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Proving Content Validity of Self-Regulated Learning Scale (The Comparison of Aiken Index and Expanded Gregory Index)

Heri Retnawati

This study aims to prove the content validity of the self-regulated learning (SRL) scale using Likert model and multiple-choice model with content validity coefficient based on expert assessments with Aiken formula and expanded Gregory formula. In this study, SRL scale with Likert and multiple-choice model are developed using the same outline/format. There are three experts who assess the items' relevancy using indicators of both scale formats. The results of the expert assessments are then used to calculate the coefficient of the validity with Aiken formula and expanded Gregory formula. The results showed that the content validity coefficient based on expert assessment on Likert and multiple-choice format with Aiken formula are at 0.9 for each, while using the Aiken formula and expanded Gregory formula, the coefficient is 0.6 for Likert, and 0.8 for multiple-choice.

Keywords: validity coefficient, Aiken formula, expanded Gregory formula, SRL scale

Introduction

Successful learning is driven by many factors. One of them is self-regulated learning, which has something to do with independent learning like students at a college do. College students are students who study at college and have been considered as adults. They can be categorized as adults because of their age, and because of the demands of independent learning in college. For college students, managing themselves to learn is a factor that supports their success in learning at college. The ability to manage themselves in the study is often called by self-regulated learning.

Various opinions related to self-regulated learning are presented by experts. Pintrich states that self-regulated learning, or self-regulation is an active, constructive process whereby learners set goals for Reviews their learning and then attempt to monitor, Regulate, and Control Reviews their cognition, motivation, and behavior, guided and constrained by Reviews their goals and the contextual features in the environment (Schunk, 2005). Zimmerman said that the self-regulated learning strategies are actions and processes directed at acquiring information or skills that involve; agency, purpose, and Instrumentality perceptions by learners (1989; 1990). It means that a person carries out self-regulated learning in the learning process if he/she controls his/her behavior and cognition systematically by noting the rules made by him/herself, controlling the learning process, integrating the knowledge, practicing to remember the information obtained, and developing also maintaining positive values from his/her learning.

Bandura's social cognitive theory (Kivinen, 2013) presents the theoretical basis of the self-regulated learning development model in an individual, in which contextual factors and interactional behavior give advantages to students to organize their study and to set themselves at the same time. Social cognitive perspective differs from the standpoint of personal interaction, behavior and his/her environment that is often called as triadic process from Bandura.

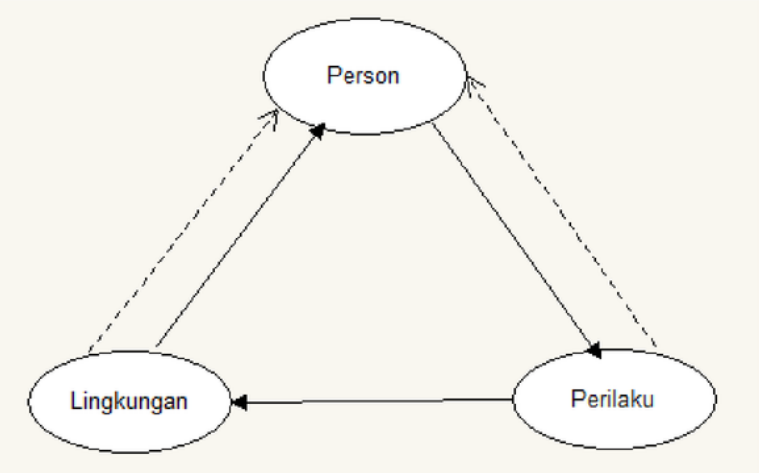

Figure 1. Self-regulation Triadic Form from Zimmerman (Kivinen, 2013)

Self-regulation is a cyclical process, because the input of the initial capabilities is used to make decisions to repeat the efforts that have been made. The effort of those repetitions is necessary because people, environment, and behavior always change during learning process that is always observed and monitored.

Discussion on self-regulated learning includes three phases, forethought and planning phase, performance monitoring phase, and reflection on performance phase (Zumbrunn, S., Tadlock, J., Danielle, E., 2011). In the forethought and planning phase, there are two related things, the task analysis, and self-confidence and motivation. Determination or performance monitoring phase includes self-control and specific observations. Self-reflection phase consists of self-development and self-reaction. These three phases are interrelated and influenced each other that they make up a cycle. The cycle is described as follows.

