

Self-Regulated Online Learning Instrument Adaptation: A Measurement Model

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Keywords	Abstract
self-regulated online learning, online learning, confirmatory factor analysis, exploratory factor analysis	Self-regulated online learning (SOL) is the self-regulation of students who study independently in an online learning environment. Jansen et al. (2017) show that self-regulated online learning (SOL) has five dimensions or factors: 1) metacognitive skills, 2) time management, 3) environmental structuring, 4) persistence, and 5) help-seeking. SOL is a new instrument that measures students' self-regulation in online learning. However, this instrument has yet to be adapted to Indonesian culture, thus requiring an adaptation process to be undertaken. This study aimed to determine the validation of SOL in an Indonesian context. The adaptation process was carried out following the guidelines of Beaton et al. (2000). Data were collected from 780 students in Vocational High Schools (VHS), majoring in the Automation and Office Management Programme (AOMP) in Central Java, Indonesia, and selected by incidental sampling. Data analysis relied on Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA), assisted by SPSS 23.0 and LISREL 8.80. The results show that the construct of the SOL adaptation instrument needs to be validated and more reliable. Thus, this instrument does not meet the principle of convergent validity.

Introduction

Learning in online environments has become a trend in the last decade. Online learning provides several benefits, including flexibility in terms of time and location. Online learning presents challenges for both teachers and students as they adapt to a physically separated environment. Students are encouraged to learn independently and take responsibility for self-management in the learning process, including managing their time for studying and having awareness in themselves to carry out assignments. The ability to utilise various learning resources is one of the requirements for students.

Many studies have been conducted to test the effectiveness of online learning in improving student achievement. However, there is still room for improvement in analysing the effects of psychological and technical changes on student learning. Even though online learning is not something new, in Indonesia, online learning only became widely known during the extraordinary Covid-19 pandemic. After this remarkable event, the majority of students in Indonesia, especially at the secondary level, became familiar with online learning or hybrid



learning, which combines online and face-to-face learning. Traditional learning offers better psychological conditions and understanding before switching to online learning (Yazid & Neviyarni, 2021). In modern times, the internet has become the most preferred and enjoyable medium of learning, surpassing other forms of learning media (Manurung et al., 2021).

It cannot be denied, however, that online learning offers more convenience in the learning process, separated by space. Online learning can be a challenging experience for many students. It requires not only access to the necessary technological facilities but also a certain level of psychological preparedness. The ability to stay motivated, manage time effectively, and maintain focus is crucial for success in online learning. The students who possess these skills are more likely to excel in this mode of education. Previously, online learning was an option only when school conditions did not allow face-to-face learning; for example, natural conditions were unsuitable. Online learning is an alternative that allows learning activities to continue. Online learning can be carried out with the help of internet networking media, including Zoom meetings, Google Meet, Microsoft Team Meeting, Google Class, and WhatsApp groups.

Students must have proficient learning independence because the key to successful online learning depends on both students and teachers. Online learning requires student learning independence in the learning process (Mufidah & Surjanti, 2021), and one of the key skills required for successful online learning is the ability to independently regulate one's own learning activities (Khoerunnisa et al., 2021). The online learning environment requires students to apply self-regulation, making it critical to study student psychology in order to gain insight into their ability to do so. Meanwhile, the accuracy of measuring instruments is vital so that they can represent the actual situation. In this study, we propose and validate a self-regulation instrument for online learning. We adapted an existing instrument that has been established through rigorous development across various sample populations to ensure its validity and reliability within the Indonesian context. Additionally, there is a need for more instruments relating to self-regulation in online learning in Indonesia. Our research focused on vocational school students in a trial area in Central Java, Indonesia.

Literature Review

Self-Regulation and Students' Achievement

Learning achievement is one of the benchmarks for student learning success (Azhar, 2015). Empirically, even though students' abilities may be high, they cannot achieve optimal learning if they fail to self-regulate in learning activities. This statement becomes a reference for the importance of self-regulated learning for each student. Self-regulated learning is the ability for students to regulate their self to be active in metacognition, motivation, and attitude (behaviour) in learning (Zimmerman, 1989). Self-regulation also emphasises the importance of personal responsibility and the control of the knowledge and skills acquired by students, resulting in a positive and significant relationship to student achievement through the use of self-regulation strategies, especially in the context of online learning. (Zimmerman & Martínez-Pons, 2012).

Previous research has also supported the idea that self-regulated learning is one of the factors consistently having an impact on student academic achievement (Broadbent & Poon, 2015; Cho et al., 2017; Cho & Shen, 2013; Juaninda et al., 2020; Wong et al., 2018). The results of Maldonado-Mahauad et al. (2018) also support that individuals who self-regulate their learning tend to achieve higher academic results than individuals who cannot regulate their learning behaviour. For this reason, self-regulated learning is essential to success in online learning (Littlejohn et al., 2016).

Self-regulated learning skills are critical in online learning environments because students must plan, manage, and control their learning activities to complete the learning process successfully (Wang et al., 2013). Self-regulated learning can, therefore, help achieve learning objectives (Kizilcec et al., 2017). Students with high levels of self-regulation tend to take advantage of a more flexible approach to managing their learning process (Littlejohn et al., 2016). Students with high self-regulation spend more time watching video lectures and taking regular tests, and they are also more likely to return to learning the subject matter (Kizilcec et al., 2017).

