Evaluation of Ingressants in Distance Education Courses through the Item Response Theory

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Abstract

The use of Item Response Theory (IRT) in the evaluation of freshmen students undertaking long distance learning in order to allow linking the profile of the student with its features, their performance and retention. The scale created based on the IRT, with the addition of items and respondents, broadens the benefit of bringing the measure to the profile entrant and the interpretation of its knowledge, combining them. The objective is to develop an assessment scale of measurement of the student profile in Distance Education (DE) courses. As for its development, we sought qualitative methods, predominantly, being components of an exploratory research. It carried out a review of the pertinent literature, collection of research data and the authors' experience on the subject. It is noteworthy that there are those who use distance learning courses, hastily, as understood as "simple" by overlook planning studies. Thus, they cause evasions, and the consequent waste of time and money not only for students but also the institutions themselves. The purpose of this article is to present this measure evaluation as an aid to the entities in the selection and improvement of freshmen in distance education courses.

Keywords: Evaluation measure. Distance Education (DE). Item Response Theory (IRT). Construction measurement scale.

1 Introduction

The 21st Century emerges in a new globalizing socioeconomic order involved in the increase of education, science and technology. In this context, education has been one of the reasons why governments seek to minimize social differences. In order to be reached, the objective can not be attached to the classroom, limited to teaching-learning, not neglecting here, its value (LITTO; FORMIGA, 2009).

Distance Education (DE) is a resource of incalculable importance to attend large numbers of students, more effectively than other modalities and without risks of reducing the quality of services offered as a result of the expansion of the stakeholders served. This is made possible by the new technologies in the areas of information and communication that are opening up numerous possibilities for distance teaching-learning processes (NUNES, 1994).

The DE as a teaching modality shortens distances, promotes autonomy, benefits the community and carries out the teaching and learning process in places where face-to-face teaching can not act for the most diverse reasons (FERREIRA, ELIA, 2013).

It is intended to develop a measure of evaluation of the profile to the enrollee in DE courses, in order to identify the characteristics for such courses and verify if they present the appropriate profile for these courses. The proposed measure will help identify social-emotional competencies related to school success; thus guiding institutional policies to improve teaching, such as minimizing DE dropout rates. According to Dore (2013), avoidance is one of the main reasons for low qualification and professional qualification. According to the author, prevention is among the main strategies to combat the problem, and for this it is necessary to understand, guide and follow the student from the moment he makes his first choice in the field of professional training.

According to the Analytical Report of Distance Learning in Brazil (CensoEAD.BR, 2010), the average level of avoidance among the institutions surveyed is 18.5%, with significant variations in some cuts. In the public sector, it is 21.1% and in the private sector it is 17.3%. The average evasion in the country is concentrated in the North and Northeast, whose respective indices are 27.8% and 21.7%. While in the South it is 14.8%, in the Southeast 19.0% and in the Center-West 17.3%.

The distance courses use many communication resources for student-teacher interaction in order to allow their full functioning considered the virtual medium as a correspondence and link between many tools for: writing, reading, images, video, audio, video conferencing, web conferencing, chat , forum, e-mail, among other resources. One of the basic premises of DE is student autonomy. It is considered that the students must organize their time and space for the study, counting on the aid of technological resources, didactic and with the support of tutor face-to-face or at a distance, according to the pedagogical project of the institution.

This autonomy proposed in the DE gives rise to one of the great challenges to be faced, which is to avoid the evasion of the Virtual Learning Environment (AVA) and the face-to-face moment at the pole. Thus, this autonomy delegated to the student constitutes, on the other hand, a strong factor of influence in the avoidance of the distance courses, if the student is not prepared and aware of the said autonomy (BELLONI, 2009).

Behar (2009), defines that the direct participation of the student through the face-to-face moments strengthens the relationship: teacher-student, student-student, student-content, where knowledge is blended through face-to-face and virtual activities, which that there is better in each of the modalities - face-to-face vs. distance.

