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Development and Validation of the Vark Instrument in Citizenship Education Learning: A Structural Equation Modeling Approach for More Accurate Learning Style Measurement

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ABSTRACT

Purpose of the study: This research aims to develop and test the VARK learning style instrument in Citizenship Education Learning using SEM (Structural Equation Modeling) to produce a valid, reliable and goodness of fit instrument for more accurate measurement of learning styles.

Methodology: This study employs quantitative methods to evaluate the VARK learning styles theory in citizenship education through three primary phases: (1) assessing interrater validity to verify the construct's feasibility, (2) establishing empirical validity via Confirmatory Factor Analysis (CFA) to examine the construct's effectiveness and reliability, and (3) utilizing Structural Equation Modeling (SEM) along with goodness-of-fit (GOF) analysis to determine the model's overall suitability.

Main Findings: The findings of this research indicate that the VARK learning styles framework and related instruments in citizenship education are very suitable for measurement. The model meets the main criteria: (1) Inter-rater Validity Test confirms its validity, (2) Construct Validity Test using Confirmatory Factor Analysis shows validity and reliability, and (3) Goodness-of-Fit Test places the model in the acceptable fit category. So this instrument can be used to measure learning styles accurately.

Novelty/Originality of this study: The novelty of this research lies in the development and instrument of VARK learning styles in Citizenship Education learning which was tested using Structural Equation Modeling (SEM) to produce a feasible and accurate instrument for measuring learning styles.

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1. INTRODUCTION

Technological developments and changes in environmental conditions have had a significant impact on students' learning styles in the modern era. One of the most visible changes is the increasing use of digital technology in the learning process, especially since the Covid-19 pandemic. During that time, digital applications were widely used in the education sector to support teaching, learning, and assessment based on computer technology [1], [2]. This transformation requires a more adaptive learning approach to suit the needs

and characteristics of today's students. On the other hand, Citizenship Education (PKn) is often considered a boring subject by students. Many students do not like PKn because the learning method tends to be based on memorization, the material is considered difficult, and the use of the dominant lecture method in the teaching process. This makes learning less interesting and there is minimal interaction that can improve student understanding [3], [4]. In fact, PKn has a complex competency structure and covers various important aspects such as law, politics, culture and history, socio-communicative, environmental-geographical, and health care [5]. Therefore, more innovative learning strategies are needed to improve the effectiveness of PKn learning.

Learning innovation in citizenship education learning can be done in various ways. Innovations ranging from methods, strategies, media, teaching materials and learning evaluation to support learning effectiveness [6], [7], [8]. However, to develop or innovate in civic education learning, an analysis of the needs of students with the VARK learning style can be carried out[9]. The existence of learning analysis can make it easier for teachers to plan learning, implementing and evaluating learning[10]. With mature planning, learning can be effective and efficient.

One approach that can be used to improve learning effectiveness is to understand students' learning styles. Understanding learning styles is very important in organizing learning materials to suit individual student preferences [11], [12]. VARK (Visual, Auditory, Read/Write, Kinesthetic) is one model that can be used to identify students' learning styles and help them process, understand, and store information more effectively [9], [13]. The implementation of the VARK learning model with online-based learning media has an effect on students' understanding of concepts and mathematical problem solving abilities [14] VARK analysis uses an approch to preparing learning resources in the implementation of e-learning and learning teaching materials [15], [16]

In the context of higher education, it is important for lecturers to assess students' learning styles before applying certain teaching methods. This aims to improve the quality of education and facilitate deeper learning [17]-[19]. Previous studies have shown that VARK learning styles can affect student learning outcomes [20]-[22]. Therefore, analysis of students' learning styles in Citizenship courses is essential to determine appropriate learning strategies and provide tools that suit students' needs [23]-[26]. Thus, student learning outcomes can be more optimal and in line with the achievement of predetermined graduate competencies. One innovation that can be applied is a hybrid learning model that adapts the VARK learning style. This model has been shown to significantly increase student engagement and develop their critical thinking skills [27]-[30]. In addition, the development of an adaptive e-learning platform with a VARK-based approach can also be a solution to overcome the limitations of time and teaching staff in providing individual attention to each student [31]. Thus, it is important to develop an instrument that can measure students' learning styles in Citizenship courses so that the learning strategies applied can be more effective and in accordance with students' needs.