Self-Regulation in Online Learning

The primary objective of this study was to study the importance of self-regulated learning and its relationship with student achievement in an online learning environment. Therefore, an instrument was needed to measure self-regulated learning in an online learning environment. The Self-Regulated Online Learning Questionnaire is widely used to assess independent learning skills online (Barnard et al., 2009; Vilkova & Shcheglova, 2021). This instrument has been widely adapted for use in Turkish, Romanian, Russian, and Chinese contexts (Cazan, 2014; Chong et al., 2019; Korkmaz & Kaya, 2012; Martinez-Lopez et al., 2017). Notably, despite extensive research into the matter, there remains a pressing need to provide evidence of the effectiveness of the Self-Regulated Online Learning Questionnaire.

This study adopts the Self-Regulated Online Learning (SOL) instrument developed by Jansen et al. The instrument was developed by combining questionnaire items from the Motivated Strategies for Learning Questionnaire (MSLQ), Online Self-Regulated Learning Questionnaire (OSLQ), Metacognitive Awareness Inventory (MAI), and Learning Strategies Questionnaire (LS) (Vilkova & Shcheglova, 2021). SOL instruments have been applied in parts of the West, such as Europe and the United States. In Indonesia, research within the context of validating the adaptation of the SOL measuring instrument has yet to be explicitly undertaken. Therefore, it is vital to conduct research focusing on the adaptation and validation of the self-regulated online learning instrument developed by Jansen et al. (2017) in the Indonesian context. Thus, this study aimed to understand independent learning skills in an online learning environment utilising Self-Regulated Online Learning.

Research Objectives

The objectives of this study were to:

- 1) Adapt and validate the Self-Regulated Online Learning (SOL) instrument for students in the Indonesian vocational education context, particularly in the Archival Learning for Automation and Office Management (AOMP) programme;
- 2) Examine the factorial structure of the adapted SOL instrument using Exploratory Factor Analysis (EFA) to identify the number of underlying factors and item loadings;
- 3) Confirm the construct validity of the adapted SOL instrument through Confirmatory Factor Analysis (CFA);
- 4) Evaluate the convergent validity of each factor based on standardised factor loadings and t-values; and
- 5) Assess the construct reliability of each dimension of the SOL instrument in the Indonesian context.

Methods

Research Methodology

This study employed a quantitative survey design to adapt and validate the Self-Regulated Online Learning (SOL) instrument in the Indonesian context. Data analysis involved Exploratory Factor Analysis (EFA; $n = 430$) and Confirmatory Factor Analysis (CFA; $n = 350$) using SPSS 23.0 and LISREL 8.80 to examine factor structure, construct validity, and reliability.

Participants

The subjects of this study were Grade 11 students majoring in the Automation and Office Management Programme (AOMP). The samples were collected from 14 different Vocational High Schools (VHS) located across the Central Java region, Indonesia. From the total population of students in these schools, 780 respondents participated in the study, consisting of 36 male students and 744 female students.

The sampling process employed an incidental sampling technique (a type of non-probability sampling), where data were gathered from students who were accessible and willing to participate during the data collection period. Data collection was conducted online using Google Forms in December 2021. Detailed information regarding the distribution of respondents across the 14 participating schools is presented in Table 1.

Table 1: Data on Research Respondents

Schools	Number
Public VHS 1 Cilacap	92
Public VHS 1 Wonosobo	36
VHS Ma'arif NU Tirto	31
VHS Yapek Gombong	62
Public VHS 2 Karangdadap	65
VHS YPE Sampang	29
Public VHS 1 Bawang	71
Public VHS 1 Kendal	37
VHS Muhammadiyah Salaman Magelang	26
Public VHS 2 Semarang	35
Public VHS 1 Batealit	84
Public VHS 1 Slawi	145
Public VHS 2 Magelang	45
VHS Islam Sultan Agung 1 Kalinyamatan Jepara	22
Total	780

Instrument

The study's instrument was adapted from Jansen et al.'s 2017 study on Self-Regulated Online Learning (SOL). SOL consists of 36 items representing five dimensions: metacognitive skills, time management, environmental structuring, persistence, and help-seeking.

Adaptation Procedure

Instrument adaptation is a term that describes the process of translating an instrument from the original language to the target language. In its development, instrument adaptation has become more popular using the term cross-cultural adaptation. Cross-cultural adaptation includes the process of language transfer and cultural adaptation issues in preparing instruments by adjusting where the instrument will be used (Beaton et al., 2000). The flow of instrument adaptation is presented in Figure 1.

Stage 1 involved correspondence via email with Jansen, the original developer of the Self-Regulated Online Learning (SOL) instrument, to obtain formal permission to adapt the instrument. The researchers obtained permission on October 14, 2021 to adapt the SOL. The initial translation from the original to the target language was completed at this stage. Translator 1 was NS, an English Lecturer at Tadulako University. He served as a person who understood the concept of a questionnaire and could provide equivalence from the perspective of the measured construct. Translator 2 was SA, an Economics Lecturer at Universitas Negeri Semarang. Translator 2 was tasked with detecting differences in meaning from the original questionnaire with Translator 1.

Stage 2 synthesised the results of the translation from the previous stage. Researchers conducted the synthesis stage to observe possible discrepancies between the two translation results. At the end of the synthesis process, statement items were produced and carried out in the back translation process at Stage 3.

Stage 3 was back translation, translating the synthesis results into the original language. This process ensured that the translated version represented the same exact item content as the original version.

