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Dimensionality and Predictive Validity of Schommer Epistemological Questionnaire among Philippine Pre-service Teachers

Rudolf T. Vecaldo
Asst. Prof., College of Teacher Education, Cagayan State University, Tuguegarao City, Philippines, *0728rud@gmail.com*

Schommer Epistemological Questionnaire (SEQ) has been widely used in varying purposes providing significant input to the growing body of epistemological research. However, there is no consensus regarding its factor structure. Since researchers in teacher education still use the said instrument, the study aimed to investigate both the dimensionality and predictive validity of SEQ. Data came from 229 pre-service teachers of a public university in Cagayan Valley Region, Northern Philippines. The dimensionality of SEQ was analyzed using Confirmatory Factor Analysis (CFA), and its predictive validity was examined through Structural Equation Modeling (SEM). CFA results showed a one-dimensional structure, which contends the multidimensionality of epistemological beliefs as initially theorized by Schommer. Moreover, SEM analysis provides evidence that the one-dimensional epistemological beliefs extracted in the study possess predictive validity as the theoretical model successfully accounts for the observed relationship between epistemological beliefs and professional education grade. Hence, SEQ may still be used as a valid measure in the context of the study only if treated as a one-dimensional scale.

Keywords: epistemological beliefs, Schommer Epistemological Questionnaire, dimensionality, predictive validity, pre-service teachers

INTRODUCTION

Scale development is an indispensable aspect of social science research because it generates instruments or tools that can measure or assess with precision and accuracy the social and behavioral phenomena that are highly abstract (Kyriazos & Stalikas, 2018) or any attribute of interest that are unobservable (Tay & Jebb, 2017). It is a series of studies that focus on the generation of items, analysis of theory or constructs, and assessment of psychometric properties (Morgado, Meireles, Neves, Amaral, & Ferreira, 2017). This process is done, according to Netemeyer, Bearden, and Sharma (2003:17), to ensure that "any measure must be valid to allow for constructing confident interferences from empirical studies."

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One of the unobservable or abstract concepts that previous researchers sought to examine was the epistemological beliefs. For several decades, scale development became instrumental in coming up with tools that could measure such a construct. The significance of epistemological beliefs in the learning process has inspired educators and researchers to design and develop valid and credible measures for empirical studies.

In context, Shaver (1992:1) defines epistemology as "the division of philosophy that investigates the nature and origin of knowledge." Epistemological beliefs, therefore, focus on the views the individual holds about the nature of knowledge and the process of its acquisition (Elliot & Chan, 1998). Interestingly, these beliefs are linked to student learning in various ways such as in grade point average (Schommer-Aikins & Easter, 2006; Kadivar, Tanha, Jvadi, & Farzad, 2011; Arslantas; 2016), reading comprehension (Schommer, 1990), reflective judgment scores (Lodewyk, 2007), reflective thinking (Phan, 2008), surface learning approach (Ismail, Hassan, Muhamad, Ali, & Konting, 2013) academic goal-setting (Braten & Stromso, 2005) and have led to the conception of some studies exploring their diverse dimensions (Hofer & Pintrich, 1997; Hoffer, 2001) . In teacher education, epistemological beliefs become indispensable variables in the teaching-learning process (Aslan, 2017) because getting acquainted with pre-service teachers' views on the nature of knowledge and learning allows the attainment of effective learning outcomes (Brownlee, 2001).

Noteworthy to mention is the groundwork of epistemological studies that was initially established by Perry (1968), who theorized the one-dimensional perspective of epistemological beliefs. This point presupposes that if one dimension matures, the other dimensions mature too. Theorizing further, he came up with the view of several epistemic positions focusing on the knowledge that is composite and provisional, which is a derivative of reason and empirical evidence (Schommer & Hutter, 2002). This idea, however, was challenged by Schommer (1990). Synthesizing Perry's (1970) and Dweck's and Leggett's (1988) studies, Schommer shifted to another epistemological direction. She proposed the multidimensionality of the epistemological belief system, revealing that beliefs do not necessarily mature at the same rate. She claimed that individuals may have naive beliefs on a particular dimension and may have sophisticated beliefs on another at the same time. This view fittingly impelled more discussions and reviews in the said field.

