sciendo

Acta Educationis Generalis
Volume 10, 2020, Issue 2

DOI: 10.2478/atd-2020-0010

Investigation of the Core Beliefs of the Teacher Candidates through Artificial Neural Networks

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Received: January 20, 2020; received in revised form: April 8, 2020;
accepted: April 13, 2020

Abstract:
Introduction: The research aims to investigate the relationship between pedagogical beliefs, epistemological beliefs of teacher candidates as well as their beliefs toward learning.
Methods: The study is a quantitative study based on a correlational survey model. Analysis of the data was done through artificial neural networks. The sample consists of fourth-grade students (teacher candidates) in social studies education in Süleyman Demirel University.
Results: In this study, it is found that beliefs toward learning are effective regarding pedagogical beliefs, epistemological beliefs.
Discussion: Hence, our finding is important in terms of implying that beliefs toward learning are more fundamental than the epistemological beliefs and pedagogical beliefs so that beliefs toward learning should be remedied to educate more qualified teachers.
Limitations: There were several limitations to this study. First, the very nature of identifying beliefs is difficult. The second limitation is that this research relied on only teachers' self-reported data. The third limitation is the population. Our population is small for making more general deductions regarding teacher candidates' core beliefs such as taking teacher candidates from different geographical areas of Turkey even from different cultures.
Conclusion: In this study, it is found that beliefs toward learning are effective regarding pedagogical beliefs, epistemological beliefs and pedagogical beliefs are effective about epistemological beliefs to the same extend. Hence, our finding is important in terms of implying that beliefs toward learning are more fundamental than the epistemological beliefs and pedagogical beliefs so that beliefs toward learning should be remedied to educate more qualified teachers.

Key words: pedagogical beliefs, epistemological beliefs, beliefs toward learning, artificial neural networks.

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Introduction

Epistemology is an area of philosophy concerned with the nature and justification of human knowledge (Hofer & Pintrich, 1997). In this regard, humans in one respect are epistemological machines because they are influenced by their belief systems when humans meet with new information or track the information in particular ways. Such convictions often influence many cognitive processes ranging from perception and conceptualization of the data to decision making processes to the views, thoughts, motivations, and actions of individuals. In this intersection between philosophy and psychology, Piaget (1950) employed the term genetic epistemology to describe his theorization of intellectual developments (Hofer & Pintrich, 1997). Piaget called this system as schemas as the building blocks of knowledge enabling us to form a mental representation through assimilation and accommodation processes (Piaget & Cook, 1952). Piaget (1950) used the term genetic epistemology to describe his theory of intellectual development, initiating the interest of developmental psychologists in this intersection of philosophy and psychology. In this context, individuals ' epistemic beliefs mainly involve elements that organize and play an active role in learning processes beliefs about nature, limits, content, source, precision and the knowledge process (Hofer, 2002). The first conceptualization of individual epistemology was made in 1970 by Perry during his study of the moral and intellectual development of Harvard students. In 1990 Schommer introduced a multidimensional perspective on epistemology.

In this article, epistemological beliefs (Figure 1) are classified in terms of the scale developed by Schraw, Bendixen and Dunkle (2002). According to this scale, there are five dimensions of epistemological beliefs given as the source of knowledge, stability of knowledge, structure of knowledge, control, and speed of knowledge acquisition. The dimension “structure of knowledge” aspect represents a continuum from a simplistic perspective that knowledge is organized simply and consisting of independent components to a dynamic, interrelated position of knowledge. The "stability of knowledge" requires a complete and stable understanding status over time to a role in which information undergoes a constant cycle of growth. The “source of knowledge,” dimension indicates a position that implies a place whereby knowledge is omniscient, to a position that knowledge can be gained through personal experiences. The “control of learning processes,” describes a range from the position that the learning capacity is determined when it is born to the view that learning ability is acquired through experience. The dimension, “speed of knowledge acquisition” extends from the view that learning is a process that succeeds on an ad-hoc basis or not at all to the view that learning is a step-by-step process (Paechter et al., 2013).

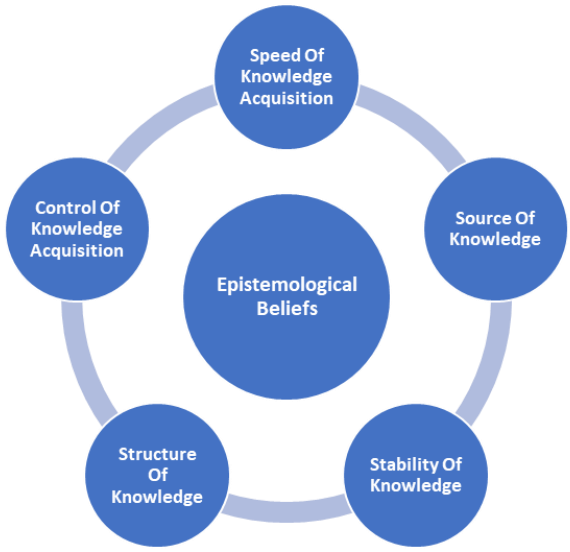


Figure 1. Epistemological beliefs according to Schraw, Bendixen and Dunkle (2002).

The teachers' initial ideas or beliefs about learning-teaching are the most central instrument of teacher education because the indicators of teacher candidates' ability to adapt to more contemporary or learner-centered, learning-teaching approaches are embedded in their pedagogical belief systems. Teacher education can be improved and reformed through since that the systematic description of teacher trainees' pedagogical belief systems could provide significant information about the orientations of teacher educators' pedagogical belief systems. Teachers' ideas or beliefs about learning-teaching can be classified in many ways. According to Soysal, Radmard, Kutluca (2018), it can be classified in terms of three dimensions as "structuring knowledge according to individual differences", "traditional structuring of social and epistemic authority in-class" and finally "diffusion of knowledge from more to lesser ones". These are conceptualized as learner-centered beliefs and teacher-centered beliefs given in Figure 2.

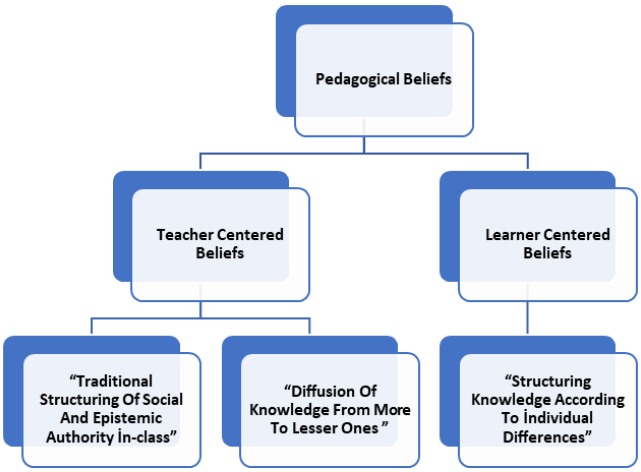


Figure 2. Pedagogical beliefs according to Soysal, Radmard, and Kutluca (2018).

