Construction and identification of psychometric property self-regulated learning scale for university students

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Abstract

Previous studies state that self-regulated learning is a pivotal component in predicting students’ learning outcome. The present study aims to test the psychometric property of self-regulated learning scale to obtain a sound instrument. The procedure in this study included the scale construction, followed by psychometric property identification covering the content validity (using Aiken’s V and reliability test (Cronbach’s Alpha) of the data obtained from 203 respondents. The reliability coefficient of the final scale was 0.908, its discriminating power ranged between 0.307 and 0.626 with a mean score of 0.462. In other words, the self-regulated learning scale exhibit adequate psychometric property to measure university students’ self-regulated learning.

Keywords

reliability, scale, self-regulated learning, student, validity

Introduction

Academic achievement still become a relevant and important topic in the field of psychology, especially the field of educational psychology. Based on Google Scholar search, the phrase “academic achievement” leads to more than 20,000 published research between 2015-2020. Academic achievement is among the indicators of an individuals’ academic success. For university students, it can be seen from their GPA. Students’ GPA can be predicted since the student admission process by understanding the predictors of academic achievement. Based on Google Scholar search, the phrase “academic achievement predictor” yields about forty published research between 2015-2020. These works report that one’s academic achievement is affected by internal and external factors (Gustina & Rahayu, 2020; Kurniawan et al., 2017; Suddin, 2019). Although both factors are equally important, the internal factors appears to play more significant role within the context of student candidate’s academic achievement prediction.

Previous studies show that self-regulated learning is among the internal factors contributing to the students’ academic achievement (Pamungkas & Prakoso, 2020; Sukmawansyah et al., 2019; Puspita & Rustika, 2018; Sarirah et al., 2017; Darmiany, 2016). Higher self-regulated learning skill is reported to allow individuals achieve their academic goals more easily. According to Pintrich (2000), self-regulated learning refers to an active and constructive process in which students determine their learning goal, monitor, manage, and control their cognition, motivation, and behaviors, directed by their goals and environments. Schunk & Zimmerman (2011) It can also be defined as an individual’s effort to regulate himself by involving metacognitive ability, motivation, and active behaviors, three important aspects of self-regulated learning. Siddaiah-Subramanya et al. (2017) States that self-regulated learning emphasizes individuals’ autonomy and control that direct and maintain individuals to achieve the learning goal.

Self-regulated learning comprises four aspects (Pintrich, 2000): (1) Cognitive control, involving cognitive and metacognitive activities, (2) Motivation, involving efforts to maintain one’s motivation. (3) Behavior, involving one’s effort to control his/her behaviors. (4) Context, involving one’s effort control the context when engaging with the classroom learning activities. Furthermore, Pintrich (2000) state that individuals with proper self-regulated learning skill are able to set their learning goal and plan, monitor and control their cognitive aspects, motivation, and behaviors to achieve the goal.

DiFrancesca et al. (2016) State that the important difference between high and low achievers lies in their self-regulated learning skills, (e.g., their ability to perform metacognitive control, use learning strategy, and self-efficacy). The study conducted by Dörrenbächer & Perels (2016) reports that self-regulated learning is significantly associated with students’ high achievement and low test anxiety, lower neurotic level, and represent a readiness to actively receive the learning process.

Considering the important role of self-regulated learning in academic achievement, it is necessary to develop a quality instrument. There are currently two widely used SRL instruments, Motivated Strategies for Learning Questionnaire (MSLQ) and Learning and Study Strategies Inventory (LASSI). To date, MSLQ has been adapted in many countries (Segura-Robles et al., 2021; Khosim & Awang, 2020; Rosito, 2018; Aziz, 2016; Saks et al., 2015; Feiz et al., 2013). This

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instrument measures different motivational components and learning strategies. Another popular SRL instrument was LASSI (Abdelsamea & Bart, 2019; Abulela & Davenport, 2020; Khalil et al., 2017, 2020; Van Wyk & Mason, 2021). There is also Writing Strategies for Self-Regulated Learning Questionnaire (Teng & Zhang, 2016). Similar to MSLQ, LASSI and Writing Strategies for Self-Regulated Learning Questionnaire is to see the learning strategies.

