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Thematic content analysis of postgraduate theses on epistemological beliefs in science education: The Türkiye context

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ABSTRACT
The aim of the study was to examine postgraduate theses on epistemological beliefs in science education in Türkiye. Data collected included the publication years, researcher genders, universities, disciplines, aims, methods, sample/study groups, time allocated to the research, and data collection tools. The thematic content analysis method was used in the study. The data were obtained from the doctoral and master's thesis published until 2022 (including 2022) inclusive held at the CoHE National Thesis Centre. Access was gained to 149 theses dealing with the subject of epistemological beliefs in science education. The theses in the study were classified with reference to the matrix prepared by Ormancı, Çepni, Deveci and Aydın. The data obtained were analysed using content and descriptive analysis methods. The majority of the theses aimed to investigate the effect of a certain learning-teaching method on epistemological beliefs and the relationship between epistemological beliefs and some variables. It was determined that scales and questionnaires were mostly used as data collection tools in the evaluation of epistemological beliefs. There is a need for studies on the effect of current science learning-teaching methods on the development of epistemological beliefs or the relationship between epistemological beliefs and 21st-century skills.

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Introduction

The Information Age or the Digital Age is a time of rapid and unprecedented human change and development. Information technology and human beings are transforming in ways that affect every aspect of life, such as society, culture, health and education. The digital era offers new possibilities for research, innovation and collaboration, but also poses risks, problems and responsibilities. Ethical, legal and security issues arise from the way individuals' access, process, share and create information (e.g., social networks and academic data pages). Jenkins (2009) argues that the information and technology age makes it easier to access information, but also harder to distinguish between scientific and non-scientific information. To overcome these challenges, people must develop skills such as information and technology literacy, critical thinking, decision-making, and epistemological beliefs. Epistemological beliefs may be the most important skill to acquire and grow in this age. Therefore, people need to learn how to access, verify, process, evaluate and interpret information effectively. Greene, Yu and Copeland (2014) suggest that people with developed

epistemological beliefs do you mean ‘advanced’ are more information-technology-literate. Sound epistemological beliefs support people's development as lifelong learners.

Research on epistemological understanding helps us understand how individuals analyse knowledge claims in structured and unstructured problems, how they evaluate new knowledge, and how they make fundamental decisions that affect their lives and the lives of others (King & Kitchener, 1994; Kuhn, 1991). However, epistemological beliefs how people relate new knowledge and concepts to their existing knowledge in the educational process and how people know knowledge. For example, beliefs about the nature of knowledge are related to strategy use, information processing, and conceptual change learning (Hofer, 2001). People develop conceptions of learning and teaching based on their epistemological beliefs (Hofer & Pintrich, 1997). In this context, it is thought to be useful to examine epistemological beliefs a little more closely.

Epistemological Beliefs

Epistemological beliefs are a philosophical concept and although there is no agreed definition in the literature, they are expressed by educators as beliefs about the nature of knowledge and justification for knowing. These beliefs consist of core beliefs about how people express knowledge, what the limits of knowledge are, and how it is acquired and processed (Hofer & Pintrich, 1997; Schommer, 1990; Schommer, 1994). Epistemological beliefs also emerge as critical interpretations of knowledge (Schommer, 1990).

Psychological research on epistemological development began in the mid-1950s. Piaget (1950), using the term genetic epistemology, described his theory of intellectual development and aroused the interest of developmental psychologists and educators in this intersection of philosophy and psychology (Hofer, 2001). Piaget proposed that intellectual development consists of universal stages and that each child passes through these stages in a specific order. This interest was an important step in reaction to the fact that the science of learning was completely dominated by behaviourism at the time (Kohlberg, 1971). Following Piaget, in 1970 Perry attempted to explain the characteristics of the development of epistemology. Perry's (1970) attempts to understand how university students interpret pluralistic educational experiences led to the theory of epistemological development. According to this theory, students perceive the nature and source of knowledge in different ways. However, Perry's explanation of the development of epistemology in individuals based on a sample consisting almost entirely of men attracted the attention of Belenky and colleagues (1986). In response, Belenky et al. (1986) conducted epistemological research on "women's ways of knowing" by working on a sample consisting only of women.

Magolda (1992) designed a five-year longitudinal study on how epistemological development and epistemological assumptions affect the interpretation of educational experiences. They opined that epistemological reflection consists of the dimensions of absolute knowing, provisional knowledge, independent knowledge and contextual knowledge. Following Magolda, King and Kitchener (1994) proposed the reflective judgment model of epistemology. In this model, the developmental progression of individuals' epistemic cognition, their assumptions about the nature of knowledge, and their responses to ill-structured problems and the justifications for their beliefs about these problems were analysed. Similar to King et al.'s model, Kuhn (1991) also conducted research on individuals' argumentative informal reasoning skills in everyday life. Informal reasoning is concerned with how individuals respond to structured problems in everyday life that do not involve definite solutions. In this context, although Kuhn's primary aim in his study was to investigate argumentative reasoning, his efforts to understand why and how individuals know something revealed beliefs about knowledge. At this point, Magolda (1992), King and Kitchener (1994) and Kuhn (1991) were interested in epistemological thinking and reasoning processes. In these models, individuals with advanced epistemological beliefs are sceptical about the source of knowledge, while those with more simple beliefs believe that knowledge is certain and revealed by authorities (Hofer & Pintrich, 1997). Researchers before Schommer (1990) thought that epistemologies are unidimensional and develop in

stage-like trajectories (Kılınç & Seymen, 2014). In other words, approaches that can be analysed under the title of developmental approaches are based on the assumption that there is a developmental succession in individuals' beliefs about knowledge and knowing.