Stage 4 was the expert committee, which combined all the versions compiled to develop a pre-final version for field testing. The expert committee consisted of a methodologist (UF), a linguist professional (NS), and a translator expert (SA). The researcher compiled the instrument before distributing it to participants who met the criteria. Items were answered on a 7-point Likert scale, ranging from "very uncharacteristic of me" (= 1) to "very characteristic of me" (= 7).

Stage 5 involved testing subjects with the same characteristics as the population to be studied. At this stage, the researcher analysed the data that was collected using Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). The data was collected from 780 respondents, N = 430 with EFA and N = 350 with CFA. The sample division into two groups in the EFA and CFA analysis aimed to avoid false discoveries (Anderson et al., 2017; Kumalasari et al., 2020).

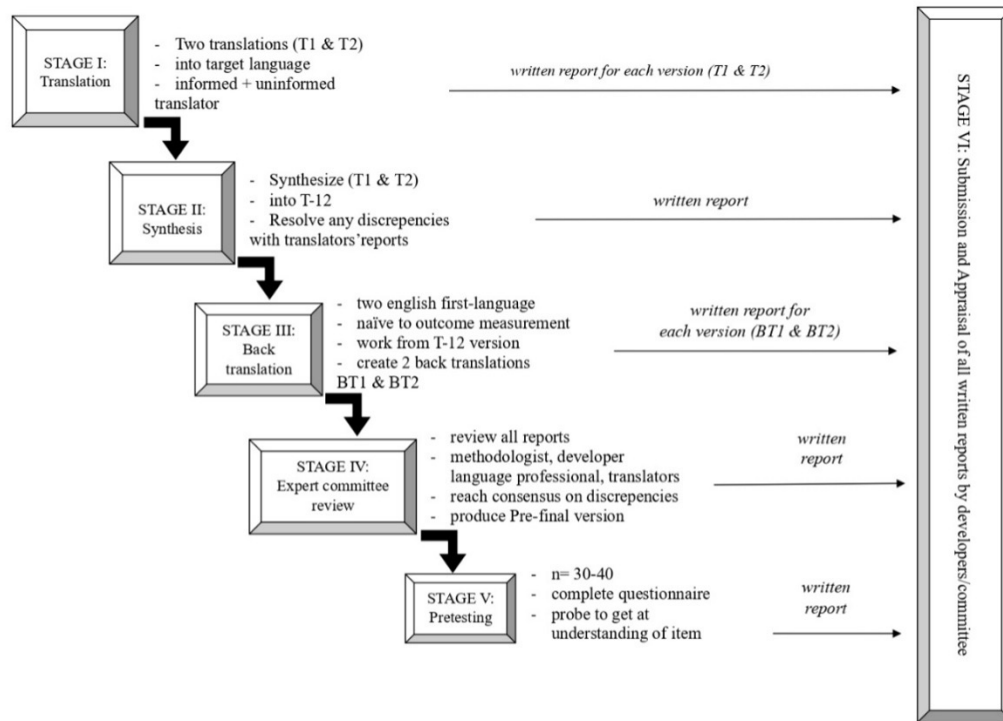


Figure 1: Graphic representation of the stages of cross-cultural adaptation recommended
Findings and Discussion

Exploratory Factor Analysis (EFA)

The first step in SOL validation was to perform an EFA analysis using SPSS Version 23.0. However, this research adapted the SOL measuring instrument, which already had many factors (Jansen et al., 2017). Costello and Osborne (2005), and Kumalasari et al. (2020) still recommend performing EFA on adaptation measuring tools to provide more convincing empirical evidence regarding the number of these construct factors in different samples.

Table 2 shows the results of Total Variance Explained, which explains the factor structure formed by adjusting the previous research article, namely, five factors using SPSS 23.0 data processing results. The total variance that the EFA model can explain is 53.183. The first factor (metacognitive skills) was 22.730; the second factor (time management) was 9.338; the third factor (environmental structuring), 8.951; the fourth factor (persistence), 7.827; and the fifth factor (help-seeking), 4.336.

Table 2: Result of Total Variance Explained

Component	Rotation Sums of Squared Loadings	
	% Variance	Cumulative %
1	22.730	22.730
2	9.338	32.69
3	8.951	41.020
4	7.827	48.847
5	4.336	53.183

The number of factors formed can also be seen from the scree plot image. The number of points above the eigenvalue one equated with the factors specified in the previous research article was five. It shows that there were five groupings of factors. More details can be seen in Figure 2.

Rotation is necessary to find out which items are included in each factor. The rotation uses the varimax method with Kaiser Normalisation through rotation converged in six iterations. A factor is said to have a significant factor loading if the value is above 0.3 (Field, 2013; Kumalasari et al., 2020). Table 3 presents the results of the Rotated Component Matrix, which places each item in its component factor. Empirically, however, it has been found in item B2 (I make sure that I keep up with the weekly readings and assignments for this online learning) with the loading factor (0.418) from factor 2 (time management) shifting to factor 1 (metacognitive skills). It also happened on item C5 (I know what the instructor expects me to learn in this online learning) with a loading factor (0.472) from factor 3 (Environmental structuring) shifting to factor 1 (metacognitive skills).