In Indonesian context, several studies on self-regulated learning report that the SRL is measured using Self-Regulated Learning developed based on Zimmerman’s SRL theory (Retnawati, 2016; Sukmawansyah et al., 2019). However, studies on SRL involving Indonesian university students do not provide detail information related to the theory used in SRL scale development process (Efendi et al., 2020; Hasanah et al., 2019; Oktariani, 2018; Rohmaniyah, 2018), as most of them merely show the reliability coefficient. Studies focusing on self-regulated learning scale development for Indonesian university students are still limited. To our knowledge, there is only one study that focuses on self-regulated learning scale development for university students, conducted by Arbiyah & Triatmoko (2016). It is necessary to conduct a study that focuses on SRL scale development in order to carefully construct the scale, ensuring a high quality, accurate measurement quality. In this regard, the present study attempts to develop self-regulated learning scale for university students with adequate psychometric properties, i.e., high validity and reliability coefficients, to obtain accurate depiction of university students’ self-regulated learning.

In this study, we developed the SRL scale based on the construct proposed by Pintrich (2000). Items in the study were developed based on four aspects of SRL: cognition, motivation, and context. Pintrich’s SRL construct was selected because it specifically suits the learning context and contains behavioral and contextual aspects, which is different from other SRL theories. We consider contextual aspects important because it supports the SRL construct, which is related to the learning environment. Panadero (2017) states that Pintrich’s SRL construct is unique when compared to other SRL constructs, as involves individuals’ effort to control their own overt behavior. Instead of modifying the existing SRL instruments (e.g., MSLQ, LASSI, SRLI, and Writing Strategies for Self-Regulated Learning Questionnaire) because it supports the SRL construct, which is related to knowledge, there is only one study that focuses on self-regulated learning scale development for university students with adequate psychometric properties, i.e., high validity and reliability coefficients, to obtain accurate depiction of university students’ self-regulated learning.

The score ranged between 1-5 (1 = not relevant with the measured construct), 5 = highly relevant with the theoretical construct). The five expert judgments were analyzed using Aiken’s V formula \((V = \frac{\Sigma s}{\sqrt{n(c-1)}})\), and in order to find \(\Sigma s\), the formula of \(\Sigma s = s_1 + s_2 + s_3\) was applied (Azwar, 2017). Any V higher than 0.50 indicates a high content validity (Azwar, 2017). Aiken’s V estimation result is presented in Figures 1.

As displayed in Figure 1, items no.1 to 30 exhibited an Aiken’s V value higher than 0.5, indicating a good content validity. Meanwhile, figure 1 also shows two items with Aiken’s V value equal to and lower than 0.5 (i.e., item no. 59 (V = 0.5) and item 64 (V = 0.45). This shows that there were sixty two items (96.875%) with V coefficient value higher than 0.5. Items no. 59 and 64 were dropped because their values equal and lower than 0.5. Considering that there were too many items left, those with V value lower than 0.6 was also dropped (i.e., item 6 and item 10, V = 0.55, respectively), leaving sixty items with good content validity coefficient. The average content validity coefficient of these 60 items was 0.831, indicating good relevance with the measured construct.
Table 1. Initial Blueprint

| Aspects       | Indicator                                                                 | No. of item | Fav | Unfav | Total | Loading |
|---------------|---------------------------------------------------------------------------|-------------|-----|-------|-------|---------|
| Cognition     | Applying metacognitive strategy to develop a plan                         | 3           | 3   |       | 16    | 25%     |
|               | Applying metacognitive strategy to monitor                                | 3           | 2   |       | 16    | 25%     |
|               | Able to modify one’s cognition                                            | 2           | 3   |       | 7     | 25%     |
| Motivation    | Believe in learning goal                                                  | 2           | 2   |       | 16    | 25%     |
|               | Understand the materials and finish the given tasks                       | 2           | 2   |       | 16    | 25%     |
|               | Able to maintain motivation                                               | 2           | 2   |       | 16    | 25%     |
|               | Able to choose and build strategies to maintain motivation.               | 2           | 2   |       | 16    | 25%     |
| Behavior      | Managing the study time                                                   | 2           | 2   |       | 16    | 25%     |
|               | Able to monitor learning efforts                                          | 2           | 2   |       | 16    | 25%     |
|               | Preparing the study needs                                                 | 2           | 2   |       | 16    | 25%     |
|               | Improving and maintaining learning behaviors                               | 2           | 2   |       | 16    | 25%     |
| Context       | Having a positive perception of the given tasks                           | 4           | 4   |       | 16    | 25%     |
|               | Able to control, regulate, and control the context and the surroundings.  | 4           | 4   |       | 16    | 25%     |
| Total         |                                                                           | 32          | 32  | 64    | 100%  |         |

Figure 1. Coefficient validity test result (item no. 1-64)

Instrument Test

The instrument was tested after performing the content validity test, 60 items were considered having a good content validity. All items were renumbered. The test blueprint was displayed in Table 2.

