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Measuring self-regulation in online and blended learning environments

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ABSTRACT

In developing the Online Self-regulated Learning Questionnaire (OSLQ) to address the need for an instrument measuring self-regulation in the online learning environment, this study provides evidence toward the reliability and validity of the instrument. Data were collected from two samples of students. The first sample of students took coursework using an online course format while a second sample of students took coursework delivered via a blended or hybrid course format. Cronbach alpha (α) and confirmatory factor analyses were performed to assess the psychometric properties of the OSLQ across both samples of students. Results indicate the OSLQ is an acceptable measure of self-regulation in the online and blended learning environments.

Since the mid-1990s, there has been a boom in the number of U.S. colleges and universities providing courses and degree programs via distance education—education or training courses delivered to off-campus locations via audio, live or prerecorded video, or computer technologies (Lewis, Snow, Farris, & Levin, 2000). According to the U.S. Department of Education statistics, there has been a 72% increase in the number of institutions offering distance education, with 1680 intuitions offering about 54,000 online courses and 1190 distance learning programs enrolling 1.6 million students. This rapid growth is expected to continue (Web-based Education Commission, 2000). In 1998, 44% of higher education institutions in the country offered distance education courses, an 11% increase from 1995 (Carnevale, 2000). With the rapid development of online instruction, our understanding of teaching and learning in this new environment is lagging behind. In a comprehensive review of the literature, Tallent-Runnels, Thomas, Lan, Cooper, Ahern, and Liu (2006) indicated many important issues of online instruction and learning which have yet to be addressed in research. As such, existing principles and theories of educational psychology need to be reexamined or modified to reflect unique characteristics of the online learning environment and help us to understand online teaching and learning (Broad, 1999).

Among the different course delivery formats in distance education, the Internet has been the medium of choice for most institutions. Additionally, the Internet is also being used to supplement instruction thereby changing the traditional face-to-face course delivery format. One distinguishing characteristic of online learning is the autonomy students experience in the learning environment. As such, online instruction eliminates the limitation of place, time, and physical materials and to a great degree gives students the control over when, what, and how to study (Cunningham & Billingsley, 2003). Researchers contend that this autonomy gives students the freedom to unrestrictedly move from one topic to another "without concern for predetermined order or sequence," (McManus, 2000, p. 221). Consequently, Bowen (1996) found that the online learning environment was the most beneficial for the students with an internal locus of control who believed they had control over events and situations in their lives. Bowen (1996) concluded that students with internal accountability beliefs generally perform better than students with an external locus of control in online courses.

As the online learning environment is characterized with autonomy, self-regulation becomes a critical factor for success in online learning. Researchers have repeatedly shown the enhancing effects of self-regulatory behaviors on students' academic performance in regular classrooms (Kramarski & Gutman, 2006; Kramarski & Mizrachi, 2006; Lan, 1996; Orange, 1999). If these self-regulatory learning skills are important to the success of learning in the traditional face-to-face classroom, it can be expected that these self-regulatory learning skills will play an even more important role in learning in the online environment. Students lacking self-regulatory learning skills may misconstrue the autonomy of the online learning environment and, as a result, may not accomplish learning tasks they are expected in online courses. However, the role of self-regulatory skills in the online learning environment has not received the same attention as it does in the traditional face-to-face environment.

In one study that we found that investigated the relationship between self-regulated learning and academic performance in online courses, McManus (2000) adapted an Aptitude Treatment Interaction (ATI) paradigm to investigate effects of the aptitude variable of self-regulated learning and two treatment variables of linearity of information presentation and availability of advanced organizer on educators' learning on applications of computer software. Students' self-regulated

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Table 1
Blended course internal consistencies for each subscale

