CONTENT VALIDITY OF THE MATHEMATICS LEARNING INDEPENDENCE INSTRUMENT FOR JUNIOR HIGH SCHOOL STUDENTS USING AIKEN'S V

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Abstract: This study aims to examine the validity of the content of mathematics learning independence instruments for junior high school students which are developed based on five main dimensions: initiative, discipline, responsibility, time management, and problem solving. The instrument consists of 20 statements that are assessed by four experts using a Likert scale of 1–5. Content validity is calculated using the V Aiken index to measure the degree of agreement among experts on the relevance of an item to a theoretical indicator. The results of the analysis showed that of the 20 grains, as many as 6 grains had high validity ($V \geq 0.8125$), 13 grains had moderate validity ($0.5 \leq V < 0.75$), and 1 grain was in the low category ($V = 0.375$). The item with the highest value reaches 0.875, while the lowest is 0.375. These findings suggest that most instrument items are still good and usable although they still need to be revised slightly to better represent the measured construction. This research has implications for improving the quality of the development of non-cognitive instruments in the field of mathematics education. The Aiken's V method can be used as a reference in assessing the validity of the instrument's content objectively. The results are also useful for teachers and researchers in ensuring the accuracy of the student learning independence measurement tool.
Keywords: Content Validity, Instruments, Learning Independence, V Aiken

1. INTRODUCTION

Independent learning is one of the important competencies in the 21st century educational process, where students are required to have the ability to manage their own learning process actively, consciously, and responsibly [1]–[3]. In the context of mathematics learning, learning independence has a very strategic role due to the nature of this subject which requires high reasoning power, problem-solving skills, and consistency in practice and mastery of concepts [4], [5]. At the junior high school level, the phase of students' cognitive and affective development is at a crucial transition stage, where the formation of an independent attitude in learning becomes an important foundation for academic success at the next level.

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The urgency to foster and measure mathematics learning independence in junior high school students is also increasing along with the implementation of the Independent Learning Curriculum policy which emphasizes strengthening character and lifelong learning competencies. In this policy, teachers play the role of facilitators who accompany students to find meaning and manage their own learning process [6], [7]. Therefore, knowing the level of independence in learning mathematics is a need that cannot be ignored, both in the context of classroom learning and in efforts to improve education policy more broadly [8].

However, to get an accurate picture of the level of student learning independence, a measurement tool that has high validity and reliability is needed [9]. One of the important aspects of instrument development is the validity of content, i.e. the extent to which the statements in the instrument represent all aspects or dimensions of the construction to be measured [10]–[12]. Unfortunately, in various existing studies, the instruments used to measure learning independence are often developed without going through a systematic and measurable content validation process. Many instruments rely only on conceptual validation or one-sided opinions without the accompaniment of quantitative analysis from experts.

This gap is a serious problem in the world of educational research and practice. When the instrument used is invalid in terms of content, the data generated will be biased and do not reflect the actual reality of the students [13]. This has an impact on inaccuracies in interventions provided by teachers, inaccurate decision-making by policymakers, and methodologically weak research conclusions. Therefore, content validation efforts are a very important stage in the instrument development process, especially for non-cognitive constructs such as learning independence.

Among the various techniques available to measure the validity of content, the V Aiken method is the most widely used quantitative approach because it is able to provide an objective picture of the extent to which experts agree on the relevance of each statement item in an instrument. Using Aiken's V, researchers can determine which items are worth using, which need to be revised, and which ones should be discarded, based on a statistically responsible numerical index [14]. The use of this method not only improves

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the quality of the instrument, but also strengthens the methodological foundation of the research conducted.

Unfortunately, the use of the V Aiken method in validating the content of mathematics learning independence instruments for junior high school students is still relatively minimal, especially in Indonesia. Previous studies have focused more on construct validation and reliability testing, while aspects of content validity are often overlooked or conducted simply without a strong quantitative approach [15]. This shows that there is a gap in educational research methodologies, especially in the development of non-cognitive instruments that concern students' attitudes, values, and learning characteristics.

