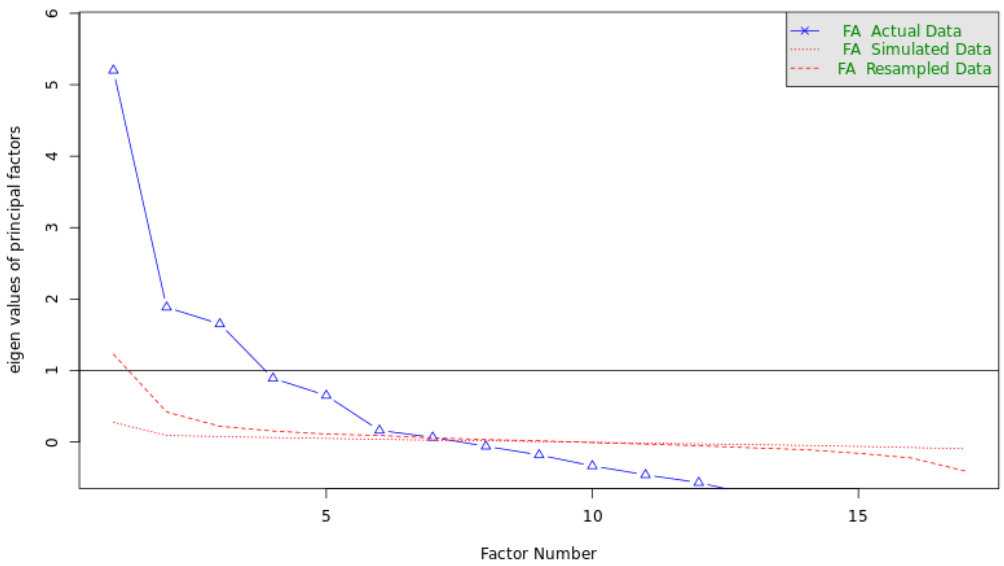
Table 2: Descriptive statistics of the items and Kaiser-Meyer-Olkin test results

	Mean	Std.Dev	Median	Min	Max	25th	75th	MSA	Skew
Item8	0.97	0.18	1.00	0	1	1	1	0.71	-5.21
Item9	3.44	1.10	4.00	0	5	3	4	0.78	-1.33
Item10	3.94	1.22	4.00	0	5	3	5	0.76	-1.22
Item11	0.98	0.14	1.00	0	1	1	1	0.60	-6.79
Item12	3.51	1.05	4.00	0	5	3	4	0.76	-1.22
Item13	3.90	1.26	4.00	0	5	3	5	0.75	-0.88
Item14	0.25	0.43	0.00	0	1	0	0	0.85	1.16
Item15	0.93	1.69	0.00	0	5	0	0	0.80	1.41
Item16	0.98	1.79	0.00	0	5	0	0	0.79	1.42
Item17	0.90	0.30	1.00	0	1	1	1	0.75	-2.73
Item18	2.61	1.35	3.00	0	5	1	4	0.66	-0.56
Item19	2.71	1.70	3.00	0	5	1	4	0.72	0.01
Item20	1.53	1.56	1.00	0	4	0	3	0.84	0.35
Item21	2.35	1.37	3.00	0	4	1	3	0.86	-0.65
Item22	2.17	1.32	2.00	0	4	1	3	0.70	-0.30
Item23	1.98	1.26	2.00	0	4	1	3	0.69	-0.19
Item24	2.03	1.60	2.00	0	4	0	4	0.89	-0.11

Source: the authors (2020).

To determine the total number of latent factors, we used Horn's parallel analysis (HORN, 1965) and, according to the recommendations indicated in (BARENDSE; OORT; TIMMERMAN, 2015; WATKINS, 2018) we used the MLR estimator (Maximum Likelihood estimation with Robust Huber-White's method) and the method of polychoric correlations. This was justified as the screening showed that the data were discrete, with different scales and without normal distribution. According to the generated eigenvalues, shown in Fig. 2, the number of factors recommended for EFA is 06 (six) or 07 (seven) factors.

Fig. 2: Result of the parallel analysis to perform EFA



Source: the authors (2020)

During the seven-factor analysis, Item 24 was removed as it is cross-loaded and weak in all factors (<0.40) and because there cannot be a scale of latent factors added by a single item. Thus, the final result of the EFA analysis with promax oblique rotation and six (06) factors is shown in Table 3. These factors are labeled “Technical Information - Internet at Home” (ML4) with eigenvalue 2.6 explain 19% of the variation with items 8, 9 and 10 and factor loadings from 0.76 to 1.09. The factor "Technical Information - Internet on Mobile / Smartphone" (ML1) with eigenvalue 2.6 consists of items 11, 12 and 13 explaining 19% of the variation with factor loadings from 0.82 to 0.98. The factor “Technical Information - Internet at Work” (ML5) is composed of items 14, 15 and 16 explaining 21% of the variation with eigenvalue 2.89 and factor loadings from 0.94 to 0.99. The factor “Technical Information - Internet at the HEI” (ML2) with eigenvalue 2.69 explains 20% of the variation through items 17, 18 and 19 with factor loadings from 0.91 to 0.98. The factor “Experience with Distance Learning” (ML6) defined by items 20 and 21 with eigenvalue 1.30 explains 9% of the variation with factor loadings of 0.51 and 0.78. Finally, the factor “Experience with Videoconferences” (ML3) with eigenvalue 1.67 explains 12% of the variation with factor loadings of 0.73 and 1.01 for items 22 and 23.