Beliefs toward learning (Figure 3) is also an important concept for the understanding of teachers' pedagogical stance because beliefs toward learning have an impact on the thinking of teachers as to how learning occurs, affect their views on the teacher and student roles in the process and play a decisive role in their classroom practices. According to Bay et al. (2012), beliefs toward learning can be classified as "Traditional", "Social constructivism", "Cognitive Constructivism" and "Radical constructivism." In the traditional approach, the student is perceived as an individual having a passive role based on taking information; the teacher has an active role in information-transferring and decision-making processes. The principle of cognitive constructivism is that knowledge does not form an entire body of facts that can be transferred outside the individual and that it is created by internalizing by the individual. The starting point of cognitive constructivism is the individual's experiences and the perceptions of the subject and their mental constructs. According to the social constructivist approach, knowledge is constructed based on cultural and historical sources, radical constructivism emphasized that each individual comes to the learning and teaching process with different experiences. Knowledge reflects a world created, organized and organized by the individual's own experiences (Bay et al., 2012).

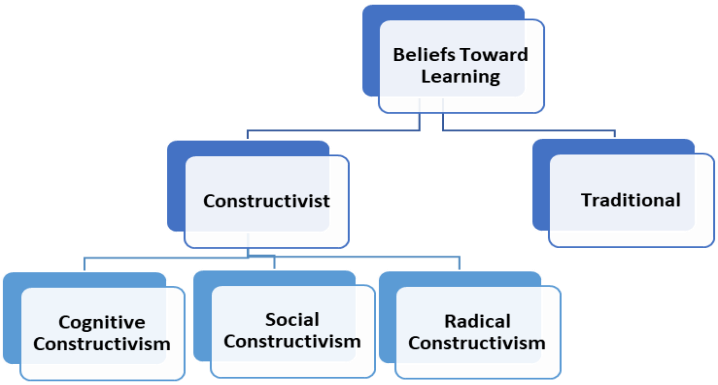


Figure 3. Beliefs toward learning according to Bay et al. (2012).

When epistemological beliefs, pedagogical beliefs, beliefs toward learning are investigated conceptually, it can be seen that epistemological beliefs can be regarded as the base of pedagogical beliefs because they are more abstract than pedagogical beliefs. Similarly, pedagogical beliefs can be regarded as the base of beliefs toward learning since they are more generalized than beliefs toward learning. Therefore, in this study, it is aimed to investigate how the hierarchy is structured and how they are related in this regard. Therefore, the following questions were sought in this regard:

1. What is the relationship between epistemological beliefs, pedagogical beliefs?
2. What is the relationship between pedagogical beliefs, beliefs toward learning?
3. What is the relationship between epistemological beliefs, beliefs toward learning?

These questions were investigated in this study to determine the core beliefs of teacher candidates because core beliefs about knowing are central associated with most other values, whereas peripheral beliefs about learning and teaching are extracted from these core beliefs and are more readily expressed and changed (Brownlee, Boulton-Lewis, & Purdie, 2002). In this respect, it is important to determine the degree of the centrality of the beliefs for achieving more qualified teacher education.

1 Methods

The study is a quantitative study based on a correlational survey model. The Multilayer Perceptron Network (MLP) which is an artificial neural network in SPSS was used in the analysis of the data.

1.1 The sample

However, WE differs from ELF as WE emphasizes the codification of national varieties which is mainly in the Outer circle of Kachru's (1986, 1992) model whereas, ELF emphasizes the uses of English in all the three circles: Inner, Outer, and Expanding with the Expanding Circle being its special interest. Nonetheless, as ELF is abo The sample of the study consists of 154 teacher candidates in the social science teaching department at Süleyman Demirel University. The sample was selected in terms of the convenience sampling technique. Convenience sampling is a specific type of sampling method that relies on data collection from population members who are conveniently available to participate in the study in terms of time and cost, the sample group was chosen as the most available group of individuals in the 4'th grade students (teacher candidates) in social studies education in Süleyman Demirel University. Additionally, to determine the size of the sample, the formula of Yamane (2010) was used as follows:

$$n = \frac{Nz^2pq}{(N-1)d^2+z^2pq} = \frac{312(1.96)^2 0.5.0.5}{(311)(0.07)^2+(1.96)^2(0.5)(0.5)} = \frac{299.645}{2,4843} = 120,62$$

Where N= the number of individuals in the population as 312 individuals;
z = 1.96 (standard normal distribution table value for the desired reliability level (95%);
d = 0.07 (sensitivity);
p: the ratio of individuals with the desired feature in the stack (p + q = 1, p = q = 0.50 to make the maximum sample diameter).
As a result of the procedure, it is assumed that the sample of 121 students can represent the population (http://egitim.sdu.edu.tr/tr/ogrenci-sayilari/ogrenci-sayilari-9375s.html) and this value is accepted as the lower limit for the sample size. Therefore, because our sample consisting of 154 teacher candidates, it is appropriate representing the population.
Additionally, for correlational survey models, the number of sample size is taken into consideration as a result of the calculation made with the following formula (Tabachnick & Fidell, 2007):
N> 50 + 8m;
N: Number of participants m: number of independent variables where m= 11 (4 independent variables from beliefs toward learning, 3 from pedagogical beliefs and 5 from epistemological beliefs);
N> 146 where the target sample size for this study is 154 which meets the requirement.

1.2 Research tools

The research tools used in this study are Pedagogical Belief Systems Scale, Epistemic Beliefs Inventory, and Belief scale towards learning. These scales are briefly explained below.

1.2.1 Pedagogical Belief Systems Scale

The Pedagogical Belief Systems Scale was adopted into Turkish by Soysal, Radmard, and Kutluca (2018) that is conducted to 689 prospective teachers (PTS) in diverse teaching programs. The Cronbach alpha internal consistency coefficient of the pedagogical belief systems scale was found to be 0.77. As a result of confirmatory factor analysis, the chi-square value of the model (2 = 155.78; N = 689; sd = 296; p = 0.00) was found to be significant. Therefore, it can be said that this scale is reliable and valid for scientific researches.

1.2.2 Epistemic Beliefs Inventory

The Epistemic Beliefs Inventory which was originally developed by Schraw, Bendixen, and Dunkle in 2002 and was adopted into Turkish by Velipaşaoğlu (2011) to explore the beliefs of students of Dokuz Eylül Medical School towards knowledge. The scale which has 19 questions under five dimensions and is a valid and reliable tool. The total score of the scale ranged from 32 to 160; low scores were interpreted as a subjectivist tendency and high scores were interpreted as an objectivist tendency. It was found that the Cronbach Alpha value was 0.775 and the standardized item alpha value was 0.760, which showed that the scale had an acceptable internal consistency, in other words, it was reliable (Velipaşaoğlu, 2011).

