Student Online Readiness Assessment Tools: A Systematic Review Approach

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Abstract: Although there are tools to assess student's readiness in an ***online learning context,*** little is known about the ***psychometric*** properties of the tools used or not. A systematic review of 5107 published and unpublished papers identified in a literature search on student online readiness assessment tools between 1990 and 2010 was conducted. The objective of this paper was to identify via a systematic review different tools allowing to assess the level of student's preparation in an online learning environment and which were published or not in scientific journals, and determine which of these tools have been validated. The results of the systematic review show that a standard tool does not exist, and that only ten instruments have been developed and published over the past 20 years to assess student's readiness. In addition, few tools published demonstrated good psychometric qualities, and many unpublished tools, considered as homemade tools, were internally developed in the universities by a team of professors without regard to their psychometric quality. Also, it appears that the tools that were published in scientific journals are rarely used by universities that offer online courses. Generally, the universities prefer to develop their own instrument that fits their online programs.

Keywords: Systematic review of online preparedness; Tool Validity; Readiness for online learning; Internet-delivered training

1 Introduction

The recent studies have reported that the dropout rate of online students is higher compared to that of campus students (Dray & al., 2011). As the dropout rate remains high, it becomes a critical issue for online learning and a major concern for universities that offer online courses. Although there have been studies focused on development of the student *online readiness assessment tools*, they seem to have ignored an important detail about the *psychometric quality of these* instruments. Then, the objective of this paper is to identify via a systematic review the different tools that have been developed to assess online learning readiness and that have been psychometrically validated.

2 Systematic review method

In our study, we relied on the guide to conducting a systematic literature review prepared by Okoli & Schabram (2010), which is very comprehensive.

2.1 Searching the literature

The first step *of a* systematic review *is to establish a research question that is clear and concise. In the context* of this paper, the question chosen was: *"What are the different student* online readiness assessment tools*?"*. To guide our research, we were assisted by a *librarian* specialist in identifying the major databases in the fields of education and of management and information systems. Nine electronic databases were searched: Aisel, CSA (ERIC, FRANCIS, PsychInfo), EBSCO (Professional Development Collection, Business Source Complete), ED/ITlib, Education Abstracts (Wilson), Elsevier (ScienceDirect, Scopus), Emerald (Emerald Management Xtra), Sage, ProQuest (ABI / INFORMDateline, ABI / INFORM Global, ABI / INFORM Trade & Industry, CBCA Complete). In addition, an Internet search was conducted using Google Scholar. Also, other sources consisted of a hand-searching of relevant journals: Canadian Journal of Learning and Technology, Educational Technology and Society, European Journal of Open Distance and E-learning, International Journal of Instructional Technology & Distance Learning, International Review of Research in Open and Distance Learning, Journal of Educational Technology & Society, Journal of Interactive Media in Education, Journal of Interactive Online Learning, Journal of Learning Design, Language Learning and Technology, Turkish Online Journal of Distance Education, and International Journal of technologies in Higher Education.

To identify all eligible studies on the development of measuring instruments in the context of e-learning, we used all terms obtained from the lexicon of e-learning. Identical terms in english are "cyber-training, distance

education, distance learning, e-training, e-learning, e-university, Internet-based learning, Internet-based training, Internet-delivered learning, Internet-delivered training, online education, online training, online course, online university, tele-education, teleteaching, virtual classroom, virtual learning, virtual university, Web-based education, Web-based Instruction, Web-based learning", and the French version**s** of these terms w**e**re also used: « apprentissage en ligne, apprentissage par Internet, apprentissage virtuel, etc. ».

Others terms necessary for our research and their synonyms were also taken into account, namely, in English: "e-readiness, e-preparedness, e-preparation, predicting, success, instrument, development, scale, survey, questionnaire, tool", and in French: "développement, instrument, échelle, outil, e-préparation, prédiction, succès". We used two strings of information retrieval. The first string (string 1) is formed by three groups of keywords: 1) keywords referring to synonyms of e-learning "cyber-training, distance education, e-training", 2) keywords referring to the development of instruments "survey, scale", and finally 3) keywords referring to readiness "e-readiness, e-preparedness, e-preparation, etc**.**". The second string of information retrieval (string 2) is the french version of **s**tring 1.

Then, studies were included if they met the following four criteria: (1) studies published in journals**,** conference proceedings, and reports of expert groups, (2) studies aimed at the development of the measuring instrument in the context of online learning readiness, (3) editorials, books, theses, and studies done on a professional basis were not considered, (4) studies published in another language other than English or French were excluded, and (5) studies published from 1990 to 2010.