Table 3: Exploratory Factor Analysis

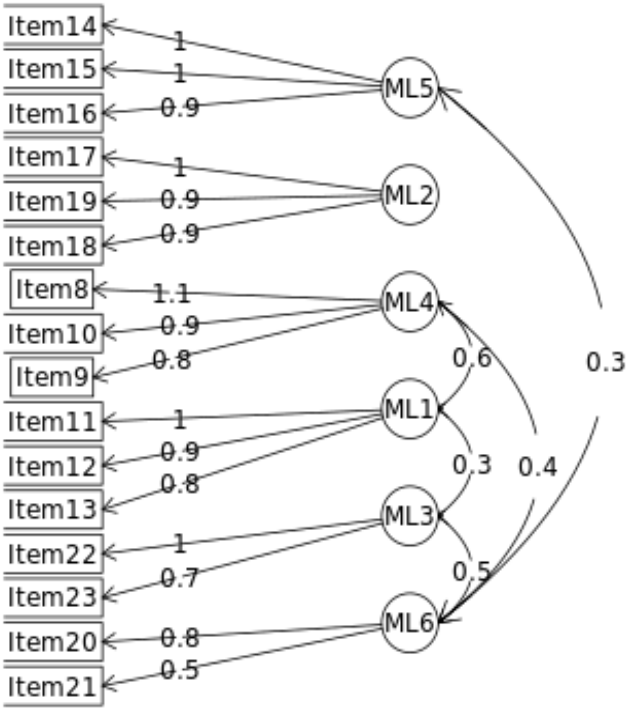
	ML5	ML2	ML4	ML1	ML3	ML6
Technical Information - Internet at Home						
Item8: Do you have access to the Internet at your home?	0.08	-0.03	**1.09**	-0.1	0.07	-0.21
Item9: What is the quality of the Internet access ...?	0.00	0.00	**0.76**	0.19	0.01	0.11
Item10: How available is the access ...?	-0.04	0.05	**0.87**	-0.01	-0.05	0.08
Technical Information - Internet on Mobile / Smartphone						

Item11: Do you have Internet access on your cell phone / smartphone?	0.10	0.05	-0.09	**0.98**	0.15	-0.38
Item12: What is the quality of the Internet access ...?	-0.05	0.01	0.05	**0.93**	-0.15	0.29
Item13: How available is the access ...?	-0.02	-0.06	0.06	**0.82**	0	0.04
Technical Information - Internet at Work						
Item14: Do you have access to the Internet at work?	**0.99**	-0.01	0.03	-0.03	0.01	-0.02
Item15: What is the quality of the Internet access ...?	**0.96**	0.00	-0.01	0.06	0.05	0.01
Item16: How available is the access ...?	**0.94**	0.01	0.02	0	-0.08	0.12
Technical Information - Internet at the HEI						
Item17: Do you have access to the Internet at UFAL?	-0.03	**0.98**	0	0.09	-0.01	-0.11
Item18: What is the quality of the Internet access ...?	0.03	**0.91**	-0.1	0.04	0.02	0.07
Item19: How available is the access ...?	0.00	**0.94**	0.11	-0.12	-0.01	0.03
Experience with distance learning / video classes						
Item20: What is your level of experience as a distance learning student?	0.11	0.00	-0.1	-0.07	0	**0.78**
Item21: What is your level of experience with video classes?	-0.04	0.00	0.07	0.02	0.08	**0.51**
Experience with Videoconferences						
Item22: What is your experience like with videoconferences?	0.00	-0.02	0.06	0.01	**1.01**	-0.06
Item23: What is your experience like with videoconference meetings?	-0.02	0.03	-0.05	0.01	**0.73**	0.29
SS loadings	2.89	2.69	2.6	2.6	1.67	1.3
Proportion Var	0.18	0.17	0.16	0.16	0.1	0.08
Cumulative Var	0.18	0.35	0.51	0.67	0.78	0.86
Proportion Explained	0.21	0.20	0.19	0.19	0.12	0.09
Cumulative Proportion	0.21	0.41	0.59	0.78	0.91	1

Source: the authors (2020)

Fig. 3 shows the structure of the model resulting from the EFA, which is quite similar to the theoretical model the Working group built to define the set of items related to “Technical Infrastructure” (INF) and “Experience” (EXP) of students with Digital Technologies in Education. Although it was expected that there would be significant positive correlations between the Technical Information and the experiences with Digital Technologies in Education, the ML2 factor regarding “Technical Information – Internet at the HEI” is not related to any factor. This fact may be associated with the period of the Covid-19 pandemic and not with the construction of the instrument, since students did not have access to the HEI infrastructure, many of them may have answered the items related to the ML2 factor (Internet at the HEI) with bias due to the lack of access to the HEI during the quarantine period.

Fig. 3: Structure and factor loadings of the model resulting from EFA



Source: the authors (2020)

To verify the structure adjustment of the model resulting from the EFA, we performed Confirmatory Factor Analysis (CFA) with the observed responses and the MLR estimator. The results indicate an acceptable, but not excellent, adjustment of the model, with χ2 (99) = 3959.01; 0.924 CFI; 0.908 TLI and 0.094 RMSEA with CI [0.092 - 0.097]. In addition to checking the adjustment with the structure of the model resulting from the EFA, we verified the adjustment of the data with the "orthogonal model" without covariance among factors, the "multidimensional model" with covariance among all factors and the "theoretical model" with the which the instrument was developed. The CFA adjustment statistics with the different models are presented in Table 4, in which the structure of the theoretical model presents the best acceptable adjustment in comparison to the other structures with χ2 (97) of 3097.30; 0.941 CFI; 0.927 TLI; and 0.084 RMSEA with CI [0.082 - 0.088].