Schommer (1990) argues that personal epistemologies are multidimensional as opposed to being unidimensional and in sequential stages in which these dimensions are somewhat independent of each other and that individuals may have different levels of beliefs for each of those dimensions. According to Schommer's model, individuals with simple epistemological beliefs believe that knowledge is unchangeable, that knowledge is produced by authorities and that learning is innate. However, individuals with advanced epistemological beliefs believe that knowledge is changeable, that it is constructed by the individual and that learning changes depending on effort (Schommer-Aikins, Mau, Brookhart & Hutter, 2000). However, when all models of epistemological beliefs, including Schommer's model, are examined, they focus on people's general epistemological beliefs. As a reaction to this, Hofer and Pintrich (1997) stated that people's epistemological beliefs can change according to the fields and that instead of general epistemological beliefs, domain-oriented epistemology should be invoked.

According to Hofer and Pintrich (1997), the learning process is closely related to an individual's personal epistemological beliefs about knowledge. Moreover, it was suggested that epistemological beliefs may change in different disciplines. Hofer and Pintrich (1997) developed a domain-oriented model of personal epistemological belief understanding and argued that general epistemological belief scales are insufficient in the field of education. Epistemological beliefs are individual beliefs about what knowledge and knowing are, how they are formed and how they are evaluated. This model argues that individuals' epistemological beliefs are shaped by learning and teaching experiences in home, school and community settings rather than cognitive development. It also states that epistemological beliefs can change during the learning and teaching process.

Epistemological Beliefs in Science Education

Scientific and technological advances in the last 25 years have transformed the world in various domains, such as transport, health and communication. These changes have also affected the global workforce and the new generation, who need to be multi-skilled, creative, entrepreneurial and tech-savvy. However, in this global information network where everyone can easily share whatever they want, it makes it difficult to identify accurate and reliable information. This difficulty can be overcome by providing people with a set of skills that will enable them to question the source of information and distinguish between scientific and non-scientific information (Facione, 2011). This has brought up the problem of re-discussing and re-evaluating the concept of science literacy. Science literate individuals should have qualities such as producing knowledge, using it functionally in life through problem solving, critical thinking, questioning, being decisive, and so on (Ministry of National Education, 2018; National Research Council, 2013; Sabah, Akour & Hammouri, 2023). A science literate individual understands the epistemological aspect of science (developing epistemological beliefs) so that s/he can make personal decisions in the context of relevant issues in daily life (Walker, 2011). At this point, science education extends far beyond formal education to informal and digital learning environments. Epistemological beliefs are not only a subject of philosophy but also a research topic for educators, especially science educators.

Science education aims to enable individuals to understand natural phenomena and the basic concepts of science and to provide them with skills such as scientific process skills, inquiry and problem solving. At the same time, science education enables individuals to address the epistemic aspect of science that allows us to discuss "what we know, how we know, and why we believe" (Duschl, 2008). In other words, being aware of the impact of science on society involves not only the individual's ability to understand science and how to 'do science', but also characteristics such as attitudes towards science and the ability to connect science to other fields (Istyadji & Sauqina, 2023). Epistemological beliefs are at the centre of science education (Hofer & Pintrich 1997; Kaçar, 2019;

Kılınç & Seymen, 2014) as they are important in understanding the nature of scientific knowledge and how science develops (Chai, Deng, Wong & Qian, 2010; Shahat, Ambusaidi, & Treagust, 2022; Zhao et al., 2021). For this reason, many science educators have conducted research on the development of epistemological beliefs or their impact on learning.

In science education studies, the relationship between epistemological beliefs and different variables has sometimes been examined. For example, Hofer and Sinatra (2010) investigated the effect of students' epistemological beliefs on understanding and learning in science education. Hofer and Pintrich (1997) examined the role of epistemological beliefs in shaping learning strategies and outcomes in science education. Many researchers believe that it is important to develop individuals' epistemological beliefs and there are various studies on the effect of different teaching-learning methods on epistemological beliefs in science education. For example, argumentation-based learning (Banihashem, Noroozi, Biemans, & Tassone, 2023; Noroozi, 2023), inquiry-based learning (Georgiou & Kyza, 2023; Wen et al., 2023), and the STEM model (Wan, So, & Zhan, 2023), etc. This study will add to the literature by examining in detail the postgraduate theses conducted on epistemological beliefs in science education in Türkiye. In line with this purpose, the research questions of the study were as follows;

1. How is the distribution of postgraduate theses on epistemological beliefs in science education in Türkiye according to years?
2. What is the distribution of the postgraduate theses on epistemological beliefs in science education in Türkiye according to the gender of the researchers?
3. What is the distribution of the postgraduate theses on epistemological beliefs in science education in Türkiye according to the universities and geographical regions (where they were published)?
4. What is the distribution of postgraduate theses on epistemological beliefs in science education in Türkiye according to their aims?
5. What is the distribution of postgraduate theses on epistemological beliefs in science education in Türkiye according to research method?
6. How is the distribution of postgraduate theses on epistemological beliefs in science education in Türkiye according to sample type and size?
7. What is the distribution of postgraduate theses on epistemological beliefs in science education in Türkiye according to the data collection tools used?

