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Aylin Cam ^a , Mustafa Sami Topcu ^a , Yusuf Sulun ^a , Gokhan Guven
^a & Sertac Arabacioglu ^a

^a Department of Elementary Science Education , Mugla
University , Mugla , Turkey

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Translation and validation of the Epistemic Belief Inventory with Turkish pre-service teachers

Aylin Cam, Mustafa Sami Topcu*, Yusuf Sulun, Gokhan Guven and Sertac Arabacioglu

Department of Elementary Science Education, Mugla University, Mugla, Turkey

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The purpose of this study was to translate the original version of the Epistemic Belief Inventory developed by Schraw, Bendixen, and Dunkle (2002) for pre-service teachers in a Turkish context and validate its construct. Studies on the epistemological beliefs of Turkish students have been heretofore limited in number and have been largely conducted using adapted versions of the Schommer (1990) instrument. First, the original questionnaire was translated from English to Turkish and then was scrutinized by experts in language, content, measurement, and evaluation. Then, the revised questionnaire was administered to 166 Turkish pre-service teachers. The results of exploratory factor analyses suggested 3 epistemological belief dimensions – quick learning, innate ability, and certain knowledge. The results of the study further revealed support for multidimensional theories of epistemological beliefs among pre-service teachers. In order to verify the results of the present study, further examination of pre-service teachers' epistemological belief systems is necessary.

Keywords: epistemological beliefs; Epistemic Belief Inventory; pre-service teachers; translation and validation of scale; Turkish education

Introduction

A student's epistemological beliefs are defined as their personal and implicit beliefs systems or a student's assumptions about the nature of knowledge and learning (Schommer, 1990). The focus on epistemology in education encompasses beliefs about "the definition of knowledge, how knowledge is constructed, how knowledge is evaluated, where knowledge resides, and how knowing occurs" (Hofer, 2002, p. 4). Students' epistemological beliefs can affect their learning, and the advancement of epistemological beliefs can lead to higher learning potential in students. In order to create better learning environments for students, teachers themselves need to be epistemologically advanced. Thus, not only are students' epistemological beliefs important but also those of pre-service and in-service teachers (Gill, Ashton, & Algina, 2004).

The inference is that teachers' epistemological beliefs affect their teaching method preferences and their students' learning and knowledge acquisition in real classroom

*Corresponding author. Email: msamitopcu@gmail.com

settings (Hammer, Elby, Scherr, & Redish, 2005; Hofer, 2004). For example, Johnston, Woodside-Jiron, and Day (2001) and Haswesh (1996) revealed that teachers having sophisticated epistemological beliefs used constructivist approaches and implemented conceptual change strategies and discussions in their teaching. Similarly, pre-service teachers using the constructivist approach activated their students' conceptual change. On the other hand, teachers having naïve epistemological beliefs generally used traditional approaches (Haswesh, 1996). Schommer (2004) provided the example that if facts are given quickly by teachers, the students may hold the belief that knowledge consists of isolated facts in a short time rather than the belief that knowledge is fluid and connected.

The beneficial and problematic nature of epistemological research

Perry (1970) is the pioneer for examining the intellectual development of college students. He indicated that students move from dualistic (knowledge is right and wrong) to multiplistic conceptions of knowledge (both views are good) and then to relativism (knowledge is interpreted as contingent and contextual). King and Kitchener (1994) followed his view by considering epistemological beliefs as unidimensional. Their seven-stage development model for epistemological beliefs focused on reflective judgement and how reasoning processes were affected by epistemological beliefs. Each of these researchers proposed that a person moves through one stage to another by cognitive development in an earlier stage. Studies such as these led to epistemological beliefs being popularly regarded as complex.

Contrary to those studies, Schommer (1990) proposed that each dimension of epistemological beliefs was independent from the others and that it was not necessary to demonstrate all of the dimensions at the same time. This theory suggested the multidimensionality of epistemological beliefs and characterized these as *simple knowledge* (ranging from isolated bits and pieces to integrated concepts), *certain knowledge* (ranging from unchanging to continually changing), *omniscient authority* (ranging from handed down by authority to derived from empirical evidence and reasoning), *quick learning* (ranging from quick all-or-none to gradual), and *innate ability* (ranging from fixed at birth to improvable with time and experience).

Hofer and Pintrich (1997) criticized Schommer's epistemological beliefs model, including the five epistemological beliefs dimensions. Hofer (2000) proposed that epistemological beliefs have two dimensions – nature of knowledge and the nature or process of knowing. Nature of knowledge was defined as “what one believes knowledge is” (p. 380), and Schommer's certainty and simplicity of knowledge dimensions were included in this. Nature of knowing was defined as “how one comes to know” (p. 380); source and justification of knowledge were included in this. Though they maintained the general consensus among researchers regarding beliefs in certainty and simplicity of knowledge, Hofer and Pintrich in particular argued that innate ability was related to the nature of learning and not related to epistemological beliefs.