Table 4: Adjustment statistics of the tested models using CFA

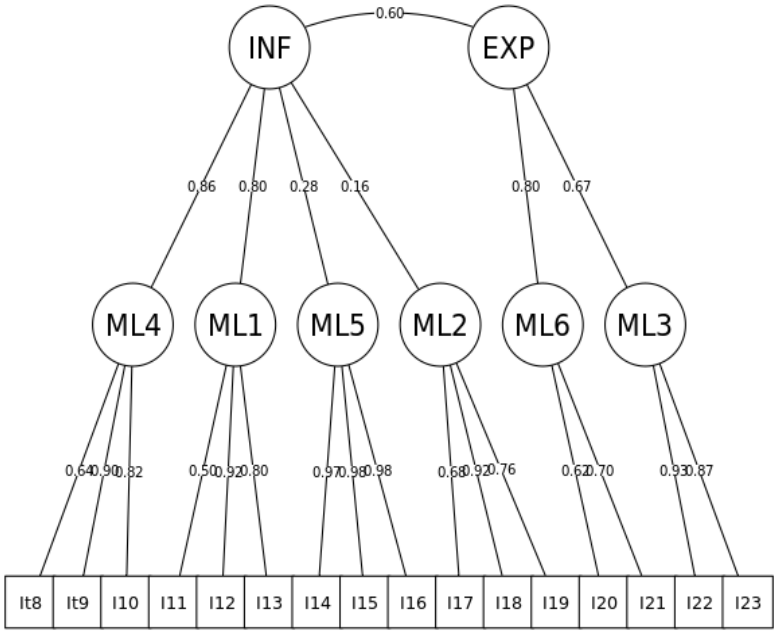
	χ^2	df	CFI	TLI	RMSEA	Δ χ^2	Δ df	Pr(>χ^2)
- orthogonal model	6803.505	104	0.87	0.85	0.121 [0.119; 0.124]			
- multidimensional model	2916.528	89	0.94	0.92	0.085 [0.083; 0.088]			
- model resulting from EFA	3948.370	99	0.92	0.91	0.094 [0.092; 0.097]			
- comparison of model (2) with model (1)						1071.21	10	8e-224
- theoretical model	**3097.299**	**97**	**0.94**	**0.93**	**0.084 [0.082;0.087]**			
- comparison of model (3) with model (1)						171.08	8	7e-33

-	comparison of model (3) with model (2)	1443.31	2	3e-314

Source: the authors (2020)

This result demonstrates that the theoretical model structure with which the instrument was designed is adequate to measure the relationship between "Technical Information" (INF) of access to Digital Technologies and the "Experience" (EXP) of HEI students with Digital Technologies in Education. Fig. 4 shows the structure of the theoretical model and the factor loadings resulting from the CFA with all the observed responses.

Fig. 4: Structure of the theoretical model and factor loadings resulting from the CFA



Source: the authors (2020)

4.3 Multi-group Confirmatory Factor Analysis (MGCFA)

To validate the instrument's invariance in reference to the different groups it was applied, we performed the Multi-Group Confirmatory Factor Analysis (MGCFA). The instrument's invariance ensures that the latent factors are in fact valid and comparable constructions between all groups. For this study, we defined the groups according to the respondents' unit and course modality.

The analysis was not carried out in the groups of the departments “Instituto de Matemática - IM”, “Faculdade de Medicina - FAMED”, “Faculdade de Nutrição - FANUT” and “Instituto de Computação - IC” as the answers to Item 8 has no variance (all respondents indicated Internet access at home). The groups from “Faculdade de Odontologia - FOUFAL”, “Faculdade de Direito - FDA”, “Escola de Enfermagem e Farmácia - ESENFAR” were removed from the analysis as Item 11 has no variance (all respondents in the groups indicated having Internet access on cell phone / smartphone). Finally, the group from “Escola Técnica de Artes - ETA” was also removed from the analysis because Item 17 has no variance, all respondents in that group indicated they have Internet access at the HEI.

Prior to the invariance test, we established the baseline models for each group, separately, using the CFA. The baselines established for each group are shown in Table 5, revealing that there was no possibility to define a baseline in the “Instituto de Química e Biotecnologia - IQB” and that there is no significant difference between the multidimensional model and the theoretical model for the groups of respondents from “Campus CECA”, “Faculdade de Economia, Administração e Contabilidade - FEAC”, “Faculdade de Arquitetura e Urbanismo - FAU”, “Instituto de Ciências Biológicas e da Saúde - ICBS” and “Instituto de Psicologia - IP”.

Table 5: Adjustment measures in the definition of baseline models

	χ^2	df	CFI	TLI	RMSEA	$\Delta\chi^2$ (1)	Pr(> χ^2) (1)	$\Delta\chi^2$ (2)	Pr(>χ^2) (2)	
Unit: Campus CECA (n=231)										
(1) multidimensional model*	208.49	89	0.95	0.94	0.08					
(2) EFA resultant model	268.30	99	0.93	0.92	0.09	68.63	8e-11			
*(3) theoretical model**	*224.37*	*97*	*0.95*	*0.94*	*0.08*	*14.90*	*0.06*	*450.11*	*1e-98*	
Unit: Campus Arapiraca (Arapiraca, Palmeira dos Índios e Penedo) (n=790)										
(1) multidimensional model	605.66	89	0.94	0.92	0.09					
(2) EFA resultant model	749.46	99	0.93	0.91	0.09	152.19	1e-27			
(3) theoretical model	*633.24*	*97*	*0.94*	*0.93*	*0.08*	*26.10*	*0.001*	*233.33*	*2e-51*	
Unit: Instituto de Quí-mica e Biotecnologia - IQB (n=120)										
(1) multidimensional model	238.78	89	0.90	0.87	0.12					(n)
(2) EFA resultant model	268.04	99	0.89	0.87	0.12	35.88	8e-05			(n)
(3) *theoretical model*	250.77	97	0.90	0.88	0.11					(n)
Unit: Faculdade de Economia, Administração e Contabilidade - FEAC (n=224)										
(1) multidimensional model*	277.21	89	0.93	0.91	0.10					
(2) EFA resultant model	391.38	99	0.89	0.87	0.11	136.85	1e-24			(n)
*(3) theoretical model**	*289.64*	*97*	*0.93*	*0.91*	*0.09*	*11.20*	*0.19*	-	-	
Unit: Instituto de Ciências Humanas, Comunicação e Artes - ICHCA (n=256)										
(1) multidimensional model	265.13	89	0.94	0.92	0.09					
(2) EFA resultant model	331.21	99	0.92	0.90	0.10	69.10	6e-11			
(3) theoretical model	*285.68*	*97*	*0.93*	*0.92*	*0.09*	*20.49*	*0.008*	*59.19*	*1e-13*	
Unit: Faculdade de Arquitetura e Urbanismo - FAU (n=264)										
(1) multidimensional model*	229.95	89	0.95	0.93	0.08					
(2) EFA resultant model	268.53	99	0.94	0.93	0.08	53.48	6e-08			
*(3) theoretical model**	*236.62*	*97*	*0.95*	*0.94*	*0.07*	*7.08*	*0.527*	-	-	
Unit: Centro de Tecnologia - CTEC (n=334)										

