Evaluation of the Quality of Learning Objects in the Health Care Area:

Evidence of Validity and Internal

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Abstract

In Brazil, distance education plays an important role in the training of human resources in the health area. In this context, learning objects, understood as modular digital resources used to support learning, are widely used tools in the process of knowledge construction, although not all are valid resources. To date, the literature does not have a specific instrument in Portuguese to evaluate the quality of learning objects in the health area. In order to fill this gap, this paper describes the search for evidence of validity of internal structure and convergent validity of Equalis-OAS: Scale to evaluate the quality of learning objects in the health area. For the study, Equalis-OAS was applied to professionals and undergraduate students from the different areas of Health Sciences, all participants taking a continuing education health course about Food and Nutrition in Primary Health Care. One thousand and sixty-nine volunteers participated in the study. An Exploratory Factor Analysis revealed that the instrument, which has as its construct "Quality of learning objects for the health area", covers three dimensions: "Intrinsic Concepts of Learning Objects in the Health Area", "Educational Characteristics" and "Presentation". The final instrument consisted of 41 items, which explained 66.8% of the total variance of the scores. The scale had excellent internal consistency indexes (overall scale: α = 0.979; "Intrinsic Concepts of Learning Objects": α = 0.927; "Educational": α = 0.947; "Presentation": α = 0.977). Regarding convergent validation, Pearson's correlation indicated that Equalis-OAS had a moderate correlation (r=0.59, p<0.01) with LORI version 2.0, translated into Portuguese, an instrument for the evaluation of learning objects in general (i.e., not specific to the health area). These results indicate that Equalis-OAS is an instrument that presents good evidence of validity, indicating its use in the context of health education and research.

Keywords: Teaching Materials; Distance Education; Health Education; Validation Studies; Psychometrics.

1. Introduction

Continuing Education refers to the acquisition, strengthening and maintenance of knowledge, skills and attitudes of professionals. In the field of health, it has a great importance in updating work practices,

enabling the training of professionals in order to face real demands that are renewed every day, incorporating knowledge and experiences based on reality and, ultimately, the transformation of professional practices and of the organization of work in the health area (Brasil, 2007).

One of the most widely used resources for Continuing Education in health are distance education practices (Tomaz, Mariano, Fonseca, Cavalcante and Nogueira, 2004; Silva, Santos, Cortez and Cordeiro, 2015; França, Rabelo, Oliveira, Dahmer, Pinto and Tubelo, 2016). A number of experiences at the national and international levels have demonstrated the validity of the use of this teaching strategy to promote initial and professional training (Laraia, et al., 2008; Viguier et al., 2015; Reeves, Fletcher, McLoughlin, Yim and Patel, 2017; Mattos, Dahmer and Magalháes, 2015; Oliveira et al., 2015; Cunha et al., 2016; Dahmer, Tubelo, Pinheiro, Costa and Pinto, 2016; Harzheim et al., 2016; Cezar, Costa and Magalhães, 2017). In this context, the use of Learning Objects (LO) is an important strategy and tool to help the construction of knowledge in Distance Education.

Learning objects (LO) are elements of a new type of structuring of teaching, based on the computer and on the internet, founded on the paradigm of object orientation, originating from Computer Science. One of the first definitions for LO came from the Learning Technology Standards Committee (LTSC) of the Institute of Electrical and Electronics Engineers (IEEE), which describes that "a learning object is as any entity, digital or non-digital, which can be used, re-used or referenced during technology supported learning" (IEEE, LTSC, 2007). LO may be understood as small educational components, "self-sufficient", or as "block-cells", which may be combined with each other, forming, thus, new educational objects. They may be used an indefinite number of times, by several people and in different circumstances, in order to support learning. This segmentation characteristic of LO makes it possible to use it in different learning contexts, such as face-to-face classes, online courses, computer-based training, tutorial development, lesson topics, courses, assessments, and more. LO may be presented in different forms - exercise, simulations, sounds, videos, questionnaire, diagram, figure, plot, textual narration, wording of a question, etc. - in order to promote learning activities for a student or a group of students (Wiley, 2000; Rozados, 2009; Munhoz, 2013).

