



VALIDATION OF THE INDONESIAN VERSION OF THE EPISTEMOLOGICAL BELIEF QUESTIONNAIRE

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ABSTRACT: The lack of studies on epistemological beliefs in Indonesia is the background for this research, with the availability of the Indonesian version of the questionnaire of epistemological beliefs, it is hoped that it can help practitioners who want to study epistemological beliefs. The purpose of this study was to validate the Indonesian version of the epistemological belief questionnaire which was adopted from the epistemological belief questionnaire developed by Conley et al. (2004). A total of 124 prospective teachers as voluntary respondents in this study, consisting of 20 biology prospective teachers from The Mandalika University of Education, 49 prospective teachers for science education from IAIN Salatiga, 25 biology prospective teachers from The Madiun University of Education, and 30 biology prospective teachers from The Muhammadiyah University of Malang. The data obtained were then analyzed using the exploratory factor analysis (EFA) technique using SPSS version 22 for windows, while confirmatory factor analysis (CFA) was performed using SPSS Amos version 24 for windows. Based on the results of the EFA analysis, the KMO value = 0.755, it was stated that the data met the criteria for factor analysis. Furthermore, from the results of the CFA, of the 17 items from the EFA analysis, 15 items were obtained that support a fit model, with a P-value = 0.081, CFI = 0.960, TLI = 0.950, NFI = 0.819, and RMSEA = 0.050, and it was concluded that 15 items are declared valid and reliable.

Keywords: Epistemological Beliefs, Exploratory Factor Analysis, Confirmatory Factor Analysis, Prospective Teachers.



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INTRODUCTION

Epistemology is a branch of philosophy seeks to answer the question of what is meant by knowledge, and how knowledge is obtained. In the context of psychology and education, epistemology (theory of knowledge) is conceptualized as epistemological beliefs or personal epistemology (Hofer & Bendixen, 2012; Topcu, 2013). For Hofer and Pintrich, epistemological beliefs refer to one's beliefs and views on how to develop and assess knowledge (Lee & Yuan, 2012), while Schommer explains that epistemological beliefs refer to the nature of learning and learning aptitude, and both (nature and learning aptitude) are very important related to the acquisition and use of knowledge, and it is a belief system (Ekinci, 2017).

The study of epistemological beliefs was first conducted by Perry and other researchers (Brownlee et al., 2017; Topçu et al., 2011). In his study, Perry





used four dimensions, namely multiplism, dualism, commitment, and relativism (Reddy, 2020; Ortwein et al., 2015), and after conducting interviews, Perry concluded that students at the beginning of their study believed that knowledge was simple, constant, and experts as sources of knowledge, while senior students believe that knowledge is tentative, complex, difficult to predict (Langcay et al., 2019).

After Perry succeeded in initiating a study of epistemological beliefs, several researchers continued to study epistemological beliefs, including Schommer, Hofer and Pintrich, and Conley. Schommer in his first study of epistemological beliefs uses five dimensions, namely certainty of knowledge, simple knowledge, sources of knowledge, innate ability, and speed of learning (Bahçivan, 2016). Simple knowledge is factual knowledge that can be interconnected (Brownlee et al., 2017; Schreiber & Shinn, 2011). The dimension certainty of knowledge reflects one's belief from absolute, knowledge is constant to knowledge is tentative (Brownlee et al., 2017; Cole et al., 2014; Schreiber & Shinn, 2011).

The dimension of the source of knowledge reflects a person's beliefs about knowledge ranging from the knowledge that is outside himself, believing in experts as a source of knowledge, to beliefs about knowledge formed by individuals through their interactions with various sources of knowledge (Brownlee et al., 2017), including experts, experience, and others (Hofer & Bendixen, 2012). The dimension of innate ability reflects a person's belief that innate abilities are very influential in learning until beliefs about learning abilities can be obtained (Cole et al., 2014). The speed of learning dimension reflects one's belief whether learning occurs in a short time or takes a long time (Schreiber & Shinn, 2011), or reflects one's belief that learning can occur in a short time to the belief that learning occurs gradually (Brownlee et al., 2017).

