Assessing a Measurement Model of Self-regulated learning in an Online Collaborative Learning Environment

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ABSTRACT

CONTEXT

The ability of students to regulate their learning process is essential to the success of their education. This metacognitive ability is also called self-regulation of learning (SRL). The importance of SRL in education has been becoming a motivating factor for many researchers to develop the measurement model for students' SRL behaviour. One of the SRL measurement models in online learning is Online Self-regulated Learning Questionnaire (OSLQ), developed by Bernard et al.(2008). Several studies have tested, adapted and translated the OSLQ in different contexts. However, none of these studies assessed the OSLQ in online-collaborative learning environments, especially in Indonesia.

PURPOSE

The current study aims to assess the OSLQ measurement model's fitness in an Indonesian online collaborative learning environment. The result of this study will provide additional evidence to the validity of OSLQ as an instrument for measuring SRL in online learning, particularly for online collaborative learning.

METHODS

We collected questionnaire (Online Self-regulated Learning questionnaire) data from 277 students. We perform confirmatory factor analyses (CFA) through R studio software to assess the model's fitness to the data. As the indicators for the good of fitness of the model, we used several indices, like CFI, LTI, RMSEA, SRMR and Chisq/df ratio.

OUTCOMES
Based on the result of CFA, we obtained the value for each index as follow, Chisq/df = 1.66 , CFI = 0.926, TLI= 0.914, RMSEA = 0.055, and SRMR = 0.065. All the indicators showed that the OSLQ model has the goodness of fit to the data.

CONCLUSIONS

Based on these findings, we can conclude that the OSLQ can be used d as a measurement model for online collaborative learning.

KEYWORDS
Self-regulated Learning, Online Collaborative learning, Confirmatory Factor Analysis, Self-regulated learning Measurement, OSLQ

Introduction

In the mid of the covid-19 pandemic, many educational institutions moved their learning activities entirely online. This situation has made online learning the primary mode of instruction for many universities whose face-to-face instruction is impossible due to Covid-19 restrictions. In practice, the usage of online learning varies depending on the course characteristics. Some courses use synchronous lecturing mode using video conference platform, while others combine it with online-collaborated learning activities.

The ability of students to regulate their learning is required to succeed in their education (Bergin et al., 2005; Long & Aleven, 2017; Zimmerman, 2000). This metacognitive ability is also known as Self-regulated Learning (SRL) (Zimmerman, 1989). Several studies have shown that self-regulated learning strongly correlates with students' academic performance (Lucieer et al., 2016; Zimmerman, 1990). Theoretically, SRL is a metacognitive capability to regulate internal aspects like emotion, motivation and cognition to achieve the learning objective (Zimmerman, 1989). SRL is increasingly important in online learning, especially in the unit that combines its instruction with a project or collaborative learning activities(Barnard et al., 2009).

Because of the significance of SRL, many scholars have developed several approaches to assess students' self-regulated learning by considering the context of the learning process. According to Araka et al. (2020), in their review of trends in self-regulated learning in online education, the self-report questionnaire is the most common method for measuring students' self-regulation. This type of measurement also identified that most of the studies used MSLQ. Compared to MSLQ, all the items in the OSLQ have been contextualised to an online or blended learning environment. Barnard et al. (2008) argued that it was not appropriate to measure SRL using an instrument that was not intended in online learning.

In OSLQ, Barnard et al. (2008)measured the students SRL based on six subscales. These subscales are associated with six SRL strategies. The six scales consist of goal setting, environment structuring, task strategies, time management, help-seeking, and self-evaluation. Each SRL strategy has four to six items that will capture the student perceptions when practising each strategy (the description of each item can be seen in Appendix A).

Several studies have tested, adapted and translated the OSLQ in different contexts. A survey by Martinez-Lopez et al. (2017) adopted OSLQ to measure students SRL in a Russian MOOC (Massive Open Online Course). They reported that SRL skill was moderate, with a high goal setting and environment structuring level, but low in help-seeking. Similar to Martines-Lopez et al. (2020)., the study by Zalli et al. (2020) also adopted OSLQ in the Malaysian context and concluded that OSLQ is suitable to measure SRL in the MOOC environment. The latest study by Mutiara & Rifameutia (2021) adopted and translated OSLQ for the Indonesian context and reported that the Indonesian version only fitted for 22 of 24 items of OSLQ.