1.2.3 Belief scale towards learning

The belief scale towards learning was developed by Bay et al. (2012). It was conducted to 233 teachers who worked in a primary school in the city center of Gaziantep during the first semester of the academic year 2011-2012. The content validity of the scale was provided via expert judgment. The Cronbach Alpha internal consistency coefficient and the split-half method were examined. As a result of the reliability analysis, the internal coefficient was determined as .86 for the “Traditional Constructivist” subscale, .85 for the “Social constructivist” subscale, .74 for the “Cognitive constructivist” subscale and .73 for the “Radical constructivist” subscale. The reliability coefficients for the subscales assessed by the way of the split-half method were .77 for social constructivist subscale, .84 for traditional subscale, .66 for cognitive constructivist subscale, and .67 for radical constructivist subscale. These results indicated the Belief Scale towards Learning is at the level of sufficient reliability.

1.3 Data analysis

The first Artificial Neural Network design was developed in 1943 by McCulloch and Pitts, influenced by the human brain's programming capabilities, and designed a functional neural network with an electronic circuit. Hebb in 1949 attempted to show how the human brain neurons were taught. Developments in the field of artificial neural networks accelerated in 1957 after Frank Rosentblatt realized Perceptron (Çırak, 2012). The mechanisms of neurons in the brain

shortly encourage artificial neural networks to provide capabilities such as reading, recalling, and processes information processing (Taşgetiren, 2006). The advantages of artificial neural networks are that they do not require any presuppositions and can run the system by limiting them to the data at hand (Başman, 2014). Neural Networks developed for this purpose generally perform the following functions (Öztemel, 2003):

- Estimation: Artificial neural networks used for this purpose estimate the corresponding output values using the information presented to the network.
- Classification: Artificial neural networks used for this purpose assume the task of categorizing the information given to them.
- Data association: Networks trained for this purpose determine whether the data presented to the network is incorrect.
- Data filtering: Networks trained for this purpose perform the task of identifying appropriate data from among many data.
- Recognition and matching: Recognition of different shapes and patterns can perform matching and recognition functions by processing incomplete, complex, ambiguous information.
- Diagnosis: Networks developed for this purpose carry out the process of identifying the problems of the systems and identifying the problems.
- Interpretation: Interpretation of new events using information obtained from the samples collected about an event and generated as a result of training is considered within this scope.

Multilayered Perceptron-MLP (Figure 4) was used for the analysis of the data in this regard since it can produce solutions to nonlinear problems compared to single-layer artificial neural network models such as Hebb Net, Perceptron and Adaline. A multilayer perseptron uses a learning rule called the Generalized Delta Rule, which is the generalized form of the Delta Rule, which is based on the least-squares method. Multilayer Perceptron Network (MLP) consists of three parts: the input layers as neurons which represent the available data in this case the multispectral image band values, the hidden layer which demonstrates the network training process and finally the output layer which will be the bathymetric information. A hypothetical example of (MLP) ANNs with 4 input layers, 5 hidden layers and one output layer (4-5-1) is demonstrated in Figure below (Mohamed et al., 2015).

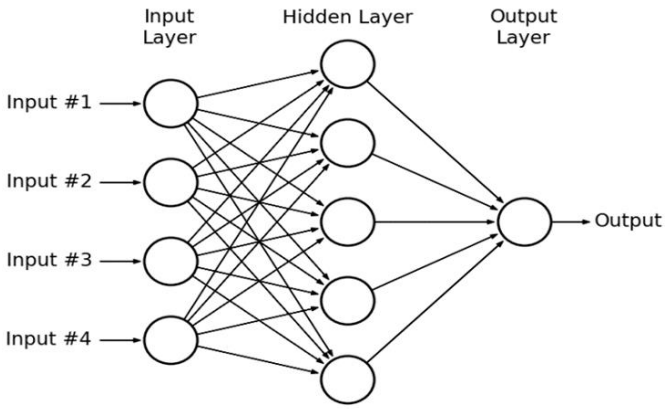


Figure 4. A hypothetical example of the Multilayer Perceptron Network (Mohamed et al., 2015).

When the normalized importance of epistemological beliefs, pedagogical beliefs, beliefs toward learning are investigated to determine which one can be classified as a core belief than other, the formula developed by researches given as below was used:

$$\mathrm{p} = \frac{\sum_{i=1}^{n} t_i}{n\ 100} \times 100$$

where p stands for strength of the significance level, t is the point for the dimension of significance level for each model for the others and n the number of dimensions for each model.

2 Findings

2.1 Findings regarding the relationship between epistemological beliefs and pedagogical beliefs

Model summary regarding the relationship between epistemological beliefs and pedagogical beliefs can be given as in Table 1 below.

Table 1

Model summary regarding the relationship between epistemological beliefs and pedagogical beliefs

	Model Summary		
Training	Sum of Squares Error		135.770
	Average Overall Relative Error		.870
	Relative Error for Scale	pisfactor1	.882
	Dependents	pisfactor2	.826

		pisfactor3	.903
	Stopping Rule Used		1 cons1qecutive step(s) with no decrease in error[a]
	Training Time		0:00:00,05
Testing	Sum of Squares Error		54.594
	Average Overall Relative Error		.902
	Relative Error for Scale	pisfactor1	.855
	Dependents	pisfactor2	.867
		pisfactor3	.959

a. Error computations are based on the testing sample.

Model summary regarding the relationship between epistemological beliefs and pedagogical beliefs are given in Figure 5 below.