Subscale	α
Environment structuring	.90
Goal setting	.86
Time management	.78
Help seeking	.69
Task strategies	.67
Self evaluation	.78

learning was measured by the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich, Smith, Garcia, & McKeachie 1993), then, categorized into three levels as low, medium, and high. Instructional materials were presented in six different manners constituted by three levels of nonlinearity (low, medium, and high) and two levels of availability of advanced organizer (presence vs. absence). Students' declarative knowledge was measured by a multiple-choice test, and their procedural knowledge was measured by 20 computer applications in an authentic situation. McManus found that the advance organizer helped students when materials were presented with low or medium levels of nonlinearity but had a detrimental effect on learning when information was presented with a high level of nonlinearity. Interestingly, he found mixed effects between self-regulation and non-linearity, that is, with the low nonlinearity of presentation, low and medium self-regulated learners performed better than highly self-regulated learners, with the medium nonlinearity of presentation, the three self-regulated groups performed equally well, and with the high nonlinearity of presentation, low self-regulated learners did better than medium and high self-regulated learners.

The findings that students with higher levels of self-regulated learning performed significantly poorer than those with lower level of self-regulated learning in both low and high nonlinearity presentation conditions could be puzzling for self-regulated learning researchers. A possible explanation for the puzzling findings could be the measurement used to classify learners into different levels of self-regulation in learning. With most researchers believing that self-regulation is a context-specific process (see Zimmerman, 1998), an instrument that is valid in the traditional learning environment, such as the MSLQ (Pintrich et al., 1993), may become invalid in the online environment, given the dramatic differences between the two learning environments. As the researcher indicated in his explanation of the interaction effects between self-regulated learning and nonlinearity, it may be that the online environment "does not lend itself to self-regulation strategies use and is unsuitable for these (high and medium self-regulated) learners," (McManus, 2000, p. 243).

More recently, Lynch and Dembo (2004) examined the relationship between self-regulation and online learning in a blended learning context. Lynch and Dembo (2004) found that self-efficacy and verbal ability appeared to significantly relate to academic performance in the form of course grades. In conducting their study of 94 undergraduates in a blended learning context, Lynch and Dembo (2004), however, did not utilize a measure of self-regulation contextualized to the online or blended learning environment. In this instance, a measure of self-regulation of learning for the online and blended learning contexts would be particularly useful for researchers as research continues to indicate a positive relationship between these self-regulatory learning skills and academic performance as contextualized to the online or blended learning environments (Chang, 2007).

The purpose of the current study is to examine the psychometric properties of an instrument created to measure a student's ability to self-regulate their learning in environments that are wholly or partially web-based. In creating the Online Self-regulated Learning Questionnaire (OSLQ), we sought to examine its psychometric properties (e.g. reliability and validity) across students experiencing a blended or hybrid course delivery format as well as a wholly online course format. A blended or hybrid course format consists of instruction that takes place in both the online and traditional face-to-face learning environments. To achieve this purpose, we examined the instrument across two samples of students. The first study sample consisted of students enrolled in a blended course delivery format while the second study sample consisted of students enrolled in an online course delivery format.

1. Study 1: method

1.1. Participants

The sample consisted of 434 students enrolled in a course having a blended or hybrid class format at a large, public university located in

