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Psychometric properties of the changing epistemic beliefs questionnaire in Iraqi nursing students

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Abstract---The aim of this study was to construct and validate of Changing Epistemological Beliefs Questionnaire(CEBQ) in Iraqi nursing students.for this purpose, first with the help of psychology professors, the relevant research literature was studied, then 17 items related to the changing epistemological beliefs were created. The research method was descriptive correlational studies. The statistical population of the study was Iraqi nursing students and a sample of 200 students was selected as a class from the research community. The face validity of the questionnaire was confirmed by psychologists, exploratory factor analysis was used to determine factor validity and Cronbach's alpha method was used to assess the internal validity of the questions. Factor analysis of the questions showed that this scale has three factors: epistemic doubt, epistemic volition and resolution strategies. In total, these three factors can explain 65.25% of the variance in the changing of epistemic beliefs and have a good fit. According to the obtained results, this questionnaire can be used as a valid tool to assess the changing of epistemological beliefs.

Keywords---epistemological beliefs, epistemic doubt, epistemic volition, resolution strategies.

Introduction

Today's society faces demographic and epidemiological changes and the emergence of health threats. Nurses play a major role in ensuring the health of the society and the health care system (1). Nurses take care of human beings through a human activity that transfers, creates and recreates knowledge in practice (2). In nursing, theory and practice work together to create knowledge (3). In a hermeneutic spiral, this dynamic structure combines several standards of knowledge. This operation occurs not in a linear logic, but a dialectic of theory and practice, systematization and clinics (4). Therefore, studying the nature of knowledge and truth or epistemology, and so-called justified knowledge is important in the nursing profession (5). This is vital in the nursing profession to provide a basis for judging the appropriateness of nursing knowledge, as well as the methods that the nurses use for developing knowledge and improving performance (3, 6). Thus, epistemology plays an important role in applying knowledge and clarifying the skillful performance in this profession (7). Knowledge of the structure of nursing students' epistemic beliefs is very important for the development of nursing education programs (8).

Current researches show that both contextual and individual factors affect nurses' academic and professional performance (9, 10). One of the most important individual factors is to understand how nursing learners perceive the nature, acquisition and development of nursing knowledge (*i.e.*, their epistemic beliefs about nursing), and how they interpret, construct and implement it individually and distinctively (1). Epistemic beliefs constitute a structure with multiple dimensions of the nature of knowledge and are per definition the personal cognitions such as certainty of knowledge, simplicity of knowledge, source of knowledge and justified knowledge (11). There is growing evidence that individuals' beliefs about the nature of knowledge and learning, or epistemic beliefs, are associated directly with their comprehension, meta-comprehension, persistence, and interpretation of information (12, 13). They influence people's attitudes and behaviors about success, progress, and learning (14). Moreover, people's beliefs about the nature of knowledge and learning are of effect on variables such as academic performance, new information processing methods, their level of understanding, source of control, strategies used in the study, higher order thinking, self-regulatory processes, approaches of problem solving and the time and effort they spend for learning (9-14, 15, 16, 17, 18, 19). In particular, researches on the intertwined relationship between the use of multiple sources and the mental processes associated with epistemic beliefs have been very fruitful in recent decades (20, 21, 22, 23, 24).

As the benefits of epistemic beliefs become increasingly apparent, research programs are increasing to bring about epistemic change and growth (25, 26). The vast majority of epistemic development interventions have been founded so far on the integrated model of personal epistemological development of Bendixen & Rule (2004). It determines the evolution of epistemic beliefs (*i.e.*, individual beliefs about knowledge and cognition) and divides it in three consecutive components: epistemic doubt, epistemic volition and resolution strategies (27). In this model, epistemic doubt describes a cognitive mismatch expressed by questioning one's beliefs about knowledge and may occur as a response to new information that

contradicts one's existing beliefs (28). For coping with this epistemic doubt deliberately, we have a need for a certain amount of epistemic volition (ie, "volition" or motivation to an epistemic change) the second central component of the model (Rule & Bendixen, 2010). The epistemic volition enables individuals to be aware of their epistemic beliefs (and their epistemic doubts), which should lead to purposeful behavior in the face of information that is not in line with their current beliefs (25). Epistemic volition is a controlled process of individual selection in which the individual "takes responsibility for his or her epistemic beliefs" and then initiates change (29). To solve the inconsistency that has given rise to epistemic doubt, individuals apply supposedly resolution strategies (28, 30). Resolution strategies are actions taken by an individual to maintain or reinforce a change in epistemic beliefs (29).