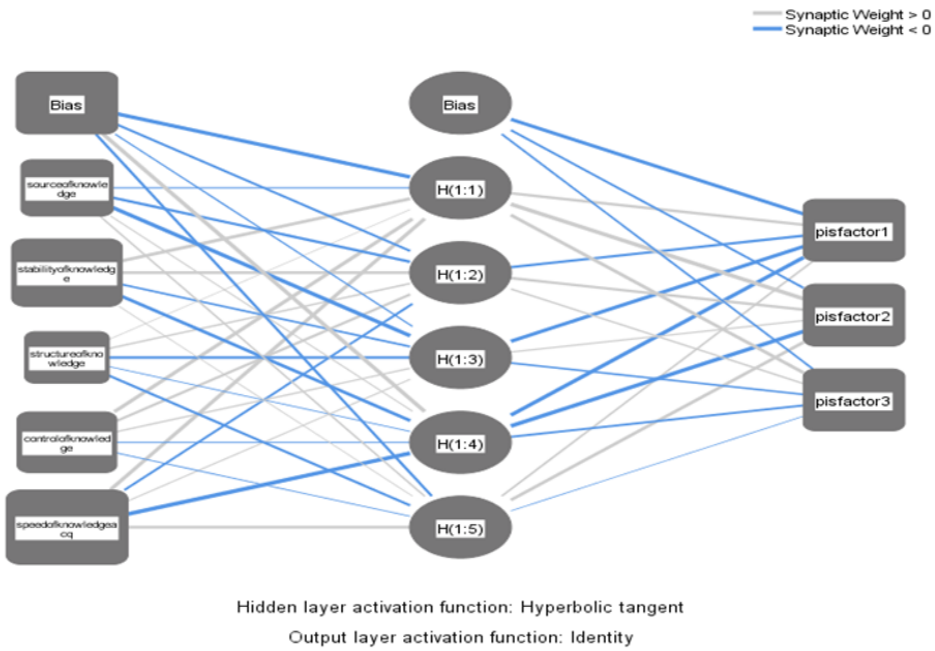
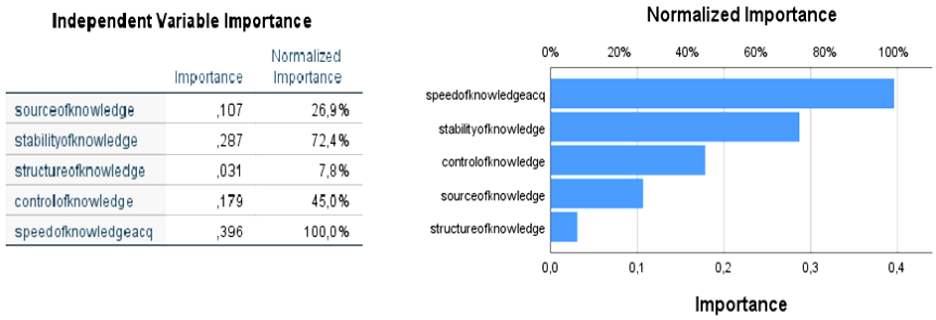


Figure 5. Model summary regarding the relationship between epistemological beliefs and pedagogical beliefs.

When the normalized importance was investigated, it was seen that the speed of knowledge acquisition is the most important factor for this model. Secondly, the stability of knowledge; thirdly, control of the knowledge; fourthly, the source of the knowledge; and fifthly, the structure of knowledge are arranged as important factors (Figure 6).



Independent Variable Importance

	Importance	Normalized Importance
sourceofknowledge	,107	26,9%
stabilityofknowledge	,287	72,4%
structureofknowledge	,031	7,8%
controlofknowledge	,179	45,0%
speedofknowledgeacq	,396	100,0%

Figure 6. Normalized importance of epistemological beliefs for the model of pedagogical beliefs.

When the reverse model was investigated, the model summary was found to be as in Table 2.

Table 2

Reverse model summary of epistemological beliefs and pedagogical beliefs

	Model Summary		
Training	Sum of Squares Error		255.323
	Average Overall Relative Error		.928
	Relative Error for Scale Dependents	Source of knowledge	.958
		Stability of knowledge	.961
		Structure of knowledge	.952
		Control of knowledge	.920
		Speed of knowledge acquisition	.852
	Stopping Rule Used	1 consecutive step(s) with no decrease in error[a]	
	Training Time		0:00:00,13
Testing	Sum of Squares Error		106.205
	Average Overall Relative Error		.921
	Relative Error for Scale Dependents	Source of knowledge	1.000
		Stability of knowledge	.867
		Structure of knowledge	.964
		Control of knowledge	.910
		Speed of knowledge	.872

	acquisition

a. Error computations are based on the testing sample.

As it can be seen the importance levels reverse model of epistemological beliefs and pedagogical beliefs are different in terms of direction and variable than the normal model.

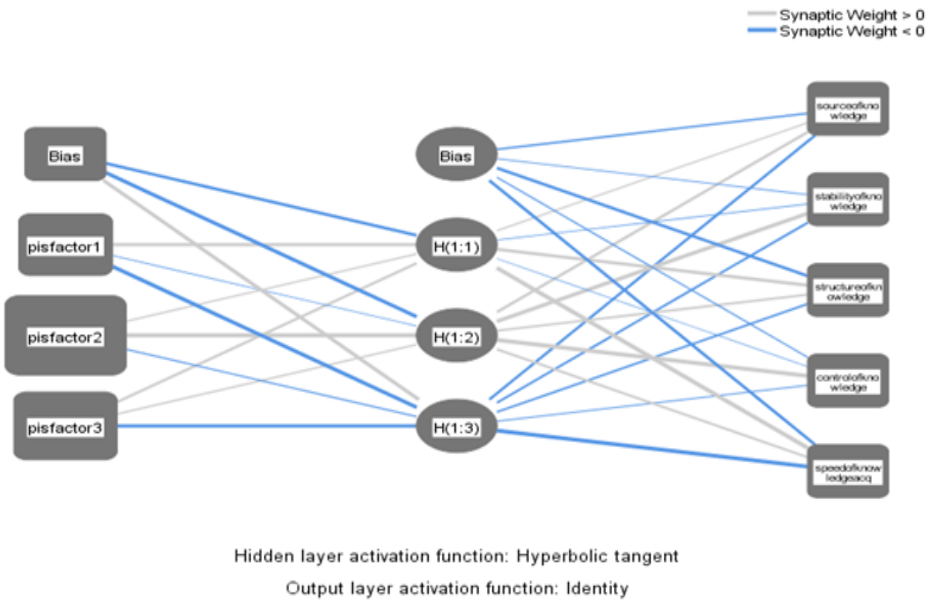


Figure 7. Reverse model of epistemological beliefs and pedagogical beliefs.

When the reverse model analyzed (Figure 7) it was seen that factor 2 belonging to learner-centered beliefs given as "structuring of social and epistemic authority in-class" is the first important factor and second important factor is found to belong to teacher-centered beliefs given as "diffusion of knowledge from more to lesser ones", the third important factor is found to be "structuring knowledge according to individual differences" given as teacher-centered beliefs (Figure 8).

Independent Variable Importance

	Importance	Normalized Importance
pisfactor1	,270	65,8%
pisfactor2	,411	100,0%
pisfactor3	,319	77,7%

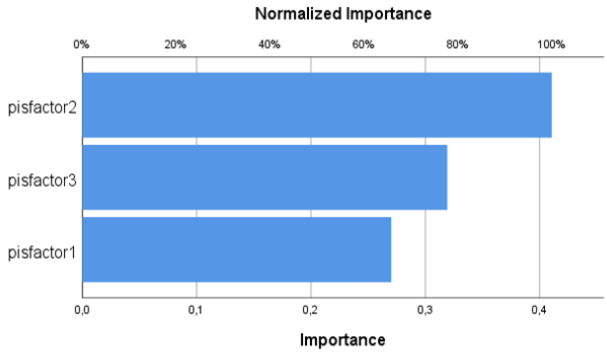


Figure 8. Importance levels for the reverse model of epistemological beliefs and pedagogical beliefs.

2.2 Findings on the relationship between pedagogical beliefs and beliefs toward learning

Model summary regarding the relationship between pedagogical beliefs, beliefs toward learning given as in Table 3 below.