Methods

The main purpose of this study is to conduct a descriptive and contextual in-depth examination of the postgraduate theses on epistemological beliefs in science education/training in Türkiye. For this purpose, the thematic content analysis method was used as the research method. In the thematic content analysis method, researchers examine the studies conducted around a specific topic or problem in depth using a matrix and classify them according to their common and different aspects (Ormancı, 2020). This reveals the relationships between the aims, methods, findings, and results of the studies.

Data Collection

The data collection process consists of two stages. The first one was the identification and gathering of graduate theses. The second part is the classification of the identified theses. These stages are explained in detail below.

Classificatin and Gathering Postgraduate Theses

The theses held by the CoHE spell out National Thesis Centre were examined using the search terms "epistemology", "epistemological", "epistemological beliefs" and "epistemology" in English and Turkish. In this screening process, it was paid attention that these words were mentioned in the title, abstract, keywords or indexing of the theses. As a result of this search, 219 Master's and 98 doctoral theses published in the field of Education and Training up to 2022 inclusive were identified. These theses were brought together and this time the theses were examined with respect to being in the field of science education/teaching, dealing with science subjects, or being on science teachers or pre-service science teachers. 118 master's and 50 doctoral theses were excluded from the study leaving 101 master's theses and 48 doctoral theses. Despite this detailed examination, the limitation of this study is that some of the postgraduate theses in the field of epistemological beliefs in science education were overlooked or inaccessible.

Classification of Theses

Within the scope of this study, a total of 149 postgraduate theses were archived and made ready for data analysis. These theses are indicated with CoHE National Thesis Center thesis no in the Appendix.

Data Analysis

The theses included in the study were analysed using the matrix developed by Ormancı, Çepni, Deveci and Aydın (2015). In this matrix, the relevant sections were taken into consideration in line with the objectives of the study and some sections were adapted. This adapted matrix consists of two sections: general and content characteristics. The general characteristics section includes information on the type of thesis, year of publication, genders of the researchers, the university where the thesis was published, and the specific science discipline involved. The content characteristics section includes information on the purpose of the thesis, research method, sample type, sample/study group size and levels, research period and data collection tools.

The data obtained were analysed by descriptive and content analysis methods. In this context, all of the general characteristics of the theses (type, year of publication, etc.) and the characteristics of the content section except for the purpose, data collection tool and results (research method of the thesis, sample type, etc.) were analyzed using descriptive analysis method. The aims, data collection tools and results were analysed again, by content analysis method. In the content analysis process, codes were firstly devised by researchers from the raw data and categories were formed by combining the appropriate codes not clear what the origin of these is. Then, frequency and percentage calculations were made for the data obtained from both descriptive and content analyses.

The analyses were conducted by two researchers specialised in science education, epistemological beliefs and qualitative data analysis. In order to ensure data analysis reliability, a certain piece of data were analysed simultaneously and independently by the two different experts. In this process, both researchers analyzed the same piece of data. After this analysis, the inter-expert analysis reliability calculation was calculated using the Miles and Huberman (1994) agreement percentage and found to be 85.6%. After this process, the analysis of the data set was continued by a single researcher.

Findings

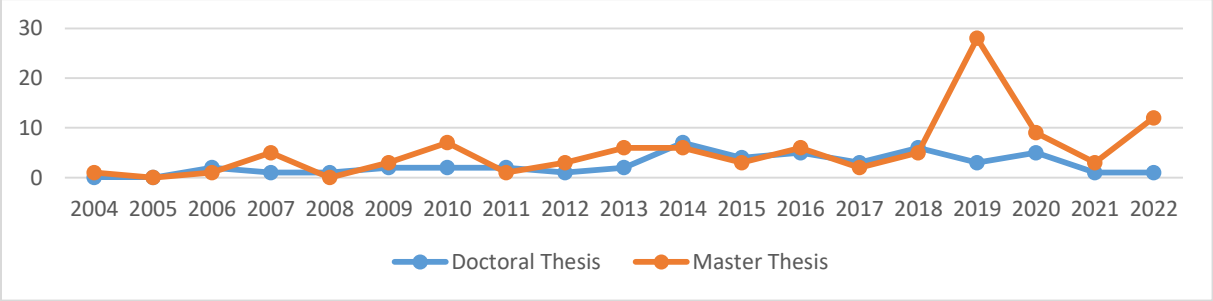
In this part of the study, the findings related to the general and content characteristics of the postgraduate theses examined within the scope of the research are presented below in order according to the research sub-problems.

Findings Related to The First Sub-Problem

The findings regarding the distribution of the 149 theses according to year are presented in Figure 1.