The seemingly crucial role of epistemological beliefs in the educative process encourages researchers to search for means to evaluate these beliefs (Duell & Schommer Aikins, 2001). Several instruments came out, such as those designed by Baxter Magolda (1992), and Jheng, Johnson, and Anderson (1993). Nonetheless, one of the most commonly used and critiqued instruments is the epistemological questionnaire of Schommer (1990). Through the years, Schommer Epistemological Questionnaire (SEQ) has been a popular measure for quantitative studies of epistemological beliefs focusing on various dimensions, and this tool has created a continuing discourse specifically on its validity and stability (Clarebout, Elen, Luyten, & Bamps, 2001). Indeed, there is a gap in the literature that necessitates further study.

Because of the variable factor structure identified in previous studies, the present study endeavored to determine further validity of the SEQ since researchers in teacher education still use the scale (e.g., Magno, 2011; Ismael et al., 2013; Ayla, Zubeyde, & Desdan, 2014; Aslan, 2017). With this, it is hoped that a clearer understanding of the use of SEQ might be suggested, especially in the Philippine context. Specifically, it attempted to test or confirm the dimensionality of SEQ when administered to Filipino pre-service teachers and to establish a predictive validity of the factor structure considering professional education grade as the ordered criterion.

Netemeyer et al. (2003:76) claim that predictive validity is a type of criterion validity that "refers to the ability of a measure to predict some subsequent and temporarily ordered criterion effectively." In this study, the professional education grade is considered a criterion, which is an interesting variable of the study because it offers an array of skills, values, and lessons that are primarily intended to prepare pre-service teachers to embrace the teaching profession. The Philippine Commission on Higher Education (CHED) defines professional education courses as those that present a curriculum component that intends to develop the range of education and skills needed in the practice of the teaching profession (CHED Memorandum Order No. 30 Series of 2004). These are composed of 54-unit courses broken down into theory and concepts, methods and strategies, field study, and special topics that enable pre-service teachers to "discover whether they want to teach and intensify their desire to teach" (Savellano, 1999:265).

Significance of the Study

In the Philippines, the use of SEQ became popular, especially with the emergence of epistemological studies in teacher education. Since SEQ is one of the widely used instruments in quantitative studies on epistemological beliefs, there is a need to look more deeply into its dimensionality and validity when applied in a particular context in order to ensure that the tool indeed is a credible means of measuring what it intends to measure considering the nuances and various circumstances. Based on the literature, there is no agreement on the factor structure of the SEQ. Hence, the conduct of further validity tests focused on dimensionality and predictive validity of SEQ is deemed necessary and significant as it primarily establishes SEQ as a valid measure of the epistemological construct. With the foregoing impetus, the present study has its end view of catalyzing not only new knowledge on SEQ but also implications to the study of epistemological beliefs in teacher education in the Philippine setting. The output of this research intends to fill in the gaps in the literature and to provide additional insights into the study of pre-service teachers' epistemological beliefs, particularly in the Philippines.

Research Questions

Generally, the present study aimed to further validate the SEQ by clarifying its dimensionality or factor structure and its predictive validity when administered to pre-service teachers in a Philippine setting. Specifically, the present study was guided by the following questions:

1. What is the dimensionality of the SEQ in the context of Philippine pre-service teachers?

2. Does the SEQ factor structure possess predictive validity?

Hypotheses

Two (2) hypotheses were formulated to examine the dimensionality and predictive validity of SEQ based on the abovementioned research questions:

$H_{o1:}$ The SEQ is not a multi-dimensional structure.

$H_{o2:}$ The SEQ factor structure does not possess predictive validity for professional education grades.

REVIEW OF LITERATURE

In the review of extant literature, the gaps were identified from which the present study tried to address. Specifically, the literature review dwelled on the theoretical model of epistemological multidimensionality as propounded by Schommer, as well as the studies that were done to investigate further validity of SEQ in the Philippines and other countries.

Understanding the Theoretical Construct of SEQ

The SEQ emanated from the theory of epistemological multidimensionality. Through an exploratory study, the tool was developed by Schommer (1990) as an alternative scale that eventually catalyzed the outset of studying quantitatively the different facets of epistemological beliefs. It is composed of 63 short statements expressing beliefs with the use of a 5-point Likert scale covering four analytic factors as follows: (a) Simple Knowledge ranges from beliefs that knowledge is uncomplicated to knowledge is complex; (b) Fixed Ability spans from the belief that learning is fixed at birth to the belief that learning develops as years go by; (c) Quick Learning goes from the belief that learning is acquired fast to the belief that learning is gradual and deliberate; and (d) Certain Knowledge focuses on beliefs that knowledge is absolute to knowledge is evolving (Schommer, 1998).