However, in order to be effective, learning objects need to present evidence of quality and relevance, which involves a complex evaluation process that considers, among other aspects, the content addressed, storage and retrieval strategies (Amador, Arteaga and Rodriguez, 2007), in addition to user characteristics, pedagogical aspects and aspects of the context in which these objects were produced (Gonzáles, Artega and Rodrigues 2007; Campos, Martins and Nunes, 2008; Reategui, Boff and Finco, 2010). The researches that offer criteria to evaluate the quality of LO available on the internet are still incipient (Vargo, Nesbir, Belfer and Archambault, 2003; Gama, 2007; Kay and Knaack, 2007; Blake, 2010), and in the health area the same occurs (Krauss and Ally, 2005). Thus, one of the main challenges in evaluation is to obtain accurate, reliable and valid measurements (Coluci, Alexandre and Milani, 2015), which may be possible through the use of psychometric techniques. This is an area of Psychology that assumes postulates of the theory of scientific measurement and establishes technical norms for the construction and validation of assessment instruments (Pasquali, 2009).

With the above in mind, considering the existence of a high number of LO evaluation tools developed and

validated inappropriately or not validated (Coluci, Alexandre and Milani, 2015; Trindade, Dahmer and Reppold, 2014), this article presents a study to find evidence of validity of internal structure and convergent validity of Equalis-OAS (Scale to evaluate the quality of learning objects in the health area). In previous research, the scale presented evidence of content validity and positive evidence for validation of internal structure in a pilot sample (Trindade, 2016).

2. Method

The present study obtained a favorable opinion from the Research Ethics Committee of a Brazilian university specialized in the health area - Federal University of Health Sciences of Porto Alegre (CEP-UFCSPA, under identification CAAE 70497317.6.0000.5345 and opinion 2.316.097). All individuals who were invited to collaborate voluntarily with the research received the Informed Consent Term (ICT) of the study, being guaranteed the anonymity of the answers and the possibility of quitting participating in the study without any onus.

2.1 About the population

The study involved a population represented by a convenience sample, formed by professionals with higher education, working in Primary Health Care (PHC) and/ or undergraduate students from the various areas of Health Sciences, all participants in a lifelong learning course conducted in the distance modality on Food and Nutrition in PHC, proposed by the Nucleus of Technical-Scientific Telehealth of Rio Grande do Sul (TelessaúdeRS-UFRGS), in 2017. Data from the 1069 students who accepted to participate in the study show that 84% had already undertaken distance education, 92% were female, with an average age of 30 years old and a standard deviation of 8.23 (minimum age of 17 and maximum age of 65), the training area was: Nutrition (72%); Nursing (10%); Medicine (6%); Dentistry (3%); Pharmacy (2%); others (7% - Physical Education, Physical Therapy, Psychology, Social Work, Biomedicine). Of these, 51% had completed at least one specialization course, 8% were masters and 2% were doctors.

2.2 About the course Food and Nutrition in PHC

The distance learning course of Nutrition in PHC aims to contribute to the qualification of the feeding guidelines provided in the scope of PHC, offering strategies for the management of feeding in response to the most frequent demands in PHC. It aims at informing and updating the PHC professionals about the care and general guidelines of feeding and nutrition that constitute routine situations in the PHC, based on the best scientific evidence available. At the end of the course, participants are expected to feel more confident in providing feeding guidelines based on current literature. The course is self-instructional and was planned in order that the content is self-explanatory. In this format, no tutors were present. With a total of 60 hours schedule, it was composed of 12 units, described as follows: (a) a setting unit, with course syllabus, tutorial for Moodle TelessaúdeRS use, presentation video, register, news forum and pretest. (b) ten units, which are available on a weekly basis (1- Encouraging healthy eating; 2- Myths and truths about feeding and nutrition; 3- Maternal and child nutrition; 4- Food allergies and intolerance; 5- Dietary care and guidelines: obesity;

6- Dietary care and guidelines: diabetes; 7- Dietary care and guidelines: hypertension; 8- Dietary care and guidelines: chronic kidney disease; 9- Dietary care and guidelines: eating disorders; 10- Dietary care and guidelines: home enteral nutrition therapy). These units included mandatory activities - texts, videos and questionnaires - and complementary activities - such as games, quizzes, and supplementary readings. Finally, there was a unit of final evaluation and course satisfaction.