The Bendixen model is not without controversy, despite more detailed explanations of epistemic change and growth, and the empirical validity of many of its assumptions is still largely unsatisfactory (31, 32). Empirical evidence to prove hypothetical mechanisms of its change and interventions to promote epistemological change is relatively rare (33). However, numerous studies on the epistemic change and its assumptions confirm the role of epistemic doubt as the driving force of epistemic development (34, 35). However, there was no sufficient empirical evidence for its other assumptions, hence increasing the demand for examining the assumptions of this model (25, 36).

A review of the research literature shows that researchers have designed various tools to measure the epistemology and epistemic beliefs of learners (37, 38, 29). Schumer (1990) introduced his 63-item questionnaire to measure his proposed five epistemological dimensions. Of these five epistemological dimensions, three dimensions relate to knowledge itself (structure, certainty, and source) and the other two dimensions (control and speed) concern knowledge acquisition. Later on, this questionnaire was reduced to four and finally three factors: Learning speed, learning ability and knowledge stability (39). Aypay (2011) adapted the latest scale to Turkish learners, but despite the satisfactory results of the statistical analysis, the factors were not consistent with Turkish culture (40). Schraw, Bendixen & Dunkle (2002) designed and validated another tool for examining the epistemic beliefs inventory with 28 items (41). Compared to Schumer's Epistemological Beliefs Questionnaire, this tool was more stable and accurate in terms of few items and could estimate the dimension of knowledge source that was not determinable and measurable in Schumer's Epistemological Beliefs Questionnaire. Ferguson, Bratton, Stromsow, and Anmarcrude (2013) developed an 18-item Justification for Knowing Questionnaire (JFK-Q), a questionnaire specifically designed to assess beliefs in the natural sciences (38). Ferguson et al. (2013) found that the data have satisfactory psychometric properties, and factor analysis confirmed these three justification dimensions in students from other countries (42). Some researchers have also used qualitative methods to examine beliefs and epistemic change (24).

Generally, the results of these studies show that, first, there is disagreement on the multiplicity of factors of epistemological beliefs. Second, they have used different qualitative and quantitative research methodologies to estimate the factors. Third, the justification for recognizing beliefs may be multidimensional,

indicating the need to pay more attention to the dimensions of epistemology (44). Fourth, the adaptation of the scales of epistemological beliefs to different cultures does not lead to valid and reliable tools, but rather to considerable differences in the number of items and factors and even different distribution of items among factors compared to the main scale (43). Finally, empirical researches have not been able to provide a necessary and sufficient support for the proposed dimensions of epistemology (32-34). The existence of such research gaps has consequences for models of epistemic beliefs that lack sufficient empirical evidence to test their assumptions (37). There is no designed standard tool for measuring their assumptions, an aspect that future researches should further explore (45). Therefore, for determining the growth of epistemological beliefs accurately, instead of adapting existing scales, we should develop a new scale that is more appropriate for the characteristics of a particular culture. To overcome this defect, the present study designed and validated a questionnaire to measure the growth of epistemic beliefs in Iraqi nursing students. Research questions include:

1. What factors and items does the Nurses' Epistemic Beliefs Growth Scale include?
2. Is the scale of growth of Iraqi nurses' epistemic beliefs a valid and reliable measurement tool?

Research Methodology

The present study is methodologically a descriptive research and an exploratory factor analysis (Varimax) that the authors has created to determine the growth of nurses' epistemological beliefs. For this purpose, first, we examined the scales that exist in the research literature to determine epistemological perspectives and beliefs. Then, we formulated the items on this scale professionally based on the most common scales of the epistemological perspectives defined by Schumer (1990), Hofer and Pintrich (1997), Alder (2002) and Bendixen & Rule (2004). During the item preparation process, as described in the introductory part of the study, we paid special attention to ensuring the cultural appropriateness of the scale. Finally, we designed 17 items of epistemic beliefs on a 7-point Likert scale (1 to 7). The score 7 indicates high agreement and the score 1 indicates a low agreement. The statistical population of the research is MSc nursing students in Diwaniyah province of Iraq in 2022. We selected a sample of 200 students (150 female and 50 male) from the population. Participants in the research were of 19 to 25 years old. We distributed the designed tools among the samples and after collecting the data, we used exploratory factor analysis to examine the internal consistency of the questions. We performed statistical analysis through SPSS version 22.

Results

To answer the first question of the research, we used exploratory factor analysis and principal component analysis (PCA). Before PCA, we evaluated the suitability of the data for factor analysis.