In addition, the use of various online training mediators, such as platforms, blogs, wikis, forums, Facebook, Second life, Twitter, require a new mastery of DE stakeholders, mastery of new technologies, of new knowledge and new behaviors (BIZZARIA, TASSIGNY, 2014).

The knowledge of the characteristics of the students in the DE and their adequate measurement will enable the institutions to implement pedagogical interventions in order to allow the student to have the expected income and their permanence in this teaching modality. In this sense, the Item Response Theory (IRT) is a theory that provides probabilistic models for latent traits and can be used to establish any measurement, from a set of items related to what is intended to be measured (VARGAS, 2007 (1997), and Van der Derden (2016).

Among the existing IRT models, the unfolding model known as proximity model will be used, since it is the most suitable attitude measurement. The IRT allows the parameters of the items to be invariant on the respondents, and the latent traits of the respondents are also invariant on the items, except for the choice of origin and scale. In addition, a scale created on the basis of IRT has the advantage of placing both items and respondents on the same measurement scale, because with the application of one of the IRT models to the set of responses given to a measurement instrument obtained from the respondents, the parameters of the items and the respondents are estimated in a single scale.IRT deployment models have provided more consistent results for assessing latent "attitude" traits, according to Roberts, Donoghue and Laughlin (2000).

In terms of current legislation, there is no specific determination as to what the DE assessment should be.
In this sense, the present article aims to present an evaluation methodology for DE courses, in order to allow the student profile to be related to the characteristics of this modality, as well as its impacts on performance and permanence in the course.

2 Theoretical Foundation

2.1 Distance education: origins, concept, importance

The DE, a mode of education, is making a great contribution to people seeking higher education, specialization and further training. Because of the ease of the flexible study, people are better able to organize themselves, take time off from work, and attend higher-level distance education of equal validity and recognition in traditional teaching. The functionality and popularization of the use of computers and the advancement of the internet, increasingly accessible, result in the great challenge of knowing if people are prepared for this new type of education. (LITTO, FORMIGA, 2009).

The use of large-scale computers facilitated access for learning, and with this, DE became very popular, people who experience locomotion difficulties, facilitating the reduction of costs, as well as lack of time to attend classroom sessions, thus contributing to the growth of distance learning. In addition, such education narrows borders and geographical distances are no longer a barrier to study in an educational institution.

The 21st Century is characterized by the Age of Information and Knowledge, requiring faster and more agile instruction, and there is something new every time, requiring constant training, unlike previous decades, in which knowledge was slow to arrive and remained long time without being modified (LITTO; FORMIGA, 2009).

The development of this type of education served to implement the most diverse educational projects and to the most complex situations, such as: vocational courses, training for work or scientific dissemination, literacy campaigns and also formal studies at all levels and fields of the system education, in addition to traditional undergraduate and postgraduate courses (specialization) (LITWIN, 2001).

According to Bernardo (2009), DE is a systematically organized form of self study where the student is instructed from the study material presented to him, has the follow-up, and supervision of student success is carried out by a group of teachers, this being possible through the application of means of communication, capable of overcoming long distances.

The literature on DE is quite vague in the context of history. His embryo can be seen in Plato's time (427-347 BC), at the time that philosopher wrote a collection of letters and more than thirty philosophical dialogues, notably in his Discourse on Socrates, in which he defended this in the trial that sentenced him to death (SCHNEIDER, 1999 apud MELO, COLLOSSI, 2004).

While for Alves (2009), DE's scientific history does begin with Johannes Gutenberg invented the press in the 15th century in Germany. Faced with this, it became indispensable to go to school to hear the masters read the books, since the privilege of obtaining a copy was restricted to the nobility and the clergy. In the middle of the XVII and XVIII centuries the main route of scientific communication was the letters, constituting in new teaching-learning process. For a better understanding of the influence imposed on the educational process at the time of the Industrial Revolution, it is sufficient to notice that during this period the production line was segmented and the product massified, following the model advocated by Ford and the capitalist system, making the educational field prone to new ideas and methods that, at the same time as equalizing knowledge, also allowed to open the opportunity of innovation, being a favorable path for DE. In this phase, DE was identified as a model of industrial education in which planning takes place to guarantee the development of the actions proposed in the teaching-learning process (BELLONI, 2009).

