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The Relationship between the Pre-service Classroom Teachers' Techno Pedagogical Instructional Competencies and Epistemological Beliefs[1]

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Abstract

The purpose of the current study is to determine the relationship between the pre-service classroom teachers' epistemological beliefs and techno pedagogical subject-area competencies. While the universe of the study is comprised of a total of 187 senior pre-service teachers attending the Department of Classroom Teacher Education in Mugla Sıtkı Kocman University in 2014-2015 academic year, the sampling consists of 141 pre-service teachers selected through the random sampling method from among the universe. The reason for selecting the senior students for the universe of the study was that they had already taken the subject-area, pedagogical and general culture courses. In the collection of the research data, The Techno Pedagogical Competency Scale and Epistemological Belief Scale and a personal information form were used. The data were analyzed by using IBM SPSS 21.0 program package. During the analysis process, first it was tested whether the data display a normal distribution and after it was determined that the data show a normal distribution, from among the descriptive statistics, t-test and one-way ANOVA were used to reveal the differences and Pearson-product Moment Correlation Coefficient analysis was used to elicit the correlations. The analyses revealed that the pre-service classroom teachers' level of techno pedagogical competencies is high and their level of epistemological beliefs is medium. Gender and academic grade point average were found to be not leading to significant differences in their techno pedagogical subject-area competencies. Moreover, a negative and significant correlation was found between the pre-service classroom teachers' techno pedagogical subject-area competencies and epistemological beliefs.

Keywords: pre-service classroom teacher, techno pedagogical education, epistemological beliefs, competency

1. Introduction

A new generation brought up in a society surrounded by technology entails changes in instructional tools and equipments, methods and teacher competencies. Teachers should be cognizant of the potentials to be produced through the effective use of technologies in their classes, should be able to select the tools and methods catering to the needs to their students, should be able to design instructional methods effectively and should be able to come up with new teaching strategies (Demiraslan and Usluel, 2008). To do so, teachers need to have technological and pedagogical content knowledge that can enable them to integrate technology with instructional processes. Thus, techno pedagogical instruction has become an important concept involved in the construction of teacher competencies. Techno pedagogical instruction means an up-to-date technology integration approach focusing on teachers' competencies necessary to integrate technology, pedagogy and content knowledge during the instructional process (Kabakçı Yurdakul, 2011). In other words, techno pedagogical instruction requires the co-execution of pedagogy and content knowledge during the instructional process; particularly the use of suitable technologies and integration of technology into the classroom environment (Bruce and Levin, 1997). Techno pedagogical instruction is the execution of all of the stages of planning, implementing and evaluation on the basis of pedagogical content knowledge to enhance the effectiveness of educational and instructional process. In teacher education, there are different models offering different perspectives of how to combine the technology and pedagogy dimensions of information and technology integration. One of the most widely accepted models is "Techno Pedagogical Content Knowledge-TPCK" model developed by Koehler and Mishra on the basis of Sluman's Pedagogical Content Knowledge (1986). This model includes three main dimensions being pedagogy, technology and content knowledge and presents the relationships of these dimensions with each other. TPCK model

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consists of three main dimensions that are content knowledge (CK), knowledge about technologies such as the computer and the Internet (TK) and knowledge about applications, processes, strategies, operations and methods involved in learning and teaching process (PK) and the relationships of these dimensions with each other (Mishra and Koehler, 2006).

Techno Pedagogical Content Knowledge (TPCK) makes it possible to communicate with the symbols of the concepts and to understand them by using technologies (Şimşek, Demir, Bağçeci and Kinay, 2013). TPCK allows the use of proper technologies to meet students' learning needs in different ways. Within this construct, knowledge about what makes the learning of concepts more difficult or easier and how to use technology to overcome conceptual difficulties can also be found. It also entails having knowledge about students' prior knowledge and epistemological beliefs and their technological expertise or shortcomings. Moreover, TPCK also involves the knowledge about students' existing beliefs and how to use technology for students to develop new knowledge structures and how to reinforce their prior knowledge (Koehler and Mishra, 2008; Harris, Mishra and Koehler, 2009; Şimşek, Demir, Bağçeci and Kinay, 2013). Revelation of the epistemological beliefs of pre-service teachers having TPCK is necessary for the healthy progression of the process.