Table 1: Correlation Matrix and Determinant Score

Items	item1	item2	item3	item4	item5	item6	item7	item8	item9	item10	item11	item12	item13	item14	item15	item16	item17
item1	1/00																
item2	0/29	1/00															
item3	0/30	0/46	1/00														
item4	0/44	0/38	0/29	1/00													
item5	0/31	0/33	0/49	0/44	1/00												
item6	0/41	0/67	0/45	0/41	0/35	1/00											
item7	0/32	0/30	0/37	0/63	0/25	0/38	1/00										
item8	0/47	0/54	0/39	0/37	0/23	0/67	0/39	1/00									
item9	0/47	0/31	0/21	0/57	0/35	0/29	0/67	0/40	1/00								
item10	0/47	0/54	0/30	0/36	0/24	0/56	0/35	0/60	0/38	1/00							
item11	0/37	0/65	0/42	0/42	0/30	0/59	0/40	0/63	0/41	0/72	1/00						
item12	0/63	0/46	0/57	0/47	0/63	0/38	0/31	0/36	0/32	0/41	0/26	1/00					
item13	0/43	0/31	0/51	0/26	0/50	0/26	0/16	0/27	0/40	0/26	0/35	0/60	1/00				
item14	0/36	0/66	0/22	0/28	0/15	0/51	0/22	0/52	0/16	0/50	0/58	0/35	0/43	1/00			
item15	0/25	0/14	0/41	0/65	0/10	0/18	0/5	0/17	0/76	0/18	0/25	0/21	0/14	0/28	1/00		
item16	0/37	0/26	0/51	0/74	0/34	0/32	0/59	0/28	0/68	0/33	0/41	0/41	0/22	0/32	0/57	1/00	
item17	0/59	0/33	0/54	0/20	0/66	0/31	0/29	0/26	0/54	0/34	0/40	0/69	0/56	0/29	0/27	0/53	1/00

The contents of Table 1: the examination of the correlation matrix of the questions of the "Growth of Epistemological Beliefs" questionnaire show that the correlation coefficients of most items are more than 0.3. This finding indicates that the items of the questionnaire have a good internal correlation and express a structure.

Table 2. The results of KMO and Bartlett "s test on EVQ

	Value	Chi square	Sd	P
KMO	0.88			
Bartlett's Test		2090.58	136	0.000

The contents of Table 2 show that the KMO index for scale sampling adequacy was 0.88 and the Bartlett test was significant for the data correlation matrix ($\chi^2(136) = 2090.58, p < 0.000$). Based on the above indicators, we can use factor analysis. Therefore, we used principal components factor analysis to determine the factor structure of the scale.

We used Eigenvalue Criterion, Cumulative Percentage of Variance and Scree Test to extract the scale factors.

Table 3: Kaiser's (Eigenvalue) Criterion (Cumulative Percentage of Variance and Eigenvalue > 1)

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7/40	43/50	43/50	7/40	43/50	43/50	4/13	24/30	24/30
2	1/90	11/17	54/68	1/90	11/17	54/68	3/82	22/45	46/74
3	1/80	10/57	65/25	1/80	10/57	65/25	3/15	18/51	65/25
4	0/96	5/68	70/93						
5	0/71	4/16	75/09						
6	0/64	3/79	78/88						
7	0/59	3/49	82/37						
8	0/51	3/02	85/39						
9	0/42	2/47	87/86						
10	0/40	2/37	90/23						
11	0/33	1/94	92/16						
12	0/31	1/84	94/00						
13	0/27	1/56	95/56						
14	0/21	1/26	96/83						
15	0/21	1/21	98/04						
16	0/17	1/01	99/05						
17	0/16	0/95	100/00						

According to Table 3, we identified three primary factors with an eigen value of higher than one, which express the amount of variance explained by each factor. The first factor explains 43.5%, the second factor 11.17 and the third factor 10.57%, and they explain totally 65.25% of the total variance in the growth of epistemological beliefs.