In the third millennium the diffusion of DE in the world, due to the pedagogical globalization, of which the present technology facilitates the interconnection between the countries even distant, was felt. The union and joint work among countries becomes interesting, since the cost is reduced, which characterizes the existence of common programs (NISKIER, 2000).

The Theory of Measure has its object in the use of the number made in the description of the natural phenomena, and the nature of this measure implies in three basic questions: the representation, the unicity and the error (PASQUALI, 1996, 2003). The problem of representation consists in representing natural phenomena with numbers, preserving their own characteristics. The question of uniqueness consists in reproducing a natural attribute (ordinal or interval scale) in a unique way, or rather, that such reproduction is the most adequate one can conceive. The question of error, which is typical in any measure, is analyzed within statistical theories to determine if the value found is within acceptable limits (PASQUALI, 1996, 2003).

The complexity of the problems due to the profound changes that occur when new activities come, at a time when others disappear, require a decision in the area of education. The dynamics of technology and the growth of information, linked to the generation of new products, have posed challenges to organizations in their economic and administrative life. According to Maia (2001), these challenges, coupled with new theories, are demanding continuous reassessment of work and solutions with quality differentials and short deadlines, so that companies survive competitiveness.

2.2 Usefulness of Item Response Theory in Distance Education

The IRT is based on a probabilistic mathematical approach to understanding nonlinear relationships between individual characteristics, item features (eg difficulty), and patterns of response patterns (DRASGOW; HULIN, 1990).

The theory under consideration suggests models for latent traits (such as ability, attitude, preference, quality of life, among others) by proposing ways of representing the relationship between the probability of an individual giving a response to an item and its latent area that is being evaluated or verified, which can not be directly observed (ANDRADE; TAVARES; VALLE, 2000).

The set of items used in the measurement instrument for the latent trait that will be measured must present the fundamental principles of validity and reliability (NUNNALLY, 1978; PASQUALI, 1996).

One of the lines of Theory of Measure seen as theory is the Theory of Scales and Tests (Psychometry). This line approaches the measurement of latent constructs or traces through observable manifestations, which would be the representation of the hypothetical variable. Its parameters are the legitimacy of such representation (validity) and the analysis of items in terms of difficulty and discrimination, determined through IRT (PASQUALI, 1996).

The analysis and interpretation of data, on a scale of measurement, can serve as a basis for those entering a course of DE to obtain the expected income, since this modality requires unique characteristics of study by the student.
One of the benefits of using the IRT is that it can provide non-biased estimates of the item parameters of non-representative samples. The privilege is derived from the property of TRI invariance. The parameters of the items are independent of the sample, as well as the parameters of the individuals are independent of the items. It is justified because in many cases, in organizational research, including in research on resistance to change, it is possible to use samples that are not representative of the populations for which generalizations are desired. TRI produces non-biased estimates of non-representative samples (EMBRETSON; REISE, 2000).

The validity of an item refers to the fact that it is related to what one wants to measure (PASQUALI, 2003). A measure can be reliable, however, it may not be a valid measure for what one wants to measure (NUNNALY, 1978).
The measures of the latent trait fulfill three functions: a) the affirmation of a functional relation with a specific variable; b) the representation of a specific universe of content; and c) the measurement of latent trait domains (NUNNALLY, 1978). To perform these functions there are three types of validity: criterion validity, content validity, and construct validity.

The planning of distance learning will be seen as an indispensable tool for successful teaching. Faced with many challenges that will come, education is an indispensable tool for humanity to progress in the ideals of peace, freedom and social justice. Educational policies are a permanent process of enriching knowledge, of technical capacity, fostering, mainly, a privileged structure of people and relationships between individuals, groups and between nations (DELORS, 1996).