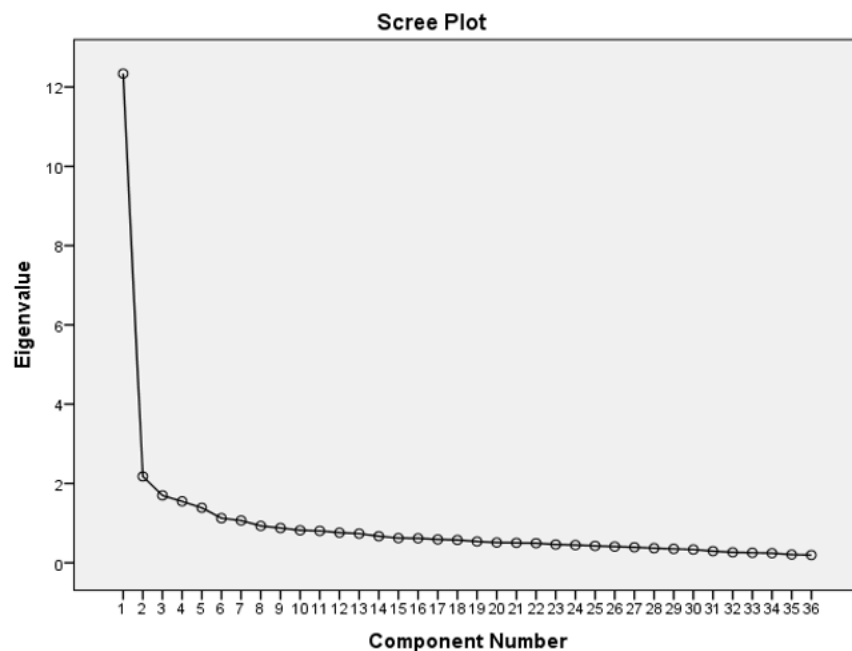


Figure 2: Scree Plot

Table 3: EFA Results on Self-Regulated Online Learning

	Rotated Component Matrix				
	Component				
	1	2	3	4	5
A1	0.569	0.144	0.224	0.190	-0.188
A2	0.567	0.183	0.249	0.194	0.056
A3	0.631	0.111	0.055	0.109	-0.063
A4	0.618	0.097	0.275	0.104	-0.127
A5	0.654	0.070	0.161	0.141	-0.001
A6	0.644	0.214	0.193	0.103	-0.134
A7	0.667	0.084	-0.010	0.201	0.083
A8	0.748	0.154	0.118	0.244	0.040

Rotated Component Matrix					
	Component				
	1	2	3	4	5
A9	0.671	0.123	0.193	0.284	-0.012
A10	0.472	0.254	0.163	0.190	-0.253
A11	0.653	0.027	0.015	0.189	0.036
A12	0.501	0.042	0.110	0.151	0.224
A13	0.499	0.190	0.365	0.010	-0.018
A14	0.571	0.128	0.341	0.017	0.097
A15	0.646	0.241	0.166	0.037	0.136
A16	0.537	0.059	0.278	0.234	0.016
A17	0.751	0.059	0.108	0.158	0.059
A18	0.607	0.333	0.154	-0.027	0.172
B1	-0.023	-0.061	0.056	-0.129	0.733
B2	0.418	0.310	0.411	0.109	-0.240
B3	0.053	0.173	0.005	0.084	0.669
C1	0.201	0.028	0.288	0.682	-0.001
C2	0.236	0.256	0.184	0.747	-0.129
C3	0.324	0.233	0.152	0.743	-0.041
C4	0.330	0.128	-0.041	0.684	0.105
C5	0.472	0.190	0.351	0.230	-0.018
D1	0.162	0.036	0.689	0.058	0.075
D2	0.414	0.104	0.577	0.226	0.006
D3	0.274	0.149	0.472	0.123	0.375
D4	0.152	0.217	0.564	0.188	0.163
D5	0.147	0.167	0.748	0.072	-0.146
E1	0.114	0.782	0.278	0.171	-0.037
E2	0.111	0.758	0.032	0.081	0.100
E3	0.437	0.467	0.165	0.146	0.103
E4	0.137	0.765	0.178	0.104	-0.038
E5	0.288	0.701	0.071	0.149	0.096

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalisation.

a. Rotation converged in six iterations.

According to the findings of the exploratory factor analysis (EFA), the adaptation tool designed for Self-Regulated Online Learning in archival learning for the Automation and Office Management Programme (AOMP) students has been deemed valid after undergoing the EFA process. The questionnaire used in the study consisted of 36 items, which were empirically shown to have a loading factor greater than 0.3. Therefore, it can be concluded that the adaptation tool is a reliable means of supporting self-regulated online learning in the AOMP programme.

Confirmatory Factor Analysis

Based on the grouping of items with EFA, further proof of the instrument's construct validity was carried out, using CFA assisted by the LISREL 8.80 programme. CFA was used to test the dimensionality of a construct by testing validity and reliability, which is one way of understanding the capability of research instruments (also known as questionnaire question items) to measure precisely, to see the validity and reliability of variable, indicator, and item questions (Sujarweni, 2018).

The overall test results in Table 4, based on five model fit criteria, show that all model fit criteria were met. Therefore, it can be concluded that the overall model test shows a good fit (Goodness of Fit).

