

Examining Construct Validity of the Student Online Learning Readiness (SOLR) Instrument Using Confirmatory Factor Analysis

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Abstract

This study examines the construct validity of the Student Online Learning Readiness (SOLR) instrument. The SOLR instrument consists of 20 items to evaluate social competencies, communication competencies, and technical competencies in online learning. A large midwestern university was selected to test the construct validity of the SOLR instrument. A total of 347 undergraduate students participated in this study. The confirmatory factor modeling approach was used to assess the construct validity of the SOLR instrument for this study. As a result of confirmatory factor analysis (CFA), the hypothesized model of 20-item structure of the SOLR instrument was verified as an acceptable fit for the data.

Keywords: student readiness, online learning, factor analysis

Yu, T. (2018). Examining construct validity of the student online learning readiness (SOLR) instrument using confirmatory factor analysis. *Online Learning, 22*(4), 277-288.
doi:10.24059/olj.v22i4.1297

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The ongoing efforts of researchers have continued to measure student readiness in online learning (Dray, Lowenthal, Miskiewicz, Ruiz-Primo, & Marczyński, 2011; McVay, 2001; Parnell & Carraher, 2002; Smith, 2005; Watkins, Leigh, & Triner, 2004), and a number of student readiness instruments in online learning have been used in higher education (Bernard, Brauer, Abrami, & Surkes, 2004; Dray & Miskiewicz, 2007; Kerr, Rynearson, & Kerr, 2006; Mattice & Dixon, 1999; McVay, 2001; Parnell & Carraher, 2003; Watkins et al., 2004). In addition, previous research has supported the positive relationship between student readiness and students' academic achievement in online learning (Bernard et al., 2004; Dray et al., 2011; Kerr et al., 2006). The importance of adequate social and academic support has been highlighted in order to enhance the students' sense of belonging in online learning both for increased meaningful learning experiences and higher retention rates (Ali & Leeds, 2009; Atchley, Wingenbach, & Akers, 2012).

In line with the importance of measuring and reinforcing the level of student readiness in the online learning environment, Yu and Richardson (2015) found that social, communication, and technical competencies are all highly associated with academic learning outcomes and learner satisfaction in online learning. In their study, they developed the Student Online Learning Readiness (SOLR) instrument to measure students' social, communication, and technical competencies in online learning. The SOLR instrument consists of 20 items, and the factorial validity and internal consistency reliability of the SOLR instrument were examined in their study with exploratory factor analysis (EFA) and item analysis. As a result of EFA, four factor structures of the SOLR instrument of student readiness in online learning explained 66.69% of the variance in the pattern of relationships among the items. All four factors had high internal consistency (all Cronbach's $\alpha > .823$).

This is a follow-up study to Yu and Richardson's (2015) study. Yu and Richardson (2015) found statistical evidence for the factorial validity and internal consistency reliability of the SOLR instrument using EFA and item analysis. In the scale development process, however, construct validity should be tested based on the theoretical foundations because EFA is not a sufficient tool to test it. Therefore, this study examines the construct validity of the SOLR instrument using confirmatory factor analysis (CFA).

Review of Related Literature

The Student Online Learning Readiness Model

The theoretical framework for the student online learning readiness (SOLR) model derived from Tinto's (1975) student integration model (SIM). In his studies, he has found evidence for the significance of students' social integration in increasing student retention in higher education by enhancing academic integration and helping students to form learning communities (Tinto, 1975, 1998, 2000, 2005, 2006, 2008). According to Tinto, the main component of social integration is the quality of students' interactions with instructors and classmates (Tinto, 1975, 2000, 2005, 2006). In addition, he stressed a positive effect of social support on student retention (Tinto, 1975, 1998, 2000, 2005, 2008). In fact, Tinto's (1975) SIM was based in the traditional face-to-face classroom setting. For this reason, to expand Tinto's social integration to the online learning environment, Yu and Richardson (2015) proposed the SOLR model as a new conceptual model for student retention in online learning, as shown in Figure 1.