Hofer & Bendixen (2012) in their study of epistemological beliefs, divide epistemological beliefs into two categories, namely the nature of knowledge and the nature of knowing. The nature of knowledge reflects a person's beliefs about what is meant by knowledge. This category includes the dimensions of simple knowledge and certainty of knowledge, while the nature of knowing includes sources of knowledge and justification of knowledge. The justification of knowledge dimension reflects one's beliefs about the ways one uses in assessing knowledge or a claim, from the simplest way (accepting knowledge without making criticism) to assessing knowledge accompanied by evidence.

Furthermore, Conley et al. (2004) proposed that the epistemological beliefs model is slightly different from the epistemological belief model of Schommer, Hofer and Bendixen, namely the epistemological belief model with four dimensions, consist of certainty, development, source, and justification of knowledge. In Schommer, Hofer and Bendixen epistemological belief model, one's belief about constant knowledge to tentative knowledge is included in the certainty of knowledge dimension, but in Conley epistemological belief model, the nature of the knowledge is divided into two dimensions, namely the dimensions of certainty and development. The dimension of certainty in Conley





epistemological belief model, only reflects one's beliefs about knowledge that is absolute, constant, while the developmental dimension reflects one's beliefs about knowledge is tentative, changes based on the new data or evidence, and justification of knowledge as a dimension that reflects one's beliefs about the role of the experiment and the methods used to evaluate or assess a claim.

In educational and psychological research related to epistemological beliefs focuses on the structure and development of epistemological beliefs of high school students and college students, as well as the epistemological beliefs of teachers in schools (Schraw, 2013). Akbay et al. (2018) states that epistemological beliefs affect how students construct reasoning and make decisions. Specifically for teachers, several studies confirm that the epistemological beliefs of pre-service teachers are related to certain topics, and affect their teaching behavior (Bahçıvan, 2016). In addition, epistemological beliefs affect on critical thinking (Hyytinen et al., 2014; Rott, 2021), critical thinking dispositions (Ünlü & Dökme, 2017), problem-solving (Reddy, 2020), motivation and self-efficacy (Mellat & Lavasani, 2011), self-efficacy and self-regulated learning (Phan, 2008), metacognitive (Yenice & Özden, 2015), reasoning (Angeli & Valanides, 2012), and innovative thinking (Orakcı et al., 2020).

Pay attention to the description above, epistemological beliefs play a very important role in learning, but especially in Indonesia, epistemological beliefs have received less attention. The lack of studies on epistemological beliefs is not a reason to say that there are no instruments for epistemological beliefs. In general logic, if there have been many studies on epistemological beliefs, it means that there are also many instruments about epistemological beliefs, then the most likely question is whether these existing instruments can be used in different cultural and linguistic contexts, so this condition is very supportive to begin with the study of epistemological beliefs by adopting and/or translating epistemological questionnaire. There are many epistemological belief models that can be use as a reference in studying epistemological beliefs, such as Schommer, Hofer, and Conley, but in this study, we chose to adopt the epistemological belief model developed by Conley et al. (2004), because the model is simple, there are not too many items so that participants or respondents do not feel bored with many items. Based on this framework, the purpose of this study is to validate the Indonesian version of the epistemological belief questionnaire.

METHOD

This research is quantitative survey research. Ponto (2015) explains that survey research can be use by quantitative strategies, can also use qualitative strategies (usually using open-ended questions), and both (quantitative and qualitative strategies) can be combined using mixed methods. The sample in this study was randomly selected from 4 universities, namely Mandalika University of Education, State Islamic Institute (IAIN) Salatiga, Madiun University of Education, and The Muhammadiyah University of Malang, and obtained a total 124 respondents, consisting of 20 biology prospective teachers from The Mandalika University of Education, 49 prospective science teachers from IAIN





Salatiga, 25 biology prospective teachers from The Madiun University of Education, and 30 biology prospective teachers from The Muhammadiyah University of Malang.

To obtain data of epistemological beliefs, we adopted the epistemological belief questionnaire developed by Conley et al. (2004), consists of four dimensions, namely source = 5 items, certainty = 6 items, development = 6 items, and justification of knowledge = 9 items. A Likert scale with four choices was used to obtain respondents' agreement, from strongly disagree to strongly agree. The instruments that have been prepared are then distributed through WhatsApp social media, by first seeking approval from the university.