(1) multidimensional model	253.78	89	0.96	0.95	0.07					
(2) EFA resultant model	331.57	99	0.94	0.93	0.08	85.21	4e-14			
(3) theoretical model	*271.61*	*97*	*0.96*	*0.95*	*0.07*	*19.64*	*1e-02*	*64.22*	*1e-14*	
Unit: Faculdade de Letras - FALE (n=160)										
(1) multidimensional model	141.45	89	0.97	0.96	0.06					
(2) EFA resultant model	182.37	99	0.96	0.95	0.07	48.16	5e-07			
(3) theoretical model	*159.89*	*97*	*0.97*	*0.96*	*0.06*	*21.08*	*0.006*	*29.99*	*3e-07*	
Unit: Centro de Educação - CEDU (n=496)										
(1) multidimensional model	355.67	89	0.95	0.93	0.08					
(2) modelo resultante AFE	521.49	99	0.92	0.90	0.09	175.81	1e-32			
(3) theoretical model	*434.69*	*97*	*0.94*	*0.92*	*0.08*	*65.90*	*3e-11*	*-*	*-*	*-*
Unit: Instituto de Ciências Biológicas e da Saúde - ICBS (n=146)										
(1) multidimensional model*	228.75	89	0.91	0.88	0.10					
(2) modelo resultante AFE	271.06	99	0.89	0.87	0.11	42.85	5e-06			(n)
*(3) theoretical model**	*236.68*	*97*	*0.91*	*0.89*	*0.10*	*6.68*	*0.501*	*182.63*	*2e-40*	
Unit: Campus Sertão (Delmiro Gouveia e Santana do Ipanema) (n=243)										
(1) multidimensional model	294.39	89	0.93	0.90	0.10					
(2) EFA resultant model	368.42	99	0.90	0.88	0.11	67.35	1e-10			(n)
(3) theoretical model	*318.28*	*97*	*0.92*	*0.90*	*0.10*	*19.78*	*0.010*	*75.41*	*4e-17*	
Unit: Instituto de Psicologia - IP (n=106)										
(1) multidimensional model*	144.08	89	0.96	0.94	0.08					
(2) EFA resultant model	182.05	99	0.93	0.92	0.09	35.67	9e-05			
*(3) theoretical model**	*158.70*	*97*	*0.95*	*0.94*	*0.08*	*14.63*	*0.066*	*17.64*	*1e-04*	
Modality: Face-to-face (n=4215)										
(1) multidimensional model	2819.87	89	0.94	0.93	0.09					
(2) EFA resultant model	3836.20	99	0.92	0.91	0.09	1065.14	1e-222			
(3) theoretical model	*2974.10*	*97*	*0.94*	*0.93*	*0.08*	*147.94*	*5e-28*	*1434.69*	*2e-312*	
Modality: Distance Learning (n=154)										
(1) multidimensional model	174.45	89	0.95	0.93	0.08					
(2) EFA resultant model*	217.16	99	0.93	0.92	0.09	39.73	1e-05			
*(3) theoretical model**	*208.64*	*97*	*0.93*	*0.92*	*0.09*	*40.88*	*2e-06*	*4.20*	*0.123*	

(n): not good fit; *: model without significant difference

Source: the authors (2020)

Once the baseline models were established, invariance tests were performed through successive comparisons of the observed responses of one group and all responses not belonging to that group. Tables 6 and 7 show the results for the levels of: (i) configural invariance (configural model) - equivalence in the number of factors and items by latent factors; (ii) metric invariance (metric model) - equivalence of the items' factor loadings; (iii) scalar invariance (scalar model) - equivalence in the intercepts of the items, values / initial mean in the latent factors; and (iv) strict factorial invariance (strict model) - equivalence of errors in the items.

As shown in Table 6, the instrument presents complete invariance at all levels, in the units “Campus CECA”, “Instituto de Química e Biotecnologia - IQB”, “Instituto de Ciências Biológicas e da Saúde - ICBS”, “Instituto de Educação Física e Esporte - IEFE”, “Instituto de Psicologia - IP” and “Instituto de Física - IF”.

Regarding the partial metric invariance of the instrument, the factor loadings of Item 9 (ML4 =~I9) is not equivalent in all groups. The factor loadings of λ = 10.154 for respondents from “Campus Arapiraca (Arapiraca, Palmeira dos Índios and Penedo)” and

the factor loadings of λnot = 14.503 for those who are not part of this group. This indicates that Item 9 may produce bias in the subjects of the unit in reference to the quality of Internet access at home. The same situation occurs at “Instituto de Ciências Humanas, Comunicação e Artes - ICHCA” and at “Faculdade de Letras - FALE”, where the factor loadings of λ = 7.432 and λnot = 8.858 correspond to the institute ICHCA, and the factor loadings of λ = 6,285 and λnot = 8,859 correspond in faculty FALE. Regarding the metric invariance test and the factor loadings resulting from Item 10 (ML4 = ~ I10), it is possible to state that subjects from the units of “Campus Arapiraca” (λ = 7,467 - λnot = 9,223) and “Faculdade de Letras - FALE” (λ = 6,826 - λnot = 8,887) may present bias when expressing their availability of Internet at home.

According to the metric invariance test ou é measurement invariance, the factor loading for Item 12 (ML1=~I12) is not equivalent at the “Instituto de Ciências Humanas, Comunicação e Artes - ICHCA” (λ=11.852 - λnot=14.109) and at “Faculdade de Letras - FALE” (λ=11.587 - λnot=13.792). Participants in these units tend to bias when they respond to Item 12 on quality of Internet access on their cell phone / smartphone. Regarding the factor loading for Item 13 (ML1=~I13), subjects at the “Instituto de Geografia, Desenvolvimento e Meio Ambiente - IGDEMA” (λ=10.154 - λnot=14.503) tend to indicate biased responses when responding to the quality of Internet access on mobile / smartphone.