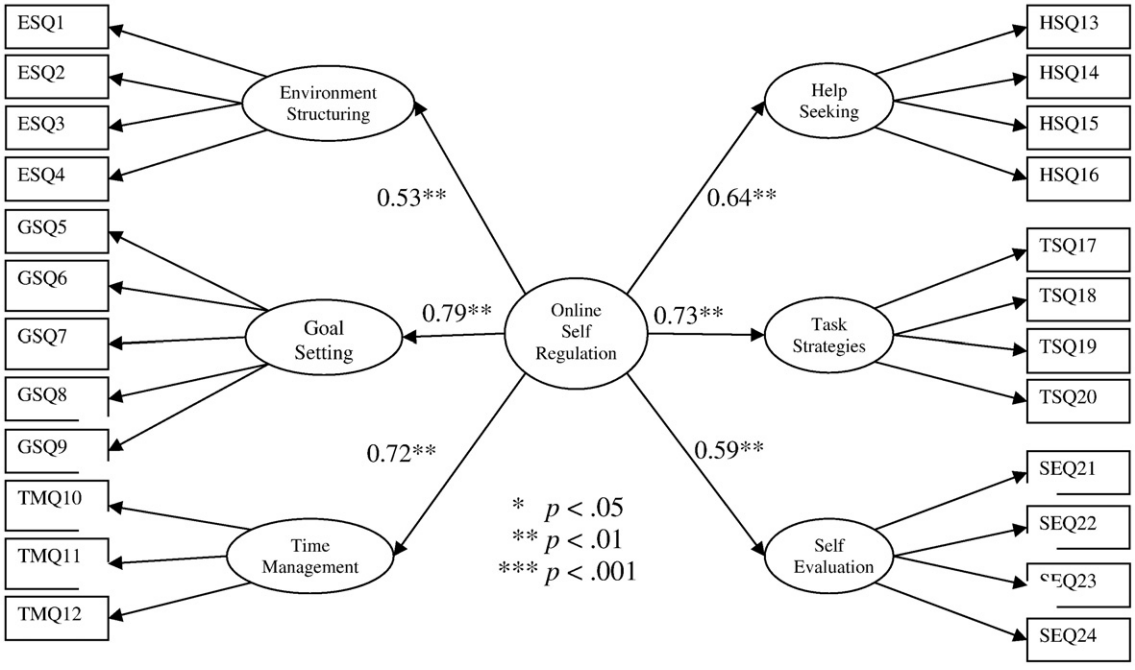

Fig. 1. OSLQ path diagram for blended course format students.

Table 2
Standardized path coefficients for blended course students

Path	Std. coeff.	Path	Std. coeff.
Environment structuring → ESQ1	.76	Help seeking → HSQ13	.65
Environment structuring → ESQ2	.66	Help seeking → HSQ14	.73
Environment structuring → ESQ3	.77	Help seeking → HSQ15	.59
Environment structuring → ESQ4	.67	Help seeking → HSQ16	.56
Goal setting → GSQ5	.58	Task strategies → TSQ17	.55
Goal setting → GSQ6	.62	Task strategies → TSQ18	.43
Goal setting → GSQ7	.74	Task strategies → TSQ19	.57
Goal setting → GSQ8	.77	Task strategies → TSQ20	.60
Goal setting → GSQ9	.45	Self evaluation → SEQ21	.44
Time management → TMQ10	.64	Self evaluation → SEQ22	.63
Time management → TMQ11	.59	Self evaluation → SEQ23	.62
Time management → TMQ12	.64	Self evaluation → SEQ24	.57

the Southwestern United States. Of those who self-selected to participate, 54% (n=235) of the sample were female while approximately 74% (n=321) of the sample identified themselves as White or European American followed by 13% (n=56) identifying themselves as Hispanic, 9% (n=39) identifying themselves as African American, and 4% (n=18) identifying themselves as Asian Americans. A total of 18 different academic disciplines were represented and resided approximate to the university given the nature of the blended course format. The majority of students enrolled were liberal arts or business majors completing the course to satisfy a general education core requirement for the university studied. The cumulative earned credit hours of the student respondents ranged from 0 to 158 h with a mean of 43.03 earned hours and a standard deviation of 10.51 h. This distribution of cumulative earned hours indicates that the majority of students were classified as freshman and sophomores. Students were recruited from a pool of 936 students enrolled in a computer-based literacy course that satisfies a university general education requirement. As 434 students self-selected to participate in the study from this sampling frame, the resulting response rate was 46%.