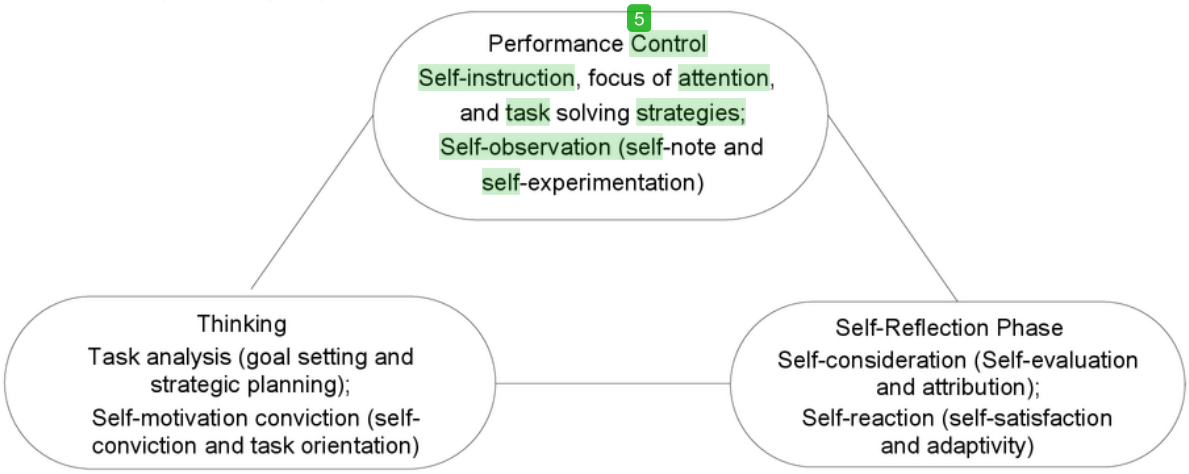

Figure 2. SRL Phase (Zumbrunn, S., Tadlock, J., Danielle, E, 2011)

The forethought phase can be classified into two points, namely the task analysis (covering self-regulation purpose and strategic planning) and self-motivation (self-confidence and task-oriented). Performance monitoring phase includes self-control (self-instruction, focus of attention, task-solving strategies). Self-reflection consists of self-consideration (self-evaluation and attribution) and also self-reaction (self-satisfaction and adaptability). To determine the SRL scale, Wolkers, Pintrich, Karanenink (2003) said that developing items is essential to be done first to measure the cognition arrangements, followed by regulation, motivation, and behavior. These three things need to be measured in the academic context.

Some researches show that the SRL is strongly associated with motivation (Vrieling, Bastiaens, Stijnend, 2012). The SRL can be reinforced by educators in the learning process by preparing tasks that support the improvement of SRL (Zumbruman, Tadlock, Roberts, 2011). Self-regulated learning (SLR) is recognized as an important predictor of student academic motivation and achievement (Zumbrunn, S., Tadlock, J., Danielle, E., 2011). Related to the importance of the SRL contribution to the success of college education, the SRL of students need to be measured. The result of the measurement can be interpreted to be followed up as an effort to maintain or improve the SRL. Therefore, the valid SRL measurement instrument is needed to be developed based on the instrument development steps in which each step can be accounted. SRL measuring instrument development steps consist of several stages. The stages are, constructing a format based on the proper construction theory, preparing items, proving the content validity, trying out instruments on the correlating respondents, estimating the reliability, understanding the characteristics of the items, and reassembling the decent items into the instrument that is ready for use.

One of the instruments that can be used to measure the SRL is questionnaires. The questions in the questionnaire have various forms, including dichotomy questions, multiple-choice questions, rank ordering, rating scale, and opened-questions (Cohen, Manion, Morrison, 2011). Each of these forms has its own characteristic, which is presented as follows. Dichotomy questions in the questionnaire only contain two answer choices. These questions are used if the researcher wants to ask the respondents related to variable containing two answers only, for example, gender (male or female, yes or no, true or false, and others). The multiple-choice questionnaire questions basically like multiple choice in description question. In the multiple-choice, respondents are usually allowed to choose one answer only. The scoring can be done by only right or wrong, or stratified. If scoring is done stratified, ideal condition needs to be thought by questionnaire maker. The questionnaire model that is most used in Indonesia is rating scale or better known as Likert model.

From the interviews with practitioners in the education field, some practitioners question the validity of the questionnaire with Likert model in multiple choice models. Each practitioner has its own arguments and they are reasonable. The Likert questionnaire model is easy to make and easy to read by the respondents then they respond to it, but the data obtained loads desirability bias. Multiple-choice questionnaire model is difficult to make and the respondents need time to read, but more valid the data is obtained. Related to this problem, this study will

describe the proof of the content validity from the questionnaire in Likert and multiple-choice model with stratified scoring.