The purpose of this study is to analyze the validity of the validity of the content of the mathematics learning independence instrument of junior high school students using the V Aiken method. Each item was assessed in terms of content suitability, construction, and readability, then analyzed with Aiken's V formula to obtain a quantitative level of content validity. This is in line with the results of research conducted by Yusoff and Almanasreh, who emphasized the importance of evidence of content validity as a prerequisite for inference from research instruments to be trusted; describe the quantitative procedures for assessing content validity; and provide more systematic evidence than just narrative opinions [13], [16]. This study is limited to aspects of content validity and does not include reliability tests, construction validity, or other empirical validity. Validation was carried out on instruments designed for junior high school students and has not been widely applied in field trials. Thus, this study is not intended to directly measure student learning independence, but rather to ensure that the developed instrument has met adequate content quality standards before being used in follow-up research or learning interventions.

Learning independence is a concept that develops in the realm of psychology and educational pedagogy that refers to the ability of individuals to direct, control, and evaluate their learning process independently without excessive dependence on other parties [17]–[19]. Learning independence is a person's ability to take the initiative in planning, implementing, and evaluating their own learning activities [20]–[22]. In the

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context of formal education, especially in mathematics learning, learning independence includes the ability of students to set learning goals, manage time and learning resources, complete assignments without coercion, and reflect on their learning outcomes. Some important dimensions of learning independence include learning initiative, time management, learning responsibility, perseverance and discipline, and the ability to solve problems independently. These five dimensions are the theoretical basis in the preparation of indicators and instrument items in this study.

Several previous studies have examined the importance of learning independence in improving students' academic achievement, especially in mathematics subjects that require a logical, systematic, and consistent thought process. For example, research by [23] explains that sIswa with high learning independence have higher motivation and math achievement. There was no significant difference between math scores before and after the implementation of SRL, but SRL was still considered important in encouraging learning responsibility [24]. Students who use SRL to solve mathematical problems gradually: planning, monitoring, control, and reflection, especially in the problem of linear equation systems [25]. However, in most of these studies, the instruments used to measure learning independence were often not accompanied by a structured and quantitative-based content validation process. This is a methodological gap that can affect the validity of research conclusions.

In the real of educational instrument development, content validity is the first and important step that must be taken to ensure that the items in the instrument truly represent the domain of the constructed being measured. Aiken introduced the V Aiken index as a technique for analyzing the level of agreement among experts (judges) about the relevance of an item to a particular construction [26], [27]. This index uses an ordinal ranking scale which is then calculated to obtain a V value that ranges from 0 to 1. The higher the value of V is closer to 1, the higher the level of validity of the item's content [26]. This method is particularly suitable for use in the validation of instruments that are affective or non-cognitive, such as learning independence, as it involves subjective assessments of experts systematically and quantitatively.

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2. RESEARCH METHODS

This study uses a quantitative approach with a descriptive design to analyze the validity of the content of the mathematics learning independence instrument of junior high school students. The quantitative approach was chosen because this study aims to measure the level of agreement between experts on the relevance of instrument items using objective numerical analysis, namely through the V Aiken index.

The data collection technique was carried out through an expert assessment form containing indicators and instrument statement items, as well as a rating scale from 1 to 5 with 5 = Very compliant, 4 = Compliant, 3 = Satisfactory, 2 = Inadequate, and 1: Highly non-compliant. Experts are asked to score on the relevance of each item to the intended indicator. The data collected is in the form of assessment numbers from experts on each item. The validation sheet for the experts is as shown in table 1.