1.2. Measure

The Online Self-regulated Learning Questionnaire (OSLQ; Lan, Bremer, Stevens, & Mullen, 2004; Barnard, Paton, & Lan, 2008) is a 24-item scale with a 5-point Likert response format with a 5-point Likert-type response format having values ranging from strongly agree (5) to strongly disagree (1). The OSLQ was developed from an 86-item pool and then examined for their internal consistency and exploratory factor analyses results for data collected. Higher scores on this scale indicate better self-regulation in online learning by students. The OSLQ consists of six subscale constructs including: environment structuring; goal setting; time management; help seeking; task strategies; and self-evaluation. The scores obtained from the measure demonstrated adequate internal consistency of scores with α=.90. Nunnally (1978) has suggested that score reliability of .70 or better is acceptable when used in basic social science research such as in this study. When examining the internal consistency of scores by subscale, values for Cronbach alpha ranged from .67 to .90 revealing sufficient score reliability on the subscale level. Table 1 contains internal consistencies for scores obtained from each of the subscales for students enrolled in the blended course format. Appendix A contains a complete copy of the instrument including subscale construct designation.

1.3. Procedure

The OSLQ was administered online. After data were collected, some items were recoded and reversed per instrument instructions. No modifications were made to the instrument. All participants were assured that their responses would remain anonymous and confidential. Data were imported from the Web into a MS Excel format and then imported into SPSS (v. 12.0). Analyses were performed in M*Plus* (v. 5.10; Muthén & Muthén, 2008). Values for missing data were handled using full information maximum-likelihood (FIML) as the method of estimation. As an extension of maximum likelihood, FIML takes advantage of all possible data points in analysis. Enders and Bandalos (2001) indicated that full information maximum-likelihood is superior to listwise, pairwise, and similar response pattern imputations in handling missing data that may be considered ignorable.

1.4. Analyses

A higher order, confirmatory factor analyses was performed to establish evidence towards the construct validity of the measure (Kerlinger, 1986). In performing the confirmatory factor analysis, five statistics reflecting fit were reported: the chi-square goodness of fit statistic (χ^2); the ratio of chi-square statistic to degrees of freedom (χ^2/df); the root mean square error of approximation (RMSEA); the Tucker Lewis Index (TLI), also known as the Non Normed Fit Index (NNFI); and the Comparative Fit Index (CFI). No post hoc model modifications were made.

2. Study 1 results

The chi-square goodness-of-fit statistic was significant indicating that the model may fit the data, $\chi^2(246)=758.79$, $p<.05$. The chi-square statistic has been indicated as being sensitive to sample size thus an adjunct discrepancy-based fit index may be used as the ratio of chi-square to degrees of freedom (χ^2/df). A χ^2/df ratio value less than 5 has been suggested as indicating an acceptable fit between the

Fig. 2. Location of online course format students by zip code.

Table 3
Online course internal consistencies for each subscale

Subscale	α
Environment structuring	.92
Goal setting	.95
Time management	.87
Help seeking	.96
Task strategies	.93
Self evaluation	.94

hypothesized model and the sample data (MacCallum, Brown, & Sugawara, 1996). With a χ^2/df ratio value of 3.08, the proposed model may have an acceptable fit. The root mean square error of approximation (RMSEA) as compensating for the effects of model complexity was 0.04, which according to Browne and Cudek (1993) indicates an acceptable fit of the model being less than or close to 0.05. The value of Tucker Lewis Index (TLI), also known as the Non Normed Fit Index (NNFI) was .95 and value of the Comparative Fit Index (CFI) was .96. Hu and Bentler (1999) note that fit index values of .95 or close to it are indicative of good fit. Thus, the model appears to fit the data well as seen in Fig. 1. The paths in the model were all significant with standardized values ranging from .43 to .77. Table 2 contains the standardized path coefficients from the latent variable constructs to the items. Results indicate evidence towards the construct validity of the OSLQ with respect to students enrolled in a blended course format.