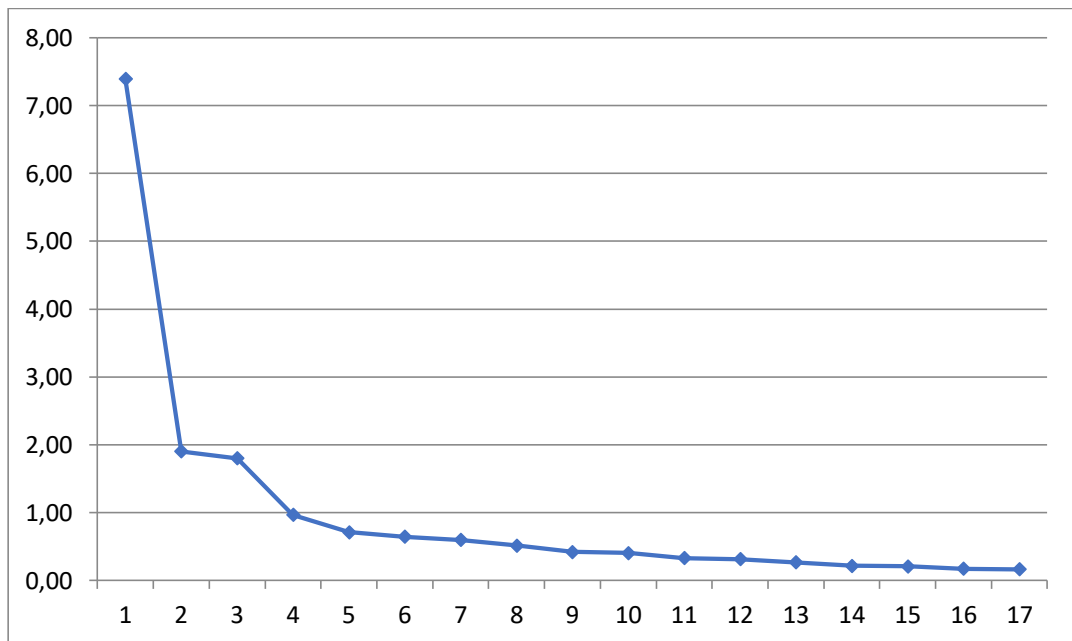


Chart1: Scree Plot for Epistemic volition

As we can see in Diagram 1, after the third factor, the slope of the graph becomes almost uniform.

Table 4: Factor structure of the Epistemic Beliefs Development Questionnaire

Items	First factor	Second factor	Third factor	Variance
8. What determines my fate are not destinies but my actions and activities.	0.794			43.5
11. I believe I know many facts about my past and to some extent my future.	0.777			
6. I am aware of my epistemic beliefs.	0.773			
2. I can create in myself any belief I want.	0.757			
10. I believe I can know many facts about my environment.	0.755			
14. I dont give in to phenomena, but I always try to be effective.	0.68			11.17
5. We are credulous people and claim knowledge with little evidence.		0.826		
17. If there is a reality and we know it, we are not be able to transmit this knowledge to others.		0.824		
1. In some realms and as ordinary human beings, we cannot access all knowledge.		0.784		
13. It is not possible to understand the exact meaning of phenomena.		.0689		
3. Some realities have no external existence at all.		0.683		10.57
12. If there is a reality, we do not have the power to know it.		0.604		
16. In my opinion, the best way to make a decision is "reflection".			0.823	
7. I always reflect on my decisions.			0.748	
9. Decisions should be goal-oriented and we should not make decisions aimlessly.			0.724	
15. My decisions determine my future.			0.711	
4. We should have a clear strategy in dealing with the countless information and knowledge we receive.			0.706	

The contents of Table 4 show that the first component includes items 8, 11, 6, 2, 10 and 14 with a factor load of 0.794, 0.777, 0.773, 0.757, 0.755 and 0.68, respectively. It explains totally 43.5% of the variance of epistemological beliefs growth. The second component includes items 5, 17, 1, 13, 3 and 12 with a factor load of 0.826, 0.824, 0.784, 0.689, 0.683 and 0.604, and together explain 11.17% of the variance of the epistemological beliefs growth. The third component includes items 16, 7, 9, 15 and 4 with a factor load of 0.823, 0.784, 0.724, 0.711

and 0.706. These 5 items explain totally 10.57% of the variance in the epistemological beliefs growth. According to the theoretical foundations of research and the experts' opinions, we called the first factor as epistemic volition, the second factor as epistemic doubt, and the third factor as resolution strategies. Cronbach's alpha method was applicable for measuring the reliability of the measurement tool, the Table 5 shows its results of which.

Table 5: Reliability, Average Variance Extracted (AVE) and Composite Reliability (CR)

Constructs	Reliability (Cronbach's alpha)	AVE	CR
Factor1	0.894	0.573	0.89
Factor2	0.879	0.547	0.877
Factor3	0.851	0.553	0.86

The contents of Table 5 show that factors 1, 2, and 3 have Cronbach's alpha values of 0.894, 0.879, and 0.851, respectively, which confirm the reliability of the survey tool. Cronbach's alpha coefficient for the total scale reliability is also 0.92. This shows that the items have a good correlation with the whole scale and are therefore internally consistent. The AVE values for components 1, 2 and 3 are 0.573, 0.547 and 0.553, respectively. According to Fornell and Larcker (1981), $AVE \geq 0.5$ confirms the convergent validity, and we can see that all AVE values in Table 5 are greater than or equal to 0.5. Thus, the convergent validity of the scale is confirmable.