Table 1. Validation of Student Mathematics Learning Independence Questionnaire

Yes	Indicators	Statement
	Dimension 1: Initiative in Learning	
1	Students have high initiative in organizing and starting the mathematics learning process independently.	I decided for myself when it was the right time to study math. I was always looking for additional material if I didn't understand math lessons at school. I feel motivated to solve math problems independently. I set my math learning goals without waiting for instructions from the teacher.
	Dimension 2: Time Management	
2	Students are able to manage their math learning time independently and disciplined.	I manage my math study time well every day. I don't procrastinate on math assignments given by teachers. I learned math consistently without being forced by others. I do math assignments on a schedule that I made myself.
	Dimension 3: Responsibility in Learning	
3	Students show a high sense of responsibility in the process and outcomes of mathematics learning.	I always solve the math practice problems given by the teacher on time. I am responsible for my own math learning outcomes. I always correct mistakes in math assignments independently. I actively ask my teacher or friend if I'm having trouble in math lessons.
4	**Dimension 4: Perseverance and Discipline**	

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	Students have perseverance and discipline in completing math assignments.	I always try to solve difficult math problems even though it takes a long time. I don't give up easily when faced with difficult math problems. I am consistent in learning math every day. I am always disciplined in following the math study schedule that I set.
	Dimension 5: Breaking Yourself	
5	Students are able to solve math problems independently and reflectively.	I prefer to try to solve math problems on my own before asking for help. I often look to other sources (internet, books) to help solve math problems. I use the various strategies I learned to solve math problems. I evaluate my own math learning outcomes to see how well I understand.

Furthermore, data analysis was carried out using the V Aiken formula, which is a quantitative method used to measure the level of agreement between experts about the relevance of an item in an instrument. Aiken's V formula used is as follows [28]:

$$V = \frac{\sum s}{n(e-1}$$

V = Aiken Validation Index V

s = r - lo

r = The number given by the validator

lo = Lowest Rank Score

n = Number of raters

e = Number of categories selected by the assessor

The results of the calculation of the V Aiken index for each subsequent item are interpreted in such a way that if the agreement index is less than 0.4, then its validity is considered low. If it is between 0.4 and 0.8, then its validity is considered mediocre, and if it is more than 0.8, then its validity is considered high.

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3. RESULTS AND DISCUSSION

A. RESULTS

1) General Description of the Instrument

The instrument developed in this study aims to measure the level of mathematics learning independence of junior high school students. The instrument consists of 20 statements that reflect five main dimensions, namely: (1) Initiative in learning, (2) Time management, (3) Responsibility in learning, (4) Perseverance and discipline, and (5) Independent problem-solving. Each dimension is represented by four statement items, designed in the form of a 5-point Likert scale, ranging from "Strongly Unmatched" (1) to "Strongly Match" (5).

The process of compiling instrument items begins with the identification of indicators from each dimension based on a literature review, followed by the preparation of an initial statement reflecting these indicators. After that, a content validity test was carried out involving five experts (validators) who were selected using the purposive sampling technique. These experts come from a background in mathematics education and educational evaluation, and have a minimum qualification of a master's degree (S2) and experience in the development of psychopedagogic instruments. The validators were asked to rate each instrument item in terms of content suitability with the indicators, clarity of sentence construction, and readability, using a rating scale of 1 to 5. The data from this assessment was then analyzed using the V Aiken formula to measure the level of agreement between experts on the relevance of the content of each instrument.

2) Results of Expert Assessment Instrument Details

The mathematics learning independence instrument for junior high school students compiled in this study consists of 20 statements designed to represent five main dimensions, namely: learning initiative, time management, learning responsibility, perseverance and discipline, and independent problem solving. Each dimension is represented by several statements that have been formulated based on the study of theory and contextual needs of mathematics learning at the junior high school level.

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To assess the validity of the content of each instrument item, an assessment was carried out by four experts (raters) who have competence in the field of mathematics education and educational evaluation. Raters were asked to rate each statement item using a scale of 1 to 5, where the number 1 means "very inappropriate" and the number 5 means "very appropriate" to the indicators being measured. The results of the expert assessment (rater) are as shown in table 2 below.