Individuals' epistemological evolution and beliefs have considerable effects on learning and teaching process (Aypay, 2011; Kozcu Çakır and Şenler, 2014; Cheng, Chan, Tang and Cheng, 2009; Mansour, 2009). Epistemological beliefs are defined as individuals' subjective beliefs about what knowledge is and how learning and knowing occur (Schommer, 1990). When research on epistemological beliefs is examined, it is seen that at first, these beliefs were treated within a single dimension as only knowledge, learning or intelligence. However, Schommer (1990) argued that dealing with epistemological beliefs under a single dimension such as knowledge, intelligence or learning is an inadequate approach and that epistemological beliefs should be considered as a multi-dimensional construct including all of these dimensions; that is, as a belief system. These dimensions can be summarized as follows (Aypay, 2011):

1. Source of information: At the one end of this continuum is there the belief that information is conveyed by omnipotent authorities and at the other end is there the belief that information is derived by individuals through inferences made with objective or subjective tools.
2. Certainty of information: At the one end of this continuum is there the belief that information is certain and absolute and at the other end is there the belief that it has a structure in a continuous development.
3. Organization of information: At the one end of this continuum is there the belief that information exists in certain forms and at the other end is there the belief that information has a highly integrated and combined complex structure.
4. Control of learning: At the one end of this continuum is there the belief that learning aptitude is genetically determined and at the other end is there the belief that it is acquired through experiences.
5. Speed of learning: At the one end of this continuum is there the belief that learning either occurs fast or does not occur at all and at the other hand is there the belief that learning is an incremental process.

Individuals' subjective beliefs about knowledge and learning, what knowledge is, how learning and knowing occurs are their epistemological beliefs (Schommer, 1990). Perry (1981) defined epistemological beliefs as a perception of what knowledge is, how it is collected and what its limits are. Therefore, individuals' epistemological beliefs affect how they process and interpret information, their study strategies, thinking, problem solving and learning (Türkan, Aydın and Öner, 2016; Tolhurst, 2007). As epistemological beliefs affect learning (Chai, Teo and Lee, 2009) and teaching (Chan and Elliot, 2004), the number of studies looking at how to enhance pre-service teachers' teaching competencies on the basis of their epistemological beliefs is increasing (Arslantaş, 2016; Löfström and Pursiainen, 2015; Kanadlı and Akbaş, 2015; Kürşad, 2015; Wegner, Andersa and Nückles, 2014; Deniz, 2014;Hartin, 2010).

As pre-service teachers' epistemological beliefs are affected from the education they are exposed to (Chai, Teo and Lee, 2009), teachers and quality of the instruction seem to be of great importance in terms of shaping their epistemological beliefs. In teacher education for the quality of the teaching-learning process, it is necessary to gain the technological competence (Seferoğlu, 2004). For teachers to be qualified enough, a great emphasis should be put on how to integrate technology into instructional settings during their teacher education. In this regard, techno pedagogical content knowledge possessed by teachers seems to be of great importance for the effective use of technology in instructional settings. Thus, it can be important for the literature to determine the pre-service classroom teachers' techno pedagogical subject-area competencies in relation to use of information and communication technologies in instructional environments and to elicit the relationship between their techno pedagogical subject-area competencies and their epistemological beliefs. In this connection, the current study aims to determine the relationship between the pre-service

classroom teachers' epistemological beliefs and techno pedagogical subject-area competencies. To this end, answers to the following questions were sought:

1) What are the pre-service classroom teachers' epistemological beliefs and techno pedagogical subject-area competencies?
2) Do the pre-service classroom teachers' epistemological beliefs and techno pedagogical subject-area competencies vary significantly depending on gender?
3) Do the pre-service classroom teachers' epistemological beliefs and techno pedagogical subject-area competencies vary significantly depending on academic achievement?
4) Is there a significant relationship between the pre-service classroom teachers' epistemological beliefs and techno pedagogical subject-area competencies?