Discussion and Conclusion

This study developed and standardized an Epistemological Growth Questionnaire in Iraqi nursing students. For this purpose, under the supervision of experts, we first studied the relevant research sources and, based on several questionnaires especially the translated version of Schumer we developed and standardized the 17-item epistemic growth scale with three components. The Table 1 showed that the sample size of the research is sufficient for factor analysis. Considering that the correlation matrix between items was significant, we decided to include all items in the new scale and maintain any items.

Based on Table 2, we identified three primary factors with an eigen value of higher than 1, which expressed the amount of variance explained by each factor. The first factor explains 24.3%, the second factor 11.17 and the third factor 10.57%, and they explain totally 65.25% of the variance in the growth of epistemic beliefs. This indicates the appropriate factor structure and predictive power of this scale. The three factors of this scale can predict the epistemic change of nursing students. In line with the relevant theoretical and research foundations, they are applicable for identifying and developing the assumptions of epistemological change models.

The findings of this research are consistent with the theoretical foundations proposed by Schumer, which ultimately reduced the epistemological dimensions to three components (42). It is also consistent with the model of Rule and

Benedixen (2010) who considered epistemic change as including epistemic doubt, epistemic volition, and resolution strategies. Although this study is consistent with the Benedixen model in the number and type of components, what is more important is the difference in the explanatory power of the components of this questionnaire with the Bendixen theoretical model. Bendixen and Rule model (2004) has assumed epistemic doubt as the main factor and as a starting point for epistemic change, the individual experiences epistemic doubt or cognitive inconsistency (37). In the present study and analysis of the factor structure of the questionnaire (according to Table 4), epistemic volition explains most powerfully the change of epistemic beliefs, ie it is somewhat the central component of factor structure. We can say that this component creates the necessary motivation for epistemic doubt and simultaneously provides the will to respond to cognitive inconsistencies (resolution strategy). Therefore, the epistemic volition has emotional and behavioral dimensions. This statistical finding challenges somewhat the model of Benedixen and Rule (2004) and has significant consequences.

The next finding on the validity and reliability of this scale according to the Table 4 indicates that components 1, 2 and 3 and the whole scale have Cronbach's alpha values of 0.894, 0.879, 0.851 and 0.92, respectively, and have good reliability. This shows that the items have a good correlation with the whole scale and are therefore internally consistent. The presence of AVE values of the components 1, 2 and 3, namely 0.573, 0.547 and 0.553 respectively in Table 4, confirms the convergent validity of this scale. Therefore, we can mention this scale as a valid and reliable tool for this purpose. What distinguishes this scale from other epistemological scales is its emphasis on the assumptions of epistemic volition, to which, as one of the assumptions in the field of epistemology, the researchers have paid less attention. In addition to developing knowledge, developing a tool to investigate this assumption can motivate further empirical researches (46).

Although this study had positive features such as the development of a scale for the growth of epistemic beliefs of Iraqi nursing students, and was a valuable starting point for the development of tool and the presentation of empirical evidence to explain epistemological models. However, due to insufficient empirical evidence to examine other assumptions for the growth of epistemic beliefs (37), we suggest a development of an epistemological tool and exploration of its components in accordance with the culture of other countries. Epistemological beliefs and perspectives are also under influence of the culture of each society, and this limits the ability to generalize the results of this research. Future studies should try to replicate this type of research among other samples with different cultures. Probable findings of this research, in addition to informing about the structure of nursing students' epistemic beliefs, can provide the necessary foundation for designing and conducting evidence-based researches in order to identify the process of epistemic beliefs growth and help develop nursing education programs.

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Appendix 1: Questionnaire for changing epistemic beliefs

1. In some realms and as ordinary human beings, we cannot access all knowledge.
2. I can create in myself any belief I want.
3. Some realities have no external existence at all.
4. We should have a clear strategy in dealing with the countless information and knowledge we receive.
5. We are credulous people and claim knowledge with little evidence.
6. I am aware of my epistemic beliefs.
7. I always reflect on my decisions.
8. What determines my fate are not destinies but my actions and activities.
9. Decisions should be goal-oriented and we should not make decisions aimlessly.
10. I believe I can know many facts about my environment.
11. I believe I know many facts about my past and to some extent my future.
12. If there is a reality, we do not have the power to know it.
13. It is not possible to understand the exact meaning of phenomena.
14. I don't give in to phenomena, but I always try to be effective.
15. My decisions determine my future.
16. In my opinion, the best way to make a decision is "reflection".
17. If there is a reality and we know it, we are not able to transmit this knowledge to others.