2.3 About the Scales

Those students who agreed to collaborate with the research had access to an online questionnaire divided into 4 parts: (1) presentation of the research; (2) demographic profile characterization questions; (3) Equalis-OAS and (4) LORI (Nesbit, Belfer and Leacock, 2009). The evaluated learning object corresponded to the unit referring to home enteral nutrition therapy.

Regarding Equalis-OAS, a study conducted by Trindade (2016) describes the process of developing the instrument and the initial results of the process of searching evidence of it. According to these evidences, the scale consists of 41 items, which contemplate three dimensions: Concepts Intrinsic to LO (11 items); Educational (13 items); Presentation (17 items), answered by an ordinal 5-point Likert scale. For each item, the respondent should indicate one of the following response options: "totally disagree", "disagree", "neither agree nor disagree", "agree" or "totally agree" (Trindade, 2016).

The Lori instrument was created to assist users in the choice of learning objects made available on the internet. It has eight aspects: 1) content quality; 2) learning goals alignment; 3) feedback and adaptation; 4) motivation; 5) presentation design; 6) interaction usability; 7) accessibility; 8) standards compliance. For each item, the quality is evaluated on a scale ranging from 1 to 5, in which: 1 indicates low (the evaluated learning object has little or none of the described characteristics); 5 indicates high (the evaluated learning object strongly presents the described characteristics). It also has the option "not applicable" if the reviewer deems it unfit to perform the evaluation (Nesbit, Belfer and Leacock, 2009).

2.4 Psychometric analyses

The online database was exported to the Excel format, where it was adapted for further analysis using the statistical software package SPSS (Statistical Package for the Social Sciences) version 24.0.

The search for evidence of internal structure validity was performed through Exploratory Factor Analysis (EFA), using extraction by main components with Varimax Rotation to the Equali-OAS items. By means of this statistical test, the objective is to identify if the items present statistical relevance in relation to the evaluated construct. To evaluate the accuracy of the instrument, the Cronbach's Alpha Coefficient was used, which is a statistical tool that reflects the level of covariance among the items, thus serving as an indicator of the instrument's internal consistency (Pasquali, 2003). In order to evaluate the convergent validity of Equalis-OAS, the scores obtained from this instrument were correlated, using the Pearson's Correlation with LORI scores (Nesbit, Belfer and Leacock, 2009), a correlated and validated instrument for local context, which evaluates learning objects developed for general use, not specific to the health area.

3. Results

3.1 Evidence of internal structure validity

For the 41 items of Equalis-OAS, the Exploratory Factor Analysis was carried out with a reduction for 3 factors, through the extraction by Principal Component Analysis and Varimax rotation with Kaiser normalization. The Rotation converged in six interactions. They were retained in the analyzes with factors with eigenvalue higher than 1. Table 1 shows the explained variation of the instrument, specifying the values of each factor and of an accumulated form. In Table 2, the items that compose each factor and their respective factor loadings are presented.

Table 1: Total explained variation

Component*	Total	Percentage of total explained variation	Accumulated percentage of total explained variation
1	12.119	29.56	29.56
2	7.750	18.90	48.46
3	7.537	18.38	66.84

*Component 1: Presentation (17 items); Component 2: Educational (13 items); Component 3: Concepts Intrinsic to LO (11 items).