2. RESEARCH METHOD

This study uses quantitative methods to test the theory of VARK learning styles in Citizenship Education learning through three main stages: (1) Interrater validity to assess the feasibility of the construct, (2) Empirical validity through Confiratory Factor Analysis (CFA) to test the effectiveness and reliability of the construct, and (3) Structural Equation Modeling (SEM) to assess the suitability of the model with goodness-of-fit (GOF) analysis [32], [33]. Interrater validity was analyzed using the Aiken's-V coefficient [34], which involved three experts in the assessment process with a five-scale instrument. After the Aiken's Coefficient was carried out, the instrument was tested on 250 student respondents. By distributing research instruments to respondents and data analysis techniques with CFA. In addition, the CFA analysis also assessed the reliability of the construct [35], Reliability and validity are determined by the delta and lambda coefficients, which indicate that the greater the loading factor (LF), the more indicators qualify as measuring instruments for latent variables. The loading factor is considered very valid if the value is 0.50 or more, while the minimum value allowed is 0.40 [35], [36].. According to Hair et al, reliability in CFA analysis includes Construct Reliability (CR) and Average Variance Extracted (AVE) [32]. Reliability is considered good if CR $\geq$ 0.7, while a value of 0.6–0.7 is still acceptable if the indicator loading factor meets the criteria. Internal consistency is measured through AVE, with a recommended value of >0.5 to ensure that the indicator only measures the targeted latent construct. Stated that the discriminant validity of a construct is adequate if AVE is greater than the quadratic correlation between latent constructs [35], [36] . The suitability of the VARK learning style in Citizenship Education learning is assessed through goodness-of-fit (GOF), considering 4–5 criteria, including the absolute fit index (AFI), the incremental fit index (IFI), and the parsimony fit index (PFI). In CFA and SEM tests, the minimum sample size is 10 times the number of research items [37]. also recommend two PLS-SEM approaches in determining sample size: (a) 10 times the largest number of formative indicators in one construct or (b) 10 times the largest number of paths to the latent construct in the structural model [32], [33]. The following is a grid of research instruments and indicators and items for VARK Learning Styles and Citizenship education.

Table. 1 The following is a grid of research instruments and indicators for VARK Learning Styles and Citizenship education.

No	Dimensi	Indicator	Item
1	Visual	I understand Citizenship material better when I see diagrams or graphs that explain it.	1
		I prefer looking at concept maps or charts rather than reading long texts	2
		Notes or explanations with colors and pictures help me remember information.	3
		I often draw or sketch when studying Citizenship material.	4
2	Auditory	Listening to explanations or discussions helps me understand the concept of Citizenship Education better.	5
		I find it easier to remember information that is discussed or explained verbally.	6
		I like to learn by listening to recordings or podcasts about the topic being studied.	7
		Group discussions or talking to other people help me understand the Citizenship material more deeply.	8
3	Reading/ Writing	I prefer reading books or articles about Citizenship Education to learn new information.	9
		Rewriting notes or creating a written summary helps me remember the information.	10
		I find it easier to understand Citizenship Education material if I read written texts.	11
		I like to make lists or summaries in written form to help understand.	12
4	Kinesthetic	I understand Citizenship Education material better when I do activities or direct practice.	13
		I like to learn by trying it myself or through real experience.	14
		Activities that involve movement or experimentation help me remember information.	15
		I prefer simulations or role-plays to understand the material rather than just listening or reading.	16

Table 2. VARK learning style indicators and items in Citizenship Education learning

No.	Indicator
1.	Visual
VIS1	I understand Citizenship material better when I see diagrams or graphs that explain it.
VIS2	I prefer looking at concept maps or charts rather than reading long texts
VIS3	Notes or explanations with colors and pictures help me remember information.
VIS4	I often draw or sketch when studying Citizenship material.
The degree of this dimension is indicated by the following scale: (1) Never, (2) Rarely, (3) Sometimes, (4) Often, and (5) Always.	
2.	Auditory
AUD1	Listening to explanations or discussions helps me understand the concept of Citizenship Education better.
AUD2	I find it easier to remember information that is discussed or explained verbally.
AUD3	I like to learn by listening to recordings or podcasts about the topic being studied.
AUD4	Group discussions or talking to other people help me understand the Citizenship material more deeply.
The degree of this dimension is indicated by the following scale: (1) Never, (2) Rarely, (3) Sometimes, (4) Often, and (5) Always.	
3.	Reading/Writing
REA1	I prefer reading books or articles about Citizenship Education to learn new information.
REA2	Rewriting notes or creating a written summary helps me remember the information.
REA3	I find it easier to understand Citizenship Education material if I read written texts.
REA4	I like to make lists or summaries in written form to help understand.
The degree of this dimension is indicated by the following scale: (1) Never, (2) Rarely, (3) Sometimes, (4) Often, and (5) Always.	
4.	Kinesthetic
KIN1	I understand Citizenship Education material better when I do activities or direct practice.
KIN2	I like to learn by trying it myself or through real experience.
KIN3	Activities that involve movement or experimentation help me remember information.
KIN4	I prefer simulations or role-plays to understand the material rather than just listening or reading.
The degree of this dimension is indicated by the following scale: (1) Never, (2) Rarely, (3) Sometimes, (4) Often, and (5) Always.	