2.2 Practical screen

Thus, the electronic search identified 3544 citations as shown in Table 1, and the hand-search method resulted in 1563 additional articles. There were 258 duplicate references identified by t*he EndNote X4 Bibliographic software* that *have been removed*, and 5049 articles were excluded based on their *titles and abstracts. After full text reading, 58 articles by two authors* and *48 studies were excluded* for not complying with the inclusion/exclusion criteria. Table 1 shows also that, after removing duplicate studies, the vast majority of studies selected are published in English (99.5%), as compared to those published in the French language, which represent only 0.5%.

Distribution of the documents	Electronic search	Manual search	Total
Documents identified	**3802**	**1563**	**5365**
Duplicate documents	**258**	**0**	**258**
Single documents	**3544**	**1563**	**5107**
% in English	**99**	**100**	**99.5**
% in French	**1**	**0**	**0.5**

Table 1: Results of global search

The exclusion of studies from the analysis was in most cases for the following reasons: 1) did not fit with the inclusion criteria, 2) not related to the question under review, 3) non-empirical studies (conceptual work, qualitative studies, etc.). Disagreements about study inclusion or exclusion were initially solved by consensus, and when this was not possible, they were arbitrarily resolved by a third reviewer. Only ten *articles remained as shown in Figure 1.*

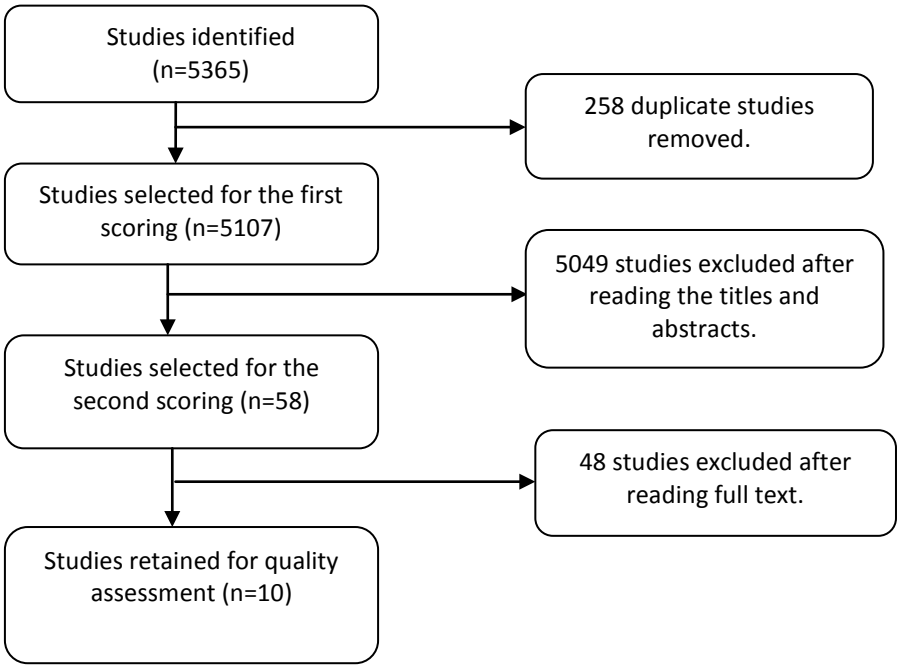

Figure 1: Prescreening process of the articles

2.3 Methodological quality and data extraction

To assess the methodological quality of ***the*** ten studies retained, we were inspired by the evaluation grid established by Straub & al. (2004) concerning the evaluation of the quality of measuring instruments in the context of information systems. A quality evaluation of each of the ten articles was based on five criteria: 1) type of research, 2) content validity, 3) pre-test and/or pilot test, 4) construct validity, and 5) reliability. According to these authors, criteria 1 to 3 are ***highly*** desirable and ***recommended, but 4 and 5*** are ***mandatory*** validities for instrument measurement.

The quality of each study was carefully assessed using predefined criteria by Straub & al. (2004). The psychometric properties of the ten studies ***which*** were retrieved ***and*** which met the inclusion criteria are presented in table 2.