The validation process of the Indonesian version of the epistemological belief questionnaire was carried out using factor analysis, exploratory factor analysis (EFA), and confirmatory factor analysis (CFA). Anderson suggested that during the analysis process, a model can be prepared through EFA, then confirmed by CFA (Hu & Li, 2015), or EFA is an initial analytical technique that must be carried out before conducting CFA (Shrestha, 2021). The analysis process using EFA was carried out using SPSS version 22 for windows, while for CFA was carried out using SPSS Amos version 24 for windows. This CFA aims to describe how each item relates to its construct, and how the relationship between constructs, in which the relationship model is evaluated based on $P\text{-value} \geq 0.05$, $\text{CFI} > 0.9$, and $\text{RMSEA} < 0.08$ (Stacciarini & Pace, 2017).

RESULTS AND DISCUSSION

To be able to perform a factor analysis, it must first be known whether the data collected is sufficient or not. Sample adequacy was measured based on the KMO value and Bartlett's test (Koyuncu & Kılıç, 2019). If the KMO is met then the Bartlett test should be significant, with a $P\text{-value} < 0.01$ (Hu & Li, 2015). According to Tabachnic and Fidell, the minimum KMO value is 0.6, while Kaiser recommends the minimum KMO value is 0.5 (Hadi et al., 2016). Based on Table 1, the KMO value is 0.755 ($\text{KMO} > 0.5$), and the Bartlett test value ($P < 0.01$), so that the existing data is stated to be sufficient for factor analysis.

Table 1. KMO and Bartlett's Test of Sphericity Values.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.755
Bartlett's Test of Sphericity	Approx. Chi-Square	645.528
	df	136.000
	Sig.	$P < 0.001$

The results of the EFA (Principal Component Analysis/PCA) analysis with varimax rotation can be seen in Table 2, showing the distribution of each item with its loading factor after rotation of the factor matrix. Initially, there were a total of 26 items, after the analysis, 9 items were excluded from the analysis process because the loading factor value was less than 0.4, so that there were 17 items remaining. Factor 1 is called development (4 items) with an $\alpha\text{-Cronbach}$ value of 0.80, the variance that can be explained is 25.59%, factor 2 is called justification of knowledge (5 items) with an $\alpha\text{-Cronbach}$ value of 0.84, the





variance that can be explained is 17.57%, factor 3 is called source (4 items) with an α -Cronbach value of 0.79, can explain 12.20% of the variance, and factor 4 is called certainty (4 items) with an α -Cronbach value of 0.67 with an explainable variance of 8.50%. The results of this EFA analysis are hereinafter referred to as the initial model which will later be retested through the CFA.

As stated earlier, the results of the EFA analysis are an initial model that will be tested further using confirmatory factor analysis. Figure 1 is a fit model regarding the relationship between items and its constructs, and the relationship between constructs after being modified from the initial model, because it does not fit or does not meet the criteria of a good model based on the reference value or index used, as a consequence there must be items are removed from the analysis process. After being modified, obtained $P = 0.081$, RMSEA = 0.050, and CFI = 960, TLI = 0.950, and NFI = 0.819. There are four constructs, namely certainty (C), source (S), development (D), and justification of knowledge (J). The visible lines show, *First*; the relationship between items and their constructs. Each item has a loading factor value greater than 0.5. *Second*; shows the relationship between constructs, which of the four constructs, dimension or construct source and certainty has the highest correlation.

Table 2. Distribution of Items and Their Loading Factors After Rotation of Factor Matrix.

Item	Factor Loading After Factor Matrix Rotation			
	Factor 1	Factor 2	Factor 3	Factor 4
S1			0.619	
S3			0.736	
S4			0.680	
S5			0.570	
C1				0.428
C2				0.823
C4				0.470
C6				0.622
D2	0.490			
D4	0.787			
D5	0.838			
D6	0.664			
J2		0.734		
J4		0.840		
J6		0.743		
J7		0.719		
J9		0.812		
Eigen Values	4.35	2.99	2.07	1.44
The Variance Explained by Each Factor (%)	25.59	17.57	12.20	8.50
α -Cronbach	0.80	0.84	0.79	0.67

Note: S = Source; C = Certainty; D = Development; and J = Justification of Knowledge.