3. Study 2: method

3.1. Participants

The study consisted of a sampling frame of 628 unduplicated students with working (deliverable) e-mail addresses enrolled in online courses at a large, public university located in the Southwestern United States. Of these students taking online courses, 204 self-selected to complete the survey online by responding to a recruitment e-mail message resulting in a 32% response rate. Participants were informed as to the voluntary nature of the study. Participants were also assured as to the confidentiality of their responses. Approximately thirty-six percent of the participants identified themselves as male (n=73) and 82.6% as white (n=168). The student gender distribution (73 males versus 131 females) in this study is representative of those enrolling in distance education courses across the nation (Kramarae, 2001). The student ethnic/racial distribution in this study was representative of the student population of the university studied. A total of 24 different academic degree programs and a total of 146 different U.S. postal zip codes were represented. Fig. 2 contains the locations of all students enrolled in the wholly online course format by zip code. There were approximately three students who were located internationally, whose locations are not represented on the map in Fig. 2.

3.2. Measure

The same measure employed in *Study 1* was utilized in *Study 2*. For *Study 2*, the scores obtained from the measure demonstrated an adequate internal consistency of scores with α=.92. When examining the internal consistency of scores by subscale, values for Cronbach alpha ranged from .87 to .96 revealing sufficient score reliability on the subscale level. Table 3 contains the internal consistencies for scores obtained for each subscale for students enrolled in the online course format.

3.3. Procedure

The same procedure was employed in *Study 1* as in *Study 2*.

3.4. Analyses

The same analyses were performed in *Study 1* as in *Study 2*.

4. Study 2 results

The chi-square goodness-of-fit statistic was significant indicating that the model may fit the data, $\chi^2(246)=680.57$, $p<.05$. The chi-square statistic has been indicated as being sensitive to sample size thus an adjunct discrepancy-based fit index may be used as the ratio of chi-square to degrees of freedom (χ^2/df). A χ^2/df ratio value less than 5 has been suggested as indicating an acceptable fit between the hypothesized model and the sample data (MacCallum et al., 1996). With a χ^2/df ratio

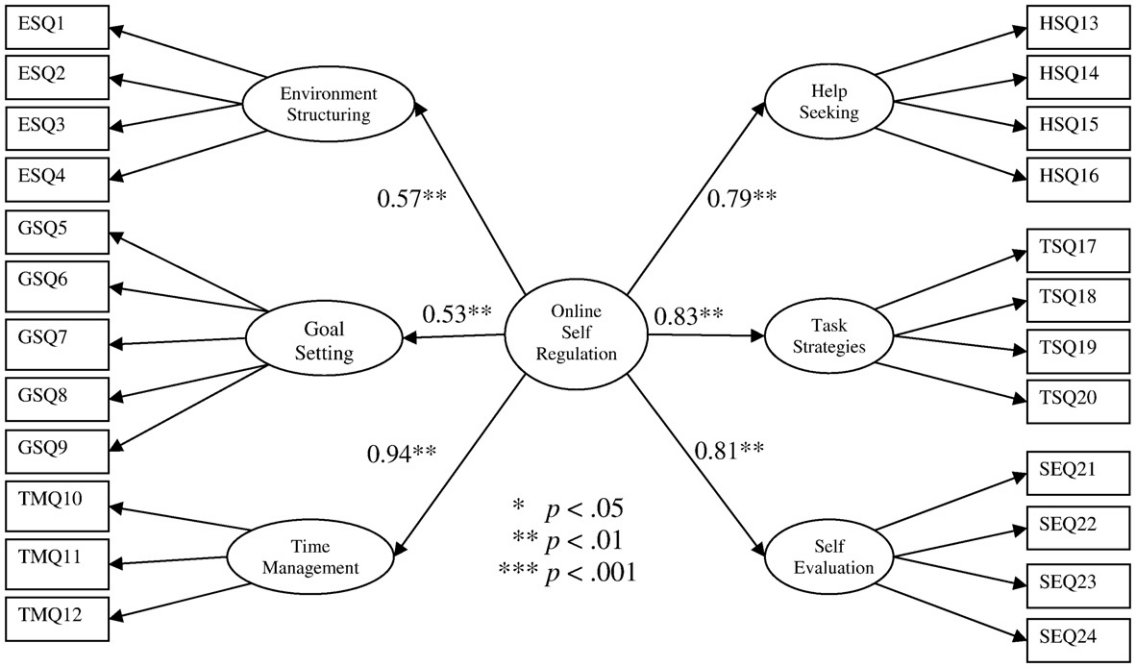

Fig. 3. OSLQ path diagram for online course format students.