While these studies have extended the validity of OSLQ, none of them tests the instrument in the online collaborative learning environment. The purpose of the current study is to examine whether the OSLQ model can be used to measure SRL in the context of Indonesian online collaborative learning by assessing its goodness of fit. The result of this study will provide additional evidence to the validity of OSLQ as an instrument for measuring self-regulated learning in online learning, particularly for online collaborative learning.

Methods

Participants

The participants in this study were university students who enrolled in an online information system course at a private university in Indonesia. All of the students were in their second year. Among 500 students, 277 (55.4%) agreed to participate in the study. From these

participants, 60.2 % (n = 167) were males and 39.8 % (n= 110) were females. Their age range was 18 to 27 years (M = 20.24; SD = 0.99).

Measures

The Online Self-Regulated Learning Questionnaire (OSLQ) by Barnard et al. (2008) was adapted and translated to build the measurement model of SRL for online collaborative learning in Indonesia. This questionnaire consists of 24 Likert- statements with five scales (ranging from 1 = *strongly disagree* to 5 = *strongly agree*). Barnard et al. (2008) grouped these items into six dimensions, each representing a latent factor in self-regulated learning. These six factors are i) goal setting, ii) environment structuring, iii) task strategies, iv) time management, v) help-seeking, and vi) self-evaluation. The information about the number of observed variables for each dimension can be seen in Table 1.

Table 1 SRL Factor Structure based on Barnard's model

Dimensions/ Factors of SRL	Associated items (Appendix A)	Items per factor
Goal Setting (GS)	GSQ1, GSQ2, GSQ3, GSQ4, GSQ5	5
Environment Structuring (ES)	ESQ6, ESQ7, ESQ8, ESQ9	4
Task Strategies (TS)	TSQ10, TSQ11, TSQ12, TSQ13	4
Time Management (TM)	TMQ14, TMQ15, TMQ16	3
Help-seeking (HS)	HSQ17, HSQ18, HSQ19, HSQ20	4
Self-evaluation (SE)	SEQ21, SEQ22, SEQ23, SEQ24	4
Total items		**24**

Procedure

All of the students were enrolled in an online course named Project Management for Information System. This unit course was delivered online for 16 weeks through video conference once a week. In addition to the online lecturing, the students were also required to participate in the weekly online quiz. Students participated in individual learning activities and project-based learning. In week four, the students were asked to form a group that consisted of five to six students. In groups, students developed project management plans. Each group created their plan using a Wiki page provided in the learning management system.

The students completed the research questionnaire in the last week of the semester, consistent with the project ethics approval. The questionnaire was administrated through the survey feature in the learning management system. Before completing the questionnaire, the students indicated consent and only students who consented continued to the questionnaire page. Among 500 students, 277 students agreed to participate in the study.

Analysis

The factor structure of OSLQ as a measurement model in the online collaborative learning context in Indonesia was assessed using Confirmatory Factor Analysis (CFA) through R Studio Software (with Lavaan (Rosseel, 2012), Psych, QuantPsyc and MVN packages).

Before conducting the CFA, several assumptions were checked. There were no missing values as identified using R studio. Mahalanobis distance (D^2) values greater than chi-square

were excluded as outliers (Brown, 2006; Harrington, 2009). Fifty-eight participants were labelled as outliers and removed from the sample. The remaining 219 responses were analysed. The statistical description of these data can be seen in Table 2.