Historically, students' epistemological beliefs have been assessed by self-report scales (Schommer, 1990; Schraw et al., 2002), interviews (Kitchener & King, 1981; Perry, 1970), and open-ended questionnaires (Yang, 2005). Questionnaires with Likert-scale responses to items have been widely used and easily applied. Schommer (1990) developed an instrument called the Epistemological Beliefs Questionnaire (EBQ), covering the previously stated five dimensions. It has since become a well-known instrument for measuring students' epistemological beliefs. Each factor of the

EBQ measures a distinct belief dimension, and each dimension has a different effect on learning. Because of the multidimensional nature of this instrument, a student could think that knowledge is acquired gradually and at the same time believe that knowledge is organized as isolated bits and pieces (Schommer, 1990). While EBQ is a commonly accepted measurement tool, it also has some reported deficiencies. These include factor-related issues, ease of use, and inconsistencies in results. These issues are highlighted in the literature to follow.

Problems related to factor structure are discussed by a number of researchers. For example, according to some researchers, EBQ could not reveal all five dimensions as proposed (K.W. Chan & Elliott, 2004; Hofer, 2001), and some item loadings on the factors could not be explained (Schommer, 1990). Also, it had low factor loadings and explained low sample variance (K.W. Chan & Elliott, 2004; Schommer, 1990).

While analyzing EBQ, 12 subsets were determined, and then factor analysis was conducted. Some researchers stated that this left too much room for different results than proposed by Schommer (1990). Schraw et al. (2002) analyzed EBQ without grouping the 63 items to 12 subsets. Their results, in fact, revealed different results than Schommer's 1990 and 1993 studies.

Regarding ease of use, EBQ contains 63 items to be completed by the subject. Some have argued that the length of the questionnaire could lead to a reduction in student motivation to complete it. In addition, some items on the EBQ are difficult to understand. Due to these deficiencies, Schraw et al. (2002) developed the Epistemic Belief Inventory (EBI). It was constructed in effort to cover the five belief dimensions of Schommer and generate higher factor loading and sample variance. In comparison to EBQ, the Schraw et al. instrument presents a reduction in the number of questionnaire items and the creation of a more simplified version of the five dimensions.

In this study, Schraw et al.'s Epistemic Belief Inventory (EBI) was translated and its construct was validated in a Turkish context. As EBI has not been used in Turkey until now, this study was conducted in order to provide another resource for the examination of epistemological beliefs among pre-service teachers in Turkey in future studies. It also contributes to the study of the cross-cultural validity of the instrument as a base to study the cross-cultural validity of the survey. The impact of pre-service teachers' epistemological beliefs has spawned its investigation internationally. This type of investigation is especially important in a performance-based education system such as Turkey's which is undergoing shifts from more traditional to more constructivist approaches to pedagogy and learning.

International research on epistemological beliefs

Hong Kong pre-service teachers' epistemological beliefs were investigated using the K.W. Chan and Elliott 2002 instrument, a revised form of Schommer's EBQ (K.W. Chan, 2004). Four factors were extracted – innate/fixed ability, learning effort/process, authority/expert knowledge, and certainty of knowledge. The reliability values are relatively higher than Schommer's (1990, 1993) studies, and these ranged from .58 to .69. Moreover, the omniscient authority dimension was extracted, a result not found in Schommer's (1990) study. Schommer's simple knowledge and quick learning dimensions were combined as one learning effort/process dimension. The study revealed that there was no significant difference in the epistemological beliefs of the pre-service teachers in terms of age, gender, and fields of study.

In China, N. Chan, Ho, and Ku (2011) examined epistemological beliefs of undergraduate students using an adapted version of the EBI. Three factors – innate ability, certain knowledge, simple knowledge – were extracted according to the factor analyses results. The reliability values for each factor were .67, .66, and .71, respectively. They also revealed that while male undergraduates tended to believe the certainty of knowledge, female students tended to believe uncertainty of knowledge.

In Singapore, Chai, Khine, and Teo (2006) also examined epistemological beliefs of pre-service using an adapted version of the EBQ. Echoing K.W. Chan and Elliott's (2004) results, the same four factors were extracted. The reliability values ranged from .61 to .73. They found, however, that three of the factors – innate/fixed ability, authority/expert knowledge, and certainty of knowledge – were significantly different in terms of gender. They also revealed that pre-service teachers having hard-domain majors tended to see knowledge as more certain.

Sulimma (2009) investigated epistemological beliefs by EBI in a cross-cultural context using both German and Australian samples with an average education level. Some items were deleted while interpreting the factor analysis results, and 15 of 32 items for Germany and 10 of 32 items for Australia were kept. Three factors were extracted, and the reliability values for the factors ranged from .67 to .77. Both adapted instruments revealed the following dimensions: structure of knowledge, source of knowledge, and control of knowledge acquisition. However, each instrument did not have the same items in each dimension, and development of each epistemological beliefs dimension was different for each sample. The Australian sample held more sophisticated beliefs about the source of knowledge and control of knowledge acquisition than the German sample. On the other hand, the Germans had more sophisticated beliefs about the structure of knowledge dimension than the Australians.

In America, Nussbaum and Bendixen (2003) investigated US pre-service teachers' epistemological beliefs using EBI. They attempted to produce a five-factor solution but extracted only three factors, namely, simple knowledge ($\alpha = .69$), certain knowledge ($\alpha = .69$), and innate ability ($\alpha = .77$). The four omniscient authority items from the Schraw instrument (Schraw et al., 2002) were observed under the certain knowledge dimension. A variance of 40% was explained. Bath and Smith (2009) also examined American university students' epistemological beliefs using EBI. Three factors were extracted – certainty of knowledge and learning, simple knowledge and authority, and innate ability and success – and the reliability values ranged from .59 to .68.