Table 4
Standardized path coefficients for online students

Path	Std. coeff.	Path	Std. coeff.
Environment structuring → ESQ1	.81	Help seeking → HSQ13	.48
Environment structuring → ESQ2	.87	Help seeking → HSQ14	.73
Environment structuring → ESQ3	.86	Help seeking → HSQ15	.32
Environment structuring → ESQ4	.79	Help seeking → HSQ16	.30
Goal setting → GSQ5	.78	Task strategies → TSQ17	.72
Goal setting → GSQ6	.79	Task strategies → TSQ18	.54
Goal setting → GSQ7	.78	Task strategies → TSQ19	.59
Goal setting → GSQ8	.84	Task strategies → TSQ20	.68
Goal setting → GSQ9	.58	Self evaluation → SEQ21	.74
Time management → TMQ10	.77	Self evaluation → SEQ22	.46
Time management → TMQ11	.72	Self evaluation → SEQ23	.68
Time management → TMQ12	.71	Self evaluation → SEQ24	.66

value of 2.77, the proposed model may have an acceptable fit. The root mean square error of approximation (RMSEA) as compensating for the effects of model complexity was 0.06, which according to Browne and Cudek (1993) indicates an acceptable fit of the model being less than or close to 0.05. The value of Tucker Lewis Index (TLI), also known as the Non Normed Fit Index (NNFI) was .93 and value of the Comparative Fit Index (CFI) was .95. Hu and Bentler (1999) note that fit index values of .95 or close to it are indicative of good fit. Thus, the model appears to fit the data well as seen in Fig. 3. The paths in the model were all significant with standardized values ranging from .46 to .84. Table 4 contains the standardized path coefficients from the latent variable constructs to the items. Results indicate evidence towards the construct validity of the instrument for students enrolled in an online course format.

5. Discussion

When having the option, Roblyer (1999) found that students chose online course formats over traditional face-to-face courses. It is clear that the enrollment of students delivered by blended and online course formats will only increase thus the development and validation of the OSLQ to assess self-regulatory skills in the blended and online learning environments is timely.

The results of both *Study 1* and *Study 2* indicate evidence toward the reliability and validity of the OSLQ to assess the self-regulatory learning skills of students enrolled in both blended and online course formats. The OSLQ intends to provide a means of assessing the self-regulatory learning skills of students in both the online and blended learning environments. In the current study, the two samples were not combined to test for different levels of measurement invariance given that the data for the students in the blended and online course formats were collected at different points of different academic semesters. Future research should consider testing for measurement invariance by collecting the data for both groups of students at approximately the same point in a semester. Additionally, those students in the blended course format sample were taking at least one course that had a blended course delivery format. Their remaining coursework could have employed online, blended, or traditional face-to-face course delivery formats. Conversely, those students in the online course format sample were taking all of their coursework online. From the diverse course delivery formats possible within the blended sample, the researchers did not find it appropriate to compare these two samples by employing multi-group modeling.

Zimmerman (2008) noted that vast amounts of research on learning and performance are evident of the importance of self-regulated learning in any learning context whether it may be online, blended, or face-to-face. The development of self-regulated learning is a proactive process and thus as the context of students' learning changes and develops so must the methods of measuring self-regulation evolve. As such, Zimmerman questioned whether these new contexts in which we measure self-regulation could address the question of whether changes in students' use of self-regulatory skills are linked to overall academic achievement as the learning would be primarily personally managed in such contexts such as the online and blended learning environments. The OSLQ would be a helpful measure to address this specific query. As utilized in future research, the OSLQ could be utilized to investigate whether increases in students' self-regulatory skills in online and blended courses, personally managed, student-centered learning contexts, are associated with increases in overall academic achievement.