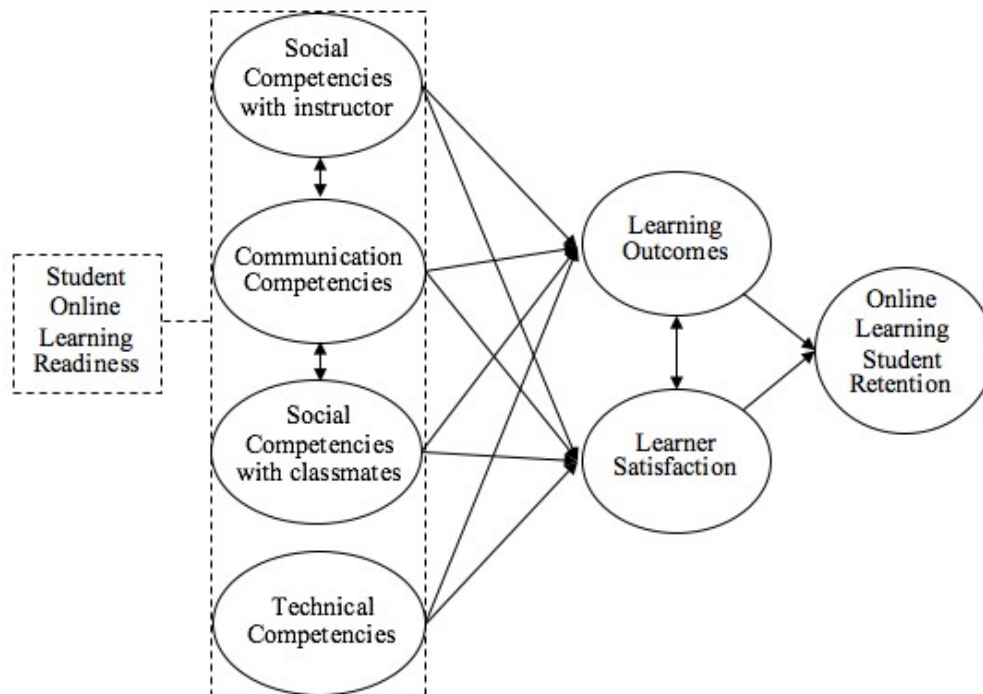


Figure 1. Student Online Learning Readiness (SOLR) Model

The SOLR model consists of four components to measure student readiness for online learning (i.e., social competencies with the instructor, communication competencies, social competencies with classmates, and technical competencies). The positive relationships between four components of the SOLR model and learning outcomes or learner satisfaction in an online learning environment have been verified in previous research (e.g., for social competencies with the instructor see Chen, Huang, Chang, Wang, & Li, 2010; Parker, Hogan, Eastabrook, Oke, & Wood, 2006; and Shen, Cho, Tsai, & Marra, 2013; Williams, 2003; for communication competencies see Betermieux & Heuel 2009; Dabbagh, 2007; Dabbagh & Bannan-Ritland, 2005; Volery & Lord, 2000; and Williams, 2003; for social competencies with classmates see Shen et al., 2013; and for technical competencies see Cho, 2012; Herrera & Mendoza, 2011; Osika & Sharp, 2002; Selim, 2007; Watulak, 2012; and Whale, 2006). In addition, the influence of learning outcomes and learner satisfaction on student retention rates in online learning has been supported (Carey, 2011; Lee & Choi, 2013). That is, student online learning readiness as measured by students' social, communication, and technical competencies plays a significant role in the enhancement of student retention in online learning in the SOLR model.

The Student Online Learning Readiness Instrument

The Student Online Learning Readiness (SOLR) instrument (Yu & Richardson, 2015) consists of 20 self-reported items, including five items for the measurement of social competencies with the instructor in online learning (Shen et al., 2013), five items for the measurement of social competencies with classmates in online learning (Shen et al., 2013), four items for the measurement of communication competencies in online learning (Dray et al., 2011; McVay, 2001), and six items for the measurement of technical competencies in online learning (Wozney et al., 2006), as shown

in Table 1. Cronbach's alpha for internal consistency for each subscale was .882 for technical competencies, .823 for social competencies with classmate, .874 for social competencies with the instructor, and .871 for communication competencies, with sample size of 331 (Yu & Richardson, 2015).