Figure 1

Distribution of The Postgraduate Theses by Years



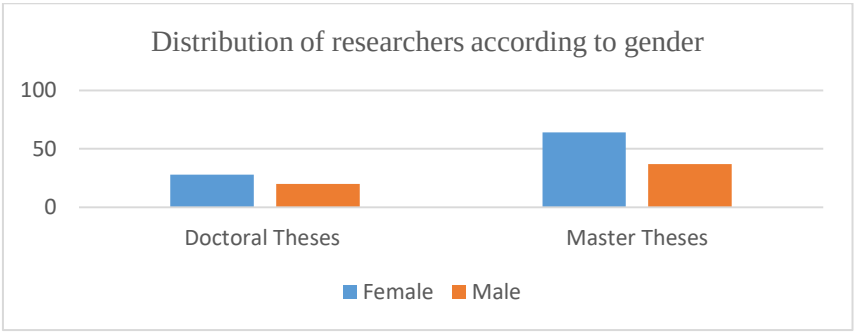
The first Turkish studies on epistemological beliefs in science education were a master's thesis by Çalışkan in 2004, and doctoral theses by Kaplan and Eren in 2006. These were followed in 2006 by two doctoral and one master's theses. In 2007, a total of six theses were written, one in doctorate and five in master's degree; in 2008, a total of one postgraduate thesis was written, only one in doctorate. In 2014, a total of thirteen theses were published, seven of which were doctoral and six of which were master theses; in 2016, a total of eleven postgraduate theses were published, five of which were doctoral and six of which were master theses. The highest number of theses on epistemological beliefs was in 2019, when a total of thirty-eight postgraduate theses, three of which were doctoral and twenty-eight master's theses, were contributed to science education. When the theses in 2020 and 2022 are examined, it can be said that the studies on epistemological beliefs continue to increase.

Findings Related to The Second Sub-Problem

The findings regarding the distribution of researchers by gender in the 149 theses examined within the scope of the research are presented in Figure 2.

Figure 2

Distribution of Researchers by Gender



As seen in Figure 2, 64 of 101 master theses were written by female and 37 by male researchers; 28 of 48 doctoral theses were written by female and 20 by male researchers. Accordingly, 61.74% of the postgraduate theses on epistemological beliefs in science education/training in Türkiye were written by female and 38.26% by male researchers.

Findings Related to The Third Sub-Problem

The findings regarding the distribution of the 149 postgraduate theses examined within the scope of the research according to universities and geographical regions of Türkiye are presented in Table 1.

Table 1

Distribution of Theses According to Published Universities and Geographical Regions of Türkiye

Categories	Code	Doctoral Thesis		$Total_{Doctoral}$		Master's Thesis		$Total_{Master}$		Total	
		f	%	f	%	f	%	f	%	f	%
Mediterranean	Mersin University	-	-	-	-	4	2.67	7	4.67	7	4.67
	Akdeniz University	-	-			3	2.00				
Eastern Anatolia	Atatürk University	-	-	7	4.67	5	3.33	11	7.33	18	12.00
	Fırat University	5	3.33			-	-				
	İnönü University	2	1.33			1	0.67				
	Ağrı İbrahim Çeçen University	-	-			2	1.33				
	Erzincan Binali Yıldırım University	-	-			1	0.67				
	Kafkas University	-	-			1	0.67				
	Van Yüzüncü Yıl University	-	-			1	0.67				
Aegean	Muğla Sıtkı Koçman University	-	-	6	4.00	7	4.67	14	9.33	20	13.33
	Dokuz Eylül University	4	2.67			1	0.67				
	Afyon Kocatepe University	1	0.67			1	0.67				
	Ege University	-	-			2	1.33				
	Mehmet Akif Ersoy University	1	0.67			1	0.67				
	Manisa Celal Bayar University	-	-			1	0.67				
	Uşak University	-	-			1	0.67				
Southeastern Anatolia	Adıyaman University	-	-	-	-	2	1.33	3	2.00	3	2.00
	Siirt University	-	-			1	0.67				
Central Anatolia	Middle East Technical University	16	10.67	24	16.00	16	10.67	28	18.67	52	34.67
	Gazi University	4	2.67			4	2.67				
	Erciyes University	1	0.67			2	1.33				
	Kırıkkale University	-	-			2	1.33				
	Kırşehir Ahi Evran University	1	0.67			1	0.67				
	Tokat Gaziosmanpaşa University	-	-			2	1.33				
	Eskişehir Osmangazi University	-	-			1	0.67				

	Hacettepe University	1	0.67			-	-				
	Necmettin Erbakan University	1	0.67			-	-				
Black Sea	Bolu Abant İzzet Baysal University	2	1.33	2	1.33	5	3.33	9	6.00	11	7.33
	Zonguldak Bülent Ecevit University	-	-			2	1.33				
	Recep Tayyip Erdoğan University	-	-			1	0.67				
	Sinop University	-	-			1	0.67				
Marmara	Marmara University	3	2.00	7	4.67	8	5.33	27	18.00	34	22.67
	Bursa Uludağ University	1	0.67			4	2.67				
	İstanbul Aydın University	-	-			5	3.33				
	Balıkesir University	2	1.33			1	0.67				
	Yıldız Teknik University	1	0.67			2	1.33				
	Çanakkale Onsekiz Mart University	-	-			2	1.33				
	İstanbul University	-	-			1	0.67				
	İstanbul Sabahattin Zaim University	-	-			1	0.67				
	Kocaeli University	-	-			1	0.67				
	Sakarya University	-	-			1	0.67				
	Yeditepe University	-	-			1	0.67				
Total		48	32.00	48	32.00	102	68.00	102	68.00	150*	100.00

**Note:* In one master thesis, one number was overstated because two different universities merged their master's institutes.