Self-regulated learning is indeed a process that may fluctuate and change with each variation within the learning context. The advantage of using the OSLQ is that it expands self-regulation research into the online learning domain. Researchers can employ the OLSQ to assess self-regulatory learning skills as well as changes in the use of these skills in an online learning format and therefore provide key information about both the learner and the context in which the learning takes place. Schraw (2007) has suggested that self-regulatory learning skills can be enhanced by computer-based instruction found in the online and blended learning environments. Findings from a large, multi-national study identified several aspects of technology-enhanced learning environments that had the potential to support self-regulated learning (Steffens, 2006). These aspects include but are not limited to an environment that provided more opportunities for interaction, contained a feedback and self-monitoring system, used a method of cognitive apprenticeship (i.e., coaching), and supported self-efficacy beliefs and optimistic attributions among learners (Steffens, 2006). An online or blended learning environment that incorporated these aspects may suggest enhance self-regulated learning skills yet there is no evidence as of yet to support the claim. To provide this evidence (negating or supporting), researchers could employ the OSLQ across similar online learning formats and across time to help identify those online and blended learning environments that truly have potential for the facilitation of self-regulatory learning skills.

The many applications of the OSLQ in future research are as diverse as the many contexts of online and blended learning that take place. As the number of students enrolling in online and blended courses increase, it is likely that the variation in the methods of teaching and learning that occur will also increase. Currently, online courses are expanding beyond the traditional, face-to-face educational environment while becoming more and more incorporated into economic institutions interested in enhancing the skill level and abilities of its workers. For that reason, self-regulatory processes may come to play a larger and more significant role within online and blended course format than it has previously in traditional, face-to-face education. Thus, the development and further validation of an instrument like the OSLQ becomes relevant and even necessary given the need to assess courses and learners in emerging online and blended learning environments. The OSLQ would be one of many methods of assessing courses and learners with specific respect to how these courses facilitate self-regulatory learning skills and how learners develop these skills.

Appendix A

Item	Subscale
1. I set standards for my assignments in online courses.	Goal setting
2. I set short-term (daily or weekly) goals as well as long-term goals (monthly or for the semester).	
3. I keep a high standard for my learning in my online courses.	
4. I set goals to help me manage studying time for my online courses.	
5. I don't compromise the quality of my work because it is online.	
6. I choose the location where I study to avoid too much distraction.	Environment structuring
7. I find a comfortable place to study.	
8. I know where I can study most efficiently for online courses.	
9. I choose a time with few distractions for studying for my online courses.	
10. I try to take more thorough notes for my online courses because notes are even more important for learning online than in a regular classroom.	Task strategies
11. I read aloud instructional materials posted online to fight against distractions.	

(continued on next page)

Appendix A (*continued*)

Item	Subscale
12. I prepare my questions before joining in the chat room and discussion.	
13. I work extra problems in my online courses in addition to the assigned ones to master the course content.	
14. I allocate extra studying time for my online courses because I know it is time-demanding.	Time management
15. I try to schedule the same time everyday or every week to study for my online courses, and I observe the schedule.	
16. Although we don't have to attend daily classes, I still try to distribute my studying time evenly across days.	
17. I find someone who is knowledgeable in course content so that I can consult with him or her when I need help.	Help seeking
18. I share my problems with my classmates online so we know what we are struggling with and how to solve our problems.	
19. If needed, I try to meet my classmates face-to-face.	
20. I am persistent in getting help from the instructor through e-mail.	
21. I summarize my learning in online courses to examine my understanding of what I have learned.	Self evaluation
22. I ask myself a lot of questions about the course material when studying for an online course.	
23. I communicate with my classmates to find out how I am doing in my online classes.	
24. I communicate with my classmates to find out what I am learning that is different from what they are learning.	

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