Table 2. Exam Result Scores Conducted by Raters

No Items	Assessor 1	Assessor 2	Assessor 3	Assessor 4
1	5	4	4	**4**
2	2	5	3	4
3	2	4	4	5
4	5	5	3	2
5	3	3	5	3
6	3	4	2	3
7	2	5	3	4
8	2	3	4	2
9	2	3	5	3
10	3	5	4	4
11	2	2	3	3
12	4	4	5	3
13	3	5	5	4
14	3	4	4	3
15	2	4	4	3
16	2	5	3	4
17	3	4	5	5
18	3	4	2	2
19	3	5	4	3
20	3	5	5	3

The data obtained in table 2 shows that there is a variation in scores between items and between assessors. Most of these items obtained fairly high scores, such as items 1, 10, 12, 13, 17, and 20 which generally obtained scores of 4 and 5 from the majority of assessors. Meanwhile, there are some items such as items 8 and 11 that tend to get lower scores, with values varying between 2 and 3.

3) Results of the Calculation of the V Aiken Index

The validity of the instrument's content was analyzed using the V Aiken index based on the assessment of four experts. Each item is graded on a scale of 1-5, then an s score and

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a V value are calculated to determine the level of conformity of the item's content with the indicator. The results of the calculation are shown in Table 3 below.

Table 3. Aiken Index Score

No Items	Assessor 1	Assessor 2	Assessor 3	Assessor 4	S1	S2	S3	S4	Σs	V	Criterion
1	5	4	4	**4**	4	3	3	3	13	0.8125	Tall
2	2	5	3	4	3	4	2	3	12	0.75	Keep
3	2	4	4	5	3	3	3	4	13	0.8125	Tall
4	5	5	3	2	4	4	2	1	11	0.6875	Keep
5	3	3	5	3	2	2	4	2	10	0.625	Keep
6	3	4	2	3	2	3	1	2	8	0.5	Keep
7	2	5	3	4	5	4	2	3	14	0.875	Tall
8	2	3	4	2	4	2	3	1	10	0.625	Keep
9	2	3	5	3	5	2	4	2	13	0.8125	Tall
10	3	5	4	4	2	4	3	3	12	0.75	Keep
11	2	2	3	3	1	1	2	2	6	0.375	Less
12	4	4	5	3	3	3	4	2	12	0.75	Keep
13	3	5	5	4	2	4	4	3	13	0.8125	Tall
14	3	4	4	3	2	3	3	2	10	0.625	Keep
15	2	4	4	3	1	3	3	2	9	0.5625	Keep
16	2	5	3	4	1	4	2	3	10	0.625	Keep
17	3	4	5	5	2	3	4	4	13	0.8125	Tall
18	3	4	2	2	2	3	1	1	7	0.4375	Keep
19	3	5	4	3	2	4	3	2	11	0.6875	Keep
20	3	5	5	3	2	4	4	2	12	0.75	Keep

Based on the results of the assessment of four experts in table 3 against 20 instruments of the statement of independence in mathematics learning for junior high school students, a score of the V Aiken index was obtained which showed a variation in values between 0.375 to 0.875. Of the total 20 items, there are six items that have a content validity value in the high category, namely items number 1, 3, 7, 9, 13, and 17. These items received Aiken's V values of 0.8125 to 0.875, indicating a high level of agreement among experts regarding the relevance of the item's content to the measured indicators. On the other hand, one item, item number 11, showed the lowest Aiken V value of 0.375 and was categorized as having low or "less" validity, making it considered unfit for use without in-depth improvement. Meanwhile, the other thirteen items were in the range of 0.5 to 0.75 and were included in the category of moderate validity. This shows that most

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items can already represent indicators of learning independence accurately and consistently.

B. DISCUSSION

1) General Description of the Instrument

The development of mathematics learning independence instruments for junior high school students in this study was carried out systematically and based on theory. The selection of the five main dimensions as the basic framework of the instrument refers to the theory of learning independence that has been widely used in educational research. This step shows that the instrument is built with a strong conceptual foundation, so that each item has a clear foundation and can be scientifically accountable. The preparation of statement items is not carried out arbitrarily, but through the stages of identifying indicators, elaborating measurable behavior, and formulating statements in language that is in accordance with the level of understanding of junior high school students.