3. RESULTS AND DICUSSION

The construction and validity of the VARK learning style instrument in Citizenship Education learning are explained empirically to assess the validity, reliability, and suitability of the model. This analysis was conducted using the Structural Equation Modeling (SEM) test. The research results obtained are as follows:

3.1. Interrater Validity Test

The interrater instrument validity test was conducted by involving three experts using a five-level assessment scale with the Aiken formula [34]. In this calculation, the validity of the item is determined based on three raters and a scale of five, with a 5% error rate and an Aiken index coefficient of 0.79. The test results show that the index exceeds 0.79, the item is declared valid. The test result of 0.79 is included in the high validity category (good) [38].

3.2. Construct Validity Test using Confirmatory Factor Analysis

Test the validity and reliability of the construct using confirmatory factor analysis (CFA) using Lisreal 8.8 software. The first validity test was carried out by looking at the standardized loading factor (SLF) and the Average variance extracted (AVE). Instruments with convergent validity show SLF values > 0.5 and AVE values > 0.5 [32], [33]. The following are the results of the confirmatory factor analysis (CFA) test shown in the following figure 1.

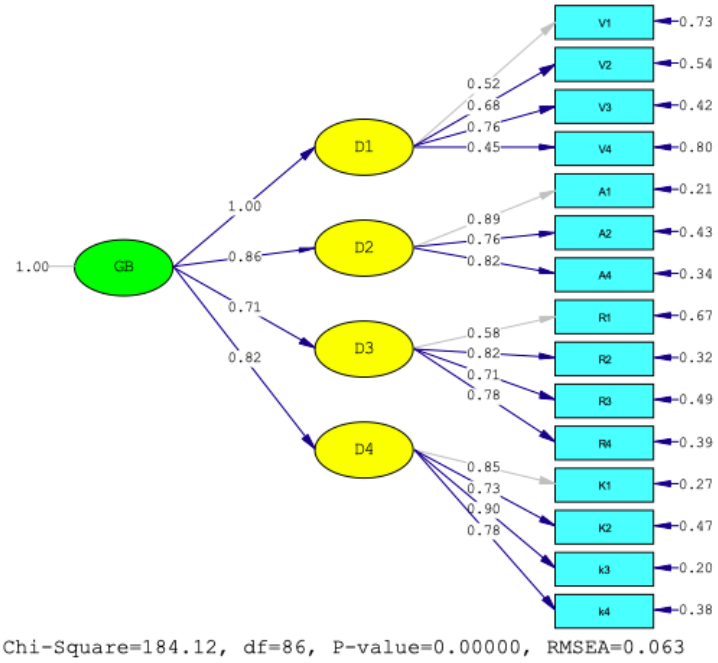

Figure 1. Standardized first order and second order solutions (stage 1)

Based on Figure 1. Standardized first order and second order solutions (stage 1) that out of 12 indicators there is one indicator whose standardized loading factor (SLF) value is less than 0.5, namely in the VIS 4 indicator (0.45). Then the invalid indicators are deleted, while those with values more than 0.5 are declared valid to continue to calculate Construct Reliability (CR) and Average Variance Extracted (AVE). Reliability in CFA analysis includes Construct Reliability (CR) and Average Variance Extracted (AVE) [32], [33]. Reliability is considered good if CR ≥ 0.7[39], while a value of 0.6–0.7 is still acceptable if the indicator loading factor meets the criteria. The following are the results of the calculation of AVE and CR.

Table 3. Results of AVE and CR First Order Values (stage 1)

No.	Dimensions	AVE	CR	Information
1	Visual (D1)	0.43820225	0.55242967	Not Valid/Reliable
2	Auditory (D2)	0.67634301	0.86185485	Valid/Reliable
3	Reading/Writing (D3)	0.53465099	0.8188897	Valid/Reliable
4	Kinesthetic (D4)	0.6270932	0.86985987	Valid/Reliable

Based on Table 3. Results of AVE and CR First Order Values (stage 1) that the dimensions for D2, D3, and D4 are included in the category of valid and reliable AVE and CR. Then there is a dimension that AVE is

less than 0.5 and CR is less than 0.7, namely in the Visual dimension (D1). Furthermore, the dimensions that are not valid and reliable are removed from the low indicators. From the SLF analysis, the lowest value was found in the VIS 1 indicator (0.53), this was done to see the effect on the AVE and CR values. Then after being removed from the VIS 1 indicator (0.53), the results of the confirmatory factor analysis (CFA) analysis were found as follows figure 2.