Over time, Schommer's instrument evolved into several versions for specified groups - high school, college, and adult. Undeniably, this has been widely used in varying contexts and purposes (e.g., Chan, 2004; Tanriverdi, 2012) that provided significant input to the growing and advancing body of epistemological research. Researchers have viewed and acknowledged the importance and use of Schommer's (1990) survey of epistemological beliefs because of ease in administration and scoring, the appealing concept of multidimensionality, and established relationships between scores on its factors and performance on different learning tasks (Wood & Kardash, 2002).

Studies on SEQ in Various Countries

Several studies were undertaken to explore the stability of SEQ as a tool. When used in diverse settings, SEQ has yielded differentials in findings. Several researchers initiated scrutiny of the instrument itself and came up with conflicting results, particularly along with the loading of factors. In the study of Bendixen, Dunkle, and Schraw (1994), they found similar factors as theorized initially by Schommer (1990) and were further affirmed by the research of Paulsen and Wells (1998).

Nevertheless, there are some studies both in American and non-American settings that gave contradictions (e.g., Hofer, 2000; Cole, Goetz, & Willson, 2000). Results obtained ranged from the four-factor model to a two-factor model. In a Norwegian study of Braten and Stromso (2005), the items were taken from different subsets coming up with four factors, namely Speed of Knowledge Acquisition, Knowledge Construction and Modification, Certainty of Knowledge, and Control of Knowledge Acquisition. On the other hand, Chan and Elliot (2000), in the Hongkong context, found three factors, namely Innate Ability, Authority Knowledge, and Certainty Knowledge. Also, in a Turkish study of Deryakulu and Büyüköztürk (2005), they came up with a three-factor model consisting of the Belief of Learning Depending on Talent, Belief of Learning Depending on Effort, and Belief of the Existence of Only One Truth while Clarebout et al. (2001), in the second phase of their study in Belgium, extracted only two factors labeled as Simple Knowledge and Certain Knowledge. Looking deeply, one would surmise that the variations of findings call for more studies situated in different contexts.

Examining SEQ in Philippine Context

Inspired by the call for studies revolving on the proposition and identification of other possible aspects and assessments of epistemological beliefs (Youn, 2000), researchers in the Philippines have found interest in examining epistemological beliefs among pre-service teachers (Magno, 2011; Morales, 2014). Subsequently, there is an emerging inquiry of epistemological beliefs that led to the adoption of foreign scales, such as the SEQ, because up to this time, no instrument on Filipino epistemological beliefs has been developed.

Along this vein, Bernardo (2008) first attempted to examine the dimensionality of SEQ using bilingual teacher education students. In his study, he used two versions of SEQ, Filipino and English. Using CFA, the said researcher examined the data gathered from 864 pre-service teachers from two geographical regions (Region 5 and the National Capital Region) in the Philippines. Findings revealed that in the Filipino version of SEQ, he extracted one factor while the English version yielded a two-factor model, though statistically, he obtained a high correlation of the two factors (r=0.92), which might suggest a further test on discriminant or convergent validity. Remarkably, he noted that the set of items for both the one-factor and two-factor models were identical. In his discussion of such observation, he settled with Simple Learning and Structured Learning as factor loadings. He reasoned out that such finding is indicative of the Philippine education system and its pedagogical tensions. However, there was no further test of validity undertaken, which could be a significant input in filling in gaps in literature since there is a dearth of it mainly in the Philippine setting.

METHOD

Design

This research employed a quantitative design. According to Basol (2008), the primary aim of quantitative research is evident in its ability to make a description of the phenomenon, to surface the existing associations or differentials, or to create potential measures or procedures. Notably, in this study, the scale development approach was

used. This scientific process ensures that the social and behavioral concepts that are abstract are measured accurately (Kyriazos & Stalikas, 2018). Determining the dimensionality and predictive validity of an existing instrument are essential steps in scale development. According to Netemeyer et al. (2003:10), "identifying the dimensionality of an instrument is a pre-requisite process in the determination of its reliability and validity." Also, it reveals the homogeneity of items in a particular construct. On the one hand, predictive validity establishes the ability of the instrument to project subsequent criteria (Tian, Bearden, & Hunter, 2001). In this study, the dimensionality of SEQ was first examined; then, from the result, the predictive validity of the extracted factor structure was assessed by using the professional education grade as the ordered criterion.