The test was performed online using Google form (https://bit.ly/risetmahasiswa2020), involving university students. Prior to giving their responses, respondents were asked to fill the consent form and make sure that they suit the respondent criteria. The test was done between 30 November and 12 December 2020. During the test, 203 students gave their responses and gave their consent to participate in this study. The obtained data were analyze to see the discriminating power of the items and the scale reliability coefficient.

Instrument Reliability

The reliability test was performed to see the reliability of a measurement (Azwar, 2014). Items with discriminating power lower than 0.30 was (rit) were dropped, because items with good discriminating power should have at least a value of (rit) 0.30 (Azwar, 2017). Two-stage analysis was performed to obtain the best Cronbach’s Alpha coefficient with rit value of ≥ 0.30 and to obtain an item composition that suits the initial research goal. At the first stage, sixty items were analyzed and results in a Cronbach’s Alpha of 0.931 with discriminating power ranging from -0.11 to 0.635. Eleven items with rit < 0.30 were dropped, leaving 49 items with discriminating power higher than 0.30. At the second stage, the cronbach alpha coefficient of 49 items was 0.933 with discriminating power ranging between 0.321 and 0.627. By considering item proportionality of each aspect (25% for each aspect), the number of items were adjusted to that of initial blueprint. The process resulted in 32 items with reliability coefficient of 0.908 and discriminating power ranging between 0.307 and 0.626 (average discriminating power: 0.462) (Table 3).

The final version of the scale consists of 32 items with content validity coefficient ranging from 0.6 to 1 and average V value of 0.8326 (Table 3). The validity and reliability tests showed that the developed SRL scale exhibited an adequate psychometric properties, indicated by reliability coefficient of 0.908, average discriminating power of 0.642, and content validity coefficient of 0.836. The blueprint of final version of the scale is presented in table 4.

Construct Validity

In this study, the construct validity of the scale was examined using the exploratory factor analysis, an analysis aiming to see whether the items of the scale represents the aspects intended to to measure, and whether there is a relationship between these aspects. Self-regulated learning theoretically comprises four aspects: cognition, motivation, behavior, and context (Pintrich, 2000) and we tested the final version of the scale to see whether these 32 items represent those four aspects.

The KMO value was 0.834 and the Bartlett’s test of sphericity significance was 0.000, allowing us to proceed to the factor analysis. The 32 items were extracted into four factors, considering that SRL is theoretically comprises 4 aspects. The total variance explained indicate that reducing 32 items into four factors allow the scale to account for 46.696% variance. The factor loading of each factor is displayed in Table 5.
Table 2. Test Blueprint

| Aspects       | Indicator                                                                 | No. of item | Fav | Unfav | Total | Loading |
|---------------|---------------------------------------------------------------------------|-------------|-----|-------|-------|---------|
| Cognition     | Applying metacognitive strategy to develop a plan                         | 3           | 2   |       | 14    | 23.33%  |
|               | Applying metacognitive strategy to monitor                                | 3           | 1   |       | 14    |         |
|               | Able to modify one’s cognition                                           | 2           | 3   |       | 5     |         |
| Motivation    | Believe in learning goal                                                  | 2           | 2   |       | 4     |         |
|               | Understand the materials and finish the given tasks                      | 2           | 2   |       | 4     |         |
|               | Able to maintain motivation                                               | 2           | 2   |       | 4     | 26.67%  |
|               | Able to choose and build strategies to maintain motivation.               | 2           | 2   |       | 4     |         |
|               | Improving and maintaining learning behaviors                              | 2           | 2   |       | 4     |         |
| Behavior      | Managing the study time                                                   | 2           | 2   |       | 4     | 26.67%  |
|               | Able to monitor learning efforts                                          | 2           | 2   |       | 4     |         |
|               | Preparing the study needs                                                 | 2           | 2   |       | 4     |         |
| Context       | Having a positive perception of the given tasks.                          | 4           | 4   |       | 8     | 23.33%  |
|               | Able to control, regulate, and control the context and the surroundings.  | 3           | 3   |       | 6     |         |
|               | Total                                                                      | 31          | 29  |       | 60    | 100%    |