There are various opinions on the validity of the instruments used for the measurement, both in education and psychology field. According to the American Educational Research Association, American Psychological Association and the National Council on Measurement in Education (AERA, APA, and NCME) in the Standards for Educational and Psychological Testing, validity refers to the degree of facts and theories that support the interpretation of instruments scoring, and the most important consideration in the development of an instrument (1999). Another expert points out that the validity of measuring instrument is to what extent the measuring instrument able to measure what should be measured (Nunnally, 1978; Allen & Yen, 1979, p. 97; Kerlinger, 1986; Syaifudin Anwar, 2000, p. 45).

Meanwhile, Linn & Gronlund (1995) explain that validity refers to the adequacy and interpretation appropriateness that is made of assessment, related to a specific use. This opinion is reinforced by Messick (1989) who said that validity is an integrated evaluative policy concerning to what extent of empirical facts and theoretical reasons support the adequacy and appropriateness of inferences and actions based on test scores or score of an instrument. Based on those opinions, it can be concluded that the validity will show support to empirical facts and theoretical reasons on the interpretation of test scores or score of an instrument, and it is associated with the measurement precision.

The validity can be grouped into three types, namely: (1) criterion validity (criterion-related), (2) content validity, and (3) construct validity (Nunnally, 1978; Allen & Yen, 1979; Fernandes, 1984; Woolfolk & McCane, 1984; Kerlinger, 1986; and Lawrence, 1994). This validity can be known through validity existence facts. Sources of validity facts can be grouped into content validity, response process, internal structure, relations with other variables, and the consequences of the implementation of data collection (AERA, APA, and NCME, 1999; Cizek, et al., 2008). The validity existence of an instrument can be identified through content analysis and empirical analysis from instrument score of item response data (Lissitz & Samuelsen, 2007).

The criteria of validity are divided into two, namely the predictive validity and concurrent validity. Fernandes (1984) said that the validity based on criteria is intended to answer the question to what extent instruments predict the participants' ability in the future (predictive validity) or estimate the ability of other measuring devices in almost same deadline (concurrent validity). A similar opinion is also expressed by Lawrence (1994) who says that the instrument is said to have predictive validity if the instrument is able to predict capability in the future. In the analysis of the predictive validity, performances to be predicted are called as criteria. The size of the estimated predictive validity price of an instrument is described by the correlation coefficient between the predictors of those criteria.

Content validity of an instrument is the extent of the items in the instrument representing the components in the overall area of the contents of the object to be measured and the extent of the items reflects behavioral traits that will be measured (Nunnally, 1978; Fernandes, 1984). Meanwhile, Lawrence (1994) explains that the content validity is the questional representation of

special abilities that must be measured. Based on this opinion, it can be concluded that the content validity is related to the rational analysis of the domain to be measured to determine the representation of the instrument with the ability to be measured.

Construct validity is the validity which shows to what extent the instruments reveal ability or a particular theoretical construct to be measured (Nunnally, 1978; Fernandes, 1984). Construct validation procedure starts from an identification and restriction regarding the variables to be measured and is expressed in terms of a logical construct based on a theory of those variables. From this theory, a practical consequence of the results of measurements on certain conditions is drawn, and this consequence will be tested. If the result is in line with expectations, the instrument is considered to have good construct validity.

On an instrument, validity is an indispensable term that is required in instrument's development. According to Sireci supported by Lissitz & Samuelsen (2007), validation of instruments used in education should involve a content analysis and empirical analysis of the scores obtained from the instrument and the response data on the items by the respondents. The content analysis instrument is associated with content analysis that later, empirical analysis is also needed to prove the construct validity. Both of these analyzes are intended to make instruments in the world of education are qualified as a standard measurement instrument.

Content validity is determined using expert agreement. Expert of study agreement or often called as measured domain determines the content validity stratification (content related). This happens because of the measuring instruments, for example a test or questionnaire is proved to be valid if the expert believes that the instrument measures mastery abilities defined in the domain or the measured psychological constructs. To understand this agreement, validity index can be used, including index proposed by Aiken (1980; 1985). The item validity index proposed by Aiken is formulated as follows:

$$V = \frac{\sum s}{n(c-1)} \qquad (1)$$

with V as the item validity index; s is scores assigned each rater minus the lowest score in the used category (s = r - lo, with r = rater category selection score and l_o the lowest scores in the scoring category); n numbers of rater; and c the number of categories that rater can choose.