The factor loading for Item 15 (ML5=~I15) is different with the responses observed from “Campus Sertão (Delmiro Gouveia e Santana do Ipanema)” (λ=3.737 - λnot=3.970) and from “Faculdade de Serviço Social - FSSO” (λ=4.516 - λnot=3.957) indicating a bias in the item when subjects from these units express their opinion on the quality of Internet access at work. Item 16, referring to the availability of Internet at work, has a bias at “Instituto de Ciências Sociais - ICS” (λ=4.626 - λnot=4.200).

Finally, the factor loading for Item 18 (ML2=~I18) with λ=4.605 and λnot=6.603, and the factor loading for Item 19 (ML2=~I19) with λ=4.802 and λnot=6.883 in the metric invariance test indicate that the subjects from “Centro de Educação - CEDU” may be biased when they express an opinion on the quality and availability of Internet access at the HEI, respectively.

Table 6 - Measures to adjust the instrument's invariance by units

	χ^2	df	CFI	TLI	RMSEA	$\Delta\chi^2$	Pr(> χ^2)
Unit: Campus CECA							
- Configural model	3194.86	194	0.941	0.927	0.084		
- Metric model	3218.55	208	0.941	0.931	0.081	13.13	0.516

- Scalar model	3228.87	216	0.941	0.934	0.080	7.91	0.442	
- Strict model	3261.89	232	0.940	0.938	0.077	9.37	0.897	
Unit: Instituto de Química e Biotecnologia - IQB								
- Configural model	3281.72	194	0.939	0.925	0.085			
- Metric model	3294.07	208	0.939	0.930	0.082	5.04	0.985	
- Scalar model	3303.09	216	0.939	0.932	0.081	6.84	0.554	
- Strict model	3372.58	232	0.938	0.936	0.079	17.49	0.355	
Unit: Instituto de Ciências Biológicas e da Saúde - ICBS								
- Configural model	3233.67	194	0.940	0.926	0.085			
- Metric model	3254.87	208	0.940	0.931	0.082	6.66	0.947	
- Scalar model	3270.30	216	0.940	0.933	0.080	11.54	0.173	
- Strict model	3335.66	232	0.939	0.937	0.078	19.23	0.257	
Unit: Instituto de Educação Física e Esporte - IEFE								
- Configural model	3204.76	194	0.941	0.927	0.084			
- Metric model	3231.15	208	0.940	0.931	0.082	11.04	0.683	
- Scalar model	3236.90	216	0.940	0.934	0.080	3.92	0.865	
- Strict model	3268.68	232	0.940	0.938	0.077	10.32	0.850	
Unit: Instituto de Psicologia - IP								
- Configural model	3181.34	194	0.941	0.927	0.084			
- Metric model	3203.49	208	0.941	0.932	0.081	11.88	0.616	
- Scalar model	3215.89	216	0.941	0.934	0.080	10.21	0.250	
- Strict model	3247.76	232	0.940	0.938	0.077	10.52	0.838	
Factor model	3256.28	241	0.940	0.941	0.076	4.90	0.843	
Unit: Instituto de Física - IF								
- Configural model	3210.19	194	0.941	0.926	0.084			
- Metric model	3238.89	208	0.940	0.931	0.082	21.68	0.086	
- Scalar model	3245.87	216	0.940	0.934	0.080	6.69	0.570	
- Strict model	3282.29	232	0.940	0.938	0.078	14.86	0.535	
Unit: Centro de Tecnologia - CTEC								
Configural model	3175.79	194	0.941	0.927	0.084			
Metric model	3233.57	208	0.940	0.931	0.082	17.07	0.252	
Scalar model	3267.92	216	0.940	0.933	0.080	24.03	0.002	*
Scalar model: I14~1 I8~1	3244.25	214	0.940	0.933	0.081	8.65	0.194	
Strict model: I14~1 I8~1, I11~~I11 I14~~I14 I15~~I15 I16~~I16 I17~~I17 I18~~I18	3275.58	224	0.940	0.936	0.079	17.06	0.073	
Unit: Faculdade de Letras - FALE								
Configural model	3168.65	194	0.941	0.927	0.084			
Metric model	3213.82	208	0.941	0.932	0.081	31.05	0.005	*
Metric model: ML4=~I9 ML4=~I10 ML1=~I12	3200.03	205	0.941	0.931	0.082	18.95	0.062	
Scalar model: ML4=~I9 ML4=~I10 ML1=~I12, I14~1	3213.57	212	0.941	0.933	0.081	11.07	0.135	
Strict model: ML4=~I9 ML4=~I10 ML1=~I12, I14~1	3270.13	228	0.940	0.937	0.078	24.45	0.080	
Unit: Centro de Educação - CEDU								
Configural model	3207.85	194	0.941	0.927	0.084			
Metric model	3328.75	208	0.939	0.929	0.083	37.03	0.001	*
Metric model: ML2=~I18 ML2=~I19	3282.55	206	0.940	0.930	0.083	20.28	0.062	
Scalar model: ML2=~I18 ML2=~I19, I14~1 I17~1 I21~1 I23~1	3295.82	210	0.939	0.931	0.082	6.80	0.147	
Strict model: ML2=~I18 ML2=~I19, I14~1 I17~1 I21~1 I23~1, I14~~I14 I15~~I15 I16~~I16	3371.11	223	0.938	0.933	0.080	22.01	0.055	
Unit: Campus Sertão (Delmiro Gouveia e Santana do Ipanema)								
Configural model	3224.17	194	0.940	0.926	0.085			
Metric model	3275.73	208	0.939	0.930	0.082	23.80	0.048	*
Metric model: ML5=~I15	3262.56	207	0.940	0.930	0.082	18.38	0.144	
Scalar model: ML5=~I15, I19~1	3276.06	214	0.940	0.932	0.081	9.16	0.241	
Strict model: ML5=~I15, I19~1	3328.55	230	0.939	0.936	0.079	17.06	0.381	