Brownlee conducted research on a wide range of issues relevant to teacher education in Australia (Brownlee, 2001, 2003; Brownlee & Berthelsen, 2006; Brownlee, Purdie, & Boulton, 2001). Brownlee (2004) implemented a teaching programme in order to foster pre-service teachers' epistemological beliefs. The aim of the teaching programme was to link unit content to epistemological beliefs literature and students' epistemological beliefs. The programme was called relational pedagogy. A particular set of epistemological beliefs were then brought into the teaching programme. Pre-service teachers' epistemological beliefs were determined by interview at the beginning and at the end of instruction. Additionally, pre-service teachers were engaged in journal writing, through which they could reflect on their individual experiences. The study revealed that pre-service teachers developed relational epistemological beliefs over time. This suggested that pre-service teachers having relativistic epistemological beliefs could see teaching as constructivist rather than transmissive.

In Turkey, epistemological beliefs of students have been investigated in a small number of studies. First, Büyüköztürk and Deryakulu (2002) adapted Schommer's (1990) Epistemological Beliefs Questionnaire and administered it to different departments (Education, Communication, Science, Social Science and Engineering) at different universities. Their survey was adapted to include 32 items. Those items with high loadings on more than one factor and those with factor loadings under .30 were eliminated. The remaining items were divided into three dimensions. Schommer's previous dimensions were renamed as "belief about learning is related to effort", "belief about learning is related to ability", and "belief about only one right answer". The reliability of the dimensions were .83, .62, and .59, respectively; a relatively consistent result when compared to the original instrument's values of .51 to .78.

In a later study, Yılmaz-Tüzün and Topçu (2008) adapted the same instrument and administered the questionnaire to 236 pre-service teachers. They retained the 63 items of Schommer's original questionnaire and were able to find four dimensions. They extracted innate ability, certain knowledge, simple knowledge, and omniscient authority dimensions with reliability values ranging from .20 to .60. More recently, Topçu (2011) used the same adapted instrument, with another group of pre-service teachers. He found four dimensions but was unable to glean omniscient authority as a factor. Instead, he extracted the quick learning dimension. The reliability values ranged from .35 to .60.

As many beliefs are shaped by culture, the variation in results from these instruments could be directly related to their cultural contexts. Similarly, cultural environment could have an influence on epistemological beliefs. As such, Hofer (2008) suggested that more empirical validation of studies of new measures across cultures is needed. The limited number of published studies on the epistemological beliefs of Turkish pre-service teachers combined with the limited number of varied instruments translated into Turkish for use and analysis reinforce this need. A review of this published literature reveals that while epistemological beliefs have been assessed using EBQ in Turkey, they have not been widely assessed using EBI. More research is needed for determination of the epistemological belief dimensions of Turkish pre-service teachers. Thus, in the present study, the Epistemic Belief Inventory, in its heightened simplicity, was adapted into Turkish, and its validity, reliability, and factor structure were analyzed.

Purpose

The purpose of this study was to translate the original version of the Epistemic Belief Inventory developed by Schraw et al. (2002) from English into Turkish and to validate the construct of the instrument within this context.

Method

Sample

The sample of this study consisted of 166 sophomore and junior pre-service teachers of Science Education ($n = 83$, 50%), Turkish Education ($n = 51$, 30%), and Elementary Education ($n = 32$, 20%) at a public university in southwestern Turkey. Pre-service teachers of Science Education and Turkish Education were trained to teach sixth-grade through eighth-grade students. On the other hand, Elementary Education teachers were trained to teach first through fifth grades. Of the 166 pre-service teachers who participated in the survey study, 51.8% were male and 48.2%

were female. This distribution was consistent with national trends for gender among these groups of pre-service teachers. The age range was from 19 to 26 years old ($M = 21.12$, $SD = 1.315$). The population of the study was western, mid-size public universities in Turkey. There were five universities in this population, and the total number of pre-service teachers was about 3000. One of these universities was randomly chosen because most of the students' characteristics in each of these universities were almost the same in terms of their University Entrance Exam (UEE) scores. In Turkey, all universities admit students based exclusively on a national entrance exam called the UEE. According to results of this exam, students got very similar scores to enter the faculties of education in these five universities. For each particular university, students' exam scores did not vary significantly, and students from all regions of Turkey were considered in proportion to the particular region's population figures. Since these universities had very similar characteristics in terms of their university admission scores and quality of their pre-service teacher education, only one university was chosen randomly in order to generalize our results to the population.

Pre-service teachers entering the public university in this study were mid-level achievers; they were neither in the uppermost nor lowermost percentiles on the UEE. The sample used for the present study also reflected this standard. In the Turkish education system, in order to enter the UEE, students must graduate from high school in one of three departments – *quantitative*, *verbal*, and *equal weight*. Students enrol in these departments by choice. Those in the *quantitative* department get a heavier emphasis of science- and mathematics-related courses and, as a result, can choose science- and mathematics-related departments in universities such as medicine, engineering, and pure science. Students enrolling in the *verbal* department get a heavier emphasis of social science-related courses, qualifying them for social science-related departments such as law and sociology. Students enrolling in the *equal weight* department get emphasis in both social science- and mathematics-related courses and can choose from either type of department in universities.