Respondents

The respondents of the study were 229 (45 male, 184 female) pre-service teachers of a public university in Cagayan Valley Region, Northern Philippines. The computation of the sample size was based on the method of MacCallum, Browne, and Sugawara (1996) in calculating the required sample size in factor analysis and structural equation models given the desired power (1-β=0.80) and fit index (RMSEA=0.05). The respondents were identified through stratified random sampling, in which 74 respondents came from the Bachelor of Elementary Education, and 155 came from the Bachelor of Secondary Education.

Moreover, the respondents completed all the required professional education courses garnering a mean grade of 86.7 (SD=2.7), and the median grade was 86.6. They can understand and communicate through the English language since it is an official medium of instruction in the Philippines. All of them gave their free, prior, and informed consent before the survey was undertaken. Permission from respective university authorities was properly sought, and utmost confidentiality was observed in the handling of the documents relative to the respondents.

Research Instrument

The primary data gathering instrument was the 63-item SEQ, college version (second revision), based on Schommer's (1998) study. This scale consists of 63 statements on several beliefs about knowledge and learning. Sample items include "Most words have one clear meaning"; "Being a good student generally involves memorizing facts"; "The really smart students do not have to work hard to do well in school"; "Genius is 10% ability and 90% hard work"; and "To me studying means getting the big ideas from the text, rather than details." The items are further categorized into 12 subsets that loaded into four factors. Of the 63 items, 22 items were negatively stated. Guided by the report of Clarebout et al. (2001), the table below shows the factors, subsets, and items placement of SEQ.

Table 1
Factors, Sub-sets, and Items Placement of SEQ

Factors	Subsets	Items Placement
Factor 1 Simple Knowledge	avoid ambiguity	Items no. 9, 27, 41, 42, 44
	single seek answers	Items no. 11, 16, 17, 19, 22, 23, 30, 33, 56, 58, 59
	avoid integration	Items no. 14, 18, 31, 35, 37, 38, 54, 63
	depend on authority	Items no. 5, 29, 36, 40
Factor 2 Fixed Ability	can't learn how to learn	Items no. 4, 15, 25, 28, 62
	success unrelated to hard work	Items no. 26^{-}, 32^{-}, 43^{-}, 49^{+}
	learn the first time	Items no. 20, 24, 52
	concentrated effort is a waste of time	Items no. 51, 53
Factor 3 Quick Learning	quick learning	Items no. 1, 10, 39, 50, 60
	innate ability	Items no. 8, 47, 55, 57
Factor 4 Certain Knowledge	certain knowledge	Items no. 2, 12, 21, 34, 48, 61
	don't criticize authority	Items no. 3, 6, 7, 13, 45, 46

The pre-service teacher respondents answered on a Five-point Likert Type Scale (Strongly Disagree-1, Disagree-2, Neutral-3, Agree-4, Strongly Agree-5). Lastly, written permission was sought first from Schommer before the researcher finally used the instrument in the study.

Data Analysis

The data were analyzed using AMOS 21. The Confirmatory Factor Analysis (CFA) was performed to test the multidimensionality of the originally hypothesized four-factor structure of SEQ. The figure below presents the SEQ factor structure that was examined in the present study.