Unit: Instituto de Ciências Atmosféricas - ICAT								
Configural model	3227.97	194	0.940	0.926	0.085			
Metric model	3262.86	208	0.940	0.931	0.082	16.13	0.305	
Scalar model	3272.01	216	0.940	0.933	0.080	7.00	0.536	
Strict model	3370.78	232	0.938	0.936	0.079	40.27	0.001	*
Strict model: I14~~I14 I15~~I15	3310.25	228	0.939	0.936	0.079	19.18	0.084	
Unit: Faculdade de Serviço Social - FSSO								
Configural model	3257.65	194	0.940	0.925	0.085			
Metric model	3333.69	208	0.938	0.929	0.083	24.69	0.038	*
Metric model: ML5=~I15	3292.22	207	0.939	0.930	0.083	14.26	0.356	
Scalar model: ML5=~I15, I15~1	3306.38	214	0.939	0.932	0.081	10.97	0.140	
Strict model: ML5=~I15, I15~1, I11~~I11 I14~~I14 I15~~I15	3332.04	227	0.939	0.935	0.079	17.44	0.180	
Unit: Instituto de Ciências Sociais - ICS								
Configural model	3197.73	194	0.941	0.927	0.084			
Metric model	3235.34	208	0.940	0.931	0.082	24.68	0.038	*
Metric model: ML5=~I16	3226.80	207	0.940	0.931	0.082	21.39	0.066	
Scalar model: ML5=~I16	3238.83	215	0.940	0.933	0.080	8.62	0.375	
Strict model: ML5=~I16	3277.26	231	0.940	0.938	0.078	16.67	0.407	

Source: the authors (2020)

The scalar invariance test indicates that the intercepts of Item 8, Item 14, Item 15, Item 17, Item 19, Item 21 and Item 23 are not equivalent in all groups of units (Table 6). The I8~1 interceptor for Item 8 (τ=0.947) and the I14~1 interceptor for Item 14 (τ=0.221) resulting from the subjects from “Centro de Tecnologia - CTEC” present a difference with the intercepts for Item 8 (τnot=0.019) and Item 14 (τnot =0.253) for subjects not belonging to this unit. This indicates that there may be non-real differences on the comparison between “Centro de Tecnologia - CTEC” with the other units in the means of the latent factors “Technical Information - Internet at Home” (ML4) and “Technical Information - Internet at Work” (ML5), these differences may be due to the non-equivalence of intercepts for Item 8 and Item 14, respectively.

Regarding the unit “Centro de Educação - CEDU”, the interceptor I14~1 for Item 14 (τ=0.265 - τnot=0.221) can affect comparisons of the unit in the mean “Technical Information - Internet at Work” (ML5), the interceptor I17~1 for Item 17 (τ=0.869 - τnot=0.913) can affect unit comparisons in the mean “Technical Information - Internet at the HEI” (ML2), the interceptor I21~1 for Item 21 (τ=1.901 - τnot=2.353) can affect unit comparisons in the mean “Experience with Distance Learning / Video classes” (ML6) and the interceptor I23~1 for Item 23 (τ=2.085 - τnot=1.977) can affect comparisons in the mean “Experience with Videoconferences” (ML3).

The interceptor I15~1 for Item 15 (τ=1.093 - τnot=0.927) can affect comparisons of the unit “Faculdade de Serviço Social - FSSO” in the mean of the latent factor “Technical Information - Internet at Work” (ML5), while comparisons of “Campus Sertão (Delmiro

Gouveia and Santana do Ipanema)" in the mean of the latent factor "Technical Information - Internet at the HEI" (ML2) can be affected by the difference in the interceptor I19~1 for Item 19 (τ= 3.008 - τnot=2.676).

The results of the strict invariance test for the different academic units (Table 6) indicate that there are differences in the residual variances of the items, indicating differences in the reliability of the observed variables. The respondents from "Centro de Tecnologia - CTEC" have the residual variance I11~~I11 for Item 11 with value Ɛ=0.009, and residual variance of Ɛnot =0.015 for those not belonging to the group. This indicates a possibility of systematic variance that does not originate in a random process, but rather, due to measurement errors arising from external variables not related to Item 11, which tries to measure Internet access on your cell phone / smartphone. In this group, there is a difference in the residual variance I14~~I14, I15~~I15, I16~~I16, I17~~I17 and I18~~I18 regarding Item 14 (Ɛ=0.006 - Ɛnot=0.253), Item 15 (Ɛ= 0.048 - Ɛnot=0.934), Item 16 (Ɛ=0.053 - Ɛnot=0.993), Item 17 (Ɛ=0.033 - Ɛnot=0.900) and Item 18 (Ɛ=0.426 - Ɛnot=2.589).

Respondents from "Centro de Educação - CEDU" show differences in the residual variances for Item 14 (Ɛ=0.020 - Ɛnot=0.010), Item 15 (Ɛ=0.212 - Ɛnot=0.086) and Item 16 (Ɛ=0.200 - Ɛnot=0.092), while respondents from "Faculdade de Serviço Social - FSSO" show differences in the residual variances for Item 11 (Ɛ=0.047 - Ɛnot=0.015), Item 14 (Ɛ=0.003 - Ɛnot=0.011) and Item 15 (Ɛ= - 0.021 - Ɛnot=0.102).

Table 7 presents the results of the instrument's invariance tests according to the two course modalities. According to the partial measurement invariance, there is a difference in the factor loadings for Item 9 (ML4~= I9) for respondents in the "Face-to-face" modality (λ = 8.594) and "Distance Learning" (λ = 26.054), therefore, there may be a bias when the quality of Internet access at home is indicated in each of the groups. The factor loadings for Item 10 (ML4~= I10) in the "Face-to-face" (λ=8.710) and "Distance Learning" (λ=23.504) modalities are different and may cause bias when respondents indicate availability of Internet access at home.