Table 2: Distribution of items by factor with their respective loadings

Item number	Item description (of Equalis-OAS)	Factor		
		1	2	3
41	Apresenta título claro que se relacione com o tema.	0,791		
34	A estrutura do texto apresenta organização do conteúdo de forma lógica e ordem compreensível.	0,790		
36	A quantidade de texto (conteúdo) apresentada por tela está adequada.	0,784		
40	Há identificação clara de títulos, cabeçalhos e colunas.	0,771		
33	A estrutura do texto apresenta identificação de cabeçalhos, e outros elementos estruturais.	0,770		
32	O texto utiliza uma linguagem em estilo de escrita e terminologia condizente com o nível do conteúdo.	0,770		
30	O texto utiliza uma linguagem concisa e direta.	0,765		
35	A estrutura do texto apresenta hierarquia de tópicos e enumeração.	0,752		
29	O texto utiliza uma linguagem clara e simples.	0,745		
27	A relação entre nomes e siglas dos comandos e suas funções está adequada.	0,740		
37	O uso de imagens estáticas, tais como fotos, diagramas,	0,723		

	tabelas, gráficos e botões, de um modo geral, está contextualizado e adequado.			
26	A relação entre ícone (desenhos, setas) e sua função está adequada.	0,714		
31	O texto utiliza uma linguagem pontuada adequadamente, para a percepção dos leitores de tela.	0,711		
28	Existe um padrão com relação aos comandos utilizados nas telas.	0,698		
25	As instruções apresentadas estão compreensíveis.	0,698		
38	O uso de áudio, de um modo geral, está adequado.	0,652		
39	O uso de vídeos ou animações, de um modo geral, está adequado.	0,647		
20	O conteúdo apresentado é suficiente para permitir que o público-alvo atinja os objetivos propostos.		0,750	
21	As atividades e/ou avaliações incluídas no objeto de aprendizagem são suficientes para permitir que o público-alvo atinja os objetivos propostos.		0,738	
22	As atividades propostas pelo objeto de aprendizagem são diversificadas.		0,711	
15	O conteúdo do objeto de aprendizagem enfatiza os pontos-chaves, com nível de detalhe adequado		0,707	
18	Os objetivos educacionais propostos no objeto de aprendizagem estão adequados ao público-alvo.		0,658	
19	As atividades e/ou avaliações propostas/fornecidas pelo objeto de aprendizagem estão em consonância com o objetivo apresentado.		0,655	
14	conteúdo do objeto de aprendizagem está atualizado.		0,607	
24	O uso do objeto de aprendizagem pelos estudantes/profissionais da saúde estimula o aprendizado de novos conceitos.		0,602	
23	As mensagens emitidas pelo objeto de aprendizagem apresentam uma linguagem apropriada ao público-alvo.		0,592	
16	O conteúdo do objeto de aprendizagem respeita as diferenças de grupos culturais e étnicas.		0,589	
13	O conteúdo do objeto de aprendizagem é apoiado por evidências científicas.		0,588	
17	Os objetivos educacionais são facilmente identificados no objeto de aprendizagem.		0,561	
12	O conteúdo do objeto de aprendizagem não induz ao erro.		0,530	
7	O programa necessário para acessar/utilizar o objeto é facilmente identificado.			0,738
5	O nome dado ao objeto de aprendizagem está facilmente identificado no catálogo.			0,734
6	Os pré-requisitos para a utilização do objeto de			0,719

	aprendizagem são facilmente identificados em seu catálogo.			
8	O público-alvo do objeto de aprendizagem está facilmente identificado no catálogo.			0,688
9	O catálogo descreve o tipo de recurso que caracteriza o objeto de aprendizagem (Animação, Áudio, Imagem, Material Interativo, Material Multimídia, Slide/Apresentação, Texto, Vídeo).			0,684
11	As palavras-chaves que constam no catálogo do objeto de aprendizagem são encontradas em dicionários/glossários da área da saúde.			0,672
10	A descrição textual do conteúdo do objeto de aprendizagem está condizente com o conteúdo apresentado.			0,672
3	Recomendaria a utilização do objeto de aprendizagem em outro curso/disciplina/lição da área da saúde.			0,623
4	Recomendaria a utilização do objeto de aprendizagem a outro profissional de saúde.			0,613
1	O objeto de aprendizagem pode ser utilizado, sem prejuízo de suas funcionalidades, em vários hardwares, sistemas operacionais e navegadores de internet.			0,603
2	O objeto de aprendizagem pode ser reutilizado por várias vezes em diversos ambientes virtuais de aprendizagem, sem necessidade de modificação.			0,518

3.2 Precision Measurement Test

The level of internal consistency was evaluated by the Cronbach's Alpha coefficient. The total instrument obtained an alpha value of 0.980, being considered excellent (Maroco et al., 2006). Table 3 shows Cronbach's Alpha values for each extracted component, as well as the means, standard deviation and values corresponding to 25, 50 and 75 percentiles.