Pasquali (1998) proposes a model for the elaboration of psychological scales that are applicable to the construction of psychological tests of aptitude, of personality inventories, of psychometric attitudes scales and of the semantic differential. The model aims to provide a practical framework to obtain the validity of the measurement instrument, divided into theoretical, experimental and analytical procedures.

In an interesting document published in 1997, the United Nations Educational, Scientific and Cultural Organization (UNESCO) considered that DE would be a challenge for education systems at the beginning of the 21st century. His argument was that DE and face-to-face education are ordered in a continuous line, since they are not excluded, since both in one and the other contact with the teacher is indispensable. There is a more traditional educational function, seen from one pole, which explains, clarifies, communicates ideas and experiences and, while at the other pole, there is the sharing with the students of the same experiences, insofar as the student is a source of information and learning facilitation (MELO, COLLOSSI, 2004).

Another benefit of IRT is that the amount of information that an item provides on the latent trait can be determined for any level of the latent trait and is called the item's information function. The information function of the item reflects the quality of the individual items and the set of items as a whole, used to estimate the resistance to change (BAKER; KIM, 2004).

According to Rumble (2003, page 15), organizational management can thus be defined as "a process that allows the development of activities with efficiency and effectiveness, making decisions regarding actions that are necessary, choosing and verifying the best way to execute them ".

It is emphasized that the first example of DE project was designed to attend a higher education course to be taught in municipalities of the interior of the State. The institution required a viable, low-cost model, opportunizing to migrate from a successful experience of free face-to-face courses given at weekends. A team of teachers traveled alternately to the localities and ministered their courses. The management wanted to maintain this dynamic of weekly meetings with its rotating team of teachers (RIBEIRO, 2007).

The management team is composed of professionals who define, organize, and follow the activities of the DE project. They make up the multidisciplinary team, select the macro strategies to reach the objectives of the institution or the project. In medium and large institutions, different departments are involved in these assignments. (LITTO, FORMIGA, 2009, page 66).

Depending on the complexity of the project, especially the scope and scale of service, the number of professionals involved and the distribution of roles may vary. It is normal to find institutions that maintain a fixed staff in their functional frameworks and another variable team, outsourced or not, contracted on demand. Even institutions varying in the organization of their structures, some professional profiles are typical of DE projects, regardless of the scope and the predominantly used technologies (LITTO and FORMIGA, 2009).