Regarding the factor loadings for Item 16 (ML5=~I16) regarding the availability of Internet access at work, there is a difference for the groups in the "Face-to-face" (λ=4.207) and "Distance Learning" (λ=4.480). In the metric ou measurement? invariance test, the factor loadings for Item 18 (ML2=~ I18) in the "Face-to-face" (λ=6.469) and "Distance Learning" (λ=4.122) and the factor loadings for Item 19 (ML2=~I19) in the "Face-to-face" (λ=6.749) and "Distance Learning" (λ=4.066) modality related to the quality and availability

of Internet access at the HEI, indicating that there may be bias by the subjects of the groups when they answer these items.

Finally, the factor loading of the latent factor “Experience with Videoconferences” (EXP=~ML3) in the second-order factor of “Experience with Digital Technologies in Education” differs in the “Face-to-face” (λ=1.066) and “Distance Learning” (λ=0.243) modalities. This indicates that there may be bias by the subjects of each group when they answer the items referred to the latent factor (ML3).

Table 7: Measures to adjust the instrument's invariance by modality

	χ^2	df	CFI	TLI	RMSEA	$\Delta\chi^2$	Pr(> χ^2)	
Modality: On-Campus								
Configural model	3182.74	194	0.941	0.927	0.084			
Metric model	3319.59	208	0.939	0.929	0.083	37.98	0.001	*
Metric model: ML4=~I9 ML4=~I10 ML5=~I16 ML2=~I18 ML2=~I19 EXP=~ML3	3207.40	202	0.941	0.930	0.083	15.44	0.051	
Scalar model: ML4=~I9 ML4=~I10 ML5=~I16 ML2=~I18 ML2=~I19 EXP=~ML3, I17~1 I20~1	3251.42	208	0.940	0.931	0.082	11.75	0.068	
Strict model: ML4=~I9 ML4=~I10 ML5=~I16 ML2=~I18 ML2=~I19 EXP=~ML3, I17~1 I20~1, I14~~I14 I15~~I15	3397.86	222	0.938	0.932	0.081	23.47	0.053	
Modality: Distance Learning								
Configural model	3182.74	194	0.941	0.927	0.084			
Metric model	3319.59	208	0.939	0.929	0.083	37.98	0.001	*
Metric model: ML4=~I9 ML4=~I10 ML5=~I16 ML2=~I18 ML2=~I19 EXP=~ML3	3207.40	202	0.941	0.930	0.083	15.44	0.051	
Scalar model: ML4=~I9 ML4=~I10 ML5=~I16 ML2=~I18 ML2=~I19 EXP=~ML3, I17~1 I20~1	3251.42	208	0.940	0.931	0.082	11.75	0.068	
Strict model: ML4=~I9 ML4=~I10 ML5=~I16 ML2=~I18 ML2=~I19 EXP=~ML3, I17~1 I20~1, I14~~I14 I15~~I15	3397.86	222	0.938	0.932	0.081	23.47	0.053	

Source: the authors (2020)

The instrument presents partial scalar invariance in reference to the respondents' course modality. The intercepts for Item 17 and Item 20 are not equivalent. The interceptor I17~1 for Item 17 shows the value τ=0.911 for the “Face-to-face” modality and the value τ=0.752 for “Distance Learning” indicating that there may be biased comparisons of both groups in the mean of “Technical Information - Internet at the HEI” (ML2). The interceptor I20~1 for Item 20 presents the value τ=1.469 for the “Face-to-face” and the value τ=2.713 for “Distance Learning” indicating that there may be bias in comparisons of both groups using the mean of “Experience with Distance Learning / Video classes” (ML6).

Finally, in the strict invariance test, the residual variances for Item 14 and Item 15 are not equivalent. The residual variance for Item 14 (I14~~I14) presents the value Ɛ=0.046 for “Distance Learning” and Ɛ=0.010 for the “Face-to-face” modality. The residual variance for Item 15 (I15~~I15) presents the value Ɛ=0.389 for “Distance Learning” and

Ɛ=0.093 for “Face-to-face”. This indicates tends to measurement errors in items from external variables not related to “Technical Information - Internet at Work” (ML5).

4.4 Internal consistency analysis (Cronbach's alpha)

In this step, the 16 items (Item 8 - Item 23) related to the latent factors of the theoretical model structure were analyzed. The 16 questions were separated into blocks according to their association with the latent factors, in which we performed the internal consistency analysis using Cronbach's alpha coefficient and for each group of respondents from different academic units. The results are shown in Table 8, observing a good internal consistency of 0.81 for all items and all data. According to (GEORGE; MALLERY, 2003; CRONBACH, 1951), only the internal consistency with Item 20 and Item 21 related to the factor “Experience with Distance Learning” (ML6) is unacceptable (<0.51) for the groups of respondents from the “Instituto de Educação Física e Esporte - IEFE", "Escola de Enfermagem e Farmácia - ESENFAR "," “Faculdade de Odontologia - FOUFAL”, “Instituto de Química e Biotecnologia - IQB” and “Faculdade de Nutrição - FANUT”. The internal consistency is poor (from 0.51 to 0.61) in the factor (ML6) for all respondents, from “Campus Arapiraca”, “Faculdade de Arquitetura e Urbanismo - FAU”, “Centro de Tecnologia - CTEC”, “Campus Sertão”, and from “Face-to-face” modality. The alpha Cronbach with respondents from the “Instituto de Matemática (IM)” is poor for all instrument items and those (Item 8, Item 9 and Item 10) related to “Technical Information - Internet at Home” (ML4). The remaining Cronbach's alpha values for the items associated with each latent factor (from ML1 to ML6, INF and EXP) and for the instrument as a whole are mostly acceptable cases (>0.70).