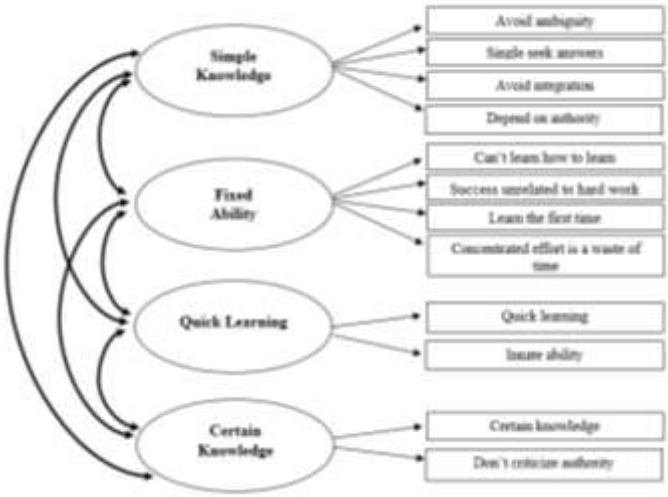

Figure 1
Factor Structure of Schommer Epistemological Questionnaire

Three-factor, two-factor, and one-factor structures were also explored to check the dimensionality of SEQ after Schommer's four-factor model was not confirmed. Subsequently, Structural Equation Modeling (SEM) was used to test the predictive validity of epistemological beliefs by examining its influence on professional grades. The CFA and SEM are analyses of covariance structure, which assess the correlations of latent variables. The acceptability of fitted CFA and SEM solution were evaluated regarding overall goodness of fit, areas of localized strain in the solution, interpretability, and significance of models parameter estimates. Multiple goodness-of-fit indices were examined and reported including an absolute index (e.g., Standardized Root Mean Square Residual; SRMR), an incremental index (Comparative Fit Index; CFI), and a parsimony index such as the Root Mean Square Error of Approximation (RMSEA) as well as its 90% confidence limits (RMSEA CL90). Table 2 shows the standards used in the study based on the perspectives of Hu and Bentler (1999), Kline (2001), and MacCallum et al. (1996). The path coefficient in SEM is significant if the absolute value of t statistics exceeds 1.96 or p-value is less than 0.05.

Table 2
Fit Indices and their Level of Acceptability

Fit Index	Threshold / Level of Acceptability
Chi-square	p-value>0.05
SRMR	<0.055 ideal; 0.055 - 0.8 fair fit
RMSEA	<0.055 ideal; 0.055 - 0.8 fair; 0.08-0.10 mediocre; >0.10 poor
RMSEA 90% CI	0.054-0.000 ideal; 0.090-0.000 adequate
CFI	>0.94 ideal; 0.90 – 0.94 adequate

FINDINGS

This study sought to investigate the dimensionality and predictive validity of SEQ among Philippine pre-service teachers. In this section, the research findings are described based on the statistical analyses done to the data. Results of the CFA to determine dimensionality and SEM to establish the predictive validity of SEQ are presented in the following paragraphs.

Dimensionality of SEQ

Dimensionality is necessary for scale development because it presents the homogeneity of items. To answer the first question, "What is the dimensionality of the SEQ in the context of Philippine pre-service teachers?" CFA was employed to explore the dimensionality of SEQ starting from the four-factor structure. The CFA model represented by the measurement model defines relations between the observed indicator variables and the underlying constructs (unobserved latent factors). The various models, namely three-factor structure, two-factor structure, and one-factor structure, were also assessed when the four-factor structure was not confirmed. Table 2 shows the measurement model from which the goodness-of-fit indices are revealed.

Table 2
Goodness-of-Fit Indices for Various Models (N=229)

Model	X^2	Df	Pvalue	Bollen-Stine	SRMR	RMSEA (90% CI)	$P_{close\text{-}fit\ Ho}$	CFI
Measurement Model								
4-factor CFA	249.07	49	<0.001	<0.001	0.1195	0.134 (0.118-0.151)	<0.001	0.565
3-factor CFA	11.66	6	0.070	0.113	0.0367	0.064 (0-0.119)	0.282	0.966
2-factor CFA	13.12	8	0.108	0.161	0.0384	0.053 (0-0.103)	0.405	0.969
1-factor CFA	16.19	9	0.063	0.112	0.0462	0.059 (0-0.105)	0.326	0.952
Structural Model								
EB->ProfEd	20.31	14	0.121	0.210	0.0448	0.044 (0-0.084)	0.544	0.962

Four-Factor Structure

The four-factor model (see Figure 1) became the starting point of the confirmatory analysis. Based on prior evidence and theory on epistemological beliefs, a four-factor model was specified in which "avoid ambiguity," "seek single answers," "avoid integration," and "depend on authority" loaded onto the factor Simple Knowledge. The subsets, namely, "can't learn how to learn," "success unrelated to hard work," "learn the first time," and "concentrated effort is a waste of time," loaded onto the factor Fixed Ability. On the other hand, the subsets, namely, "quick learning" and "innate ability," loaded onto the factor Quick Learning. Lastly, the subsets, namely "don't criticize authority," and "certain knowledge," loaded onto the factor Certain Knowledge. The indicators were subscales of SEQ.