According to Table 1, the study analyzed 149 graduate theses from different regions of Türkiye and found that Central Anatolia and Marmara Region had the highest number of publications, with 52 (34.67%) and 34 (22.67%) respectively. More, it was determined that 32 (21.33%) of 149 theses, 16 (10.67%) of which were doctoral theses and 16 (10.67%) of which were master's theses, were published at Middle East Technical University. The first thesis on epistemological beliefs in science education published in 2004 was published in Middle East Technical University. A total of 11 (7.33%), including 3 (2.00%) doctoral and 8 (5.33%) master theses at Marmara University; 8 (5.33%), including 4 (2.67%) doctoral and 4 (2.67%) master theses at Gazi University; and 8 (5. 33%); 7 (4.67%) master theses, including 2 (1.33%) doctoral and 5 (3.33%) master theses, were published at Bolu Abant İzzet Baysal University; and 7 (4.67%) master theses were published at Muğla Sıtkı Koçman University.

Findings Related to The Fourth Sub-Problem

Postgraduate theses conducted in science education mainly involve mixed or experimental studies that examine the effect of a learning/teaching method on the development of epistemological beliefs; survey or correlational survey studies that examine the relationship between epistemological beliefs and one or more variables; and survey studies that examine the epistemological beliefs of teachers, pre-service teachers or pupils. In this context, three categories were taken into consideration in the process of analyzing the aims of theses on epistemological beliefs. In this way, the aims of the theses on epistemological beliefs in science education were tried to be reflected in more detail and in accordance with the research purpose.

149 postgraduate theses examined within the scope of the research revealed that about one-third of them used mixed or experimental research methods. In these theses, epistemological beliefs were sometimes treated as dependent variables and sometimes as independent variables. Table 2 provides information about the aims of the theses in which epistemological beliefs were independent variables.

Table 2

Objectives in Theses Where Epistemological Beliefs are Independent Variables

Independent Variable	Dependent variable
The inquiry-based learning method supported by motivation, scientific epistemological beliefs and metacognition	Impact on conceptual understanding (f=1, %8.33) Impact on views on the nature of science (f=1, %8.33) Impact on epistemological beliefs (f=1, %8.33) Impact on motivation towards science (f=1, %8.33) Impact on creative writing (f=1, %8.33) Impact on metacognitive skills (f=1, %8.33)
Epistemologically enriched teaching method	Impact on epistemological beliefs (f=1, %8.33) Impact on academic achievement (f=1, %8.33)
Epistemologically and metacognitively enhanced 7E learning cycle	Impact on epistemological beliefs (f=1, %8.33) Impact on academic achievement (f=1, %8.33)
Epistemologically enriched argumentation	Impact on epistemological beliefs (f=1, %8.33) Impact on academic achievement (f=1, %8.33)
Total	100

When Table 2 is examined, it is seen that the effect of "inquiry-based learning method supported by motivation, scientific epistemological beliefs and metacognition factors" on learners' conceptual understanding (8.33%), science modification (8.33%), creative writing (8.33%) and metacognitive skills (8.33%) were examined. The thesis examined how inquiry-based learning methods supported by motivation, scientific epistemological beliefs and metacognition factors, epistemologically enriched teaching method, epistemologically and metacognitively improved 7E learning cycle and epistemologically enriched argumentation method subjects influenced the learners' epistemological belief.

When the theses that adopted the experimental or mixed research method continued to be examined, it was understood that there were theses (28.19% of all theses and f=42 theses) dealt with the effect of a learning-teaching method on epistemological beliefs. In this context, the aims of the theses in which epistemological beliefs were examined as a dependent variable are given in Table 3.

Table 3

Objectives of The Theses In Which Epistemological Beliefs Were The Dependent Variable

Independent Variable		Dependent Variable
Argumentation-based learning method	(f=6, %14.29)	
Inquiry-based learning method	(f=5, %11.90)	
Argument-based inquiry method	(f=4, %9.52)	
Cooperative learning approach	(f=4, %9.52)	
STEM practices	(f=3, %7.14)	
5E/7E learning model	(f=3, %7.14)	
History of science practices/nature of science	(f=3, %7.14)	
Teaching through modeling	(f=2, %4.76)	
Technology-based learning applications (e..g. Augmented reality)	(f=3, %7.14)	
Learning based on the constructivist approach	(f=2, %4.76)	Impact on epistemological beliefs
Argument-driven inguiry method	(f=1, %2.38)	
Case-based learning method	(f=1, %2.38)	
Cognitive linking and cognitive contradiction approach	(f=1, %2.38)	
Developed teaching materials and activities	(f=1, %2.38)	
Project-based learning	(f=1, %2.38)	
Reading-Writing-Application method	(f=1, %2.38)	
Transformational learning model	(f=1, %2.38)	
Total	(f=42 %100)	

When Table 3 is examined, it is seen that the theses mostly aimed to investigate the effect of the argumentation-based learning method (14.29% f=6) on learners' epistemological beliefs. After the argumentation-based learning method, the effect of inquiry-based learning, argumentation-based inquiry and cooperative learning approaches on epistemological beliefs with a frequency of 9.52% (f=4) were discussed.

In 12.49% (f=6) of the doctoral theses and 7.92% (f=9) of the master's theses that adopted case study, longitudinal study, sequential transformational design and some mixed research methods, it was aimed to determine the level/status of epistemological beliefs of teachers, pre-services teachers or pupils. The findings regarding the theses aiming to determine the level/status of epistemological beliefs are presented in Table 4.