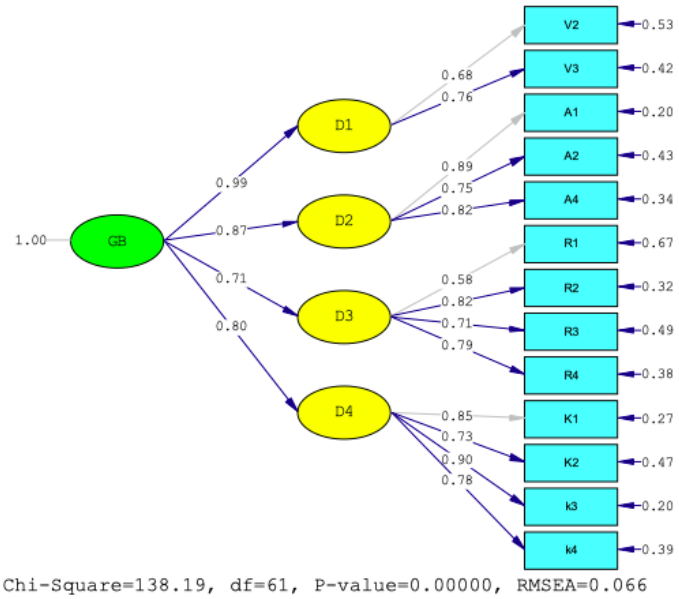

Figure 2. Standardized first order and second order solutions (stage 2)

Based on Figure 2. Standardized first order and second order solutions (stage 2) that all SLF value indicators are more than 0.5, then all indicators are calculated for the AVE and CR first order values, with the calculation results as follows in table 4.

Table 4. Results of AVE and CR First Order Values (stage 2)

No.	Dimensi	AVE	CR	Keterangan
1	Visual (D1)	0.52261307	0.70	Valid/Reliable
2	Auditory (D2)	0.67634301	0.86185485	Valid/Reliable
3	Reading/Writing (D3)	0.53465099	0.8188897	Valid/Reliable
4	Kinesthetic (D4)	0.6270932	0.86985987	Valid/Reliable

Based on Table 4. Results of AVE and CR First Order Values (stage 2) that all dimensions of AVE values are more than 0.5 and CR is more than 0.7 meaning that AVE and CR first order calculations on the VARK learning style instrument in learning are said to be valid and reliable. After the first order stage, the next step is to calculate AVE and CR in the second order. Based on the second order calculation as follows.

Table 5. Results of AVE and CR Second Order Values

Variabel	Dimensions	AVE	CR
VARK Learning Style in Citizenship Education Learning	All dimensions	0.72007698	0.91023411

Based on Table 5. Results of AVE and CR Second Order Values, the second order calculation value on the VARK Learning Style in Citizenship Education Learning variable shows that AVE is more than 0.5 and CR is more than 0.7[39], so the results show that the VARK learning style instruments in learning are said to be valid and reliable.

3.3 Model Good Fit of Test

The Goodness of Fit (GOF) test is used to assess the extent to which the theoretical model fits the empirical model. According to Latan, there are three types of GOF measures, namely absolute fit indices, incremental fit indices, and parsimony fit indices [37]. Meanwhile, Hair et al stated, that researchers are not required to meet all indicators in the GOF [32]. If 4-5 criteria have been met, then the GOF value is considered

adequate, as long as each criterion used is in accordance with the assessment standards. Details of the results of the model fit test can be seen in Table 6.