Each of the overall goodness- of- fit indices suggested that the four-factor model fit the data poorly: $X^2(49) = 249.07$, p = <0.001, SRMR = .1195, RMSEA = 0.134 (90% CI = 0.118– .151, CFit = <0.001), CFI = 0.565. Consequently, residuals and modification indices were inspected for localized points of ill fit, and models were respecified accordingly. Indicators with insignificant factor loadings (t<1.96) and high standardized residuals were dropped, leaving a three-factor structure of epistemological beliefs. It can be inferred from the finding that the four-factor structure that was originally theorized by Schommer as the dimensionality of the SEQ could not be affirmed in the present study.

Three-Factor structure

Since the four-factor structure was not confirmed, the analysis proceeded to the three-factor model. Modification on the four-factor model resulted in a three-factor model in which the factor Quick Learning was dropped while the factors Simple Knowledge, Fixed Ability, and Certain Knowledge were retained. The overall goodness-of-fit indices suggested that the three-factor model fit was acceptable: $X^2(6) = 11.66$, p = 0.07, SRMR = .037, RMSEA = 0.064 (90% CI = 0 - .119, CFit = .282), CFI = 0.966. The non-significant chi-square value implies that the fit of the data to the hypothesized model was adequate. While the SRMR and CFI values were on the ideal range, and RMSEA was acceptable, the RMSEA 90% CI lower bound was 0.119, which meant that the poor fit hypothesis could not be rejected.

Upon inspection of the parameter estimates and diagnostic fit, it was noted that the covariance between the factors Simple Knowledge and Certain Knowledge was highly significant (r=0.894). This finding threatened the discriminant validity of the three-factor structure of epistemological beliefs. Hence, a chi-square test on the difference was then computed to test the difference between the three-factor model and a two-factor model wherein the correlation of the factors Simple Knowledge and Certain Knowledge was fixed to 1.00. Chi-square test ($X^2_{\Delta(1)}$=0.197, p=0.657) result showed that the two-factor model was not significantly different from the three-factor model. The more parsimonious two-factor model was now preferred and continued to be tested.

Two-Factor Structure

The three-factor structure was not ideal and statistically acceptable; thus, the two-factor model was considered for further analysis. For the two-factor model, subsets from the factors Simple Knowledge and Certain Knowledge were merged to become the first latent construct. On the one hand, the second latent construct came from the subsets of the factor Fixed Ability. The overall goodness-of-fit indices of the two-factor structure from the three-factor model slightly improved: $X^2(8) = 13.12$, p = <0.108, SRMR = .0384, RMSEA = 0.53 (90% CI = 0 .103, CFit = .405), CFI = 0.969. The CFI, SRMR, and RMSEA were all within the ideal parameters, but the RMSEA 90% CI lower bound was 0.103.

This finding only indicated that the poor fit hypothesis still could not be rejected. To further analyze the factor structure, the discriminant validity of the two factors was tested. It was found out that the square root of the average variance extracted (AVE=0.283) of the factor Simple Knowledge was less than its correlation with the factor Fixed Ability (r=0.768). Hence, a one-factor structure of epistemological beliefs was suggested to be further tested.

One-Factor Structure

For the one-factor structure of epistemological beliefs, all indicators were initially tested. Indicators with insignificant factor loadings and high standardized residuals were dropped. The final one-factor model of epistemological beliefs consisted of the subsets, namely "avoid ambiguity," "seek single answers," "avoid integration," "learn the first time," "innate ability," and "concentrated effort is a waste of time."

Each of the overall goodness- of- fit indices suggested that the fit of one-dimensional model was adequate: $X^2(9) = 16.19$, p = 0.063, SRMR = .0462, RMSEA = 0.059 (90% CI = 0.00.105, CFit = .326), CFI = 0.952. The analysis only confirmed the first null hypothesis of the study "The SEQ is not a multi-dimensional structure." Hence, the present study found out that the appropriate treatment of SEQ in the context of the study must be unidimensional.