Table 4

Objectives of The Theses Whose Level/Status Regarding Epistemological Beliefs Were Analysed

Categories	Codes	f	%	Total f	Total %
Determining epistemological beliefs	To determine teachers' epistemological beliefs	8	14.55	21	38.19
	To determine pre-service teachers' epistemological beliefs	8	14.55		
	To determine middle students' epistemological beliefs	4	7.27		
	To compare the epistemological beliefs of pre-service science teachers about the nature of knowledge and learning with those of the science and mathematics fields	1	1.82		
Demographic variables (gender, technology use, etc.)	To determine teachers' epistemological beliefs differ according to demographic variables	9	16.37	13	23.64
	To determine pre-service teachers' epistemological beliefs differ according to demographic variables	2	3.64		
	To determine university students' epistemological beliefs differ according to demographic variables	1	1.82		
	To determine students' epistemological beliefs differ according to demographic variables	1	1.82		
Pedagogical content knowledge	To examine the reflections of science teachers' epistemological beliefs on their classroom practices	2	3.64	11	20.00
	To determine the effect of preschool teachers' and pre-service science teachers' epistemological beliefs on their pedagogical competencies	4	7.27		
	To examine the impact of epistemic reasoning on pedagogical implications	1	1.82		
	To determine the epistemological beliefs of science teachers and their teaching on socioscientific issues	1	1.82		
	To examine how science teachers' pedagogical and epistemological beliefs have changed over the years	1	1.82		
	To examine teachers' perceptions of the formal curriculum according to the epistemological belief scale	1	1.82		
	To determine how science teachers' epistemological beliefs affect their STEM awareness	1	1.82		
Scientific discussion and reasoning	To analyze their discussions about socio-scientific issues in terms of epistemic beliefs	2	3.64	6	10.91
	To examine the argumentation skills of pre-service teachers with different epistemological beliefs about socioscientific issues	1	1.82		
	To examine knowledge production based on reasoning from an epistemological perspective	1	1.82		
	To evaluate how knowledge is made sense of within the scope of epistemological beliefs	1	1.82		
	To analyze decision-making processes regarding a controversial text in the context of epistemic profiles	1	1.82		
Others	To examine the differences between general and domain-oriented epistemological beliefs of university students	1	1.82	4	7.27
	To develop the scale of the Epistemic Reasoning Scale	1	1.82		
	To analyze physics curriculum in terms of epistemological beliefs	1	1.82		
	To determine the epistemological beliefs that effective school administrators should have according to teachers' perceptions	1	1.82		
Total		55	100	55	100

When Table 4 is examined, it is seen that in 149 theses studied, the aim was to determine the epistemological beliefs of teachers, teacher candidates, and students with a frequency of 38.19% (f=21). Among the theses, the variation of epistemological beliefs of teachers, teacher candidates, and students according to demographic characteristics ascertained at a frequency of 23.64% (f=13).

In 37.51% (f=18) of the doctoral theses and 54.45% (f=28) of the master's theses examined, it was aimed to examine the relationship between epistemological beliefs and some variables. The findings regarding the variables with which epistemological beliefs were associated in these theses are presented in Table 5.

Table 5

Purposes of The Theses In Which The Relationship Between Epistemological Beliefs And Another Variable Is Examined

Categories	Codes	f	%	Total f	Total %
Demographic Features	Gender	32	11.99	127	47.57
	Seniority / professional experience	14	5.24		
	Branch	13	4.87		
	Age	11	4.12		
	Graduated school type	11	4.12		
	Education level/status	9	3.37		
	Grade level	8	3.00		
	Family structure / parental education	7	2.62		
	Socioeconomic status	6	2.25		
	Type of school where you work	4	1.50		
	Type of faculty	3	1.12		
	Individual innovativeness	2	0.75		
	Department/field of study	2	0.75		
	Availability of internet connection	2	0.75		
	Number of books read	1	0.37		
	Marriage status	1	0.37		
	Temperament and character	1	0.37		
Emotional Features	Attitude/motivation towards science	14	5.24	55	20.60
	Students' perceptions of learning	13	4.86		
	Science teaching self-efficacy beliefs	9	3.37		
	Perceptions of the nature of science	3	1.12		
	Perceptions about learning environments	3	1.12		
	Scientific process skills	2	0.75		
	Confidence in knowledge and information	2	0.75		
	Attitudes/beliefs of resistance to change	2	0.75		
	Family attitudes	1	0.37		
	Achievement goal orientations	1	0.37		
	Values	1	0.37		
	Emotional intelligence	1	0.37		
	Science teaching intention and behavior	1	0.37		
	Attitude towards technology	1	0.37		
	STEM attitude	1	0.37		
Cognitive Features	Academic achievement	21	7.87	34	12.73
	Science literacy	9	3.37		
	Environmental knowledge levels	2	0.75		
	Conceptual change level	1	0.37		