Table 2 Description of Sample Data (N = 219)

Items	*M*	*SD*	*median*	*min*	*max*	*range*	*skew*	*kurtosis*
Goal Setting (GS)								
GSQ1	3.89	0.62	4	2	5	3	-0.05	-0.12
GSQ2	3.9	0.67	4	2	5	3	-0.16	-0.14
GSQ3	3.82	0.7	4	2	5	3	-0.06	-0.38
GSQ4	3.94	0.63	4	2	5	3	-0.29	0.43
GSQ5	3.75	0.79	4	2	5	3	-0.29	-0.3
Environment Structuring (ES)								
ESQ6	4.13	0.69	4	2	5	3	-0.34	-0.27
ESQ7	3.97	0.72	4	2	5	3	-0.25	-0.33
ESQ8	4.03	0.68	4	2	5	3	-0.21	-0.28
ESQ9	3.88	0.68	4	2	5	3	-0.29	0.11
Task Strategies								
TSQ10	3.55	0.77	4	1	5	4	0.04	-0.1
TSQ11	3.48	0.8	4	1	5	4	-0.28	-0.26
TSQ12	3.27	0.72	3	2	5	3	0.36	0.04
TSQ13	3.47	0.74	3	2	5	3	0.2	-0.31
Time Management (TM)								
TMQ14	3.64	0.7	4	2	5	3	-0.02	-0.28
TMQ15	3.66	0.65	4	2	5	3	-0.12	-0.15
TMQ16	3.62	0.7	4	2	5	3	-0.23	-0.12
Help Seeking (HS)								
HSQ17	3.98	0.64	4	3	5	2	0.01	-0.53
HSQ18	3.96	0.62	4	2	5	3	-0.09	-0.03
HSQ19	3.48	0.97	4	1	5	4	-0.34	-0.41
HSQ20	3.69	0.65	4	2	5	3	0.09	-0.38
Self Evaluating (SE)								
SEQ21	3.55	0.69	4	2	5	3	0.04	-0.27
SEQ22	3.79	0.63	4	2	5	3	-0.12	-0.05
SEQ23	3.74	0.7	4	2	5	3	-0.26	-0.01
SEQ24	3.89	0.65	4	2	5	3	0.01	-0.41

Note: Items are described in Appendix A

According to Bandalos (2014), the sample size (n > 200) is adequate for CFA analysis. Multivariate normality was assessed based on the value of Mardia skewness and Mardia kurtosis, as shown in Table 3. The data departed from the multivariate normal distribution. Some researchers (Brown, 2006; Gold et al., 2003; Kline, 2016; Yuan et al., 2005) argue that non-normality can be handled by using robust maximum likelihood as the estimator. Therefore, this study used robust maximum-likelihood (MLR) from the Lavaan R package.

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Table 3 Result for Multivariate Normality Test (*N* = 219)

Test	Statistic	p-value
Mardia Skewness	5562.03	< 0.05
Mardia Kurtosis	41.066	< 0.05

Results

Assessment of model fit

This study used several CFA indices to measure the goodness of fit of the OSLQ as a measurement model. These indices consist of Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root means Square Error of Approximation (RMSEA) and Standardised Root Mean Square Residual (SRMR). Since this study uses robust maximum likelihood as the estimator, the indicators' value also refers to their robust value.

The threshold for each index varies to indicate model fit. The CFI requires a value greater than 0.9, TLI should be more than 0.9, SRMR less than 0.08 and RMSEA less than 0.06 (Brown, 2006; Kline, 2016).

Table 4 Goodness of fit based on the CFA

Indicator	Chisq/df	SRMR	RMSEA	CFI	TLI
Threshold for good fit	<3	<= 0.08	<= 0.06	>= 0.9 (or close	>= 0.9 (or close)
Indicator value	1.66	0.065	0.055	0.926	0.914