Table 2: Methodological quality of the reviewed studies

* Exp = Exploratory; Con = Confirmatory

Authors	Type of Research*	Content validity	Pretest / Pilot test	Construct validity	Reliability	Number of dimensions /Total scale
Bernard & al. (2004)	Exp			√	√	4 / 9 items
Kerr & al. (2006)	Exp			√	√	5 / 45 items
Mattice & Dixon (1999)	Exp				√	3 / 22 items
Muse (2003)	Exp			√	√	7 / 26 items
Osborn (2001)	Exp	√	√	√	√	6 / 20 items
Parnell & Carraher (2003)	Exp	√		√	√	3 / 9 items
Pillay & al. (2007)	Con			√	√	4 / 18 items
Roblyer & al. (2008)	Exp	√		√	√	4 / 25 items
Smith (2005)	Exp			√	√	2 / 12 items
Watkins & al. (2004)	Exp	√		√	√	6 / 27 items

2.3.1 Criterion 1: Type of the research

As can be seen in Table 2, all these studies were based on exploratory research, except one (Pillay & al.) which used a confirmatory research. According to some authors, a confirmatory factor analysis is considered necessary to ***refine*** and validate the measurement scale, and is more efficient compared to the exploratory analysis in terms of validation of instruments (Straub & al, 2004). Confirmatory factor analysis (CFA) provides more information about the fit of the model, and has become accepted as the preferred way to assess construct validity (Bourque & al., 2006).

2.3.2 Criterion 2: Pretest/Pilot test

It appears that this criterion was rarely employed in theses studies, except in the study of Osborn that used a pilot study. Therefore, Boudreau & al. (2001) recommend that prior to the administration of the questionnaire to the sample selected for the study, it is necessary to pre-test the questionnaire. This criterion is largely neglected by researchers because of cost and time constraints. Then, the pre-test and / or pilot study is an important step in the process of construction and validation of an instrument (Straub & al., 2004).

2.3.3 Criterion 3: Content validity

The table 2 shows that the studies of Osborn, Parnell & Carraher, Roblyer & al., and Watkins & al. were based on literature review and a panel of two or three experts, without conducting an empirical test. The authors of these studies have chosen a face validity approach instead of a content validity to develop their tool, and Osborn has not detailed the evaluation procedure of the questionnaire items by the three experts and the method used. Furthermore, Penta & al. (2005) emphasize that face validity is the less stringent validation process, because it refers to the apparent value of the instrument rather than its real value. There are many methods to verify a content validity, like Delphi, Q-sort, and Content validity ratio.

2.3.4 Criterion 4: Construct validity

The above table shows that the principal component analysis (PCA) is widely used by the authors to determine the construct validity of their instrument, with the exception of Pillay & al. wh**o** opted for a confirmatory factor analysis (CFA). The vast majori**t**y of authors who have used the PCA method based themselves on Kaiser's criterion (eigenvalue ***equal*** or ***higher than 1***) and ***Cattell's*** scree ***test*** to extract factors. However, Roblyer & al. did not specify in their study the ***strategies used*** to ***determine*** the ***number*** of ***factors*** to ***retain. Bernard & al.*** based themselves ***only o***n K***aiser's criterion, and Mattice & Dixon did not*** attempt to ***verify the construct validity*** of the instrument. For reasons of methodological rigor, many researchers recommend using a combination of criteria for determining the number of factors to retain, in addition to Kaiser*'s* test, such as scree plot or Horn's parallel analysis (Yong-Mi, 2009). Among the studies retained, there is only one **(**Parnell & Carraher**)** that combined three methods (Kaiser*'s* test, scree plot and parallel analysis) for determining the

number of factors to retain. However, the maximum likelihood (ML) method is considered by many researchers as being an effective method to determine the number of factors to retain (Fabrigar & al., 1999).

All the authors that have chosen the PCA method have used a varimax rotation. Although the orthogonal rotations produce solutions easier to interpret, many researchers agree on the fact that a rotation varimax can convey a distorted view of reality (Bourque & al, 2006). The latter added that solutions whose factors are completely independent, i.e. no correlation between ***factors*****,** this is rarely the case in education.

Also, some studies are based on factor loadings greater than or equal to 0.40, except the study of Kerr & al. which is based on factor loadings greater than or equal to 0.35, and Watkins & al. did not specify factors loading in their study. Hair & al. (2006) recommend that the factor loading**s** greater than 0.50 be considered practically significant. However, Roussel & al. (2002), strongly recommend to use a CFA to test the construct validity of an instrument.

2.3.5. Criterion 5: Reliability

As for this last criterion, it is found in Table 2 that the reliability data ***were limited*** to ***internal consistency*** and *were* consistently good to excellent across many studies. Nevertheless, internal consistency of some dimensions of the tools of Mattice & Dixon, Osborn, and Pillay & al. is below the threshold required by Hair & al. (2006). F*or a confirmatory* study, reliability should be equal to or above 0.70, and for exploratory study, equal to or above 0.60. For example, one of three factors of the tool of Mattice & Dixon had an *internal consistency coefficient* below *0.52; and for Osborn, three of six factors had a coefficient alpha below 0.50*. However, t*he Jöreskog rho* used in the confirmatory analysis is preferred to the Cronbach's alpha to test the reliability of internal consistency of the scale, since it is less sensitive to the number of items of a scale (Roussel & al., 2002).