Table 3. Discriminating Power and Aiken’s V of Final SRL Scale items

| Aspects   | Items | Discriminating power | Aiken’s V |
|-----------|-------|-----------------------|-----------|
| Cognition | A1    | 0.523                 | 0.95      |
|           | A3    | 0.358                 | 1         |
|           | A5    | 0.352                 | 0.7       |
|           | A8    | 0.376                 | 0.9       |
|           | A9    | 0.543                 | 0.75      |
|           | A10   | 0.483                 | 0.85      |
|           | A11   | 0.369                 | 0.95      |
|           | A12   | 0.481                 | 0.7       |
| Mean      |       | 0.436                 | 0.85      |
| Behavior  | A31   | 0.553                 | 0.95      |
|           | A32   | 0.563                 | 0.95      |
|           | A34   | 0.626                 | 0.9       |
|           | A35   | 0.307                 | 0.95      |
|           | A39   | 0.435                 | 1         |
|           | A42   | 0.549                 | 0.7       |
|           | A44   | 0.451                 | 0.95      |
|           | A45   | 0.544                 | 0.95      |
| Mean      |       | 0.479                 | 0.919     |
| Motivation| A15   | 0.406                 | 0.75      |
|           | A17   | 0.322                 | 0.7       |
|           | A20   | 0.444                 | 0.85      |
|           | A21   | 0.415                 | 0.65      |
|           | A24   | 0.561                 | 0.75      |
|           | A26   | 0.541                 | 0.6       |
|           | A28   | 0.612                 | 0.85      |
|           | A30   | 0.459                 | 0.65      |
| Mean      |       | 0.47                  | 0.725     |
| Context   | A48   | 0.478                 | 0.85      |
|           | A49   | 0.372                 | 0.8       |
|           | A50   | 0.525                 | 0.95      |
|           | A53   | 0.403                 | 0.95      |
|           | A54   | 0.469                 | 0.7       |
|           | A56   | 0.499                 | 1         |
|           | A57   | 0.414                 | 0.95      |
|           | A60   | 0.544                 | 0.6       |
| Mean      |       | 0.463                 | 0.85      |
|           |       | Average discriminating power (total) | 0.462 |
|           |       | Average Aiken’s V (total) | 0.836 |

Three items with factor loading lower than 0.4 (i.e., A28, A39, and A42) were dropped. We see that the group of items in Component 1 can be grouped into items measuring behavior, those in component 2 measures the contextual aspect, component 3 measures the cognitive aspect, while those in component 4 measures the motivation.
The final version of the scale comprises 32 items with average content validity coefficient of 0.836, indicating a relatively high content validity. As shown in table 3, these 32 items exhibited a discriminating power index ranging between 0.307 and 0.626 with an average score of 0.462. The discriminating power index is an important parameter in selecting the items, as it represents the item’s ability to separate individuals with the measured psychological attributes from those lack of the measured psychological attributes (Azwar, 2012). In other words, these 32 items have sufficient ability to separate individuals with high SRL from those with low SRL. Overall, items of the scale exhibited a good quality.

Considering the discriminating power index and Aiken’s V (Table 3), Items with high content validity coefficient do not necessarily exhibit high discriminating power.However, the selected 32 items possess content validity coefficient and discriminating power higher than minimum requirement, in other words, they have an adequate psychometric properties. Furr & Bacharach (2013) state that discriminating power is the most common concept to evaluate the degree to which an item affect the internal consistency of a measure. Items with high discriminating index represent a strong relationship with the measured construct. Therefore, from reliability perspectives, selected items are those with higher discriminating power.

Item A34 exhibits the highest discriminating power index, i.e., 0.626. According to Finch et al. (2016), discriminating power of an item refers to the extent to which an item is able to separate respondents with lower trait from those with higher trait. In this regard, item A34 possesses the best ability to separate individuals with low SRL from those with high SRL. This unfavorable item represent the behavioral aspect, which reads: “I only study when I want to”. Finch et al. (2016) argue that item’s discriminating power indicates a relevance with the trait being measured. This shows that item A34 in this scale measures one’s self-regulated learning from different direction. Respondents with low score on this item indicates high self-regulated learning. However, it is necessary to sum up the total score of the items before drawing a conclusion. Item A34 also exhibits high content-validity coefficient (V=0.9). Experts view this item highly relevant with the measured construct, i.e., self-regulated learning. In other words, Item A34 possesses good quality in terms of content validity and the discriminating power.