Based on that opinion, V is rater deal index of items' suitability (or the suitability of the items) with indicators that need to be measured using the items. If it is applied to the measurement instrument, according to a rater, then n can be replaced with m (numbers of item in an instrument). The V index value ranges between 0-1. The closer to 1, the better the item is, because it is more relevant to the indicator.

Another way to prove the content validity with expert agreement is using experts index agreement suggested by Gregory (2007). The index also ranges between 0-1. It is done by making contingency tables on two experts, with the first category that is not relevant and less relevant become the weak relevancy category, and the second category which is for quite relevant and very relevant that is created in a new strong relevant category. Expert agreement index for content validity is a comparison of the number of items of the two experts with strong relevance category of overall items.

Experts' agreement index for content validity is a comparison of the numbers of items from two experts as validators with strong relevance to the overall items category (Gregory, 2007). If the results of the relevancy tabulation (contingency tables) are presented in Table 1, the validity coefficient is presented in formula 2.

Table 1. The relevance category scoring with 2 validators

		Rater 1	
		Weak	Strong
Rater 2	Weak	A	B
	Strong	C	D

$$\text{Content validity coefficient} = \frac{D}{(A+B+C+D)} \quad (2)$$

If the validators are 3 experts, the size of contingency tables with the number of cells 2x2x2 = 8 cells is presented in Table 2. The content validity coefficient is an expansion coefficient of Formula 2. Coefficient calculation with the formula 2 expansion is presented in formula 3.

Table 2. Table of contingency to calculate the validity coefficient with Gregory formula involving 3 validators

Expert 1	Weak	Weak	Weak	Weak	Strong	Strong	Strong	Strong
Expert 2	Weak	Weak	Strong	Strong	Weak	Weak	Strong	Strong
Expert 3	Weak	Strong	Weak	Strong	Weak	Strong	Weak	Strong
Total	A	B	C	D	E	F	G	H

$$\text{Content validity coefficient} = \frac{H}{(A+B+C+D+E+F+G+H)} \quad (3)$$

This coefficient also ranges from 0 to 1. The coefficient that is close to 0 means that the validators agreement index on the relevance of instrument items with their indicators is getting lower. Conversely, if the validity coefficient is closer to 1, the validators agreement index about the relevance of instrument items with their indicator becomes greater.

Method

By using SRL components and indicators (developed from Zimmerman (2000)), sub-indicators are compiled. The results of the development of the indicator and the item numbers are presented in Table 3.

Table 3. SRL Components and Indicators (developed from Zimmerman (2000))

Components	Indicators	Sub Indicators	Items
Thought	Task Analysis	Goals Setting	1
		Strategic Planning	2
	Confidence	Self-Capability	3
		Task-Oriented	4
Performance Control	Self-control	Self-instruction	5
		Study Focus Effort	6
		Task-finishing Strategy	7
	Sufficient Observation	Metacognitive Observation	8
		Self-note	9
		Self-experimentation	10
Self-reflection	Self-consideration	Self-evaluation	11
		Causal Attribution	12
	Self-Reaction	Self-satisfaction (Reward)	13
		Self-satisfaction (Punishment)	14
		Adaptive/defensive	15

By using this outline/format, instrument items which are the SRL scale are arranged. The scale is set in two forms, namely questionnaires in Likert model and in multiple choices. For example, item 1 as Table 4 for items with Likert model and Table 5 for items with multiple choice models.

Table 4. Items with Likert model

No	Statements	STS	TS	S	SS
1	I frame my study/course goals before the activity begins	1	2	3	4
8	I make maps of activities that I have done				

Table 5. Items with multiple-choice model

No.	Items
1.	**At the beginning of the lecture (semester 1), a statement that is the most suitable with your condition is. . .**
	A. I frame my purposes clearly after I graduate. (4)
	B. I just know the best college for me, my dreams after graduate is not important. (2)
	C. I have a principle that life is just flowing, including the lecture. (1)
	D. I know what I will do after graduate, but I am not sure with that. (3)
8.	**About the efforts that you have done, which statement that describes your condition. . .**
	A. I record my failure, so it motivates me to correct it. (3)

B. Failure, success, and effort that I have been done or will do, I draw them only in my mind. (2)
C. I do not map my efforts, success, and failures that I think I fail to correct it. (1)
D. I make map or diagram from efforts that I have been done, and their results whether success or fail. (4).