2.4 Synthesis of studies

The present systematic review also showed that the tools vary *in terms of the number of factors and items*, the reliability of each factor, the process validation (type of research, content validity, pretest / pilot study, and construct validity), the size and the type of population, and the *Likert* t*ype rating* s*cales.* However, some *tools* show little evidence of reliability and/or validity. Exploratory factor analysis, to a lesser extent, is also used to assess construct validity. However, the widespread use of principal component analysis for tasks theoretically conferred to the confirmatory factor analysis (validation instruments) must be questioned (Bourque & al., 2006). Unfortunately, Fabirgar & al. (1999) emphasize that many researchers mistakenly believe that PCA is a type of EFA when in fact these procedures are different statistical methods designed to achieve different objectives. Also, some authors such as Bernard & al, Kerr & al, Muse, Osborn, and Roblyer & al. have carried predictive validity of their tool *via different technical* approaches like multi-regression analysis, discriminant analysis or binary logistic regression. This type of validity is considered to be optional and not mandatory to assess the psychometric quality of an instrument, but can also show the applied value of research (Straub & al., 2004).

Thus, the total number of dimensions or factors used to measure readiness for online learning is 44. The longer tool containing more items is that of Kerr at al., with 45 items, and the shorter is that of Smith with 12 items. Some dimensions identified from the ten tools appear quite similar (see Appendix A). For example, the items of the following dimensions: Computer skills, skills and relationships online, technology skills / mastery skills and the Web address all the issue of technical skills that a student should have before taking online courses. There are seven studies out of ten which have reported the percentage of *variance explained by the factor solution. In contrast, among these studies, only three show a percentage higher than 60%, and in three others studies, a percentage less than 50%. In the social sciences,* a factor solution that accounts for 60 percent or more of total variance is satisfactory (Hair & al., 2006). Another important point to consider is that *the sample size in the majority of studies* was very acceptable for factorial analysis except one. Eight studies out of ten had a subject to item ratio greater than 10:1; one had a ratio greater than 5:1, and one had a ratio less than 5:1. The minimal number of subjects providing usable data for the analysis should be ten participants per measured variable (Hair & al, 2006). The majority of studies were run in North America (7 in U.S. and 1 in Canada) and two others in Australia. The reported target population for all of the studies *was students,* except for the study of Watkins & al., where the target population was military people.

The results of the systematic review show that the tools for assessing e-learning readiness are very important and essential for the student, and that their use may increase the retention rate in a virtual education, because they can identify *students who are not prepared* to follow online courses. However, it was found that the majority of these tools are rarely administered by universities to determine whether learners are able to succeed in a virtual learning environment. In contrast, some universities prefer to use their own instrument developed in-house (homemade) by a team of teachers. There are some tools for assessing e-learning readiness that are not identified by the systematic review because they are internally developed by a team of university professors without going through the validation process.

A survey of eighteen universities offering online programs *in the United States was* conducted in April 2010 to check the psychometric quality of their self-assessment tools for online learners. The choice of these universities was conditioned by the fact that they had developed their own self-assessment instruments for students who wanted to take courses online. Some responses received from the responsible departments of distance education and / or the authors of the instruments show that these tools of self-assessment have not been validated or published.

Although their psychometric properties are not shown, a majority of these tools should appear *shorter* and easier to *use, and their content is more generic compared to those* identified in the systematic review. There are two aspects that differentiate unpublished tools from published ones in terms of type of scale and value of the scores. *On the one hand*, most of the unpublished tools were based on *Likert*'s *scale of 3* points (e.g. Rarely/Sometimes/Always or Excellent/Good/Fair) *or dichotomous scale (e.g. True/False or Yes/No*). On the other, the *scores obtained by these tools are arbitrary* and subjective in the sense that they are based on judgment, because there is no compelling reason why they could not be set a little higher or a little lower.

3 Discussion

According to this review, we find that most of these instruments are old and less robust. The advantage of these free online self-assessment tools is to predict whether or no students are ready to take online classes, and to provide immediate feedback about the potential success of students in online learning environment. A high score obtained from these instruments is an indication that the student evidences some of characteristics of successful online learners. But the results from these self-assessment tools are subjective rather than objectives (measurable), and they may not provide the most accurate results unless more serious research is done that proves the validity and reliability of the instrument.