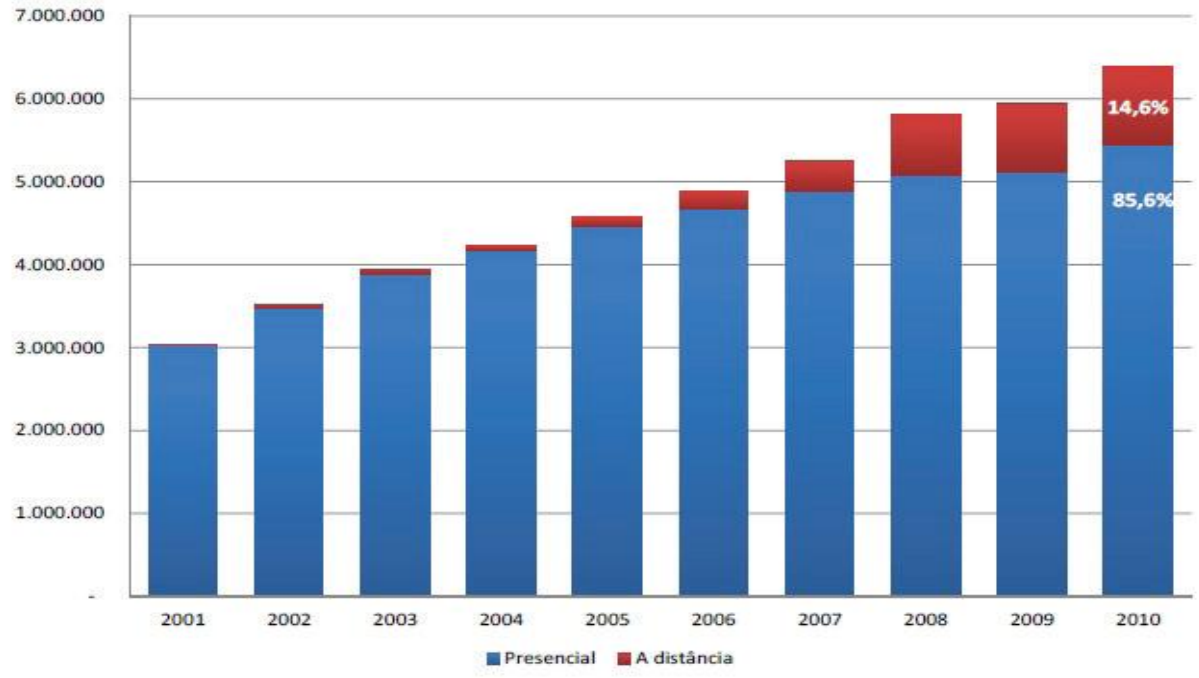
The benefits are represented by your goods and services produced. When there is a proposed change in production, increases in productivity and quality, reduction of waste, energy savings, labor, maintenance, among others, must be estimated. There are also the intangible benefits such as satisfaction, comfort, increased motivation of the students and the professionals of the DE, as compensation that draws on the benefits gained.
The purpose of a measurement instrument is to determine a score for the respondent, in order to identify the level of resistance that this respondent presents in relation to the set of items of the instrument (ANDRADE; TAVARES; VALLE, 2000).

2.3 Statistic data

Baccalaureate and face-to-face courses are part of the history of Higher Education. According to the results of the 2010 Census, the need for professional training and technological advancement has emerged, which has increased DE courses and also shorter vocational courses at the higher level (technologists).

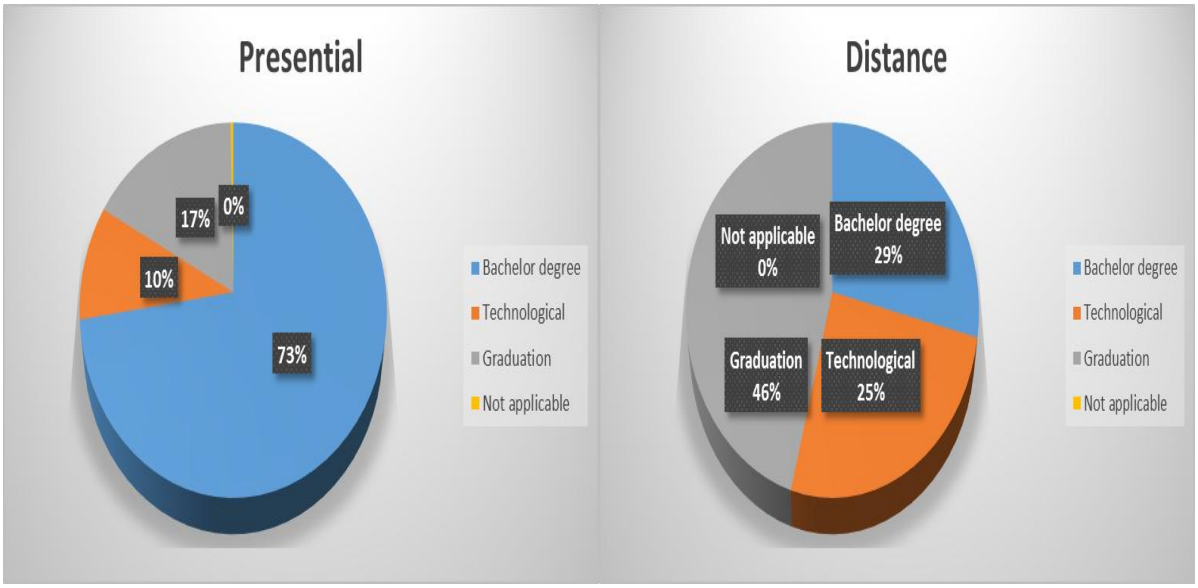
According to the 2010 Census of Higher Education 2010, distance education represented a constant growth, thus showing an important participation in the higher courses in our country considered the period 2001/2010. "The 2010 Census confirms the growth trend of distance education courses, which reach 14.6% of the total number of enrollments" (BRAZIL, 2011, p.10).