Table 3– Distribution of internal consistency by dimension

Dimension	No. of items	Alpha (α)	Mean	Standard deviation	Percentile 25	Percentile 50	Percentile 75
1	17	0.977	4.45	0.52	4.00	4.47	5.00
2	13	0.947	4.33	0.54	4.00	4.23	4.47
3	11	0.927	4.44	0.50	4.00	4.45	5.00
Total	41	0.980	4.41	0.48	4.00	4.41	4.90

*Component 1: Presentation (17 items); Component 2: Educational (13 items); Component 3: Concepts Intrinsic to Learning Objects (11 items).

3.3 Convergent validation

As a form of evaluating the validity based on external variables, a simultaneous application of Equalis-OAS and LORI was performed, an instrument for the evaluation of learning objects. The results, which

demonstrate evidence of convergent validity, are presented in Table 4.

Table 4: Correlations between results of LORI and Equalis-OAS

	LORI	Equalis-OAS – overall score	Equalis-OAS – Factor 1	Equalis-OAS – Factor 2
Equalis-OAS – overall score	0.590*	-		
Equalis-OAS – Factor 1	0.571*	0.887*	-	
Equalis-OAS – Factor 2	0.584*	0.928*	0.758*	-
Equalis-OAS – Factor 3	0.533*	0.945*	0.756*	0.809*

5. Discussion and Conclusion

The present research was originated from the observation of the fragility generally observed in the processes of evaluation of didactic resources used for teaching in the health area in Brazil, especially with regard to learning objects used in lifelong learning in the distance modality. In order to provide an instrument with evidence of validity based on the precepts of Psychometrics, this study was developed to investigate evidence of validity based on the internal structure and on the external variable of Equalis-OAS, a Portuguese-language scale created by Trindade (Trindade, 2016) to measure the quality of learning objects in the health area.

The population that participates in the process of searching for evidence of validity of Equalis-OAS differs from some validation studies for evaluation of learning objects, differentiating the created scale, a specific instrument for evaluating learning objects focused on the health area. Akpinar (2008) conducted a study for the validation of LORI 1.5 using a sample of students and their teachers of primary and secondary education. The same is observed in a study carried out by Kay and Knaack (2008), who composed a sample of high school students to validate LOEM, both instruments constructed to evaluate generalist learning objects.

The validation process of Equalis-OAS went through two stages. The first one, focused on the construction of the items and the pilot study, had the participation of teachers, technicians, tutors and students of a Specialization Course in Family Health promoted by the Open University of SUS UFCSPA, conducted in the distance modality (Trindade, 2016). The second stage, presented in this article, also included professionals and students from the health area, all participants taking a lifelong learning course of the distance modality conducted by TelessaúdeRS-UFRGS. In this second stage, it was possible to describe evidence of validity based on the internal structure of the instrument (factor analysis) and on the external variable (correlation with LORI), as well as to verify the internal consistency of the proposed instrument.

The analyzes performed to investigate the evidence of validity of the instrument demonstrated that it has good metric properties. The Exploratory Factor Analysis (EFA) indicated the existence of three factors, as the pilot study had already indicated (Trindade, 2016), which explained, overall, 66.8% of the variance of the responses. All 41 items of the scale were retained in the factor analysis and most items had a high factor loading. The items were allocated to the factors that theoretically would be expected. The first factor,

"Presentation" refers to the accessibility and usability characteristics of the learning object. The second factor, "Educational", focuses on pedagogical characteristics, covering content quality, compliance with learning goals, feedback, adaptation and motivation. The third factor, "Intrinsic Concepts to learning objects in the health area", endorse the inherent characteristics of the definition of learning objects, such as interoperability, reusability, durability and availability.