Table 3. AVE Values, CR Coefficients and Correlation between Constructs with the Square Root of AVE.

	AVE	CR	S	C	D	J
S	0.622	0.868	0.789			
C	0.638	0.841	0.388	0.799		
D	0.648	0.880	0.293	0.322	0.805	
J	0.682	0.895	-0.051	0.044	0.014	0.826

The α -Cronbach value is a value that is widely used to measure internal consistency (Heale & Twycross, 2015; Kim et al., 2016; Trizano-Hermosilla & Alvarado, 2016; Villafa e et al., 2011), with α -Cronbach ≥ 0.70 (Mayers, 2013). From the results of the EFA analysis, as shown in Table 2, only factor 4 does not meet the criteria for internal consistency, but in the context of the structure equation model (SEM) analysis, the composite reliability (CR) value is a value used to measure internal consistency, because CR is an alternative to α -Cronbach (Ghazali & Nordin, 2019), with CR > 0.7 (Saeed & Kassim, 2017). Based on the CR values on the Table 3, it is known that the CR value is greater than 0.7 so that 15 items from the CFA analysis are declared to meet the internal consistency criteria.

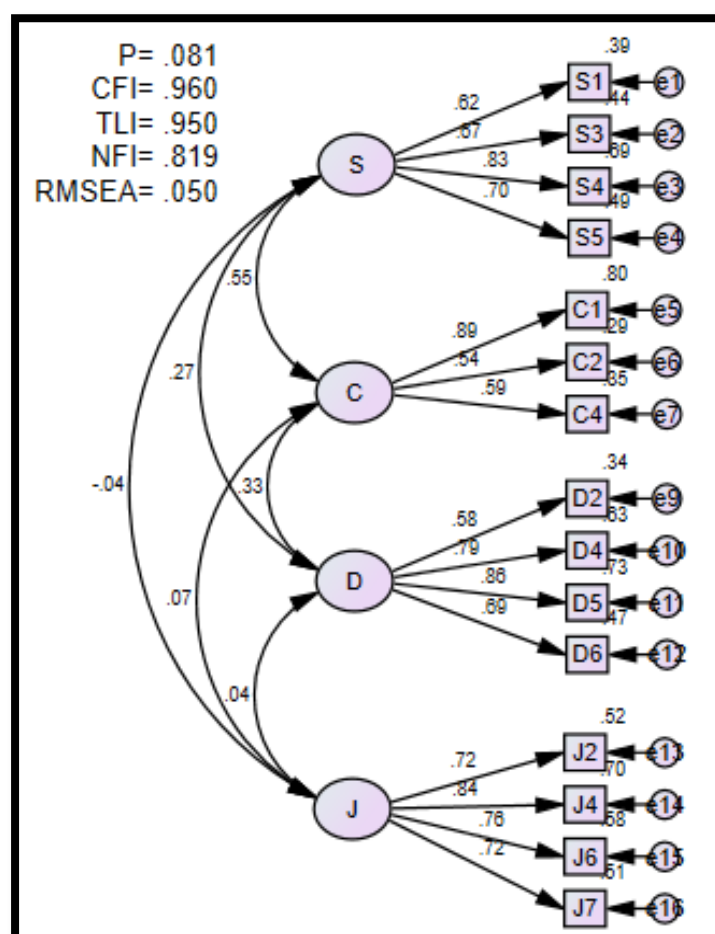


Figure 1. The Structure of Epistemological Beliefs Model.