Table 3

Model summary regarding the relationship between pedagogical beliefs and beliefs toward learning

Model Summary			
Training	Sum of Squares Error		193.082
	Average Overall Relative Error		.847
	Relative Error for Scale Dependents	Social structuralism	.893
		Traditional	.862
		Cognitive structuralism	.832
		Radical struturalism	.801
	Stopping Rule Used	1 consecutive step(s) with no decrease in error[a]	
	Training Time		0:00:00,09
Testing	Sum of Squares Error		62.832
	Average Overall Relative Error		.843
	Relative Error for Scale Dependents	Social structuralism	.792
		Traditional	.878
		Cognitive structuralism	.816
		Radical structuralism	.887

a. Error computations are based on the testing sample.

Model summary regarding the relationship between pedagogical beliefs and beliefs toward learning is given in Figure 9 below.

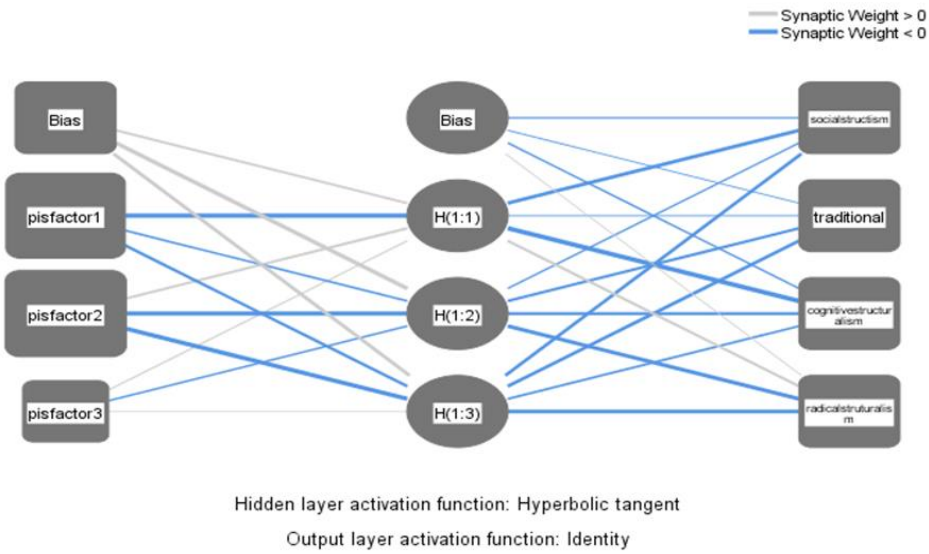


Figure 9. Model summary regarding the relationship between pedagogical beliefs and beliefs toward learning.

When the normalized importance was investigated, it was seen that factor 2 belonging to teacher-centered beliefs given as traditional structuring of social and epistemic authority in-class is the first important factor and the second important factor is found to belong to learner-centered beliefs given as "structuring knowledge according to individual differences." (Figure 10)

Independent Variable Importance

	Importance	Normalized Importance
pisfactor1	,459	95,8%
pisfactor2	,480	100,0%
pisfactor3	,061	12,7%

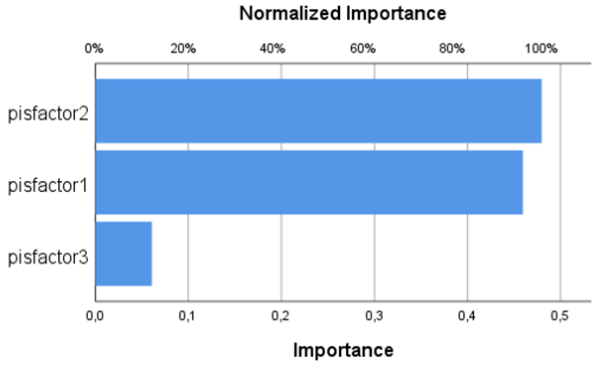


Figure 10. Normalized importance of pedagogical beliefs for the model of beliefs toward learning.

When the reverse model was investigated given as in Figure below, the model summary was found to be Table 4.

Table 4

Reverse model summary of pedagogical beliefs for the model of beliefs toward learning

	Model Summary		
Training	Sum of Squares Error		131.850
	Average Overall Relative Error		.799
	Relative Error for Scale	Pisfactor1	.797
	Dependents	Pisfactor2	.704
		Pisfactor3	.897
	Stopping Rule Used		1 consecutive step(s) with no decrease in error[a]
	Training Time		0:00:00,12
Testing	Sum of Squares Error		51.626
	Average Overall Relative Error		.810
	Relative Error for Scale	Pisfactor1	.759
	Dependents	Pisfactor2	.855
		Pisfactor3	.825

a. Error computations are based on the testing sample.

As can be seen, the importance levels reverse model of pedagogical beliefs for the beliefs toward learning are different in terms of direction and variable than the normal model.

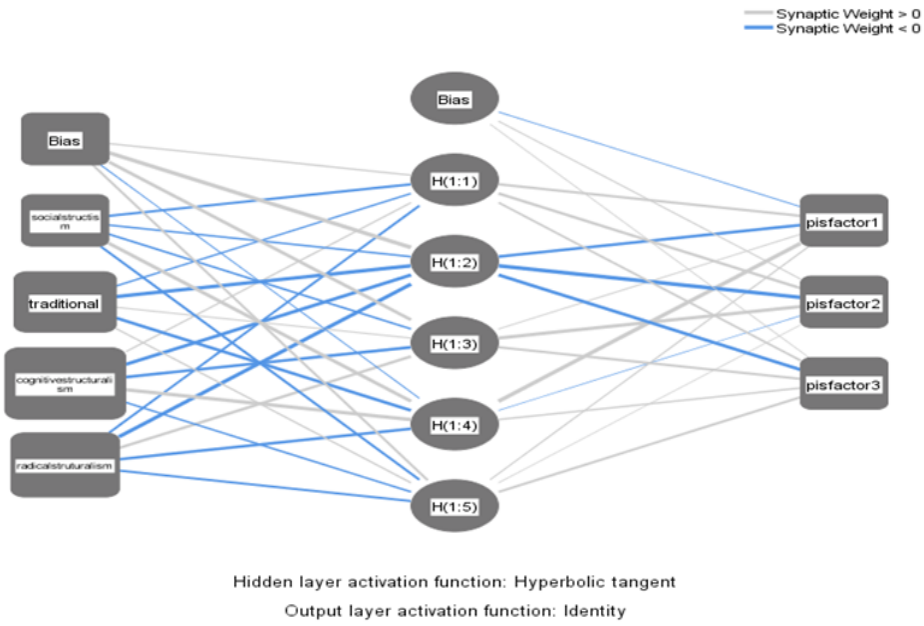


Figure 11. Reverse model of pedagogical beliefs for the model of beliefs toward learning.