Table 8: Cronbach's alpha coefficients of the instrument

	n	all	ML1	ML2	ML3	ML4	ML5	ML6	INF	EXP
All respondents	4369	0.81	0.79	0.83	0.90	0.84	0.99	*0.60*	0.78	0.74
Unit: IGDEMA	73	0.83	0.88	0.87	0.90	0.87	0.97	0.75	0.79	0.81
Unit: FOUFAL	106	0.75	0.77	0.83	0.93	0.86	1.00	**0.40**	0.70	0.69
Unit: CECA	231	0.79	0.81	0.78	0.90	0.86	0.99	0.65	0.77	0.77
Unit: Campus Arapiraca	790	0.81	0.77	0.78	0.90	0.87	0.99	*0.54*	0.80	0.73
Unit: IQB	120	0.83	0.78	0.78	0.90	0.81	0.99	**0.48**	0.82	0.78
Unit: FEAC	224	0.85	0.78	0.83	0.89	0.81	0.99	0.69	0.82	0.79
Unit: ICHCA	256	0.82	0.85	0.79	0.89	0.86	0.98	0.68	0.80	0.76
Unit: FANUT	98	0.76	0.84	0.84	0.90	0.72	0.99	**0.19**	0.73	0.65
Unit: FAU	264	0.75	0.79	0.81	0.88	0.79	0.98	*0.57*	0.72	0.70
Unit: CTEC	334	0.81	0.75	0.80	0.91	0.83	0.99	*0.54*	0.79	0.69
Unit: FALE	160	0.77	0.81	0.89	0.93	0.89	0.98	0.66	0.74	0.77
Unit: CEDU	496	0.82	0.71	0.89	0.90	0.79	0.98	0.64	0.78	0.73
Unidade: ICBS	146	0.78	0.75	0.84	0.85	0.78	0.98	0.64	0.75	0.66
Unit: Campus Sertão	243	0.80	0.77	0.79	0.89	0.85	0.98	*0.57*	0.75	0.75
Unit: IEFE	77	0.84	0.73	0.83	0.87	0.87	0.99	**0.41**	0.82	0.73
Unit: IP	106	0.82	0.79	0.87	0.86	0.87	0.98	0.62	0.79	0.76

Unit: FAMED	199	0.80	0.81	0.78	0.88	0.77	0.99	0.64	0.77	0.72
Unit: IF	31	0.85	0.89	0.79	0.93	0.82	0.98	0.64	0.81	0.71
Unit: ICAT	66	0.73	0.89	0.87	0.85	0.82	0.99	0.65	0.70	0.64
Unit: FDA	99	0.82	0.72	0.87	0.89	0.75	0.99	0.75	0.81	0.77
Unit: IM	37	*0.59*	0.90	0.93	0.82	*0.58*	0.98	0.63	0.70	0.70
Unit: ESENFAR	71	0.75	0.80	0.85	0.91	0.73	0.98	**0.50**	0.74	0.67
Unit: FSSO	38	0.75	0.91	0.91	0.83	0.81	0.99	0.66	0.74	0.69
Unit: IC	59	0.79	0.88	0.90	0.88	0.79	0.99	0.62	0.73	0.77
Unit: ICS	38	0.81	0.83	0.80	0.88	0.93	0.99	0.67	0.76	0.80
Modality: On-Campus	4215	0.81	0.79	0.82	0.90	0.84	0.99	*0.60*	0.78	0.74
Modality: Distance Learning	154	0.81	0.83	0.95	0.86	0.68	0.96	0.71	0.78	0.71

all: all items

Source: the authors (2020)

5 THREATS TO THE VALIDITY

Some threats can be identified in the study, which can lead to further investigations to minimize or eliminate such limitations. (1) an initial limitation is in the respondents' profile, considering asymmetries from the higher education courses they study. As there is a greater participation of students from the areas of exact courses, this may have - in some way - influenced the result. (2) Another limitation is the fact that due to social distancing and considering the vulnerability of the university population where the research took place, this may have posed a difficulty for students to access and respond to the online questionnaire.

Therefore, to better assess the quality of access to technologies and the Internet with the students of this university, we need to collect new data with the instrument in its complete structure as soon as the face-to-face activities resume, recruiting similar numbers from the various areas and academic units.

6 CONCLUDING REMARKS

The refinement process of the research instrument resulted in a questionnaire formed by twenty-four items (questions) appropriate to the reality of the Higher Education Institution, aiming at collecting data which allows the analysis of reality and the development of a training policy for effectively accomplishing digital technologies in the daily-life and educational context.

The final instrument was the main objective of this study, fulfilling one of the objectives established at the beginning of the investigation. With this new instrument, systematic measurements can be made in relation to “Technical Information” (INF) to

support access to Digital Technologies and the Internet, considering that this access is one of the pillars of continuing studies in scenarios of social distancing.

The validity carried out in the instrument's construction indicates that the questionnaire developed by the Working group is adequate to measure the latent factors of technical information related to “Internet on Mobile / Smartphone” (ML1), “Internet at the HEI” (ML2), “Internet at Home” (ML4) and “Internet at Work” (ML5), and the latent factors related to the experience of HEI students with “Distance Learning” (ML6) and “Videoconferences” (ML3). In addition, through this validity, it was possible to demonstrate that the correlation between the second-order latent factors of "Technical Information" (INF) of support to access to digital technologies in Education and "Experience" (EXP) of the students with these technologies.

Although there was no complete invariance of the instrument for all groups of respondents classified by academic unit and the modality they belong, the instrument proved to be relatively good for comparing the means of latent factors in most groups. Metric invariance tests for some groups indicated differences in the factor loadings for items related to quality and availability of Internet access at home (Item 9 and Item 10), cell phone / smartphone (Item 12 and Item 13) and at the HEI (Item 18 and Item 19). To avoid the bias of the group respondents, these items could be reformulated or more items could be added to the instrument to measure the quality and availability characteristics of the Internet in the set of Technical Information. Differences in interceptors and residual variances for most items are low (<1 unit), except for Item 18 and Item 20. Thus, to improve the measurement quality of the instrument, these items could be reformulated or more items could be added to adequately measure the opinion of Internet access quality at the HEI and the student's level of experience with distance learning.

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