Table 4: CFA Results on Self-Regulated Online Learning

No.	Indicator	No.	Adapted Version Statement	Indonesian Version	Factor Loading
1	Metacognitive Skills (MS)	A1	I think about what I need to learn before I start doing the task in this online learning.	Saya memikirkan apa yang perlu saya pelajari sebelum saya memulai tugas dalam pembelajaran online.	1.00
		A2	I ask myself about what I should learn before this online learning begins.	Saya bertanya kepada diri sendiri tentang apa yang harus saya pelajari sebelum pembelajaran online dimulai.	0.80
		A3	I formulate short-term goals (daily or weekly) as well as long-terms (monthly or during this online learning)	Saya merumuskan tujuan jangka pendek (harian atau mingguan) dan juga jangka panjang (bulanan atau selama pembelajaran online)	0.71
		A4	I formulate goals to help manage my study time during this online learning.	Saya merumuskan tujuan untuk membantu saya mengatur waktu belajar saya selama pembelajaran online.	0.98
		A5	I formulate specific goals before working on tasks in this online learning.	Saya merumuskan tujuan khusus sebelum mengerjakan tugas dalam pembelajaran online	0.98
		A6	I think of other ways to solve problems and choose the best way during this online learning.	Saya memikirkan cara-cara yang lain untuk mengatasi permasalahan dan memilih cara yang terbaik selama pembelajaran online.	0.89
		A7	I try to use some strategies in effective this online learning in the past.	Saya mencoba menggunakan beberapa strategi di pembelajaran online yang efektif di masa lalu.	0.78
		A8	I have a specific goal for every strategy I use in this online learning today.	Saya mempunyai tujuan khusus untuk setiap strategi yang saya gunakan pada pembelajaran online.	1.01
		A9	I am aware of what strategies I use when I study this online learning.	Saya sadar dengan strategi apa yang saya gunakan ketika saya belajar dalam pembelajaran online.	1.01
		A10	Even though we do not have to take classes every day, I still try to manage my study time for this online learning despite the different days.	Meskipun kami tidak harus mengikuti kelas setiap hari, saya tetap berusaha untuk membagi waktu belajar saya untuk pembelajaran online meskipun berbeda hari.	0.66

No.	Indicator	No.	Adapted Version Statement	Indonesian Version	Factor Loading
		A11	I regularly review to help me understand the important relationships in this online learning.	Saya melakukan review secara berkala untuk membantu saya memahami hubungan penting dalam pembelajaran online.	0.85
		A12	I find myself stopping regularly to check my understanding.	Saya menemukan diri sendiri berhenti secara teratur untuk mengecek pemahaman saya.	0.69
		A13	I ask myself how well I study during this online learning.	Saya bertanya kepada diri sendiri tentang bagaimana baiknya saya belajar selama pembelajaran online.	0.67
		A14	I think about what I should learn after I complete the task in this online learning.	Saya memikirkan apa yang harus saya pelajari setelah saya menyelesaikan tugas dalam pembelajaran online.	0.70
		A15	I ask myself how good I am at achieving my goals after I finish this online learning	Saya bertanya pada diri sendiri seberapa baiknya saya dalam mencapai tujuan-tujuan saya setelah saya menyelesaikan pembelajaran online.	0.78
		A16	I change my strategy when I was not making progress while studying in this online learning.	Saya mengubah stragegi ketika saya tidak membuat kemajuan saat belajar di pembelajaran online.	0.93
		A17	I find myself analyzing the usefulness of strategies when I study for this online learning	Saya menemukan diri sendiri menganalisis kegunaan dari strategi ketika saya belajar untuk pembelajaran online.	1.01
		A18	I ask myself if there was another way to get things done after I finished studying online.	Saya bertanya pada diri sendiri apakah ada cara lain untuk menyelesaikan sesuatu setelah saya selesai belajar secara online.	0.64
		A19	I make sure that I keep up with the weekly readings and assignments for this online learning.	Saya memastikan bahwa saya mengikuti bacaan dan tugas mingguan untuk pembelajaran online.	0.60
		A20	I know what the instructor expects me to learn in this online learning.	Saya mengetahui apa yang diharapkan Guru untuk saya pelajari dalam pembelajaran online.	0.67
2	Time Management (TM)	B1	I find it difficulties to follow the lesson schedule during this online learning.	Saya merasakan kesulitan untuk mengikuti jadwal pelajaran selama pembelajaran online.	1.00
		B3	I often find that I do not spend much time on this online learning because of other activities.	Saya sering menemukan bahwa saya tidak banyak menghabiskan waktu pada pembelajaran online ini karena kegiatan lain.	0.86