When the model analyzed (Figure 11) the first important factor for this model is cognitive structuralism, the second important factor is radical structuralism and the third important factor is the traditional view and finally, the least important factor is social structuralism (Figure 12).

Independent Variable Importance

	Importance	Normalized Importance
socialstructism	,164	49,8%
traditional	,237	72,1%
cognitivestructuralism	,330	100,0%
radicalstruturalism	,269	81,6%

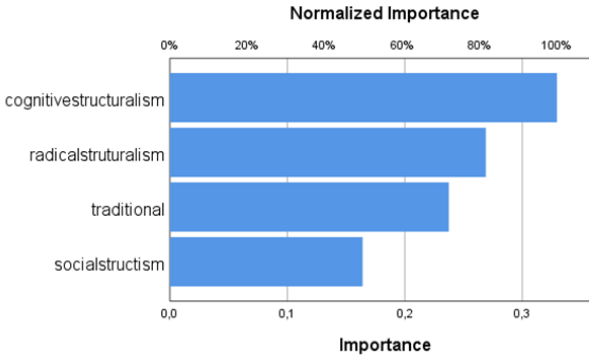


Figure 12. Importance levels for the reverse model of pedagogical beliefs for the model of beliefs toward learning.

2.3 Findings regarding the relationship between epistemological beliefs and beliefs toward learning

Model summary regarding the relationship between epistemological beliefs and beliefs toward learning can be given as in Table 5 below.

Table 5

Model summary regarding the relationship between epistemological beliefs and beliefs toward learning

	Model Summary		
Training	Sum of Squares Error		128.201
	Average Overall Relative Error		.557
	Relative Error for Scale Dependents	Social structuralism	.473
		Traditional	.733
		Cognitive structuralism	.578
		Radical structuralism	.446
	Stopping Rule Used		1 consecutive step(s) with no decrease in error[a]
	Training Time		0:00:00,15
Testing	Sum of Squares Error		50.607
	Average Overall Relative Error		.504
	Relative Error for Scale Dependents	Social structuralism	.355
		Traditional	.489
		Cognitive structuralism	.665
		Radical structuralism	.453

a. Error computations are based on the testing sample.

Model summary regarding the relationship between epistemological beliefs, beliefs toward learning given in Figure 13.

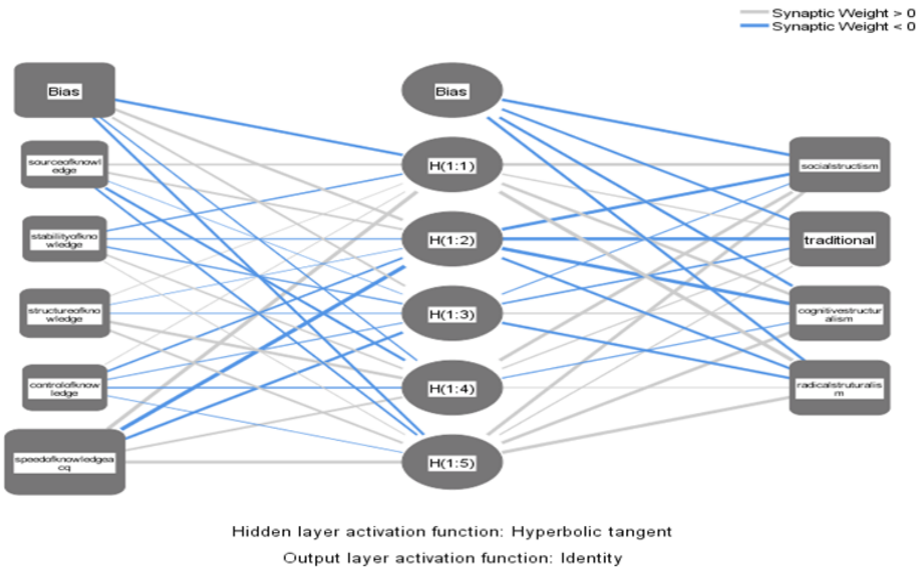


Figure 13. Model summary regarding the epistemological beliefs and beliefs toward learning.

When the normalized importance was investigated, it was seen that the speed of knowledge acquisition is the most important factor for the model so that other dimensions can be disregarded because they have so small importance levels (Figure 14).

Independent Variable Importance

	Importance	Normalized Importance
sourceofknowledge	,097	15,1%
stabilityofknowledge	,047	7,4%
structureofknowledge	,149	23,2%
controlofknowledge	,063	9,8%
speedofknowledgeacq	,643	100,0%

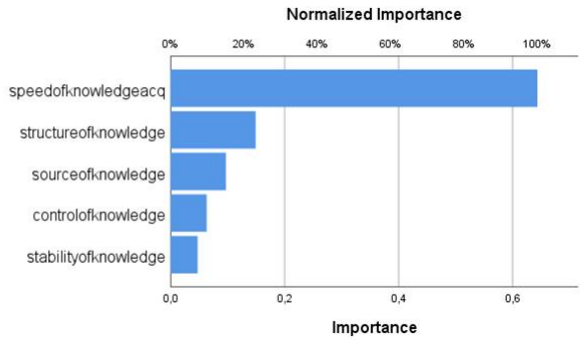


Figure 14. Normalized importance of the epistemological beliefs and beliefs toward learning.

When the reverse model was investigated given as in Figure below, the model summary was found to be as in Table 6.

Table 6

The model summary of the reverse model for epistemological beliefs

	Model Summary		
Training	Sum of Squares Error		216.655
	Average Overall Relative Error		.781
	Relative Error for Scale Dependents	Source of knowledge	.910
		Stability of knowledge	.933
		Structure of knowledge	.868
		Control of knowledge	.943
		Speed of knowledge acquisition	.249
	Stopping Rule Used		1 consecutive step(s) with no decrease in error[a]
	Training Time		0:00:00,10
Testing	Sum of Squares Error		77.272
	Average Overall Relative Error		.796
	Relative Error for Scale Dependents	Source of knowledge	1.007
		Stability of knowledge	.860
		Structure of knowledge	.865
		Control of knowledge	.906
		Speed of knowledge acquisition	.246

a. Error computations are based on the testing sample.

As can be seen, the importance levels reverse model of the epistemological beliefs for the beliefs toward learning are different in terms of direction and variable than the normal model.