	Digital literacy	1	0.37		
Skills and Competencies	Argumentation quality/discussion tendencies	5	1.87	32	11.99
	Informal reasoning	4	1.50		
	Problem solving skills	3	1.12		
	Self-regulation skills	3	1.12		
	Critical thinking skills/tendencies	3	1.12		
	Academic self-efficacy	3	1.12		
	Metacognition awareness	2	0.75		
	Guiding beliefs	1	0.37		
	Project experience	1	0.37		
	Lifelong learning competencies	1	0.37		
	Inquiry-based science teaching beliefs	1	0.37		
	STEM awareness/ self-efficacy	2	0.75		
	Environment-friendly behavior	1	0.37		
	Procrastination behaviors	1	0.37		
	Mental risk-taking behaviors	1	0.37		
Pedagogical Features	Teachers' teaching styles	4	1.50	17	6.37
	Pedagogical content knowledge competencies	4	1.50		
	Measurement and evaluation methods	2	0.75		
	Constructivist approach/environment	3	1.12		
	Educational philosophies/goals adopted by science teachers/pre-service teachers	3	1.12		
	Teachers' professional performance	1	0.37		
Other	Gifted university bridge education program	1	0.37	2	0.74
	Theories of implicit ability	1	0.37		
Total		267	100*	267	100*

**Note:* Percentage values in the table were calculated over a total of 100%, taking into account only theses that targeted relational research.

When Table 5 is examined, it is seen that 47.57% (f=127) of the postgraduate theses investigating epistemological beliefs in science education aimed to examine the relationship between demographic features (e.g. gender, branch, age) and epistemological beliefs. The other most researched variable was the relationship between emotional features (e.g. attitude/motivation towards science, students' perceptions of learning, science teaching self-efficacy beliefs) and epistemological beliefs with a frequency of 20.60% (f=55). Although rare, the relationship between pedagogical features (f=17 and 6.37%) and epistemological beliefs was the principal focus of study in the thesis.

Findings Related to The Fifth Sub-Problem

The findings regarding the distribution of the 149 postgraduate theses examined within the scope of the research according to research methods are presented in Table 6.

Table 6

Distribution by Research Methods

Codes	Doctoral Thesis		Master's Thesis	
	f	%	f	%
Quasi-experimental method with pre-test and post-test control group	13	27.08	20	19.80
Mixed research method	9	18.75	10	9.90
Correlational survey method	8	16.67	35	34.65
Survey method	6	12.50	16	15.84
Case study	4	8.33	6	5.94
Hierarchical linear model	2	4.17	-	-
Structural equation modeling	2	4.17	-	-
Longitudinal research	1	2.08	-	-
Scale development	1	2.08	-	-
Qualitative research	1	2.08	-	-
One group quasi-experimental design	-	-	3	2.97
Delphi study	-	-	1	0.99
Causal comparative design	-	-	2	1.98
Cross-sectional survey model	-	-	2	1.98
Sequential transformational design	-	-	2	1.98
Unspecified	1	2.08	4	3.96
Total	48	100	101	100

When Table 6 was examined, it was found that 27.08% (f=13) of the doctoral theses on epistemological beliefs in science education were mostly quasi-experimental with pretest-posttest control groups; and 34.65% (f=35) of the Master's theses were mostly correlational survey research designs. For the doctoral theses, 18.75% (f=9) mixed and 16.67% (f=8) correlational survey methods were among the most preferred research methods. In master theses, 19.80% (f=20) pre-test-post-test control group quasi-experimental design and 15.84% (f=16) survey research designs were preferred. Moreover, while it is known that long-term research should be conducted for the change and development of participants' epistemological beliefs, longitudinal research method was used in only 2.08% (f=1) of theses.

Findings Related to The Sixth Sub-Problem

The findings regarding the sample type of the postgraduate theses examined within the scope of the research are presented in Table 7.

Table 7

Distribution of The Analyzed Theses According to Sample/Study Groups

Codes	Doctoral Thesis		Master's Thesis	
	f	%	f	%
5th Grade Student	-	-	10	6.80
6th Grade Student	6	10.17	10	6.80
7th Grade Student	11	18.64	13	8.84
8th Grade Student	3	5.08	19	12.93
9th Grade Student	3	5.08	10	6.80
10th grade student	2	3.39	8	5.44
11th grade student	2	3.39	5	3.40
12th Grade Pupil	-	-	5	3.40
15-16 Year Old Pupils	1	1.69	4	2.72
University Students of Different disciplines	1	1.69	1	0.68
Pre-service Science Teacher	9	15.25	25	17.01
Pre-service Biology Teacher	1	1.69	2	1.36
Pre-service Chemistry Teacher	2	3.39	-	-
Pre-service Physics Teacher	1	1.69	-	-
Pre-service Pre-school Teachers	-	-	2	1.36
Pre-service Classroom Teaching Teacher	2	3.39	3	2.04
Pre-service Turkish Teacher	1	1.69	-	-
Pre-service Different Branches Teacher	2	3.39	2	1.36
Science Teacher	6	10.17	8	5.44
Physics Teacher	1	1.69	-	-
Chemistry Teacher	1	1.69	-	-
Primary, Secondary and High School Teachers in Different Branches	3	5.08	15	10.20
Preschool Teacher	1	1.69	2	1.36
Parents	-	-	2	1.36
School Manager	-	-	1	0.68
Total	59*	100	147*	100

* *Note:* In some theses, more than one sample type was used.

When Table 7 was examined, it was determined that 18.64% (f=11) of doctoral theses were mostly conducted with 7th grade pupils and 17.01% (f=25) of master theses were mostly conducted with pre-service science teachers. In doctoral theses, 15.25% (f=9) pre-service science teachers, 10.17% (f=6) 6th grade students and 10.17% (f=6) science teachers were preferred as the study group. In master theses, 8th grade students with a frequency of 10.93% (f=19), primary, secondary and high school teachers in different branches with a frequency of 10.20% (f=15) and 7th grade students with a frequency of 8.84% (f=13) were the most preferred sample/study groups. Moreover, the number of participants constituting the sample/study groups of the theses analyzed within the scope of the research was examined and the findings related to this are given in Table 8.