Evolution of the Number of Enrollments by Mode of Education - Brazil - 2001-2010



Fonte: MEC/Inep

The chart shows the evolution of the number of Enrollments by Mode of Education - Brazil - 2001-2010:



Reference: MEC/Inep

The face-to-face courses reach the totals of 3,958,544 baccalaureate enrollments, 928,748 undergraduate and 545,844 technological degree enrollments. Distance education, in turn, adds 426,241 undergraduate degrees, 268,173 baccalaureate and 235,765 enrollment in technological courses (BRASIL, 2011, p.10).

3 Methodology, Results and Discussion

For the elaboration of this article, methodologies will be used to assist in the preparation and to demonstrate the ways that were used. As for its development, we sought qualitative methods, predominantly, being components of an exploratory research. It carried out a review of the pertinent literature, collection of research data and the authors' experience on the subject.

According to Andrade (2010: 11), methodology is "the set of methods or paths that are pursued in the pursuit of knowledge". The most complex part in the writing of a research project for the elaboration of an article is generally constituted by the specification of the methodology to be adopted. Several items can be considered, depending on the length and complexity of the research, such as data collection technique, sampling, data analysis, report form, among others (GIL, 2002, page 147).

In order to elaborate this article, the academic will use the inductive method, because according to Bacon (apud ANDRADE, 2010, page 111):

[...] the inductive method favors observation as a process for reaching knowledge. The induction consists in enumerating the statements about the phenomenon that one wants to research and, through the observation, to try to find something that is always present in the occurrence of the phenomenon.

In the case of induction, the inverse path is followed by that of deduction, that is, the chain of reasoning establishes an upward connection, from the particular to the general. In this case, the particular findings are that they lead to general theories and laws (ANDRADE, 2010).

Exploratory research is used, being the first step of all scientific work. It provides information on a specific subject, helping to define objectives, delimiting the theme, and collaborating to develop quality research on the subject (ANDRADE, 2010).

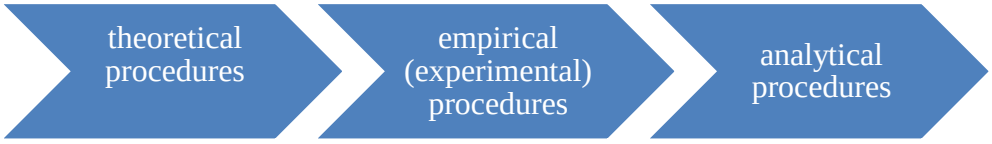
The qualitative methods are used in the development of the research. It is used for the interpretation of the phenomena and for the detailed understanding of the meanings and situational characteristics presented by the interviewees (RICHARDSON, 2015). This research was predominantly qualitative, since it was reviewed the pertinent literature, and collected data of research done on the subject.

The data will be obtained through an instrument with items related to the latent trait - student profile. Responses will be tabulated and analyzed on the basis of IRT in order to prepare a scale of measurement for the participants. The results will show students who are more adapted to the DE profile.

The latent structures have attributes and these have magnitudes, that is, they are measurable and even if these attributes are inaccessible to empirical observation, they can be expressed by a set of observable items (PASQUALI, 1998, 2003).

According to Pasquali (1998), the models of elaboration of psychological scales are based on three great poles represented in Figure 1.

Figure 1 - Model of elaboration of psychological scales.



Source: Prepared based on Pasquali (1998).