No.	Indicator	No.	Adapted Version Statement	Indonesian Version	Factor Loading
3	Environmental Structuring (ES)	C1	I choose the location where I study for this online learning to avoid too many distractions.	Saya memilih lokasi dimana saya belajar untuk pembelajaran online ini untuk menghindari terlalu banyak gangguan.	1.00
		C2	I find it a comfortable place to study during online learning.	Saya menemukan tempat yang nyaman untuk belajar selama pembelajaran online.	0.89
		C3	I know where I can learn efficiently during this online learning.	Saya mengetahui dimana saya dapat belajar secara efisien selama pembelajaran online.	0.88
		C4	I have a regular place that I have set up for this online learning	Saya mempunyai tempat regular yang telah saya atur untuk pembelajaran online.	0.85
4	Persistence (P)	D1	When I feel bored studying during these online lessons, I force myself to pay attention.	Ketika saya merasa bosan belajar selama pembelajaran online ini, saya memaksa diri sendiri untuk tetap memperhatikan.	1.00
		D2	When my mind starts to wander during these online learning sessions, I make a special effort to stay focused.	Ketika pikiran saya mulai berkelana selama sesi pembelajaran online, saya melakukan upaya khusus untuk tetap berkonsentrasi.	0.81
		D3	When I start to lose interest in this online learning, I pushed myself further.	Ketika saya mulai kehilangan minat selama pembelajaran online, saya mendorong diri sendiri lebih jauh.	0.52
		D4	I work hard to do well during this online learning even though I do not like what I have to do.	Saya bekerja keras untuk melakukan dengan baik selama pembelajaran online meskipun saya tidak suka dengan apa yang harus saya lakukan.	0.63
		D5	Even though the material in this online learning is uninteresting, I manage to keep myself working until I finish the job.	Walaupun materi dalam pembelajaran online membosankan dan tidak menarik, saya mengatur diri sendiri untuk tetap mengerjakan sampai saya menyelesaikan pekerjaan.	0.74
5	Help Seeking (HS)	E1	When I do not fully understand something, I ask classmates during online learning for ideas.	Ketika saya tidak sepenuhnya memahami sesuatu, saya bertanya kepada teman sekelas selama pembelajaran online untuk mendapatkan ide.	1.00
		E2	I share my problems with classmates during online learning to know what the difficulties are and how to solve our problems.	Saya berbagi masalah saya dengan teman sekelas selama pembelajaran online sehingga kami tahu apa yang menjadi kesulitan dan bagaimana memecahkan masalah kami.	0.97

No.	Indicator	No.	Adapted Version Statement	Indonesian Version	Factor Loading
		E3	I am persistent up on getting help from the instructor in this online learning.	Saya pantang menyerah dalam mendapatkan bantuan dari Guru dalam pembelajaran online.	0.73
		E4	When I am unsure of some material in online learning, I ask others.	Ketika saya tidak yakin dengan beberapa materi dalam pembelajaran online, saya bertanya kepada orang lain.	0.80
		E5	I communicate with my classmates to find out what I am doing in this online learning.	Saya berkomunikasi dengan teman sekelas untuk mengetahui apa yang saya lakukan dalam pembelajaran online.	0.89

The questionnaire for Self-Regulated Online Learning, in both its original and adapted versions, consisted of five indicators and 36 statements. These five indicators were Metacognitive Skills (MS), Time Management (TM), Environmental Structuring (ES), Persistence (P), and Help Seeking (HS). Following the Confirmatory Factor Analysis (CFA), there were shifts in the number of items for the Metacognitive Skills (MS), Time Management (TM), and Environmental Structuring (ES) indicators compared to the original version. Specifically, the Metacognitive Skills (MS) indicator increased from 18 items to 20 items. Conversely, the Time Management (TM) indicator decreased from three items to two items, as item B2 from the original version was reclassified as A19. Similarly, the Environmental Structuring (ES) indicator changed from five items to four items, with item C5 from the original version being reclassified as A20.

The next consideration was whether the assessment of model fit was complex and this required close attention (Ghozali, 2014). An index indicating that the model is fit does not guarantee that the model is genuinely fit. On the other hand, a fit index that concludes the model is unsuitable does not guarantee that the model is genuinely unfit. Through structural equation modeling (SEM) data processing, researchers cannot rely on one or several fit indices. Nevertheless, it is best to consider the entire fit index. The Goodness of Fit statistics output results can be seen in Figure 3.