The outline/format and items instrument for measuring SRL in 2 forms are then given to 3 validators. The validators consist of two psychologists in the education field and one educational measurement expert. Those 3 validators assess the items' relevancy with indicator, on both scale forms. Using the results of the assessment of the 3 validator, then the validity index and validity coefficient are calculated using Aiken scale (Formula 1), on both the scale models.

By using the same data, a new category is created for relevancy, weak and strong classification. With these classifications, contingency table as shown in Table 2 is made. Furthermore, the validity coefficient is calculated using the extended Gregory formula (formula 2) in both scale models.

Results

The results of the assessment of the validators are inserted into a table, which is attached in Appendix 1. Besides providing quantitative assessments, the validators also provide qualitative inputs. Qualitative inputs include 1) statements improvement in Likert items, 2) stem items and the multiple-choice options improvement, and 3) according to the validators, Indonesian respondents are not familiar yet with the multiple-choice questionnaire, because its reading takes longer time than a questionnaire with Likert model.

Furthermore, the results of the quantitative assessment, the items of validity index and the scale of validity coefficient using Aiken formula are calculated, on Likert model or scale with multiple-choice model. The results are presented in Table 6. Comparison on each item of the two models is presented in Figure 1.

Table 6. The results of validity calculation using Aiken formula

Items	Likert	Multiple-choice
1	0.78	0.78
2	1.00	1.00
3	1.00	1.00
4	1.00	0.78
5	0.78	0.67
6	1.00	1.00
7	0.67	0.67
8	0.78	0.89
9	0.78	0.89
10	1.00	0.78

11	1.00	1.00
12	1.00	1.00
13	0.78	1.00
14	0.89	1.00
15	1.00	1.00
Scale	0.90	0.90

Observing Table 6 and Figure 3, the results achieved are the calculations of the item validity index using Likert model and inventory model are not much different. Similarly, the scale using Likert model and Inventory model are obtained exactly the same result in the validity coefficient calculation.

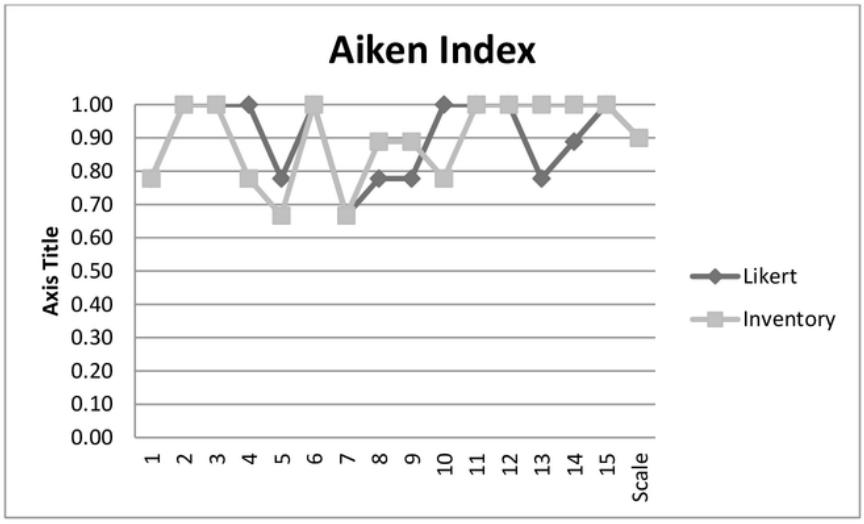

Figure 3. Aiken index on scale of Likert and Multiple-choice model

Using the same data, items relevance category that becomes only weak and strong are created. Furthermore, each category is calculated on Likert questionnaire models that are presented in Table 7.

Table 7. Likert relevance category

Expert 1	Weak	Weak	Weak	Weak	Strong	Strong	Strong	Strong
Expert 2	Weak	Weak	Strong	Strong	Weak	Weak	Strong	Strong
Expert 3	Weak	Strong	Weak	Strong	Weak	Strong	Weak	Strong
Total	0	0	0	0	0	5	1	9

Based on the Table 7, from 15 items scale, there are 9 strong items that have strong relevance according to the three validators' assessment. It shows that with formula 3, the reliability instrument coefficient SRL measurement using Likert model obtains 0.60. Using the same technique, the relevant category of the validity coefficient in multiple-choice models is also created. The results are presented in Table 8.