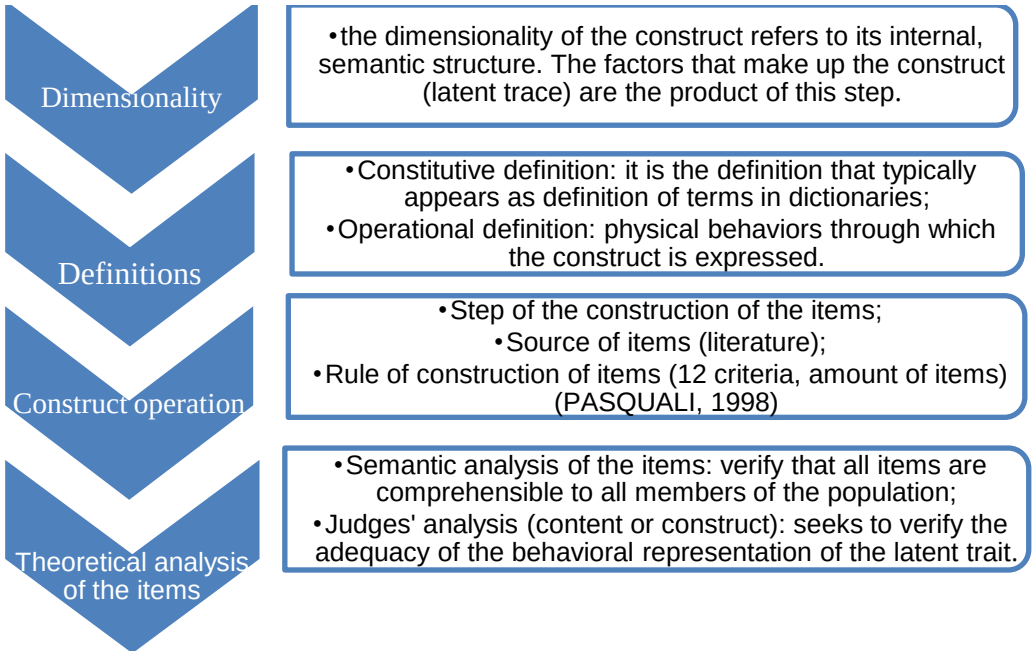
The theoretical procedure involves the explanation of the theory about the construct or psychological object for which one wishes to develop an instrument, as well as the operationalization of the construct in items. This pole explains the latent trait theory, in addition to the explanation of types, categories of behavior that constitute an adequate representation of the same trait (PASQUALI, 1998).

With reference to the empirical pole, this will guide the elaboration of the items for the measuring instrument through the empirical evidence on the construct. The empirical or experimental pole defines the stages and techniques of the application of the pilot instrument and the data collection to evaluate the psychometric quality of the instrument.

Finally, in the analytical pole, the statistical analyzes are carried out on the collected data in order to verify the evidence of validity of the instrument.

The questions regarding the steps and procedures that should be defined in the theoretical pole are systematized in Figure 2.

Figure 2 - Stages and procedures of the theoretical pole.



Source: Elaborated based on Pasquali (1998) and Nakano, Primi and Nunes (2015).

In relation to the empirical or experimental pole, the main steps and procedures are presented in Figure 3.
Figure 3 - Stages of the experimental pole.

Source: Elaborated based on Pasquali (1998) and Nakano, Primi and Nunes (2015).

Finally, the data collected at the empirical pole will be submitted to the statistical analyzes summarized in Figure 4.

Figure 4 - Stages of the analytical pole

Reliability and dimensionality	This step aims to analyze the instrument in relation to its internal structure, through: bisissorial correlation, instrument reliability (Conbrach alpha) and dimensionality: Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA).
Analysisofitems	The quality of the items will be analyzed, considering: measurement error in the calculation of the item parameters estimation, item discrimination and test information curve
Construction and validation of scale	The product of this step is the profile scale

Source: Prepared based on Pasquali (1997, 1998) and Nakano, Primi and Nunes (2015).