Based on the result of CFA (shown in Table 4), we obtained the value for the indices as follows, χ^2/df = 1.66, CFI = 0.926, TLI= 0.914, RMSEA = 0.055, and SRMR = 0.065. All the indicators showed that the OSLQ model has the goodness of fit to our data. The path diagram of the CFA model, as shown in Figure 1, represents the relationship among the latent variables and the relationship between each latent variable to correspond observed variable. The relationship among the latent variables is explained by the covariance score ranging from 0.40 to 0,93. In comparison, the relationship between latent and observed variables is described by the standardised factor loading score. According to CFA results, all the observed variables have factor loading bigger than 0.40 (ranging from 0.43 to 0.84), representing an acceptable score (Tabachnick & Fidell, 2014). The standardised factor loadings for each observed variable can be seen in Table 5.
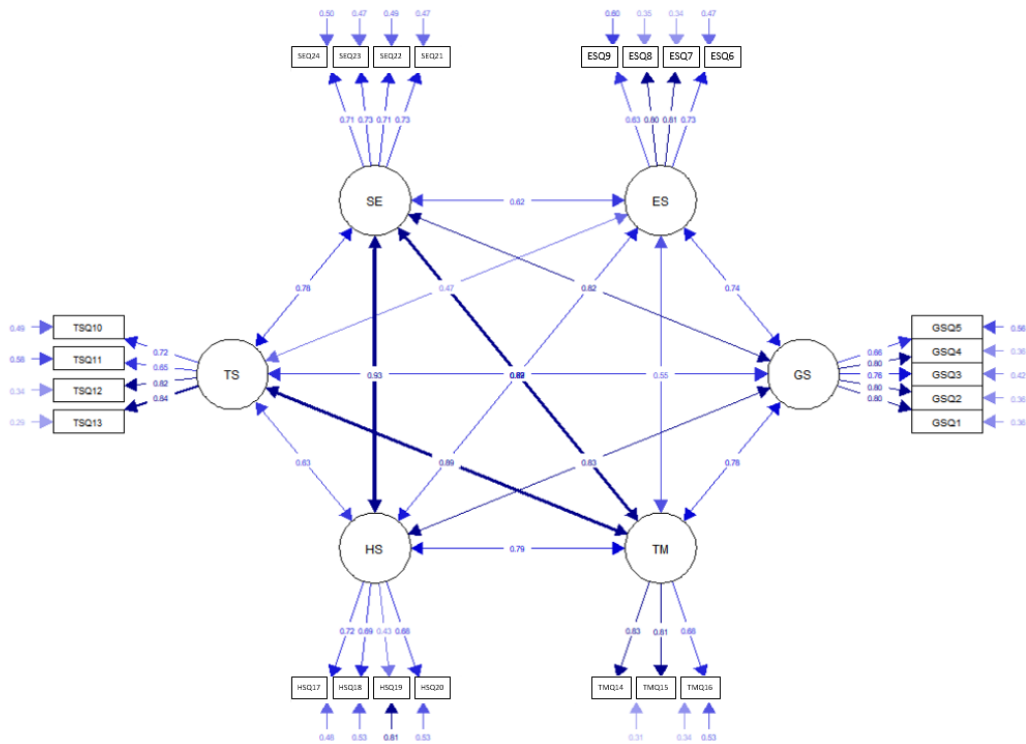
Figure 1 Measurement Model of OSLQ in Indonesian Online Collaborative Learning (*N* = 219)

Table 5 Factor loading for OSLQ Model in Indonesian Online Collaborative Learning

Latent Factor	Indicator	*Estimate*	*Std. Err*	*Z-value*	*p-value*	*Std. all*
GS	GSQ1	0.49	0.035	14.04	< 0.05	0.80
	GSQ2	0.54	0.035	15.34	< 0.05	0.80
	GSQ3	0.53	0.032	16.52	< 0.05	0.76
	GSQ4	0.50	0.040	12.65	< 0.05	0.80
	GSQ5	0.52	0.047	11.20	< 0.05	0.66
ES	ESQ6	0.50	0.044	11.33	< 0.05	0.73
	ESQ7	0.59	0.042	14.10	< 0.05	0.81
	ESQ8	0.54	0.045	11.95	< 0.05	0.80
	ESQ9	0.43	0.052	8.30	< 0.05	0.63
TS	TSQ10	0.55	0.048	11.50	< 0.05	0.72
	TSQ11	0.52	0.054	9.73	< 0.05	0.65
	TSQ12	0.59	0.052	11.29	< 0.05	0.82
	TSQ13	0.62	0.040	15.60	< 0.05	0.84
TM	TMQ14	0.58	0.037	15.48	< 0.05	0.83
	TMQ15	0.53	0.041	12.87	< 0.05	0.81
	TMQ16	0.47	0.046	10.33	< 0.05	0.68
HS	HSQ17	0.46	0.042	10.77	< 0.05	0.72