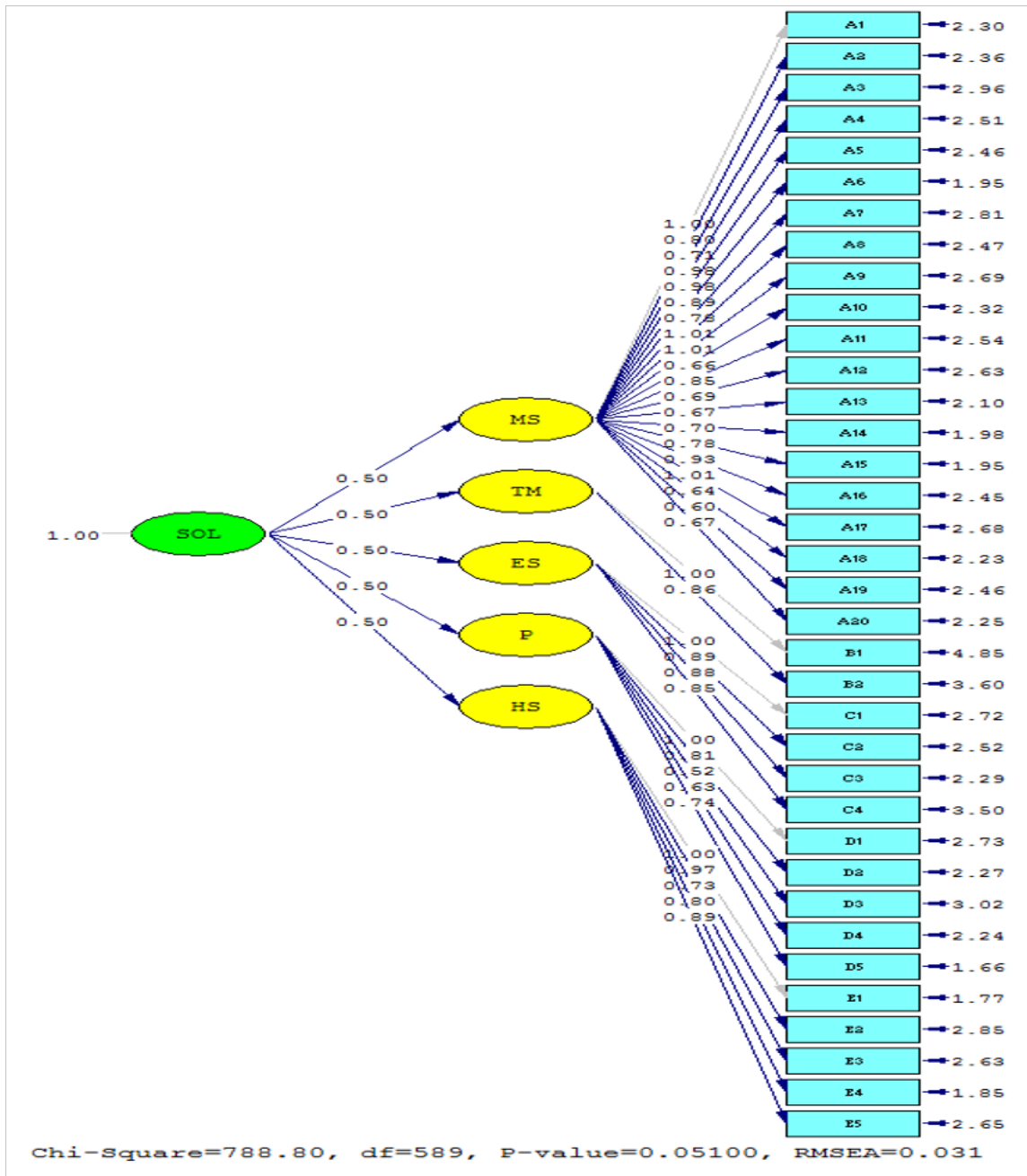


Figure 3: Output Goodness of Fit Statistics

Table 5 shows that the Goodness of Fit estimation results are generally in the fit category; only three indices were not fit, so, overall, it can be concluded that the model was reasonably fit. The sample covariance matrix was relatively the same as the estimated covariance matrix (Riadi, 2018).

Table 5: The Goodness of Fit Testing Criteria

The Goodness of the Fit Index	Cut-off Value	References	Value	Decision
Chi-Square	Chi-Square < 2 df	(Arbuckle, 1997)	Df = 589 $\chi^2 = 78880$	Fit
Significance (P-Value)	P > 0.05	(Arief Wibowo, 2004; Ferdinand, 2014; Pedhazur, 1997)	0.05100	Fit
NCP	NCP < dari 90% CI for NCP	(Ghozali, 2014; Riadi, 2018)	199.80 (130.68 277.01)	Not fit
RMSEA	RMSEA \leq 0.08	(Arief Wibowo, 2004; Ferdinand, 2014)	0.031	Fit
ECVI	ECVI < ECVI for Saturated	Ghozali (2014) Riadi (2018)	2.70 < 3.82	Fit
AIC	< AIC Saturated dan Independence Model	(Ghozali, 2014; Riadi, 2018)	942.80 < 1332.00	Fit
CAIC	< CAIC Saturated dan Independence Model	(Ghozali, 2014; Riadi, 2018)	1316.86 < 4567.38	Fit
NFI	NFI > 0.90	(Ghozali, 2014; Riadi, 2018)	1.00	Fit
NNFI	NNFI > 0.90	(Ghozali, 2014; Riadi, 2018)	1.02	Fit
CFI	CFI \geq 0.9	(Ferdinand, 2014; Pedhazur, 1997)	1.00	Fit
IFI	IFI \geq 0.9	(Ghozali, 2014; Riadi, 2018)	1.02	Fit
RFI	RFI \geq 0.9	(Riadi, 2018)	1.00	Fit
SRMR	SRMR < 0.08	(Hu & Bentler, 1998)	0.21	Not fit
AGFI	AGFI > 0.89	(Riadi, 2018)	0.57	Not fit
PGFI	PGFI > 0.5	(Riadi, 2018)	0.54	Fit

Validity and Reliability

The model fit test (Goodness of Fit) with CFA, convergent validity, and construct reliability was evidenced. One approach to testing construct validity was factor analysis (Azwar, 2017). Sujarweni (2018) used the validity test to assess whether a set of measuring instruments is appropriate for measuring what should be measured. Table 5 shows that five (5) latent variables (factors) and thirty-six (36) observation variables (items) had a standardised loading factor value of 0.50 (Hair et al., 2014) with a T-value > 1.96 (Sujarweni, 2018). This demonstrated that each observed variable (item) was significant in measuring the latent variable. Overall, thirty-six observed variables were valid items measuring the construct of Self-Regulated Online Learning.

In addition to the validity test, a reliability test was also conducted. Sujarweni (2018) stated that the reliability test showed the extent to which a measuring instrument can provide relatively the same results if repeated measurements are made on the same object. High construct

reliability indicated that internal consistency existed at CR 0.70, meaning the measures all consistently represented the same latent construct (Hair et al., 2014).

Table 6 shows the results of construct reliability. Among the five factors of Self-Regulated Online Learning, only the metacognitive skills factor demonstrated high reliability, with a reliability coefficient of 0.848, indicating that it is reliable. In contrast, the other four factors showed reliability values below 0.70 and were therefore considered unreliable: time management (0.290), environmental structuring (0.543), persistence (0.540), and help-seeking (0.621). According to Nunnally (1970), a reliability coefficient above 0.70 indicates good reliability (Greco et al., 2018). Thus, only the metacognitive skills factor met the recommended reliability threshold, while the remaining factors would require improvement to achieve adequate reliability.