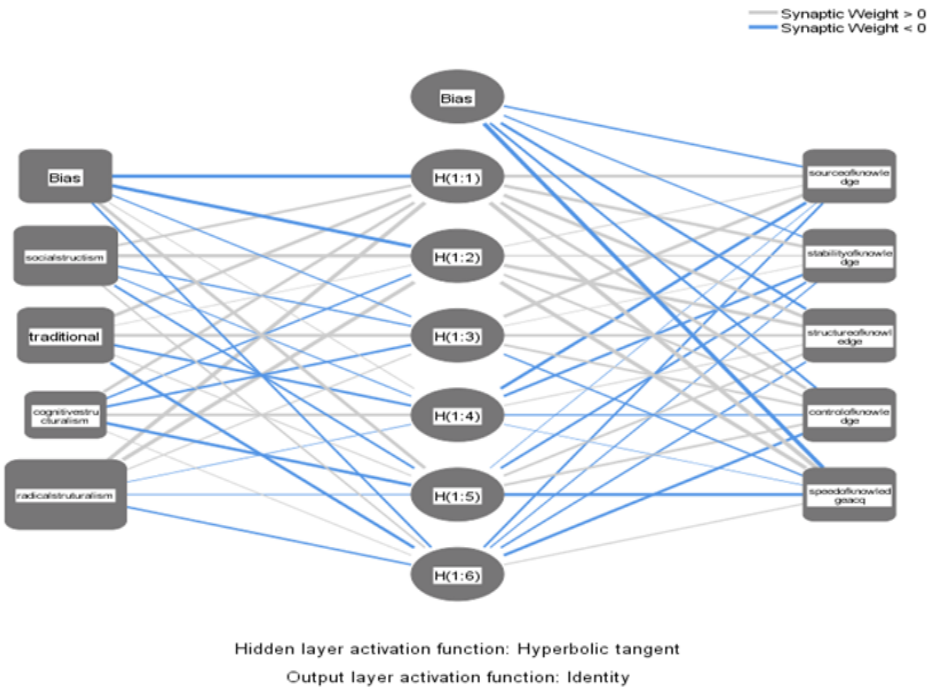


Figure 15. Reverse Model summary regarding the epistemological beliefs and beliefs toward learning.

When the reverse model was analyzed (Figure 15), the first important factor or this model was found to be radical structuralism, the second important factor was found to be social structuralism and the third important factor was the traditional view and finally, the least important factor was found to be cognitive structuralism (Figure 16).

Independent Variable Importance

	Importance	Normalized Importance
socialstructism	,271	69,2%
traditional	,219	56,0%
cognitivestructuralism	,118	30,2%
radicalstruturalism	,392	100,0%

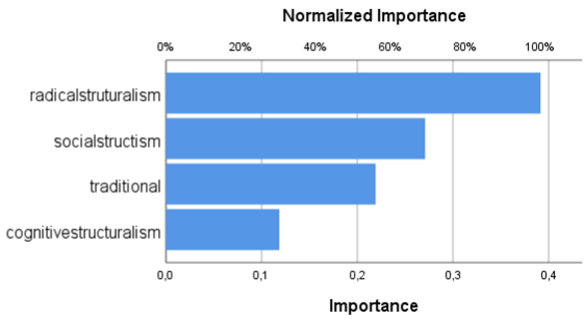


Figure 16. Normalized importance of epistemological beliefs and beliefs toward learning.

3 Discussion

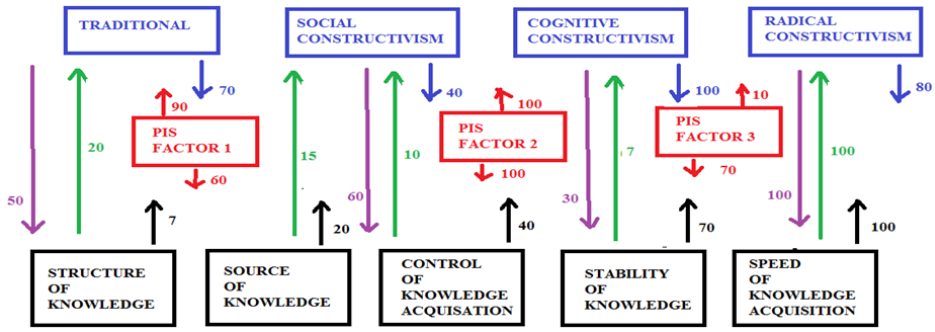


Figure 17. The relationship among the normalized importance of epistemological beliefs, pedagogical beliefs, and beliefs toward learning.

When the normalized importance of epistemological beliefs, pedagogical beliefs, beliefs toward learning are investigated (Figure 17) it seems that pedagogical beliefs have the most significant levels both for epistemological beliefs, beliefs toward learning. Let's investigate which one has the most significant values for the given model by the formula given as below (Figure 18)

$$\mathrm{p} = \frac{\sum_{i=1}^{n} t_i}{n\ 100} \times 100$$

where p stands for strength of the significance level, t is the point for the dimension of significance level for each model and n the number of dimensions for each model. For instance, n = 3 for pedagogical beliefs and $t_1 = 60, t_2 = 100, t_3 = 70$ for the importance levels of epistemological beliefs, so the strength of the significance level for epistemological beliefs is 76.6%. Similarly, 66.6% is for beliefs toward learning.

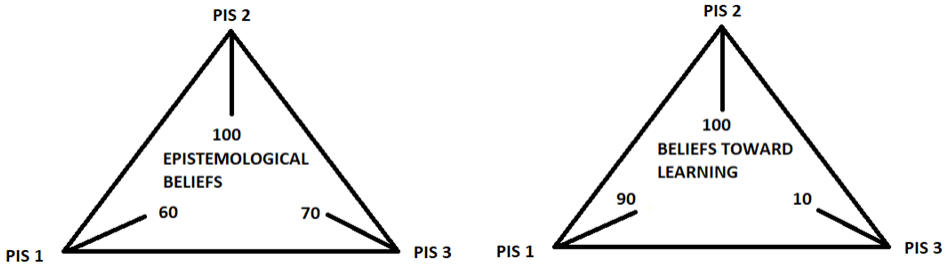


Figure 18. The importance levels of pedagogical beliefs.

As for the importance levels of beliefs toward learning (Figure 19), a 72.5% significance level is found to be for pedagogical beliefs and a 60% significance level is found to be for epistemological beliefs.

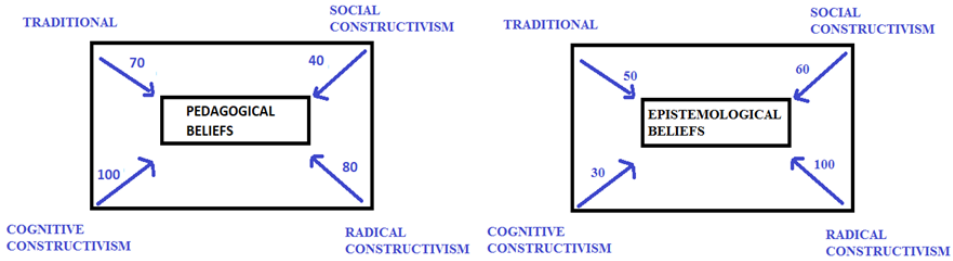


Figure 19. The importance levels of beliefs toward learning.

As for the importance levels of epistemological beliefs (Figure 20), a 46% significance level is found to be for pedagogical beliefs and a 27% significance level is found to be for beliefs toward learning.