Testing the validity of the Indonesian version of the epistemological beliefs questionnaire only focuses on construct validity, including convergent and discriminant validity (Zait & Berteau, 2011). Convergent validity refers to the level of correlation between items in a construct, while discriminant validity refers to the level of correlation between constructs empirically (Hamid et al., 2017). The Average Variance Extracted (AVE) and CR values are good evidence to test convergent validity, with the criteria $AVE > 0.5$, and $CR > 0.7$ (Hamid et al., 2017; Kim et al., 2016; Muhammad et al., 2017), while good evidence to test discriminant validity is the value square root of AVE, with the criterion that the value must be higher than the correlation value between constructs (Zait & Berteau, 2011). Based on the information on Table 3 above, the value of $AVE > 0.5$, and $CR > 0.7$, so it is stated that 15 items from the CFA analysis meet the criteria of convergent validity, or in other words, the items that make up each construct can represent their constructs. The value in brackets is the value of square root value of AVE, which is greater than the correlation value between constructs so that the 15 items from the CFA analysis meet the criteria for discriminant validity, or in other words, each construct shows a strong difference.

The purpose of this research was to validate the Indonesian version of the epistemological belief questionnaire which was adopted from Conley et al. (2004). This adoption process aims to make it easier for practitioners to examine the relationship between epistemological beliefs and various academic performances, such as thinking skills and conceptual understanding. Based on the results of the analysis that has been carried out, from the 26 items only 15 items support a fit model, with P -value = 0.081, RMSEA = 0.050, CFI = 0.960, TLI = 0.950, and NFI = 0.819. These results are relatively the same with the results of the study conducted by Conley et al. (2004) using CFA, showed that the value of RMSEA = 0.038, NFI = 0.89, CFI = 0.90. Lee & Chan (2015) in their study adapting the dimensions of epistemological beliefs Conley, from 16 items, 15 items were obtained that can construct a fit model (CFI = 0.930, RMSEA = 0.042). Likewise, the results shown by Sadi & Dağyar (2015), in their study by adapting the epistemological beliefs of Conley, showed that the value of RMSEA = 0.044, NFI = 0.90, and CFI = 0.92.

If we look again at the results of the CFA analysis in Figure 1, the 15 items obtained not only support a fit model, but also reflect the dimensions of epistemological beliefs developed by Conley, or in other words the Indonesian version of epistemological belief questionnaire reflects the model of epistemological belief developed by Conley, consists of four dimensions, namely certainty, development, source, and justification knowledge. In addition, from the results of the analysis that has been carried out, we find that the Indonesian version of epistemological beliefs is multidimensional. From the value of $AVE > 0.5$ and $CR > 0.7$, it can also basically be used to investigate the correlation between constructs, in the sense that if the items in each construct can represent their construct, it can indirectly be interpreted that the existing constructs (certainty, development, source, and justification knowledge) are not strongly correlated, but nevertheless, the correlation between constructs must be





investigated empirically through discriminant validity. The results of the analysis show that a high square root value of AVE and CR > 0.7 indicates that the existing constructs are not strongly correlated, or each construct only correlates with the items that compose it.

CONCLUSION

There are several models of the epistemological beliefs that can be used as a reference for conducting studies of epistemological beliefs, such as the model of Schommer, Hofer, and Conley's epistemological beliefs, and all of these epistemological belief models have been studied in different places. Specifically in this study, the epistemological belief model used as a reference for the study is the epistemological belief model developed by Conley. Conley epistemological belief model has also been widely adopted and adapted, such as Sadi & Dağyar (2015) adapting it into a Turkish version, as well as Lee & Chan (2015) adapting it into a Hong Kong version. In this study, we did not attempt to compare it with the original version. After analyzing using CFA, the results show 15 items that support a fit model, according to the reference index value, and indicate that the results of this study are quite good, or in other words, the 15 items are declared valid and reliable.

Although the samples in this study were obtained from four universities, but the number of respondents obtained was relatively small, so the results of this study may not be the same if retested in the large sample with different participants. This deficiency is influenced by our inability to cover prospective teachers from various universities in different locations so that although the results of this study are valid, we cannot conclude in general terms.

RECOMMENDATIONS

Referring to studies of existing epistemological beliefs, both literature studies, and empirical studies, shows that epistemological beliefs are predictors that can explain several academic performances, so for further research, it is recommended to examine the relationship between epistemological beliefs with conceptual understanding or thought processes, such as critical thinking and problem-solving skills.

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