2. Method

2.1 Participants of the Study

The current study aiming to determine the pre-service classroom teachers' epistemological beliefs and techno pedagogical subject-area competencies and to elicit the relationship between them was designed in the survey model. The reason for the selection of the senior students to be involved in the study was that they had already taken professional, pedagogical and general culture courses and they had the planning and teaching skills. Due to the huge size of the universe and the cost to be incurred by efforts to reach the entire universe and to save time, it was preferred to take a sampling. Thus, while the universe of the study is comprised of 187 senior students attending the Department of Classroom Teacher Education at Muğla Sıtkı Koçman University in the fall term of 2014-2015 academic year, the sampling consists of 141 students randomly selected from among the universe. Of the participating students, 22.7% (32) are males and 77.3% (109) are females; 14.2% (20) have a grade point average of 2.50 or lower, 39% (55) have a grade point average of 2.51-3.00 and 46.8% (66) have a grade point average of 3.01 or higher.

2.2 Data Collection Tools

In the collection of the data, *The Techno Pedagogical Instructional Competency Scale and The Epistemological Belief Scale* and a personal information form were used.

Techno Pedagogical Instructional Competency Scale: In the current study, The Techno Pedagogical Instructional Competency Scale developed by Kabakçı Yurdakul et al. (2012) was used. The Techno Pedagogical Instructional Competency Scale is made up of four factors: *design (Items 1 - 10), application (Items 11 - 22), ethics (Items 23 - 28) and specialization (Items 29 - 33)*; thus there are a total of 33 items in the scale. The scale items are in the form of 5-point Likert scale and can be responded as "I Can do it easily", "I Can do it", "I can do it partially", "I can't do it", "I can't do it at all". All of the scale items are positive statements and there is no reversely worded item in the scale. The results of confirmatory factor analysis (DFA) performed on the scale; X2 / df = 4.01, p = .01, RMSEA = 0.06, SRMR = 0.07, GFI = 0.82, AGFI = 0.88. The result of the DFA revealed that the suggested values were collected and the items were collected under the dimensions of the original scale. For the whole scale, the Cronbach Alpha value was calculated to be 0.97 and the Cronbach Alpha values of the factors were found to be ranging from 0.87 to 0.94.

Epistemological Belief Scale: The Epistemological Belief Scale adapted to Turkish by Deryakulu and Büyüköztürk (2002) was used in the current study. The Epistemological Belief Scale is made up of three factors: *the belief that learning depends on effort (Items 1 - 18), the belief that learning depends on talent (Items 19 – 26) and the belief that there is only one truth (Items 27 - 35)*; thus, there are a total of 35 items in the scale, of which 17 are negatively worded and 18 are positively worded. The scale items are in the form of 5-point Likert scale and can be responded as "Strongly Disagree", "Disagree", "Undecided", "Agree", "Strongly Agree". The results of confirmatory factor analysis (DFA) performed on the scale; X2 / df = 3.94, p = .00, RMSEA = 0.07, SRMR = 0.04, GFI = 0.83, AGFI = 0.85. The result of the DFA revealed that the suggested values were collected and the items were collected under the dimensions of the original scale. The Cronbach Alpha value for the whole scale was calculated to be 0.88; the Cronbach Alpha values for the factors were found to be ranging from 0.87 to 0.91.

2.3 Data Collection and Analysis

In the analysis of the collected data, first the data were transferred into the computer environment by the researchers and the data that were not properly marked in the scales were excluded from the analyses. The data transferred into the computer environment were analyzed by using IBM SPSS 21.0 program package. While conducting the analysis of the data, first descriptive statistics were performed and it was tested whether the data display a normal distribution and it was found that the data show a normal distribution. Then, on the basis of the research questions, from among the descriptive statistics, independent samples t-test and one-way ANOVA were used to reveal the differences and

Pearson-product Moment Correlation Coefficient analysis was used to elicit the correlations. In the interpretation of the findings obtained from the analyses, (5-1)/3 evaluation interval was taken as the basis and thus, when the arithmetic mean score is in the range of "1 – 2.33", it is accepted to be low; in the range of "2.34 – 3.67", it is accepted to be medium and in the range of "3.68 – 5.00", it is accepted to be high. That is, in the interpretation of the findings, three competency levels being low, medium and high were set for both techno pedagogical subject-area competencies and epistemological beliefs.