As mentioned earlier, pre-service teachers selected from the Science, Turkish, and Elementary Education departments in the university were included in the study. Science Education students had to graduate from a quantitative department in high school and must have met specific score requirements on the science and mathematics part of the exam. Their university curricula included science-related courses for understanding and application of science in the classroom. Turkish Education students must have graduated from the verbal department of their college and had to meet score requirements on the social sciences part of the exam. In the Turkish Education department, students got courses related to Turkish language, grammar, and the social sciences. To enter the Elementary Education department, students had to graduate from an equal weight department in high school and must have met score requirements on both the social science and mathematics sections of the exam. In the Elementary Education department, students received both social science- and science-related courses.

Instrumentation

Epistemic Belief Inventory (EBI)

The original questionnaire developed by Schraw et al. (2002) has 32 five-point Likert-type items with “1” corresponding to “*strongly disagree*” and “5” corresponding to “*strongly agree*”. Each item is written in simple prose.

The instrument is an ordinal scale since the numbers correlate with the amount of agreement on each item in ascending order. For example, “5” on the scale represents more sophisticated beliefs than “4”, and so on. In the present study, the ordinal scale was treated as a ratio in order to analyze the students’ responses to the instrument. Crocker and Algina (1986) suggested that ordinal scales be treated as ratio scales if the assumptions of the statistical procedures are met. In this study, as a statistical analysis method, principal component analysis was conducted. Its assumption was “. . . the relations among the measured variables are linear” (Crocker & Algina, 1986, p. 294). In order to check this assumption, the scatterplots indicating the pairs of items were evaluated. The relationships between the pairs of items were linear, and the scores were normally distributed. Therefore, the assumption was met in order to conduct principal component analyses.

The original EBI instrument, written in English, has five factors which were constructed based on the five epistemic factors proposed by Schommer (1990). Some items were paraphrased from Schommer’s questionnaire. However, 75% of the items were new. For the purposes of this study, the EBI was initially translated into Turkish by a team of researchers. The original and translated questionnaires were then critiqued by language, content, measurement, and evaluation experts. Following this review, the items in the questionnaire were revised according to the experts’ opinions. The revised questionnaire was later administered to pre-service teachers in the Science Education, Turkish Education, and Elementary Education faculties. Factor analysis was conducted using these data.

Data collection and analysis

The translated and revised questionnaire was administered to Science Education, Turkish Education, and Elementary Education pre-service teachers during the Spring 2011 semester. The scale and purpose of the study were explained to the participants by researchers, and they were given 20 min to complete the survey. The internal consistency, discriminant validity, and factor structure of the instrument were analyzed. Factor analysis was carried out in order to determine the dimensions of the EBI. This was done to allow for possible comparison of factor structure results with other studies’ results.

Results

Descriptive results

In the present study, three dimensions were determined – quick learning, innate ability, and certain knowledge. Participants’ mean and standard deviation scores were calculated for each dimension of the EBI. The mean score of the quick learning dimension ($M = 1.920$, $SD = 0.70$) could suggest that the sample of pre-service teachers tended to believe that knowledge was acquired gradually. In this dimension, 73.9% of the students tended to agree that learning was a developmental process. The mean for the innate ability dimension ($M = 2.882$, $SD = 0.67$) could suggest that the sample of pre-service teachers tended to believe that the ability to learn was fixed at birth. In contrast, 10.3% of the students tended to agree that learning ability could be changed. The mean of the certain knowledge dimension ($M = 2.792$, $SD = 0.64$) could suggest that the sample of pre-service teachers tended to believe that knowledge was absolute, while 14.8% of the students tended to believe that knowledge was tentative.

Factor analysis of the Epistemic Belief Inventory

The number and the characteristics of the factors representing pre-service teachers' responses to the EBI were shown through exploratory factor analysis. For this, "principal component analysis" was conducted followed by varimax rotation, yielding 11 factors with a cut-off point for eigenvalues greater than 1.0, and accounting for 60.7% of the total variation. In the factor analysis, 32 items were used. Factor loadings from principal component analysis (11-factor model) were given in Table 1, and the scree plot showing breaking points was given in Figure 1.

The scree plot suggested a three- through five-factor model, and item loadings on the factors were very scattered and not focused on the target factors in the 11-factor model. In light of the scree plot in Figure 1 and item loadings on the factors in Table 1, the researchers decided to test the five-factor model, which is Schraw et al.'s (2002) epistemological beliefs factor model. The five-factor model was tried with principal component analysis, and the results showed that this model was not a sufficiently good fit to explain the epistemological beliefs factor structure because most item loadings on the factors could not be interpreted correctly. Then the three-factor model was tried, and the results suggested that this model was the most appropriate model in order to explain the epistemological beliefs factor structure because it was a more useful model in terms of item loadings on the factors, and epistemological beliefs theory could be explained more by this model. Also, in the scree plot, there were two breaking points, suggesting a three-factor model. Therefore, the three-factor model was adopted in the present study to explain pre-service teachers' epistemological beliefs. Factor loadings from principal component analysis (three-factor model), eigenvalues, and alpha coefficients are given in Table 2. It is necessary to note that the bold numbers in the table (items related to the target factor) include the calculation of the values of alpha coefficients.