Predictive Validity of SEQ

Predictive validity in scale development is essential consideration since it tells if a specific tool or instrument can project future behavior. To answer the second question, "Does the SEQ factor structure possess predictive validity?" the one-factor structure extracted from the CFA was further analyzed through SEM. This procedure was done to determine the predictive validity of SEQ. With this, it examined the relationship of the

one-factor epistemological beliefs and the professional education grade of the pre-service teachers. The statistical assumption laid was that if professional education grade is directly affected by epistemological beliefs, then predictive validity is evident. The model from the CFA was used as a measurement of epistemological beliefs. The structural model to be tested is shown in Figure 2.

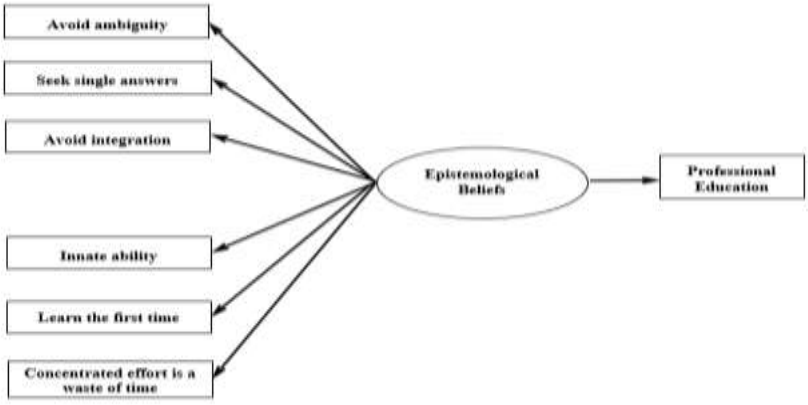

Figure 2
Structural Model of the One-Factor Epistemological Beliefs and Professional Education Grade

The Goodness-of-fit indices (see Table 2) for this SEM were all within the ideal parameters $X^2(14) = 20.31$, $p = 0.121$, SRMR = .0448, RMSEA = 0.044 (90% CI = 0.00-.084, CFit = .544), CFI = 0.962. The path coefficient from epistemological beliefs to commitment professional education grade (-2.102) was highly significant ($t = -3.695$, $p<0.001$). The theoretical model successfully accounted for the observed relationship between the one-factor epistemological beliefs and the professional education grade. This finding, therefore, rejects the second null hypothesis of the study "The SEQ factor structure does not possess predictive validity to professional education grade." This finding means that the unidimensional structure of SEQ consisting of the subsets namely, "avoid ambiguity," "seek single answers," "avoid integration," "innate ability," "learn the first time," and "concentrated effort is a waste of time," possesses predictive validity.

DISCUSSION

Contributing further to the increasing body of epistemological research in teacher education, the study primarily examined further validity of using SEQ among Filipino pre-service teachers. Interestingly, it led to significant findings for theoretical and pragmatic considerations. Based on the statistical scrutiny, the results of the CFA revealed that the four-factor model of epistemological beliefs previously established was not observed in the population and context of this study. Also, neither the three-factor and two-factor structures resulted in desirable goodness-of-fit indices. As an alternative, a one-factor structure was seen to be a good fit consisting of the beliefs in "avoid

ambiguity," "seek single answers," "avoid integration," "learn the first time," "innate ability," and "concentrated effort is a waste of time."

In essence, the result of the study does not support the multidimensionality of epistemological beliefs, as theorized initially by Schommer (1990). Accordingly, the creation of the subsets under the four factors lacked a sound theoretical underpinning in which Schommer failed to establish in her succeeding studies. Additionally, this finding is congruent with those outcomes of studies claiming that some dimensions of epistemological beliefs that are culturally specific could not be captured by SEQ (Hofer, 2000; Cole et al., 2000). As noted by Elliot and Chan (1998), there are complications in the usage of instruments designed in one culture with a different background.

Furthermore, the finding is an additional input to the understanding of SEQ in the Philippine setting. It is noted that Bernardo (2008) settled for a two-factor structure in his English version of SEQ, though statistically, because of the very high negative correlation between the two factors, it would have been a one-factor structure. The present study, on the other hand, confirms a one-dimensional model, which suggests that a one-factor structure may be tested or considered in similar studies in the Philippines.