Item A35’s discriminating power was slightly above the minimum requirement, i.e., 0.307, however, it is still considered adequate, as the minimum discriminating power is 0.30 (Azwar, 2017). According to Furr & Bacharach (2013), content validity (not including the face validity) serves as the important evidence when evaluating a construct validity. Aiken's V index is an important concept to evaluate the discriminating power of an item. In this regard, Azwar et al. (2016) argue that item’s discriminating power indicates a relevance with the trait being measured. This shows that item A35 in this scale measures one’s self-regulated learning from different direction. Respondents with low score on this item indicates high self-regulated learning. However, it is necessary to sum up the total score of the items before drawing a conclusion. Item A35 also exhibits high content-validity coefficient (V=0.9). Experts view this item highly relevant with the measured construct, i.e., self-regulated learning. In other words, Item A35 possesses good quality in terms of content validity and the discriminating power.

Item A39 exhibited Aiken’s V of 1, indicating a very high content validity and considered highly relevant to measure
the behavioral aspect, particularly the third indicator, i.e., preparing the needs during study. This item is a positively-worded statement reads: "I collect sufficient literature to do my tasks." The discriminating power of this item was 0.435. In other words, Item A39 exhibit a good psychometric property.

Item A26 was a negatively-worded statement measuring motivation with V value of 0.6. It reads “ When I feel the task is too difficult, I choose not to do it.” Four of five experts scored this item 4 (score range 1-5), while one expert gave a lower score. This item is quite relevant to measure the third indicator of SRL, i.e., motivation because it depicts one’s inability to control or manage his/her motivation. This is supported by discriminating power of 0.541, indicating a good psychometric property. Furr & Bacharach (2013) explains that high item-total correlation indicates that the item is consistent with overall measurement. In this regard, Item A26’s relatively high discriminating power shows its relatively high consistency with the scale.

Since the item in this scale was selected based on its discriminating power index, the quality of the item is guaranteed, represented by its reliability coefficient. The reliability analysis showed a reliability coefficient of 0.908, and a reliability coefficient of at least 0.8 is considered significant (Urbina, 2004; De Vaus, 2002). Self-Regulated Learning measurement like MSQL is reported to have a reliability coefficient around 0.9 (Saks et al., 2015). It shows that the scale developed in this study possess an equally high reliability when compared to other existing measures. According to Azwar (2014), higher reliability (closer to 1) indicates consistency of the measurement result, indicating a higher accuracy. The final version of the scale exhibited a reliability coefficient of 0.908, indicating a relatively high reliability.

In terms of construct validity, the distribution of 32 items (Table 6) is different from the blueprint (Table 5), three items of the final version even exhibited a factor loading lower than the recommended values (i.e., A28,A39, and A42). As shown in Table 5, item A50 (There is always a surprise in a task that draw my interest to do it) was intended to measure the context aspect, yet the exploratory factor analysis (Tables 5 and 6) showed that it tends to measure the behavioral aspect, like item A44 (“I read some additional literature to extend my understanding in the classroom.”) and A45 (“I only study in the classroom”). In addition to item A50, other items were also repositioned, indicating that the construct validity of this scale is not strong enough and requires factor structure improvements. Kurniastuti & Azwar (2014) report that the factor structure of their student well-being scale also needs further improvement. Although they developed a different measurement, they use the same construct validity test method, i.e., exploratory factor analysis. Their study reports the factors affecting the factor analysis result, including items that are not in line with their place due to inter-item correlation that does not suite the measured construct. Similar condition appears to occur in the present study, as writing an item is challenging as it should matches the construct. In order to construct an item, it is necessary to formulate the indicator of each aspect. In the present study, the four SRL aspects were derived into different indicators. However, the factor analysis result showed that some items overlapped, despite the professional judgment done to ensure the relevance. This should be valuable reminder for future studies regarding the item relevance with the measured construct.

The validity and reliability tests showed that the developed SRL scale exhibited adequate psychometric properties, indicated by reliability coefficient of 0.908, average discriminating power of 0.642, and content validity coefficient of 0.836. However, its construct validity requires further evaluation. The scale’s poor empirical evidence of the construct validity emerges as the limitation of the present study, in addition to the respondents’ factor who were mostly undergraduate students (92%).

### Conclusion

Overall, the developed self-regulated learning scale exhibited adequate psychometric properties, indicated by its reliability coefficient, average discriminating power, and content validity, yet it lacks strong empirical evidence of the construct validity. In this regard, future studies are recommended to strengthen the empirical evidence of the construct validity while involving more diverse respondents.

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