3. Findings

The analysis of the data collected for the purpose of investigating the effect of the pre-service classroom teachers' epistemological beliefs on their techno pedagogical subject-area competencies is given in the findings section.

Table 1. Means related to the pre-service classroom teachers' techno pedagogical subject-area competencies

Variable	n	k	X	X/k	ss
Design	141	10	40.24	4.02	.68
Application	141	12	49.05	4.08	.64
Effect	141	6	24.95	4.15	.64
Specialization	141	5	19.97	3.99	.73
Techno pedagogical subject-area competencies	141	33	134.23	4.06	.60

As can be seen in Table 1, the general mean score of the pre-service classroom teachers for their techno pedagogical subject-area competencies is X= 4.06. Thus, it can be argued that the pre-service classroom teachers view themselves highly competent in terms of their techno pedagogical subject-area competencies. When the findings are examined in relation to the sub-dimensions, it is again seen that the students see their competency as high in the sub-dimensions of ethics (X= 4.15), application (X= 4.08), design (X= 4.02) and specialization (X= 3.99).

Table 2. Means related to the pre-service classroom teachers' epistemological beliefs

Variable	n	k	X	X/k	ss
Learning depends on effort	141	18	34.50	1.91	.47
Learning depends on talent	141	8	24.62	3.07	1.01
There is only one truth	141	9	28.84	3.20	.90
Epistemological belief	141	35	87.97	2.51	.47

As can be seen in Table 2, the pre-service classroom teachers' mean score for their epistemological beliefs is X= 2.51. Thus, it can be argued that the pre-service classroom teachers see themselves as moderately competent in terms of their epistemological beliefs. When the findings are examined in relation to the sub-dimensions, it is seen that the pre-service classroom teachers view themselves as moderately competent in terms of the belief that there is only one truth (X= 3.20) and the belief that learning depends on talent (X= 3.07). On the other hand, they see their competency in relation to the belief that learning depends on effort as low (X=1.91). However, the low mean score taken from the Epistemological Belief Scale means that the belief related to this dimension is mature. Thus, the belief that learning depends on effort is at a high level and the belief that there is only one truth is at a medium level.

Table 3. Gender-based comparison of the pre-service classroom teachers' techno pedagogical subject-area competencies

Variable	Group	n	X	ss	t	sd	p
Design	Male	32	3.87	.91	-1.44	139	.15
	Female	109	4.06	.59			
Application	Male	32	3.94	.77	-1.18	139	.13
	Female	109	4.13	.59			
Ethics	Male	32	4.00	.85	-1.52	139	.12
	Female	109	4.20	.57			
Specialization	Male	32	3.96	.90	-.29	139	.77
	Female	109	4.00	.67			
Techno pedagogical subject-area competencies	Male	32	3.93	.79	-1.40	139	.16
	Female	109	4.10	.54			

$p<.05$

As can be seen in Table 3, there is no significant correlation between the pre-service classroom teachers' techno pedagogical subject-area competencies and their sub-dimensions and the gender variable.

Table 4. Gender-based comparison of the pre-service classroom teachers' epistemological beliefs

Variable	Group	n	X	ss	t	sd	p
Learning depends on effort	Male	32	1.94	.50	.37	139	.71
	Female	109	1.90	.47			
Learning depends on talent	Male	32	3.21	.97	.84	139	.40
	Female	109	3.03	1.02			
There is only one truth	Male	32	3.32	.87	.88	139	.37
	Female	109	3.16	.91			
Epistemological belief	Male	32	2.59	.43	1.04	139	.29
	Female	109	2.49	.48			

p<.05

As can be seen in Table 4, there is no significant correlation between the pre-service classroom teachers' epistemological beliefs and their sub-dimensions and the gender variable.