Table 1
Student Online Learning Readiness (SOLR) Instrument

Factor	No.	Items
Factor 1: Technical competencies	1	I have a sense of self-confidence in using computer technologies for specific tasks.
	2	I am proficient in using a wide variety of computer technologies.
	3	I feel comfortable using computers.
	4	I can explain the benefits of using computer technologies in learning.
	5	I am competent at integrating computer technologies into my learning activities.
	6	I am motivated to get more involved in learning activities when using computer technologies.
Factor 2: Social competencies with instructor	<i>How confident are you that you could do the following social interaction tasks with your INSTRUCTOR in the ONLINE course?</i>	
	7	Clearly ask my instructor questions.
	8	Initiate discussions with the instructor.
	9	Seek help from instructor when needed.
	10	Timely inform the instructor when unexpected situations arise.
Factor 3: Social competencies with classmates	<i>How confident are you that you could do the following social interaction tasks with your CLASSMATES in the ONLINE course?</i>	
	12	Develop friendships with my classmates.
	13	Pay attention to other students' social actions.
	14	Apply different social interaction skills depending on situations.
	15	Initiate social interaction with classmates.
	16	Socially interact with other students with respect.
Factor 4: Communication competencies	17	I am comfortable expressing my opinion in writing to others.
	18	I am comfortable responding to other people's ideas.
	19	I am able to express my opinion in writing so that others understand what I mean.
	20	I give constructive and proactive feedback to others even when I disagree.

Methods

Research Context

A survey was created and administered using the Qualtrics program, and the survey links were distributed through Blackboard Learn in the spring 2015 semester. Twenty-six online courses that were offered by the Extended Campus at a large midwestern university were selected across multiple program areas, including engineering, social science, linguistics, business, agriculture, and others, in order to reduce possible bias in competency levels among learners in a particular program. The survey links were posted in the announcement folder of each online course. The Extended Campus offers online courses that would be offered across the university system and supports online course development by providing one-on-one instructional design consulting. A recruitment message was sent to instructors via email at the beginning of the semester. But participants did not have any direct contact with the investigators. Data were checked for duplicate responses by comparing participating student names and email addresses, and duplicate responses were removed. The response rate was 20.6%.

Participants

Of a total of 1,683 undergraduate students, 347 participated in this study, and their majors included communications, computer science, mechanical engineering, animal science, political science, education, psychology, management, and others. In terms of the academic levels of the participating students in this study, 36.5% of students were seniors, 20.1% were juniors, 25.4% were sophomores, and 18.0% were freshmen. One hundred and eighty-five female students (53.3%) and 162 male students (46.7%) participated in this study. The majority of the participating students in this study (98.5%) reported being in an age range of 18–23 years old.

Data Collection

Student Online Learning Readiness survey. The SOLR instrument (Yu & Richardson, 2015) was administered to students to gather data using an online survey program. The 20 SOLR survey items were measured on a 5-point scale (1 = *disagree*, 2 = *tend to disagree*, 3 = *neutral*, 4 = *tend to agree*, 5 = *agree*). The online SOLR survey was created by using a recognized online survey tool, and the students could access to the survey link from the front page of each online course. This study was approved by the University Human Subjects Institutional Review Board, and informed consent was waived.

Data analysis. Confirmatory factor analysis (CFA) was conducted to verify the SOLR instrument by using Analysis of a Moment Structures (AMOS, version 24). The main purpose of running CFA is to examine the relationships among the latent and manifest variables supported by logic or theory (Schreiber, Stage, King, Nora, & Barlow, 2006). Multiple goodness of fit indices have been developed, such as comparative fit index (CFI), normed fit index (NFI), and root mean square error of approximation (RMSEA). The interval of CFI and GFI is 0 to 1, and closer to 1 means there is a stronger relationship between variance and covariance (Schreiber et al., 2006). According to previous research, if CFI and NFI are above .95 and .90, respectively (Hu & Bentler, 1999) and RMSEA is below .06 (Browne & Cudeck, 1993), that indicates the good model fit. Hu and Bentler (1999) also recommended reporting incremental fit index (IFI) to identify the degree of model fit. The cutoff values for an acceptable model fit are if CFI and IFI are above .09 (Bentler, 1992; Hu & Bentler, 1999), NFI is above .80 (Bentler & Bonett, 1980; Forza & Filippini, 1998; Schumacker & Lomax, 2010), and RMSEA is below .08 (Browne & Cudeck, 1993; Bryne, 1998; MacCallum et al., 1996), respectively.

Results

Descriptive Statistics

Table 2 shows the descriptive statistics, including the means, standard deviations, minimums, and maximums of the four proposed factors of the SOLR instrument. It revealed that participating students had a high level of communication competencies ($M = 4.251$), social competencies with the instructor ($M = 4.246$), and technical competencies ($M = 4.191$), whereas they felt a relatively low level of social competencies with classmates ($M = 3.674$).