Table. 6 Model Fit of the Test

No	Size for Good Fit of Test	Fit Level Target	Estimated Results	Fit Level
A. Absolute Fit Indices				
1	Chi- Square P	The Smallest value P > 0.05	Chi-Square = 138.19 P = 0.0000	-
2	Estimated Non-Centrality Parameter (NCP)	The Smaller the NCP, the Better	Estimated Non-Centrality Parameter = 77.9 90 % Confident interval for NCP = (46, 85; 115.26)	Good Fit
3	Root Mean Square Residual (RMR)	Standardized RMR < 0.05	RMR = 0.042	-
4	Root Mean Square Eror of Approximation (RMSEA)	RMSEA < 0.08 = fit RMSEA < 0.50 = close fit	RMSEA = 0.066 P = 0.035	Good Fit
5	The Goodness of Fit Index (GFI)	> 0.90 : good 0.8 – 0.9: margin fit	GFI = 0.93	Good Fit
6	Expected Cross-Validation Index (ECVI)	The Model (M) value is closer to the Saturated (S) value than the M-Value with the independent (I) value	ECVI = 0.69 S = 0.63 I = 16.70	Good Fit
B. Incremental Fit Indices				
7	Normed Fit Index (NFI)	> 0.90 : good. 0.8-0.9 : Marginal fit.	NFI = 0.97	Good Fit
8	Non-Normed Fit Index (NNFI)	> 0.90 : good. 0.8-0.9 : Marginal fit.	NNFI = 0.98	Good Fit
9	Comparative Fit Index (CFI)	> 0.90 : good. 0.8-0.9 : Marginal fit.	CFI = 0.76	Good Fit
10	Incremental Fit Index (IFI)	> 0.90 : good. 0.8-0.9 : Marginal fit.	IFI = 0.98	Good Fit
11	Relative Fit Index (RFI)	> 0.90 : good. 0.8-0.9 : Marginal fit.	RFI = 0.96	Good Fit
12	Adjusted Goodness of Fit Index (AGFI)	> 0.90 : good. 0.8-0.9 : Marginal fit.	AGFI = 0.90	Good Fit
C. Parsimony Fit Indices				
13	Akaike Information Criterion (AIC)	The Model (M) value is closer to the Saturated (S) value than the M-Value with the independent (I) value	I = 4810.25 M = 198.19 S = 182	Good Fit
14	Consistent Akaike Information Criterion (CAIC)	The Model (M) value is closer to the Saturated (S) value than the M-Value with the independent (I) value	I = 4870.92 M = 338.19 S = 606.64	Good Fit

Based on Table 6 Model Suitability Test, the results of the Goodness of Fit test show that the test results are higher than the Absolute GoF criteria, the RMSEA and RMR values are in accordance with the standard values, then for the Incremental GoF criteria, the NFI values), Non-Normed Fit Index, CFI, IFI, and RFI have been in accordance with the standard values, and for the Parsimony GoF criteria, the Independence AIC value and the CAIC independence value are in accordance with the standard. This shows that the VARK style measurement instrument in Citizenship Education learning theoretically meets the five required criteria [32], [33].

The development of technology and situational conditions force the massive use of technology in learning, one of which is in Citizenship Education learning. However, the development and changes in learning methods and technology are not accompanied by an effective and efficient analysis of student needs [40], [41]. The need for the use of technology that pays attention to needs and effectiveness in order to be able to support learning rather than creating new problems in learning. The existence of the preparation of VARK learning style

constructions and instruments in Citizenship Education learning in order to be able to analyze needs and suitability with student characteristics. The constructions and instruments that have been prepared are then tested using Structural Equation Modeling (SEM) with the results (1) the results of the Interrater Validity Test are valid, (2) the Construct Validity Test using Confirmatory Factor Analysis shows valid and reliable, (3) the results of the Good Fit of Test Model Test are included in the goodness of fit category[42]. Choosing the right learning method is one of the main elements in supporting the achievement of Citizenship education goals.

The material presented in the Pancasila and Citizenship Education book contains components to meet the indicators for the formation of political awareness of students who are trained through strategies for involving students in their residential environment [43]-[46]. To increase participation and foster tolerance and awareness as citizens, a school activity strategy has been designed involving important stakeholders such as elections and the police. In this context, the application of the VARK learning style model (Visual, Auditory, Read/Write, and Kinesthetic) can help adjust the material coordination method to the individual learning preferences of students. By adapting the VARK approach [8], [9], [47], [48], learning materials can be presented in a more interesting and varied way for example, through visual media, interactive discussions, and practical activities thus supporting a deeper understanding of key concepts such as political awareness and the formation of national identityHowever, although this strategy has supported the development of political awareness, the components of forming national identity have not been fully covered in learning materials, so learning strategies that integrate the VARK approach need to be developed further to achieve the learning objectives of Citizenship Education [49]-[53]. The importance of measuring and analyzing VARK learning styles to facilitate learning in the classroom. Suggestions for teachers or educators can carry out an analysis of student needs by conducting a VARK analysis of students to make it easier to select and implement learning strategies and use appropriate teaching materials in learning.

4. CONCLUSION

Development of VARK learning style instrument in Citizenship Education learning to be able to analyze the needs and suitability with student characteristics. The construction and instruments that have been prepared are then tested using Structural Equation Modeling (SEM) with the test results (1) the results of the Interrater Validity Test are valid, (2) the Construct Validity Test using Confirmatory Factor Analysis shows valid and reliable, (3) the results of the Good Fit of Test Model are included in the goodness of fit category.

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