Table 5. Comparison of the pre-service classroom teachers' techno pedagogical subject-area competencies depending on their academic average grade point

	Source of the variance	Sum of squares	sd	Mean of squares	F	p	Significant difference
Design	Between-groups	.40	2	.20	.43	.65	-
	Within-groups	65.25	138	.47			
	Total	65.66	140				
Application	Between-groups	.51	2	.25	.62	.53	-
	Within-groups	57.12	138	.41			
	Total	57.13	140				
Ethics	Between-groups	2.37	2	1.19	2.90	.04	2.51-3.00 > 3.01 or higher
	Within-groups	56.47	138	.40			
	Total	58.85	140				
Specialization	Between-groups	1.22	2	.61	1.13	.32	-
	Within-groups	74.17	138	.53			
	Total	75.39	140				
Techno pedagogical subject-area competencies	Between-groups	.79	2	.40	1.07	.34	-
	Within-groups	51.23	138	.37			
	Total	52.03	140				

p<.05

As can be seen in Table 5, there is no significant correlation between the pre-service classroom teachers' techno pedagogical subject-area competencies and the academic grade point average variable. No significant correlation was found between the *design*, *application* and *specialization* sub-dimensions of techno pedagogical subject-area competencies and the academic grade point average. However, it was found that there is a significant correlation between the *ethics* sub-dimension of techno pedagogical subject-area competencies and academic grade point average. This significant correlation was tested with LSD test and it was found that the significant difference emerges between the pre-service teachers having a grade point average of 2.51-3.00 and those having a grade point average of 3.01 and higher and this difference is in favor of the pre-service teachers with a grade point average ranging from 2.51 to 3.00.

Table 6. Comparison of the pre-service classroom teachers' epistemological beliefs depending on the grade point average variable

	Source of the variance	**Sum of the squares**	**sd**	**Mean of the squares**	**F**	**p**	**Significant difference**
Learning depends on effort	Between-groups	.43	2	.21	.95	.38	-
	Within-groups	31.47	138	.22			
	Total	31.91	140				
Learning depends on talent	Between-groups	1.60	2	.80	.77	.46	-
	Within-groups	142.22	138	1.03			
	Total	143.82	140				
There is only one truth	Between-groups	2.15	2	1.07	1.30	.27	-
	Within-groups	113.53	138	.82			
	Total	115.68	140				
Epistemological belief	Between-groups	.83	2	.42	1.90	.15	-
	Within-groups	30.49	138	.22			
	Total	31.33	140				

$p<.05$

As can be seen in Table 6, there is no significant correlation between the pre-service classroom teachers' epistemological beliefs and their sub-dimensions and the academic grade point average variable.

Table 7. Correlation analysis related to the effect of the pre-service classroom teachers' epistemological beliefs on their techno pedagogical instructional competencies

	Techno pedagogical instructional competencies
Techno pedagogical subject-area competencies	1
Epistemological beliefs	-.227**

**: 0.01 significance

The simple linear correlation analysis conducted to determine whether there is a correlation between the pre-service classroom teachers' techno pedagogical subject-area competencies and epistemological beliefs revealed that there is a negative and significant correlation between them ($r=-.22$, $p< 0.01$). Thus, it can be maintained that the pre-service classroom teachers' increasing techno pedagogical subject-area competencies lead to a decrease in their epistemological beliefs.

5. Discussion and Results

In light of the findings of the current study, it can be claimed that the pre-service classroom teachers' techno pedagogical subject-area competencies are highly adequate. This finding is similar to the findings reported by Çuhadar et al. (2013), Yavuz-Konokman et al. (2013), Gömleksiz and Fidan (2013) and Kabakçı Yurdakul (2011); yet, does not concur with the study of Yağcı (2016). This high level of adequacy found in relation to techno pedagogical competencies might indicate that the pre-service teachers were provided with enough opportunities to interact with technology during their undergraduate education and that they started to specialize. High level of techno pedagogical subject-area competencies shows that the pre-service teachers' competency levels in the sub-dimensions are also high. In terms of the mean scores, the sub-dimensions can be presented in descending order as follows: ethics, application, design and specialization. While determining techno pedagogical instructional competencies, first the ethical framework should be set and then application and design stages should be developed. It was an expected outcome that specialization would have a lower score than the others because it is a process difficult to acquire and taking a long time.