In the large sample, it is more important to visually assess the shape of the distribution than to test the statistical significance of skewness and kurtosis (Field, 2009). For this reason, the rule of thumb was also applied to test the normal distribution of the data because the number of samples is larger than 200 (Field, 2009).

Table 2

Descriptive Statistics of Each Element of the Student Online Learning Readiness (SOLR) Instrument

	Mean	Std. Deviation	Skewness	Kurtosis	<i>N</i>
Technical competencies	4.191	.710	-.566	-.698	347
Social competencies w/ the instructor	4.246	.706	-.753	-.133	347
Social competencies with classmates	3.674	.824	-.273	-.334	347
Communication competencies	4.251	.696	-.667	-.416	347
Total	4.086	.570	-.379	-.540	347

Confirmatory Factor Analysis for Construct Validity

Various fit indices, such as CFI, IFI, NFI, and RMSEA, have been used to examine model fit. However, the chi-square value was not considered to determine model fit because it is extremely sensitive to sample size (> 200) (Bryne, 1998; Levesque, Zuehlke, Stanek, & Ryan, 2004), and the sample size was 347 in this study. The results of CFA, $\chi^2(164, N = 347) = 512.218, p < .000$, IFI = .912, CFI = .911, NFI = .875, RMSEA = .078, verified that the hypothesized model of the 20-item structure of the SOLR instrument was an acceptable fit for the data. All four fit indices were in the ranges of the cutoff values for an acceptable model fit (i.e., CFI: .911 $>$.90, IFI: .912 $>$.90, NFI: .875 $>$.80, RMSEA: .078 $<$.08). As shown in Figure 2, the completely standardized loadings ranged between .57 and 0.90. Finally, the results of the CFA confirmed that the model fit is acceptable between the proposed model and the observed data.

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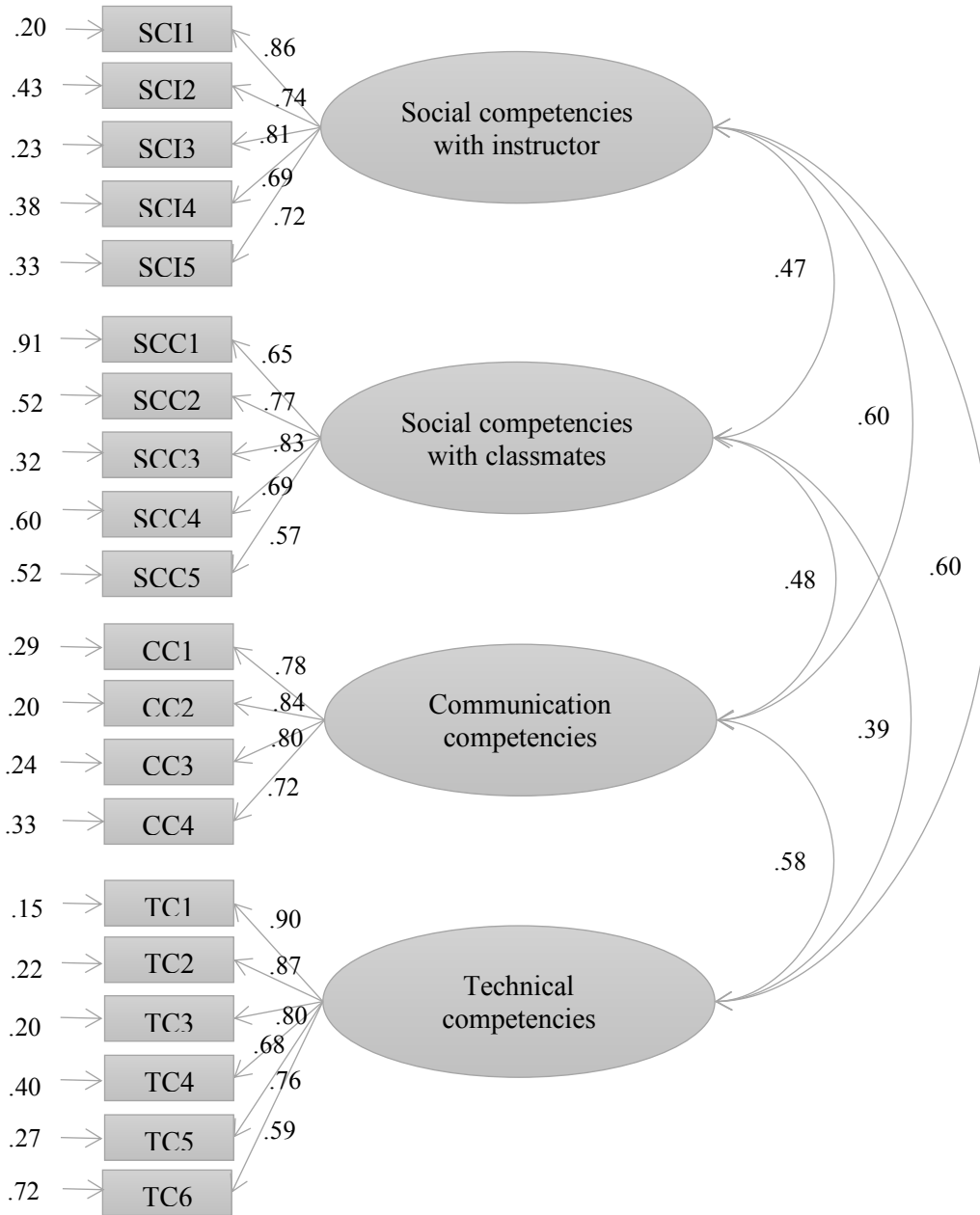