Evidence for the theoretical validity of the evasion-propensity scale to be constructed will be based on the model of psychological scales (Figure 1) according to the contemporary view of the Standards for Educational Psychology Testing 1999 (PRIMI; MUNIZ; NUNES , 2009). The validation will contemplate content analysis through the analysis of judges (specialists) in the area of education.

According to the Federal Council of Psychology (NUNES; PRIMI, 2010), contemporary evidence of validity based on content and internal structure is presented by the American Educational Research Association, American Psychological Association (APA), National Council on Measurement in Education, manual titled Standards for educational and psychological testing (1999), described as:

Content-based evidence: gather representative data about the content or domain of the test, investigating whether the set of items consists of comprehensive samples of the domain to be evaluated with the test; also investigates with specialists if there is a relation between the items and the facets of the construct and if there are methods of checking equivalence of items in tests translated from other languages. Evidence based on the internal structure: refer to the information about the structure of the correlations between items. In this case, it is investigated, mainly through factor analyzes, if the correlations obtained between items and / or scales are theoretically adequate. In addition, these studies include evidence of instrument accuracy (Federal Council of Psychology, 2010, p.71).

Regarding the evidences of validity of the internal structure, we will consider: bisserial correlation, reliability of the Cronbach - alpha instrument; full information, factorial analysis of the complete information (Full Information), confirmatory factorial analysis and the IRT (information curve and the quality of the parameters of the items - discrimination and the error associated to the measure).The bisserial correlation is an indicator if the item has the desired psychometric properties for the latent trait. For items that contribute to discrimination, positive values are expected and above 0.30 (RIBEIRO; SOARES, 2008).

Reliability is the degree to which a scale produces consistent results between repeated or equivalent measurements of the same object or person, revealing the absence of a random error (CORRADO; PAUL; DIAS FILHO, 2014). The value assumed by Cronbach's alpha varies between 0 and 1, and the closer to 1 is its value, the greater the reliability of the dimensions of the construct. In the evaluation of the internal consistency of the instrument, the values adopted as reference are those established by Hill and Hill (2000), presented in Table 1:

Table 1 - Reference values for Cronbach's alpha.

Values	Ranking
Above 0.9	Great
Between 0.8 and 0.9	Good
Between 0,7 e 0,8	Reasonable
Between 0,6 e 0,7	Low
Below 0,6	Unacceptable

Source: Prepared by the author based on Hill and Hill (2000).

4 Conclusion

This article presents the proposal to create an evaluation methodology for DE courses, in order to allow the student profile to be related to the characteristics of this modality, as well as their impact on performance and permanence in the course. It is hoped that, through this evaluation, educational institutions, whatever the distance course, can reap the desired income in this modality of education. There are those who are looking for a course in DE thinking that it is more "simple", not requiring planning of studies, and this has led to avoidance, resulting in wastage of time and money, both institutions and students.

Clear notions of the virtual world are established as potential, nurtured by the flexibility of time and space it provides for use in learning and dissemination of knowledge. What is already done in many courses, however, to deny the participation of the name of educational institutions and people circulating in communities on the Internet, is to leave the context in which people live today, as the authors describe, it is there that a great part of them interact with their families, friends, colleagues and groups and relate more constantly, and why not consider human capabilities as the main factor for better distribution of knowledge? It is unnecessary to remember that human capacities are more inclusive and consider the human being as a whole in their culture, in their values and habits, in short, in their context. This evaluation measure based on the IRT may bring more accurate indicators than the Classical Evaluation Theory.

As for the proposed objectives, these will be analyzed and applied based on an indirect questionnaire (IRT) to incoming students. The data will be tabulated and analyzed, creating a measurement scale for these participants.
It is hoped, through recognized dedication, that the institutions are better prepared to select their incoming students and that they can receive their benefits through this modality of education based on IRT, as well as their students, so that they have a better income and use of teaching.

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