Remarkably, it was also found out that the six (6) subsets that loaded in the one-factor structure in the study reflected simple epistemology. This finding only shows that in the context of the study, pre-service teachers tend to hold the belief that knowledge and learning are not complicated. From a broader perspective, the finding is consistent with the view that Filipino learners exhibit a simplistic outlook of learning, as noted by previous researchers in the Philippine setting (Bernardo, Limjap, Roleda, & Prudente, 2005; Morales, 2014). This view might be the case because, as pointed out by Bernardo (2008), the pedagogical approach and practices in the teacher training institutions may not have nurtured a sophisticated view of knowledge and learning. Since up to this time, there is no scale and even a framework developed on the epistemological beliefs of Filipino pre-service teachers; in light of this, the finding could serve as a takeoff point of potential future research focusing on the development of epistemological beliefs framework and instrument relevant to Filipino context.

Banking on the assumption that epistemological beliefs work in a continuum (Schommer-Akins 2004), the result of the study indicates that one-dimensional epistemological beliefs of pre-service Filipino teachers are valid latent construct in teacher education that considerably influence academic performance. SEM provides evidence that the one-dimensional epistemological beliefs extracted in the study possess predictive validity as it supports the theory that epistemological beliefs significantly predict or relate to grades or academic performance in general (Schommer-Aikins & Easter, 2006; Lodewyk, 2007; Kadivar et al., 2011; Arslantas, 2016). Previous studies noted that how learners manage to learn is highly influenced by how they view knowledge (Magno, 2011), thus making epistemological beliefs a contributory factor in academic progress (Jaksic & Mirkov, 2015; Aslan, 2017).

Adding further to the extant literature, the structural model found in this study indicates that the more complex the beliefs are, the better is the academic performance in the professional education courses. In other words, students with a composite view of

knowledge perform better academically since they pass more examinations and attain higher marks compared to those with simple epistemological beliefs (Jaksic & Mirkov, 2015). As theorized by Schommer (1990), what helps students learn and develop their reasoning skills and meaningfully bear effects on their academic achievement are their mature beliefs. This further means that those pre-service teachers who hold sophisticated epistemological beliefs are better knowledge constructors (Brownlee, 2001), critical thinkers (Hofer & Pintrich, 2002), and competent learners who can meet the needs and demands of teacher education. Consequently, they are those who have higher chances of successfully satisfying the intellectual and practical challenges in preparation for the teaching profession.

CONCLUSIONS AND SUGGESTIONS

Schommer Epistemological Questionnaire (SEQ) has been widely used in varying contexts providing significant input to the advancing body of epistemological research. However, there is no consensus on the factor structure of the SEQ. Since researchers in teacher education still use SEQ, the present study is first in the Philippines to examine both the dimensionality and predictive validity of SEQ. The results yielded two critical points for theoretical and empirical considerations. First, the study did not confirm Schommer's four-factor structure of epistemological beliefs. Instead, it supported the unidimensional nature of the scale. Second, this unidimensional structure was found to possess predictive validity to the professional education grade of the pre-service teachers. This point affirms the theoretical underpinning that the more sophisticated the epistemological beliefs of the pre-service teachers are, the better is their performance in the professional education courses. Remarkably, the study contributes to filling in the gaps in the literature and in laying the foundation for additional studies tailored to the culture and context in the Philippines.

For the implications of the present study to research and practice, the following are suggested. First, the SEQ may still be used by researchers as a valid measure in the Philippine setting only if treated as a one-dimensional scale. In other words, they must view SEQ not as a multi-dimensional scale but as a one-factor structure when they use it for empirical studies. Focusing on this idea will ensure the credibility and trustworthiness of the data to be gathered. Second, since SEQ cannot capture some dimensions of epistemological beliefs that are culturally specific, the present study may serve as a seminal undertaking to inspire epistemological researchers to start constructing a scale on Filipino epistemological beliefs considering the findings of the present study. Third, for the teacher education institutions that prepare pre-service teachers, they may begin highlighting in their curriculum and instruction the appropriate approaches of assisting the pre-service teachers to grow or develop epistemologically, since, in essence, the structural model found in the study provides an insight on how epistemological beliefs are significantly linked to the professional education course performance of the pre-service teachers.

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