Figure 2. Latent factor solution for the Student Online Learning Readiness (SOLR) instrument with completely standardized factor loadings.

Discussion

The purpose of this study was to test the construct validity of the SOLR instrument in an online learning setting. In the first phase of the scale development process, the factorial validity and internal consistency reliability of the SOLR instrument had been verified using EFA and item analysis (Yu & Richardson, 2015). This study then found evidence that proves the construct validity of the SOLR instrument with four factor structures of social competencies with instructor, social competencies with classmates, communication competencies, and technical competencies,

which were supported by the literature. As a result of CFA in this study, the hypothesized model of the 20-item structure of the SOLR instrument was verified as an acceptable fit for the data, $\chi^2(164, N = 347) = 512.218, p < .000, IFI = .912, CFI = .911, NFI = .875, RMSEA = .078$). The 347-student sample size was large enough for the CFA because it was larger than the suggested sample size of 300 (Comrey & Lee, 1992).

Conclusions

This study provides a reliable instrument for researchers and practitioners in higher education to measure their students' social, communication, and technical competencies in online learning. The results of this study have confirmed that the SOLR instrument can be used to measure the students' level of readiness for online learning before they take an online course. While online learning is becoming an increasingly large part of higher education, it also brings some challenges, such as lower retention rates (Angelina, Williams, & Natvig, 2007; Holder, 2007; Lee & Choi, 2011; Poellhuber, Chomienne, & Karsenti, 2008) and a low sense of belonging (Ali & Leeds, 2009; Link & Scholtz, 2000; Ma & Yuen, 2010; Reio & Crim, 2006) in online courses compared to face-to-face courses. Hence, administrators or institutions can use the SOLR instrument to build a detailed profile of their students' online learning readiness and to create support structures for the success of their students in online courses or programs.

This study also suggests what kinds of supports are needed for distance learners to succeed in online learning. Computer and technical skills have been determined to be a significant factor for student retention and learning outcomes in online learning. However, these skills alone will not be able to guarantee a better learning experience. Although the learning environments in online courses and traditional face-to-face classrooms are different, instructors and students still play the main role of the learning processes in both learning environments. Therefore, educators and administrators in higher education should pay more attention to their students' online learning readiness by looking at their social, communication, and technical competencies.

There were two limitations with regard to this study. The first limitation was an essential sampling bias. The samples in this study were collected from the online courses at a single university. This sampling process might threaten the ability to generalize the results of this study, although various samples were included from different majors or programs. The second limitation related to school setting because participants in this study were not enrolled in completely online programs but rather individual online courses. Although the survey asked them to answer the questions as a current learner or potential learner in an online course, it is possible participants answered the questions based on experiences as both face-to-face and distance learners. For this reason, it is possible different results might have been found if this study were conducted with students in a fully online program.

For future research, it is recommended that this study be repeated with students from multiple colleges or universities to overcome statistical sampling bias. Another recommendation is to compare student readiness between students enrolled in a fully online program and those that are taking a single online course. Last but not least, because the SOLR instrument was developed to measure students' perceived competencies, not actual competencies, this kind of student self-assessment can be biased. Therefore, comparing differences between students' perceived competencies and their performance is recommended.

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