We offer bellow some recommendations for advancing theory, measurement, and research in this area. This review shows that an e-learning readiness is a multidimensional construct that refers generally to computer Internet self-efficacy, self-direction, motivation, interaction, and attitude. Despite most authors of these tools agree on the multidimensionality of this construct, a systematic review reveals a lack of consensus about its dimensionality. The composition of this construct is questioned, and varies greatly from one study to the next.First, we strongly recommend clarify the concept of the e-learning readiness in order to promote greater terminological consistency. It is vital to be clear on the key constructs in the theoretical framework. Some authors have proposed a theory of e-learning readiness (Guglielmino and Gugliemino, 2003). This theory has two major components of learner readiness for successful e-learning: technical readiness and self-directed learning readiness. Each component is composed of specific knowledge, attitude, skills, and habits. In addition, we believe that some theories together (such as Moore's transactional distance theory, Bandura's social learning theory, Kember's open learning theory, and Information system success theory issued by DeLone and McLean) may help us to better conceptualize the construct of e-learning readiness in terms of its operational definition.

In our second recommendation, we suggest that the researchers follow a rigorous methodology for developing a measurement instrument proposed by Bailey and Pearson (1983), Churchill (1979) and Moore and Benbassat (1991) and combined with recommendations of Boudreau et al. (2004) and Straub et al. (2004) with regard to the reliability and validity of the instruments.

The last recommendation concerns the predictive validity of the instrument. We suggest use logistic regression or discriminant analyses to predict the probability of success and failure of the student in virtual courses. This

type of validity is most important in terms of practical value to determine whether a student is ready or not for online learning.

3.1 Limitations

This review presents some limitations with regards to missing publications. The main limitation is the fact that only papers written in English or French were included in the selection process. Another limitation was the time period covered by the search (1990-2010). However, the data uncovered after this period, we cannot exclude the possibility that recent studies have used more rigorous methodology for developing an instrument valid and reliable to assess student readiness for online learning. Therefore, Baylor and Yorkston (2007) recommend that *'The reader can follow the search strategies outlined by the review authors to find related studies published more recently that might be of interest. For example, reviews will frequently list the keywords that were used in the searches*'.

4 Conclusion

At the beginning of this work, little information was available about the tools for assessing e-learning readiness developed and used in universities. A systematic review was conducted and the content of each tool was analyzed. Existing tools were very diverse in terms of the type and number of dimensions. To our knowledge, no systematic review of tools for assessing e-learning readiness in the context of education has been undertaken and published to date.
Moreover, Bourque & al. (2006) have identified shortcomings, following an analysis of 1089 articles published during 1995-2005 in six Canadian periodicals in the field of education, in terms of presentation of factorial analysis and principal component analysis results with regard mainly to extraction and rotation methods. The same authors add that in most cases, researchers, including those in the field of education, use factorial analysis in an inappropriate way to assess the validity of psychometric instruments.

Many unpublished or "homemade" tools have been developed, because some universities attempt to address the lack of a self-assessment tool which is standardized, reliable and valid to administer to students who want to enroll in online courses. However, scores obtained through these tools to assess the readiness of a student towards e-learning remain uncertain, because their psychometric properties have not been demonstrated, and these instruments were not developed according to a theoretical and empirical approach.

This systematic review has identified the lack of standardization among these published and unpublished tools as a factor that could discourage the students from using them due to their heterogeneity. A valid and reliable student online readiness tool is very essential in order to identify students who are ready to take online courses, and to reduce withdrawal rate.

This study is an effort to raise awareness among online educators and researchers of need to give attention to effective instrument design.

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Appendix A: A Dimension synthesis of student online readiness

E-learning readiness dimensions / Authors	Bernard et al. (2004)	Kerr et al (2006)	Mattice et Dixon (1999)	Muse (2003)	Osborn (2001)	Parnellet et Carraher (2003)	Pillay et al. (2007)	Roblyer et al (2008)	Smith (2005)	Watkins et al. (2004)
Academic skills	√									
Attitude towards computers						√				
Background confidence			√							
Beliefs/Achievement beliefs							√			
Comptuter self-efficacy						√				
Computer confidence			√	√						
Computer skills	√		√							
Comfort with elearning								√		
Dependent learning	√									
Enrollment encouragement				√						
External locus of control			√	√						
Flexibility of course					√					
Importance to your success										√
Independent learning	√									
Interaction										
Interest Index		√								
Internet discussion										√
Learner preferences						√				
Motivation			√	√						√
Online audio/video										√
Online skills and relationships										√
Organization							√			
Need for online learning	√									
Readiness Index		√								
Risk-taking							√			
Quality of course					√					
Self-direction								√		
Skills										
Study environment			√	√						
Technological skills/mastery					√	√	√			
Technology access										√
Technology Index		√								
Tenacity				√						
Web skills			√							