This model explained 28% of the total sample variation. Schraw et al. (2002) stated that each factor should be composed of "at least three items with loading in excess of 0.30". In Schraw et al.'s study, all items with loadings in excess of 0.30 on one factor did not load on other factors, and each factor was described "by a marker variable loading in excess of 0.70 that was indicative of the presumed underlying construct" (p. 268). Accordingly, in the present study, the same procedure was followed when determining the factors.

Schraw et al. (2002) found five factors and labelled them as innate ability, certain knowledge, simple knowledge, quick learning, and omniscient authority in their studies. In the present study, the exploratory factor analysis showed that simple knowledge and omniscient authority did not emerge as distinct factors. Upon examining the scree plot, a sharp break was found – indicating a three-factor solution. Therefore, the three factors of quick learning, innate ability, and certain knowledge were used to describe and explain the epistemological dimensions held by the Turkish pre-service teacher sample in this study. Similar to Schraw et al.'s findings, the present results of the factor analysis demonstrated that pre-service teachers' epistemological beliefs were a set of more or less independent beliefs, since the pre-service teachers had three factors instead of one. Thus, the structure of pre-service teachers' epistemological beliefs could be supported and explained by Schommer's (1990) multidimensionality of epistemological beliefs. Discrimination validity was determined by mean correlation of each factor, or dimension, with the other factors. These values ranged from 0.16 to 0.34. This showed that the correlations among the factors were rather low and seemed to be independent of

Table 1. Factor loadings from principal component analysis (11-factor model).

Items	1	2	3	4	5	6	7	8	9	10	11
Some people just have a knack for learning and others don't	.794	.058	-.109	-.043	-.022	.162	.207	.112	.053	.021	.053
If you don't learn something quickly, you won't ever learn it	.745	-.021	.067	.028	.213	-.081	.140	-.211	-.006	.124	-.123
How well you do in school depends on how smart you are	.702	.150	.174	.145	.016	.109	-.287	.067	-.016	-.127	.070
If you haven't understood a chapter the first time through, going back over it won't help	.654	.074	.205	-.311	-.046	-.011	.167	-.226	.095	.008	-.052
People can't do too much about how smart they are	-.009	.751	.024	-.059	.088	.022	-.020	.029	-.188	-.097	.076
Smart people are born that way	.117	.600	-.086	.137	-.221	.070	-.040	-.395	.214	-.087	.175
Really smart students don't have to work as hard to do well in school	.116	.566	-.003	.140	.055	.063	.029	.052	.128	.118	-.040
Some people will never be smart no matter how hard they work	-.012	.543	.046	-.086	-.255	-.103	.207	.279	-.156	.090	.210
If a person tries too hard to understand a problem, they will most likely end up being confused	-.003	.400	.087	.129	.000	-.040	.138	.195	.235	.083	.399
When someone in authority tells me what to do, I usually do it	.099	.395	.219	.167	-.117	.360	-.185	-.259	.080	.056	-.293
If two people are arguing about something, at least one of them must be wrong	.298	.021	.640	-.028	-.018	-.006	.077	.079	.042	.013	-.012
The moral rules I live by apply to everyone	-.067	.008	.592	.009	.026	.216	-.007	-.080	.127	-.007	.117
What is true today will be true tomorrow	.277	-.049	.535	.099	.204	.027	.312	-.262	.223	.001	.072
Science is easy to understand because it contains so many facts	-.080	.006	.509	.191	-.179	-.454	-.010	-.086	-.007	-.103	-.208
People should always obey the law	-.175	.157	.493	-.047	-.224	-.079	-.174	.335	-.173	.330	-.024
Parents should teach their children all there is to know about life	.126	-.017	.125	.728	.105	.121	.028	.036	-.174	-.014	-.003

(continued)

Table 1. (Continued).

Items	1	2	3	4	5	6	7	8	9	10	11
Instructors should focus on facts instead of theories	-.073	.100	-.132	.579	-.166	-.318	.227	.104	.164	-.015	.160
Some people are born with special gifts and talents	-.247	.173	-.008	.537	-.317	-.016	-.274	-.004	.101	-.036	-.045
Too many theories just complicate things	-.148	.315	.102	.462	.003	.032	.278	.252	.007	-.048	.277
You can study something for years and still not really understand it	-.086	.090	-.108	-.159	.751	-.214	.208	-.007	.106	-.044	.027
Things are simpler than most professors would have you believe	-.122	.131	-.087	-.091	-.678	-.243	.166	.055	.026	-.063	-.038
I like teachers who present several competing theories and let their students decide which is best	.222	.147	-.052	-.230	.370	.082	.052	.071	.067	.338	-.200
People who question authority are trouble makers	.055	.221	.130	.074	-.096	.687	.334	.058	-.080	.053	-.193
Children should be allowed to question their parents' authority	.102	-.087	.028	-.049	.071	.613	-.123	-.218	.342	-.070	.128
Working on a problem with no quick solution is a waste of time	.221	.078	.086	.073	.020	.064	.821	-.121	-.044	.030	-.056
It bothers me when instructors don't tell students the answers to complicated problems	-.049	.086	-.064	.177	-.049	-.065	-.121	.748	.108	-.151	.000
Absolute moral truth does not exist	-.032	.034	.141	.037	-.013	.033	-.051	.047	.734	.183	-.164
The more you know about a topic, the more there is to know	.296	-.007	.116	-.278	.216	.154	.031	.045	.505	.051	.146
Truth means different things to different people	-.021	.032	.056	-.019	-.024	.082	.112	-.079	.222	.689	.018
Sometimes there are no right answers to life's big problems	.165	.034	.006	.030	.392	-.242	-.187	-.111	.019	.557	-.047
Students who learn things quickly are the most successful	.155	.364	.361	.064	.125	-.100	-.007	.026	.127	-.436	-.211
The best ideas are often the most simple	.006	.114	.024	.068	.006	.004	-.089	-.059	-.106	-.008	.798