An important strength in this study lies in the content validation process that involves structured expert assessments using the V Aiken quantitative approach [14]. The involvement of five validators who are experienced in their fields gives legitimacy to the results of the content validation carried out. By measuring the level of agreement between experts numerically, the validation results become more objective and statistically assessable. In addition, the selection of validators from the fields of mathematics education and educational evaluation shows that this study pays attention to the suitability of expert competencies with the validation object, so that the quality of the assessment of instrument items is more guaranteed. This approach makes an important contribution to the practice of developing non-cognitive instruments that are rarely quantitatively and methodologically documented.

2) Results of Expert Assessment Instrument Details

Based on the assessment value given by experts, it can be explained that in general this mathematics learning independence instrument has shown a fairly good level of relevance to the construction to be measured. Items that obtain high scores from all raters, such as items 1, 13, and 17, indicate that the statements in the items are seen as appropriate, clear, and representative of the indicators in question. This shows that the

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sentence formulation and word choice in the item are appropriate, and are able to describe the dimension of learning independence that is relevant for junior high school students.

On the other hand, point 11 which obtained low scores from some assessors showed weaknesses in terms of content suitability or editorial clarity. Varying scores between raters also indicate differences in perceptions about the meaning or focus of the statement. This shows the need for a revision of the item, both in terms of redaction and clarity of the indicators it represents. In the instrument development process, this is an important part that needs to be considered to improve the validity of the content and the accuracy of the measurements.

These findings reinforce the importance of expert validation processes in the development of educational instruments, especially those that measure non-cognitive aspects such as learning independence. Assessments by experts not only help identify weak grains, but also serve as a basis for making systematic improvements to the instrument before they are used in broader research or measurement [28]. Thus, this kind of content validation process greatly contributes to the quality and credibility of the developed instruments.

3) Results of the Calculation of the V Aiken Index

Calculations with the Aiken formula give an idea that some items in the instrument have met the high content validity standard, as seen in items 1, 3, and 7 that obtained an Aiken V value above 0.8125. These things are arranged by paying attention to the clarity of meaning, conformity with the indicators of learning independence, and using language that is easy for junior high school students to understand. The high agreement of the validators on the item indicates that the sentence redaction and the content of the statement have corresponded to the measured theoretical construction. However, the dominance of items with moderate validity categories indicates that there are still many statements that are not fully optimal. Variations in perception between validators on items such as numbers 5, 6, 14, and 15 indicate problems in terms of substance suitability, redaction clarity, or accuracy of indicator representation. Point 11, which has the lowest validity value, is a major highlight to be revised or even considered for elimination, as it does not make a significant contribution to measuring the construction in question.

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This condition confirms the importance of content validation by experts as a crucial stage in the development of psychopedagogic instruments [29]. The validation process aims not only to filter out items that are worth using, but also to be a mirror of the overall design quality of the instrument. In this context, the mathematics learning independence instrument developed shows potential use, but it still needs to be refined. Items that have been proven valid can be maintained and used as a reference in repairing other items. To improve the overall quality of the instrument, further steps are needed in the form of item revisions, limited trials to students as real respondents, and advanced analyses such as construction validity and reliability tests [30]. Thus, this instrument will have stronger scientific integrity and can be used effectively in measuring the independence of mathematics learning of junior high school students.

4. CONCLUSION

The study concludes that out of the 20 developed statements, six items have high validity, one item is less valid, and thirteen items have moderate validity. This indicates that most items meet the required standards, although some need improvement in wording and clarity. The study contributes to the development of non-cognitive instruments by applying a quantitative approach through the Aiken V index, which makes item evaluation more objective. It is recommended that developers revise the less valid items by referring to those with high validity and involve experts from various disciplines. For future research, empirical testing using Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) is suggested to ensure the construct validity and reliability of the instrument comprehensively.

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