Latent Factor	Indicator	Estimate	Std. Err	Z-value	p-value	Std. all
	HSQ18	0.42	0.044	9.51	< 0.05	0.69
	HSQ19	0.42	0.066	6.33	< 0.05	0.43
	HSQ20	0.44	0.045	9.88	< 0.05	0.68
SE	SEQ21	0.50	0.045	11.29	< 0.05	0.73
	SEQ22	0.45	0.040	11.15	< 0.05	0.71
	SEQ23	0.51	0.037	13.52	< 0.05	0.73
	SEQ24	0.46	0.042	10.94	< 0.05	0.71

Discussion

This study aimed to assess the validity of the structure of OSLQ as a measurement model of students' self-regulated learning in Indonesia in an online collaborative learning course. The adoption of OSLQ by several studies was based on the assumption that the socio and technical context influence the students' Self-regulated learning strategies. Most of these studies showed that OSLQ is reliable and valid as a measurement model of self-regulated learning in online learning. However, there are still limited studies that assess the validity of this model in the context of online collaborative learning environments, particularly in Indonesia. Thus the current study conducted a Confirmatory Factor Analysis (CFA). It used data from students who enrolled in an online collaborative course in an Indonesian private university. Among 500 students, 277 students agreed to participate in the study. After removing the outlier, there were 219 participants included in this study.

Based on CFA's model-fit indices (CFI, TLI, RMSEA, and SRMR), the OSLQ model had an acceptable fit to the data. This finding informed the validity of OSLQ as an instrument for measuring SRL in online learning with intensive collaborative activities. Additionally, this result also reported the validity and reliability of all 24 of the OLSQ items. This result is different from the study by Mutiara & Rifameutia (2021) that is only valid for 22 items of OSLQ.

The result of this study can be used as justification to use OSLQ as an instrument to measure student perception of SRL in the context of an online complex collaborative learning environment. It should be noted that the primary concern of this study is to assess the OSLQ as a measurement for individual SRL in a collaborative learning environment. The result is limited to information systems. Extending this model for measuring collective or socially-shared of regulation is one of the agenda for further investigation.

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Appendix A

The questionnaire item or OSLQ (Barnard, 2008)

Goal Setting
Item GSQ1: I set standards for my assignments in online courses.
Item GSQ2: I set short-term (daily or weekly) goals as well as long-term goals (monthly or for the semester).
Item GSQ3: I keep a high standard for my learning in my online courses.
Item GSQ4: I set goals to help me manage study time for my online courses.
Item GSQ5: I don't compromise the quality of my work because it is online.

Environment Structuring
Item ESQ6: I choose the location where I study to avoid too much distraction.
Item ESQ7: I find a comfortable place to study.
Item ESQ8: I know where I can study most efficiently for online courses.
Item ESQ9: I choose a time with few distractions for studying for my online courses.

Task Strategies
Item TSQ10: 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.
Item TSQ11: I read aloud instructional materials posted online to fight against distractions.
Item TSQ12: I prepare my questions before joining in discussion forum.
Item TSQ13: I work extra problems in my online courses in addition to the assigned ones to master the course content.

Time Management
Item TMQ14: I allocate extra studying time for my online courses because I know it is time-demanding.
Item TMQ15: I try to schedule the same time every day or every week to study for my online courses, and I observe the schedule.
Item TMQ16: Although we don't have to attend daily classes, I still try to distribute my studying time evenly across days.

Help-Seeking
Item HSQ17: I find someone who is knowledgeable in course content so that I can consult with him or her when I need help.
Item HSQ18: I share my problems with my classmates online, so we know what we are struggling with and how to solve our problems.
Item HSQ19: If needed, I try to meet my classmates face-to-face.
Item HSQ20: I am persistent in getting help from the instructor through e-mail.

Self-Evaluation
Item SEQ21: I summarise my learning in online courses to examine my understanding of what I have learned.
Item SEQ22: I ask myself a lot of questions about the course material when studying for an online course.
Item SEQ23: I communicate with my classmates to find out how I am doing in my online classes.
Item SEQ24: I communicate with my classmates to find out what I am learning that is different from what they are learning