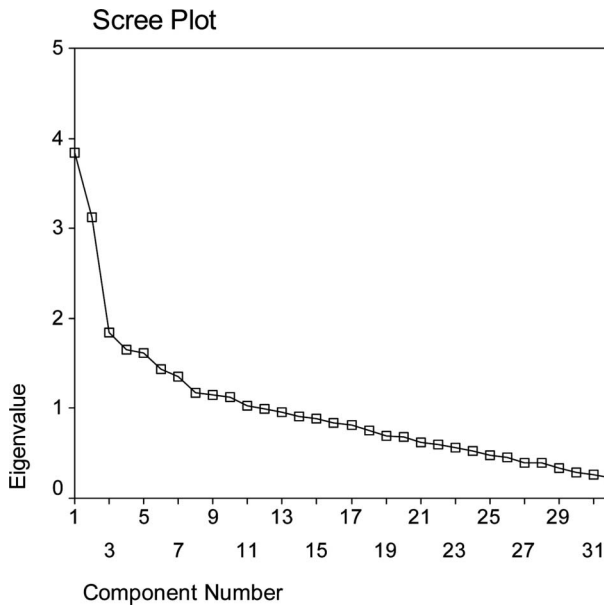


Figure 1. The scree plot showing three-factor model.

each other, as Schommer (1990) and Schraw et al. proposed. Thus, it can be stated that each EBI dimension measured what it was intended to measure.

Internal consistency values were determined according to the alpha reliability coefficient values, and these ranged from .51 to .75. Schraw et al. (2002) found a range of .58 to .68. Statistically speaking, these values might be assessed as low, but, generally, epistemological beliefs questionnaires have not had high reliability values. In epistemological beliefs studies such as Schommer's (1990), questionnaire alpha reliability values have ranged from .51 to .78. Cultural factors, translation differences, and differences in the various populations studied by researchers have all been noted in past research as potential reasons for the generally low reliability values.

Discussion of analysis and results

The purpose of this study was to validate and translate the original version of the Epistemic Belief Inventory developed by Schraw et al. (2002) from English into Turkish. EBI, known for its simplicity and higher validity and reliability values as compared to Schommer's (1990) instrument, has been used by researchers in many international studies. However, its use in Turkey, especially with pre-service teachers, has been limited. The results of the previous studies suggested varying numbers of factors within EBI. For example, Schraw et al. (2002) analyzed EBI and revealed five clean factors – certain knowledge, simple knowledge, innate ability, quick learning, and omniscient authority – and obtained better test-retest reliability (ranging from .62 to .81) in comparison with EBQ. However, Nussbaum and Bendixen, (2003) and N. Chan et al. (2011) extracted three distinct factors. The labels of the extracted factors, however, were different from Schraw et al. (2002), and the omniscient authority dimension was not extracted.

Table 2. Factor loadings from principal component analysis (three-factor model).

	Quick Learning	Innate Ability	Certain Knowledge
If you don't learn something quickly, you won't ever learn it	.660	-.005	.129
Some people just have a knack for learning and others don't	.610	.168	.115
If you haven't understood a chapter the first time through, going back over it won't help	.543	-.007	.196
How well you do in school depends on how smart you are	.498	.185	.006
*Some people are born with special gifts and talents	-.307	.196	.193
*The more you know about a topic, the more there is to know	.305	-.018	.158
**I like teachers who present several competing theories and let their students decide which is best	.258	-.003	-.049
***You can study something for years and still not really understand it	.255	.041	-.234
**Things are simpler than most professors would have you believe	-.253	.166	.004
***Working on a problem with no quick solution is a waste of time	.243	.235	.158
**Sometimes there are no right answers to life's big problems	.220	-.077	-.067
***It bothers me when instructors don't tell students the answers to complicated problems	-.219	.209	-.100
***Children should be allowed to question their parents' authority	.217	-.126	.216
***Too many theories just complicate things	-.203	.207	.077
***Instructors should focus on facts instead of theories	-.200	-.203	-.149
People can't do too much about how smart they are	.030	.608	.026
Smart people are born that way	.040	.594	.130
Really smart students don't have to work as hard to do well in school	.114	.590	.165
Some people will never be smart no matter how hard they work	-.109	.570	-.023
If a person tries too hard to understand a problem, they will most likely end up being confused	.009	.507	.056
When someone in authority tells me what to do, I usually do it	.010	.492	.127
***People who question authority are trouble makers	.135	.214	.298
***Students who learn things quickly are the most successful	.029	.206	.332
***Parents should teach their children all there is to know about life	-.139	.202	.278
**The best ideas are often the most simple	-.009	.201	-.149
If two people are arguing about something, at least one of them must be wrong	.152	.007	.577
The moral rules I live by apply to everyone	-.018	-.045	.535
What is true today will be true tomorrow	.166	-.001	.532
Science is easy to understand because it contains so many facts	-.149	-.084	.480
People should always obey the law	-.140	.067	.434

(continued)

Table 2. (Continued).