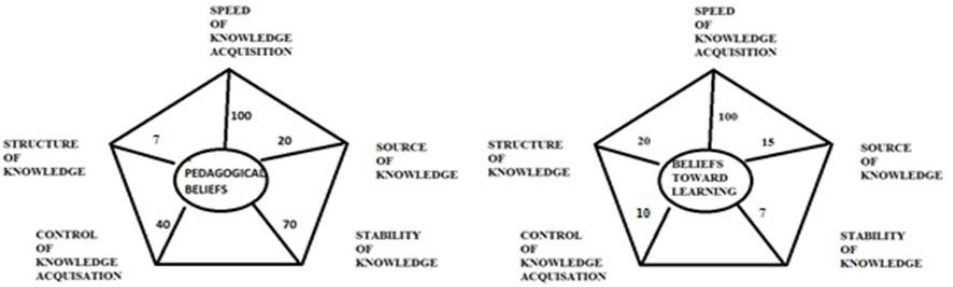


Figure 20. The importance levels of epistemological beliefs.

When the table was investigated, it can be inferred that pedagogical beliefs explain 76.6% of epistemological beliefs while epistemological beliefs explain pedagogical beliefs at the rate of 47% so that pedagogical beliefs are thought to be more fundamental than epistemological beliefs. Similarly, it can be inferred that beliefs toward learning explain 60% of epistemological beliefs while epistemological beliefs explain beliefs toward learning at the rate of 30% so that beliefs toward learning are thought to be more fundamental than epistemological beliefs. Furthermore, it can be inferred that beliefs toward learning explain 72.5% of pedagogical beliefs while pedagogical beliefs explain beliefs toward learning at the rate of 66.6 % so that beliefs toward learning are thought to be more fundamental than pedagogical beliefs (Table 7).

Table 7

The importance levels of pedagogical beliefs, epistemological beliefs, and beliefs toward learning

	Epistemological beliefs	*Pedagogical beliefs*	*Beliefs toward learning*
Epistemological beliefs	X	47%	30%
Pedagogical beliefs	76.6%	X	66.6%
Beliefs toward learning	60%	72.5%	X

Therefore, it can be assumed that there is an order given as below among the variables as pedagogical beliefs, epistemological beliefs, beliefs toward learning (Figure 21).

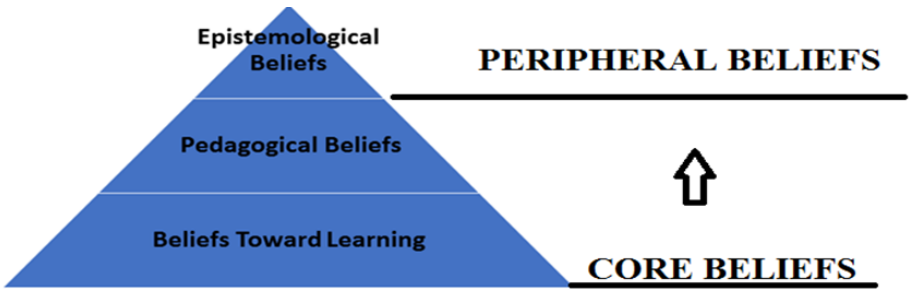


Figure 21. The hierarchy among pedagogical beliefs, epistemological beliefs, beliefs toward learning.

In this study, it is found that beliefs toward learning are effective regarding pedagogical beliefs, epistemological beliefs. Pedagogical beliefs are effective about epistemological beliefs to the same extend. When the literature is examined, it can be seen that beliefs toward learning might affect teachers' thoughts about how learning can happen, and influence teacher and student roles in their vision (Luft & Roehrig, 2007; Richardson, 1996; Shin & Koh, 2007; Woolley, Benjamin & Woolley, 2004). This study suggested that teachers' beliefs toward learning are at the core of their pedagogical and epistemological beliefs. Luft and Roehrig (2007) indicate that core beliefs are often more related and consistent within a framework, whereas peripheral beliefs are not so closely linked to other systems beliefs and may clash. Besides, more central and connected beliefs can be more resistant to change (Kagan, 1992). Therefore, it can be argued that epistemological beliefs can be regarded as more context-specific whereas beliefs toward learning are more generalizable. This can be result from the fact that individuals own profession is more effective than the more abstract beliefs such as epistemological beliefs because people mostly

think from concrete to abstract, from close to far and from simple to complex so that it is much easier to think in terms of the beliefs that are more related with their profession than the others. This variability is often associated with the core and peripheral nature of beliefs and affects one's cognitive schema in different ways (Brownlee, Boulton-Lewis, & Purdie, 2002; Luft & Roehrig, 2007; Rokeach, 1986). For example, Rokeach (1986) identified five types of beliefs existing along a continuum from the core to more peripheral in nature classified as A, B, C, D, and E where type A and B beliefs are more central, whereas Type E beliefs are peripheral. In this classification, type A beliefs concern those that are fundamental to their psychological existence whereas Type E beliefs are related to an individual's taste (Brownlee, Boulton-Lewis, & Purdie, 2002). Hence, our finding is important in terms of implying that beliefs toward learning are more fundamental than the epistemological beliefs and pedagogical beliefs so that beliefs toward learning should be remedied to educate more qualified teachers.

4 Limitations

There were several limitations to this study. First, the very nature of identifying beliefs is difficult. For instance, just like many other scholars, Schommer (1993) suggested that people can have individual convictions that have various effects on behavior or cognitive processes. The second limitation is that this research relied on only teachers' self-reported data. It may be more convenient to use a variety of measurement tools, such as direct observation and interviewing participants. The third limitation is the population. Our population is small for making more general deductions regarding teacher candidates' core beliefs such as taking teacher candidates from different geographical areas of Turkey even from different cultures.

Conclusions

In this study, it is found that beliefs toward learning are effective regarding pedagogical beliefs, epistemological beliefs through neural network analysis. It is also found that pedagogical beliefs are effective about epistemological beliefs to same extend by neural network analysis. Therefore, it is suggested that neural networks can be used to analyze also qualitative data for subsequent researches. They can be used to analyze different scales in different populations through different research designs. As for the recommendations on the findings of this research, teacher education programs aiming at remedying or changing the teacher candidates' beliefs toward learning can be improved in this regard. This finding is important for improving teacher competencies since we can identify competencies or expertise as being capable of achieving desirable outcomes to prevent undesirable consequences (Čerešník, 2011). Competencies are always goal directed and they are related to beliefs toward learning in this respect. It

should be noted that, this is not only the greatest approach to transmit ideals, beliefs and values as well as to shape the personality but also to create a constructive and universal sense of need, in which this feeling of need indicates that growth is distinct from that of the target, and pedagogical difficulties overcome the gap (Turós, 2019). Hence, more qualified teachers should only be brought up based on education enabling them to have coherent and reasonable pedagogical beliefs toward learning.

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