Table 8. Multiple-choice Relevancy Category

Expert 1	Weak	Weak	Weak	Weak	Strong	Strong	Strong	Strong
Expert 2	Weak	Weak	Strong	Strong	Weak	Weak	Strong	Strong
Expert 3	Weak	Strong	Weak	Strong	Weak	Strong	Weak	Strong
Total	0	0	0	0	0	1	2	12

Based on the table 8, from 15 items of the scale, there are 12 strong relevance items according to the three validators' assessment. It shows that with the formula 3, reliability coefficient instrument of SRL measurement with multiple-choice models gains 0.80.

Comparison of calculation results of SRL validity coefficient scale if it is compared based on its forms and formulas, is presented in Figure 4. Based on the image, it can be obtained that the result of validity coefficient calculation using Aiken formula is more stable compared with using Gregory formula. By paying attention to the shape, these results indicate that the validity coefficient calculated with Gregory formula on SRL scale of the multiple-choice model is lower than the validity coefficient scale on the Likert model.

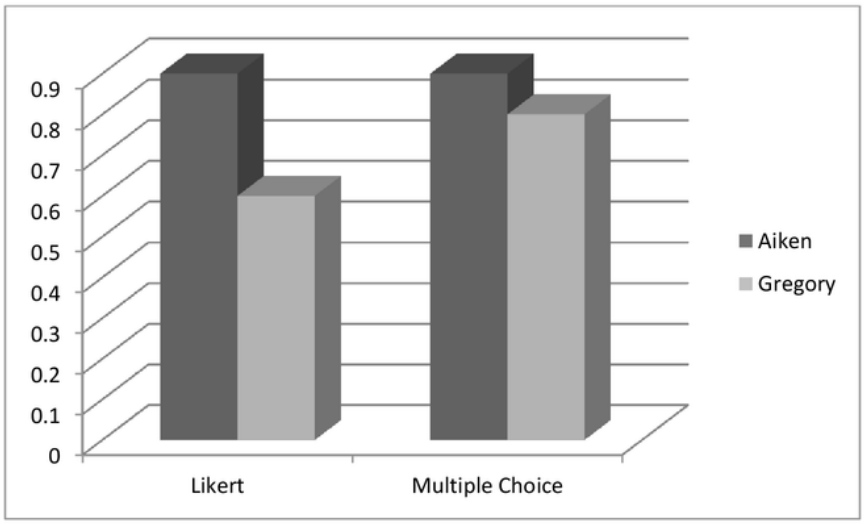

Figure 4. Comparison of validity coefficient using Aiken formula and Gregory formula

Conclusion

In this study, two instruments of SRL measurement on Likert model and multiple-choice model using the same format are developed. The formats and the two instrument models then are given to three validators to be assessed their relevance items with indicator. The results of the expert assessment then are used to prove the content validity using Aiken formula and expanded Gregory formula. The results of the study show that the content validity coefficients, based on expert assessment on Likert format and multiple choice with Aiken formula, are at 0.9 for each, with the index for each item is almost the same, and with the Aiken formula and expanded Gregory formula is 0.6 for Likert and 0.8 for multiple choice.

Observing these results, it can be obtained that the acquisition of the index and the validity coefficient using Aiken formula on Likert model and multiple-choice model are almost the same. It happens because both models are developed using the same format. However, when the validity verification is done by calculating using the Gregory formula, it gets different results. Coefficient acquisition using Gregory formula is less than the acquisition using the Aiken formula. It happens because in the Gregory formula, the probability to obtain the combination of all three validators on assessing a strong relevance item is very small.

Some future research opportunities that can be done are the stability of the number of validators. Further research is needed on the number of validators, so the acquisition of the index or the coefficient is maximized. It is better done on both Aiken formula and Gregory formula.

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Appendix 1. Experts Final Results of Items Compatibility with Indicators Data

(4= Very Relevant, 3= Adequate Relevant, 2= Less Relevant, 4= Irrelevant)

Likert			
Items	Rater1	Rater2	Rater3
1	4	4	2
2	4	4	4
3	4	4	4
4	4	4	4
5	4	2	4
6	4	4	4
7	4	2	3
8	4	2	4
9	4	2	4
10	4	4	4
11	4	4	4
12	4	4	4
13	4	2	4
14	4	4	3
15	4	4	4

Multiple-Choice			
Items	Rater1	Rater2	Rater3
1	4	4	2
2	4	4	4
3	4	4	4
4	4	3	3
5	4	3	2
6	4	4	4
7	4	2	3
8	4	3	4
9	4	3	4
10	3	3	4
11	4	4	4
12	4	4	4
13	4	4	4
14	4	4	4
15	4	4	4

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