	Quick Learning	Innate Ability	Certain Knowledge
**Absolute moral truth does not exist	.055	-.061	.286
**Truth means different things to different people	.183	.013	.077
Alpha Coefficients (α)	.75	.64	.51
Eigenvalues	2.73	2.32	1.96

*Item to factor loadings was not interpreted and theory did not explain this item loading; **Item loading < .3; ***Item loading < .3, and items were not related to the target factor.

In the present study, as in the Nussbaum and Bendixen (2003) and N. Chan et al. (2011) studies, the Turkish version of EBI revealed three interpretable, though somewhat different, factors. These were labelled as quick learning, innate ability, and certain knowledge. One possible reason for the variation in number and kinds of factors could be that some epistemological dimensions were closely related to each other. In many studies, simple knowledge and certain knowledge were combined, and in others omniscient authority was absorbed into other factors. Also, as some individual items have closely related meanings, this could lead to lower reliability values. Another possibility for the lower reliability values in the present study could be the translation and meaning held by different cultures of the items in the questionnaire (Schommer, 1994). Some of the items could have been interpreted differently by Turkish students in comparison to those from the USA.

Yet another reason for the difference could be that pre-service teachers' epistemological beliefs structures vary based on cultural differences; as was proposed by K.W. Chan and Elliott (2000). Turkish researchers Yılmaz-Tüzün and Topçu (2008) also hypothesized that different sample characteristics could lead to different factor structures. Thus, if EBI was administered to a sample having different characteristics than those in previous samples, it could lead to different results.

Hofer (2000) suggested that the reason for these discrepancies could be the domain-specific nature of epistemological beliefs. She stated that the epistemological assumptions of people change in terms of discipline and that people could not have a general view related to beliefs about knowledge. More specifically, while stating their beliefs on each item, pre-service teachers could think differently about that item in relation to varied courses. For example, they could believe that knowledge about some science topics was unchanging and at the same time think about knowledge in social science-related topics as changeable, while interpreting the same item.

Similar to the Yılmaz-Tüzün and Topçu (2008) findings, more than one factor was extracted for the pre-service teachers. Thus, it could be stated that extracting more than one factor suggests that a pre-service teacher's epistemological beliefs were developed as a set of more or less independent beliefs. In this case, the pre-service teacher's epistemological beliefs could be explained by multidimensional theory.

The dimensions of the EBI demonstrated satisfactory, though low, internal consistency reliability values. The reason for this could be that instruments measuring epistemological beliefs usually have rather low reliability values. For example, Schraw et al. (2002), while using EBI, found low reliability values from .58 to .68; Nussbaum and Bendixen (2003), in using EBI, found low reliability values from .69 to .77; Schommer (1990) as well found low reliability values from .51 and

.78 using EBQ in her studies. In the present study, the reliability values were lower than Schraw et al.'s (2002) findings. These differences also might have been caused by translation. The full meaning of the original EBI might not have been captured in the Turkish version of the EBI. Likewise, the questionnaire items might have been interpreted differently among students in the USA and Turkey due to American and Turkish cultural differences. This is the most often found limitation in translated instruments and a point of caution noted by Schommer (1994).

In addition to satisfactory internal consistency reliability values, EBI was also found to display discriminant validity. The mean correlation values of one factor with other factors ranged from 0.16 to 0.34. Thus, it can be stated that the three dimensions were not highly correlated with each other and that these three dimensions measured different epistemological belief dimensions. This is also consistent with Schommer's (1990) and Schraw et al.'s (2002) views that the dimensions of epistemological beliefs tend to be independent from each other.

In their study of the problems in measuring epistemic beliefs, DeBacker, Crowson, Beesley, Thoma, and Hestevold (2008) revealed that a confirmatory factor analysis with the five-factor model in the EBI instrument did not fit the data in their study. The fit of the model to the data was improved by removing 11 items, making the internal consistency of each dimension lower than .70. In our study, 17 items were eliminated while interpreting the factor structure. Since one or two of these items loaded on more than one of the factors, they were not interpreted as epistemological belief factors. For example, the item of "sometimes there are no right answers to life's big problems" was loaded on both certain knowledge and innate ability.

In this study, the reason for the extraction of the dimensions of quick learning, innate ability, and certain knowledge could be explained by both the educational system and family involvement in Turkey. Taking the sociocultural influence hypothesis explanation for differences into consideration, the Turkish Educational System's recent transfer from the traditional approach into the constructivist model can be considered. The quick learning dimension is related to beliefs about knowledge acquired quickly or gradually. Turkish pre-service teachers were initially taught within the traditional approach at the elementary school level, and upon entering secondary school and university they were taught within the constructivist approach. Educators in Turkey note that many students, including pre-service teachers, had difficulty adjusting to constructivist approaches, that is, the construction of their own knowledge. This could reflect the stronger responses in this epistemological belief dimension than in those which could not be determined in the present study.