The level of the pre-service classroom teachers' epistemological beliefs was found to be medium. The pre-service teachers' epistemological belief that learning depends on effort was found to be sophisticated; yet, their beliefs that

learning depends on talent and there is only one truth are not developed much. These findings are parallel to the study of Schommer (1990) focusing on the independence of epistemological beliefs; however, do not concur with the findings reported by Türkan et al. (2016), Chai, Khine and Teo (2006). Thus, it can be argued that the pre-service teachers think that effort is important in learning and this belief should be developed.

One of the variables of the current study, gender was found to be not leading a significant difference in techno pedagogical subject-area competencies and epistemological beliefs. The techno pedagogical subject-area competencies and epistemological beliefs of the male and female pre-service teachers are statistically similar to each other. This finding is similar to the findings reported by Jang and Tsai (2012), Yağcı (2016), Şimşek et al. (2013). The finding that epistemological beliefs do not vary significantly depending on gender also concurs with the findings of Şenler and İrven (2016), Türkan et al. (2016), Chan and Elliott (2002).

It was also found that the pre-service classroom teachers' techno pedagogical subject-area competencies and epistemological beliefs do not vary significantly depending on their academic grade point average. The techno pedagogical subject-area competencies and epistemological beliefs of the pre-service classroom teachers having high grade point averages were found to be statistically similar to those of the pre-service classroom teachers having low grade point averages. The finding that the techno pedagogical subject-area competencies do not vary significantly depending on grade point average is similar to the study of İşigüzel (2014). Though the pre-service teachers' techno pedagogical subject-area competencies do not vary depending on grade point average, the students' scores taken from the ethics sub-dimension were found to be varying significantly depending on their academic achievement. The source of this difference is the difference between the pre-service teachers having a grade point average in the range of 2.51-3.00 and the pre-service teachers with a grade point average in the range of 3.01 or higher in favor those having a grade point average in the range of 2.51-3.00. Thus, it can be argued that the design, application and specialization sub-dimensions do not vary significantly depending on the grade point average but the ethics sub-dimension varies significantly and this difference is in favor of the pre-service classroom teachers with low grade point averages, which indicates that the ethics sub-dimension is not related to academic achievement. As no significant difference was found among the pre-service classroom teachers' epistemological beliefs based on their grade point averages, it can be claimed that academic achievement is not a factor affecting epistemological beliefs.

The simple linear correlation analysis conducted to determine whether there is a relationship between the pre-service classroom teachers' techno pedagogical subject-area competencies and epistemological beliefs revealed that there is a negative and significant correlation between them. Thus, it seems that there is a negative correlation between the techno pedagogical subject-area competencies and the epistemological beliefs and increasing epistemological beliefs will result in decreasing techno pedagogical subject-area competencies. Within the framework of the contextual knowledge of techno pedagogical subject-area competencies are there classroom management issues, quality of education and objectives, psychological basis and the teacher's epistemological beliefs about the learner and teaching (Ay, 2015). Thus, it seems that for enhancing the pre-service classroom teachers' techno pedagogical subject-area competencies, their epistemological beliefs about teaching within the framework of the contextual knowledge should be kept at lower levels. For epistemological beliefs to be kept at lower levels, the beliefs that learning depends on talent and there is only one truth should be weakened and the belief that learning depends on efforts should be reinforced. Chai, Koh and Tsai (2013) reported that epistemological beliefs are an effective factor in the formation of techno pedagogical subject-area competencies. In order to promote pre-service teachers' techno pedagogical instructional competencies, behaviors leading to the strengthening of negative epistemological beliefs should be avoided. In light of the findings of the current study, some suggestions were made for researchers and practitioners.

Further research might focus on the detailed investigation of the other factors making up the content of the contextual knowledge of techno pedagogical subject-area competencies. Moreover, more emphasis can be put on qualitative research for the qualitative analysis of the factors playing role in the formation of epistemological beliefs. More research should be conducted to explore the relationship between pre-service teachers' techno pedagogical subject-area competencies and epistemological beliefs within learning processes. Activities should be designed to convert pre-service teachers' medium level epistemological beliefs to high level epistemological beliefs.

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