Table 6: Calculation of Validity and Reliability

Variable Code	Loading Factor ≥ 0.50	t-Value > 1.96	CR
MS	0.50	33.96	0.848
A1	1.00	*	
A2	0.80	32.20	
A3	0.71	30.07	
A4	0.98	35.55	
A5	0.98	35.55	
A6	0.89	34.01	
A7	0.78	31.75	
A8	1.01	36.01	
A9	1.01	36.01	
A10	0.66	28.74	
A11	0.85	33.24	
A12	0.69	29.55	
A13	0.67	29.02	
A14	0.70	29.82	
A15	0.78	31.75	
A16	0.93	34.73	
A17	1.01	36.01	
A18	0.64	28.18	
A19	0.60	26.99	
A20	0.67	29.02	
TM	0.50	22.22	0.290
B1	1.00	*	
B3	0.86	14.87	
ES	0.50	24.50	0.543
C1	1.00	*	
C2	0.89	18.61	
C3	0.88	18.54	
C4	0.85	18.31	
P	0.50	24.06	0.540
D1	1.00	*	
D2	0.81	17.15	
D3	0.52	18.64	
D4	0.63	15.28	
D5	0.74	16.53	

Variable Code	Loading Factor ≥ 0.50	t-Value > 1.96	CR
HS	0.50	25.46	0.621
E1	1.00	*	
E2	0.97	20.41	
E3	0.73	18.26	
E4	0.80	19.04	
E5	0.89	19.85	

In practice, the items in a measuring instrument must be valid first and then tested for reliability. As such, valid items are only sometimes reliable. Reliable items can be ascertained as valid (Sujarweni, 2018). It happened in the research on adaptation of Self-Regulated Online Learning instruments, where all items were declared valid. However, only one was reliable for construct reliability, while four were unreliable. Thompson and Vacha-Haase (2000) suggest that other factors will also affect the reliability estimates. Five of these are now discussed: test length, speed, group homogeneity, the difficulty of items, and objectivity. Strengthening the previous statement using another source, according to Fernandes (1984, p. 88), the factors affecting reliability are the length of tests, the spread of scores, and the difficulty of test items. Arikunto (2010) explains that the high or low values of item reliability is influenced by the following:

- a. The longer the test, the higher the reliability. It can be seen in Table 5 that the reliability result of the factor with the most items (20 items) was 0.848, while the factor with the fewest items (two items) was 0.290.
- b. Testees, i.e., the number of students will reflect the diversity of results that describe the size of the reliability of the test. The demographic diversity of respondents can be seen in Table 1. As seen in the table, the sampling should have been more representative. Respondents were from public and private schools, from schools with different regions (cities/districts), and some from urban areas and some suburban.

The instructions for filling out the questionnaire were included in writing in the Google Form. There has yet to be supervision for filling out this questionnaire. The questionnaire was distributed online and was addressed directly to each student through the approval of the archiving subject teacher. As a result, this was based only on the flexibility of students' time in filling out questionnaires and the varying conditions of place. Ismiyati et al. (2021) suggest that the low reliability of items in the test might be due to the students' current school environment, including ongoing renovation work and a moving class system, for example, in one day there were three examinations held in three different rooms. Moving from one room to another between examinations may have contributed to the low reliability. It is essential, therefore, to do an EFA and CFA analysis when adapting an instrument. Moreover, these instruments are from different backgrounds and cultures. It would be helpful to have a representative sample for both the EFA and CFA analyses. In addition to this, in choosing the instrument to be adapted, constructs should have factors or dimensions that do not vary much in the number of items presented, meaning there should be a manageable amount between one factor and another within each construct.

Conclusion

This study aimed to validate the adaptation of the Self-Regulated Online Learning (SOL) instrument in the Indonesian context. Based on EFA and CFA results, the instrument retained a five-factor structure consistent with Jansen et al. (2017), with minor item shifts from the time

management and environmental structuring factors to the metacognitive skills factor. The CFA indicated that the overall model fit was acceptable. All 36 items were valid, however, only the metacognitive skills factor demonstrated adequate construct reliability (CR = 0.848), while the other factors were below the recommended threshold (i.e., CR < 0.70). This shows that although the items were valid, the instrument's construct reliability needs improvement, and not all factors fully satisfied the principle of convergent validity.

These findings were consistent with other SRL scale adaptation studies (e.g., Kumalasari et al., 2020; Jansen et al., 2017), which report that some factors, especially those with fewer items, might have lower reliability when instruments are adapted cross-culturally. This highlights the challenge of transferring SRL instruments developed in the West to the Indonesian educational context.

Future research should focus on improving the reliability of less consistent factors, for example by increasing the number of items per factor or refining item wording to better reflect the construct in Indonesian culture. Additionally, further studies could explore the theoretical and practical implications of SOL in online learning, particularly the role of metacognitive skills in enhancing self-regulated learning outcomes. Strengthening instrument validity and reliability is essential to ensure accurate measurement and effective implementation of SOL in diverse educational contexts.

Ethics Approval: Formal ethics approval was not required by the institution for this type of research, as it involved minimal risk. However, all research procedures were conducted in accordance with the ethical standards of the institutional research committee and the 1964 Helsinki Declaration. Informed consent was obtained from all participants, and their anonymity and confidentiality were strictly maintained throughout the research process.

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