The innate ability dimension is related to learning ability being fixed at birth or learning ability being changeable over time. The Turkish education system has focused students on intensive study for placement into higher levels of education. For instance, students have to achieve a satisfactory score on the University Entrance Examination to enter university. This exam is multiple choice, and most questions are knowledge and comprehension based. Thus, many students' families insist on their children studying very hard – intensive rote learning – to enter university. This practice has expanded in recent decades to include placement exams for particular high school admissions. The certain knowledge dimension is related to beliefs that knowledge is either absolute or tentative. The Turkish Education System has generally enforced that students choose the one correct answer; there is black and white, no grey.

The omniscient authority factor was not extracted in this study. Topçu (2011), who administered EBQ to Turkish Elementary Education pre-service teachers, also did not find an omniscient authority factor. Some factors, such as this, combined with items of other factors thus making interpretation of the structure of epistemological beliefs is rather difficult. K.W. Chan and Elliott (2000) suggested that some dimensions could be related to each other and that the epistemological beliefs structure of the Schommer (1990) and K.W. Chan and Elliott (2000) samples were different in terms of cultural factors. In this study, it is possible that the omniscient authority dimension was not extracted since the sample of the study was junior and sophomore pre-service teachers who could view authority as related to other constructs, such as certain knowledge.

In this study, the simple knowledge dimension of epistemological belief was not extracted. Similar to Schraw et al.'s (2002) study, however, Topçu (2011) and Yılmaz-Tüzün and Topçu (2008) found simple knowledge as a dimension of epistemological beliefs in the Turkish context. In the present study, this factor was sometimes combined with the certain knowledge dimension. This could support Hofer's (2000) view that the beliefs about knowledge dimension include certain knowledge and simple knowledge.

Conclusion

EBI was constructed in order to get a more valid and reliable instrument with the five-factor structure proposed by Schommer (1990). However, this study and other studies (Nussbaum & Bendixen, 2003) showed relatively low internal consistency values. Instead, a three-factor structure was extracted.

Culture by culture, or context by context, some factor items have been combined into other, more prominent factors. This is the case in both previous studies and in the present study and has made interpretation within the original two schema (EBQ and EBI) challenging, necessitating changes to the dimensions. Generally, epistemological beliefs research was conducted on American and Western cultures (Hofer & Pintrich, 1997), and the first studies were conducted on elite university students at American institutions (Perry, 1970). For this reason, the generalization of the epistemological beliefs schema can be problematic, and more study is needed among other cultures. Some cultures give more value to family and authority, while others give more value to independence and personal freedom. Thus, the views of these cultures could be different in terms of omniscient authority and certain knowledge dimensions of epistemological beliefs. In addition to socio-cultural explanations for variance between studies, translation differences and the close relationship between some items and dimensions have been cited as possibilities. This finding is also consistent with previous research in the field.

The preliminary result of the study suggests that EBI could be administered to a larger sample of pre-service teachers in a Turkish context for the purposes of obtaining more valid and more reliable information regarding their epistemological beliefs. The results of this study are largely consistent with results from other international studies using the Epistemic Belief Inventory. In order to validate the results of this study, however, the EBI instrument should be used and tested in a wider variety of settings in Turkey to determine its usefulness and to gain a greater understanding of pre-service teachers' epistemological beliefs in Turkey.

This study highlights a need for future studies, to develop valid epistemological instruments for the improvement of Turkish pre-service teachers' epistemological beliefs. There are a limited number of studies measuring Turkish pre-service teachers' epistemological beliefs and a limited number of instruments to assist in this research. Past studies have demonstrated that pre-service teachers' epistemological beliefs can influence their teaching preferences and also affect their students' epistemological beliefs. As the Turkish Educational System's emphasis has been gradually shifting from a more traditional approach to constructivist approaches to learning and pedagogy, the present study provides a much needed tool to evaluate pre-service teachers' epistemological beliefs and development. More studies are needed, however, to confirm the reliability of the Epistemic Belief Inventory and its consistency within a Turkish context.

Notes on contributors

Aylin Cam is assistant professor at the Department of Elementary Science Education at Mugla University, Turkey. She studies students and teachers' beliefs and educational practices, argumentation, teaching methods, and epistemological beliefs.

Mustafa Sami Topcu is associate professor at the Department of Elementary Science Education at Mugla University, Turkey. His research interests are teachers' beliefs and educational practices, socio-scientific issues, argumentation, and epistemological beliefs.

Yusuf Sulun is assistant professor at the Department of Elementary Science Education at Mugla University, Turkey. He studies environmental education, scientific literacy, and achievement.

Gokhan Guven is research assistant at the Department of Elementary Science Education at Mugla University, Turkey. His study areas are scientific literacy and epistemological beliefs.

Sertac Arabacioglu is research assistant at the Department of Elementary Science Education at Mugla University, Turkey. He focuses creating and practicing science-based experimental activities by using innovative teaching methods for teaching basic concepts in science.

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