The scale presented excellent indexes of accuracy, both in the evaluation of the total measurement (α 0.980) and in the evaluation of isolated factors (Presentation: $\alpha = 0.977$; Educational: $\alpha = 0.9479$; Concepts Intrinsic to LO: $\alpha = 0.927$). These indexes were higher than those found in the study conducted by Kay and Knaack (2008), $\alpha = 0.75$, e.g., which investigated the internal consistency of LOEM, another instrument to evaluate learning objects in general. In the study carried out by Vargo, Nesbit, Belfer and Archambault, (2003), the reliability of the instrument was obtained through the application of a collaborative model, called the Convergent Participation Model, resulting in a Cronbach's alpha equal to or higher than 0.8 among the evaluators.

Differently from the current study, in the pilot study in which evidence of validity based on the internal structure for Equalis-OAS (Trinity 2016) was sought, a specific learning object was not used. The respondents could adopt, by individual choice, any of the learning objects that were made available in the course they were taking in the distance modality. Thus, this method was identified as "masking" regarding the selection of the learning object, and it was considered positive, since the analysis of the data was exempt from any biased notation or decision. In addition, the results suggested that Equalis-OAS may be applied to different learning objects in the health area. However, this characteristic differed from studies conducted by Kay and Knaack (2008) and Akpinar (2008) or those from Trindade, Dahmer and Reppold (2014), in which specific learning objects were chosen or developed to validate the instrument. Thus, for the present study, a specific learning object was used, making the entire Equalis-OAS application refer to the same learning object.

From the findings presented, it is considered as a positive aspect the fact that the created instrument may be used to support the process of creating several learning objects in the health area, helping the work of developers, designers and/or people who make the content. The scale, once validated, may be used for professionals working with continuing education courses in health in the distance modality in Brazil, such as UNASUS (Granville, Souza, Calabró and Martins, 2017; Dahmer et al., 2017) and TelessaúdeRS-UFRGS (Harzheim et al., 2016). It may also be used by teachers when they research and select in digital repositories learning objects to compose their didactic activities. Finally, make the instrument (Equalis-OAS) available to students and final users (e.g., patients) could favor the educational process of this public on accessibility and interoperability (Krauss & Ally 2005), in addition to making them more aware and critical regarding the educational material provided to them or even searched on the internet.

Although many authors relate the use of learning objects and/or their quality with results related to knowledge and learning testing (Vollmar, Schürer-Maly, Frahne, Lelgemann and Butzlaff, 2006; Bucarey and Alvarez, 2006; Lymn, Bath-Hextal and Wharrad, 2008; Henkel, 2010; Bath-Hextal, Wharrad and Leonardi-Bee, 2011; Windle, McCormick, Dandrea, and Wharrad, 2011), it is known that the use of these resources alone does not guarantee learning (Akpinar 2008), even though the criterion of validity of the

instruments is a basic premise for their choice. Thus, in order for learning to provide the reconstruction of previously established concepts, from the personal experiences and the subject's own intention to understand the meaning of what is studied, methods that stimulate the student's initiative and responsibility in relation to their own learning must be proposed, especially in the health area, in which updating content is of vital importance to the training of professionals (Trindade, Dahmer and Reppold, 2014).

It is known that the evaluation process is not a trivial task, considering the multiplicity of technical and educational factors involved, especially in this case, in which the focus of evaluation were learning objects. The literature presents several studies that report the use of instruments to evaluate learning objects developed for general evaluation, favoring the internal validity of the study, however, making it difficult to compare results and evaluate the efficiency of the use of learning objects in a specific area (Trindade, Dahmer and Reppold, 2014). In this sense, we believe to have collaborated for the discussions that involve the process of evaluation and quality of learning objects developed specifically for the scope of health teaching, considering the precepts of Psychometrics, which served to guide the construction process and validation of the created instrument.

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