Table 8

Distribution of Sample/Study Group Size of The Analyzed Theses

Codes	Doctoral Thesis		Master's Thesis	
	f	%	f	%
1-5 persons	2	3.92	1	0.95
6 - 10 persons	-	-	4	3.81
11 – 20 persons	5	9.80	6	5.71
21 – 30 persons	3	5.88	3	2.86
31 – 100 persons	13	25.49	26	24.76
101 – 500 persons	12	23.53	41	39.05
501 – 1000 persons	5	9.80	14	13.33
1001 and over persons	11	21.57	10	9.52
Total	51*	100	105*	100

**Note:* In some theses, more than one sample type was used.

Table 8 shows that doctoral theses had a sample/study group size of 31-100 people in 25.49% (f=13) of the cases, while master theses had a sample/study group size of 101-500 people in 39.05% (f=41) of the cases. Conversely, doctoral theses had a sample/study group size of 101-500 people in 23.53% (f=12) of the cases, and master theses had a sample/study group size of 31-100 people in 24.76% (f=26) of the cases. It can be said that these results are in parallel with the results of survey and relational survey methods, which are the most commonly adopted methods in theses, and that this is not a surprising finding.

Findings Related to The Seventh Sub-Problem

The data collection tools used by the theses examined within the scope of the research to evaluate the epistemological belief were examined. The findings regarding the data collection tools used to measure epistemological beliefs in postgraduate theses are given in Table 9.

Table 9

Epistemological Beliefs Scales Used As Data Collection Tools in The Analysed Postgraduate Theses

Developer of the Scale (Original)	Scale Name	Adapted Scale	f	%	f	%
Conley, Pintrich, Vekiri & Harrison (2004)	Epistemological Belief Questionnaire	Özkan (2008)	22	16.30	38	28.15
		Kurt (2009)	4	2.96		
		Kaynar (2007)	2	1.48		
		Evcim (2010)	2	1.48		
		Bahçivan (2014)	2	1.48		
		Fırat (2014)	1	0.74		
		Ağgül (2016)	1	0.74		
		Durmaz (2017)	1	0.74		
		Yalçın ve Yalçın (2017)	1	0.74		
		İyi (2018)	1	0.74		
		Kızıltepe (2020)	1	0.74		
Schommer (1990)	Epistemological Belief Questionnaire	Deryakulu & Büyüköztürk (2002)	19	14.07	36	26.67
		Deryakulu &Büyüköztürk (2005)	8	2.22		
		Topçu & Yılmaz-Tüzün (2006)	3	0.74		
		Kaymak (2010)	3	1.48		
		Yılmaz-Tüzün & Topçu (2008)	2	2.22		
		Tuncay-Yüksel (2016)	1	5.93		
Elder (1999)	Epistemological Belief Scales	Acat, Tüken & Karadağ (2010)	13	0.74	14	10.37
		Tüken (2010)	1	9.63		
Pomeroy (1993)	Scientific Epistemological Beliefs Survey	Deryakulu &Hazır Bıkmaz (2003)	10	7.41	10	7.41
Schommer (1998)	Epistemological Belief Questionnaire	Karhan (2007)	6	4.44	6	4.44
Saunders (1998)	Epistemological Beliefs Questionnaire	Çalışkan (2004)	2	1.48	4	2.96
		Özkal (2007)	2	1.48		
Sing-Chai, Teo & Beng-Lee (2009)	Epistemological Beliefs Scale about Teaching and Learning	Kutluca, Soysal ve Radmard (2018)	3	2.22	3	2.22
Elby, McCaskey, Lippmann, & Redish (2001)	The Maryland Physics Expectations Survey-II	Yerdelen-Damar, Elby & Eryilmaz (2012)	1	0.74	2	1.48
		Özmen (2017)	1	0.74		
Chan & Eliot (2002)	Epistemological Beliefs Questionnaire	Aybay (2011)	2	1.48	2	1.48
Wood & Kardash (2002)	Epistemological Beliefs Survey	Sünger (2007)	1	0.74	1	0.74

Schraw & Olafson (2002)	Epistemological World View Scale	Yılmaz-Tüzün &Topçu (2008)	1	0.74	1	0.74
Tsai and Liu (2005)	Scientific Epistemological Views Survey	Uysal (2010)	1	0.74	1	0.74
Kuhn, Cheney & Weinstock (2000)	Epistemic Beliefs Questionnaire	İşbilir (2010)	1	0.74	1	0.74
Adams, Perkins, Podolefsky, Dubson, Finkelstein &Wieman (2006)	Colorado Learning Attitudes about Science Survey	Şahin (2010)	1	0.74	1	0.74
Elby, Frederiksen, Schwarz ve White (1999)	Epistemological Beliefs Assesment for Physical Science	Yaman (2013)	1	0.74	1	0.74
Bråten, Gil, Strømsø & Vidal-Abarca (2009)	The Topic Specific Epistemic Beliefs Questionnaire	Hiğde & Oztekin (2013)	1	0.74	1	0.74
Bendixen, Schraw & Dunkle (1998)	Epistemic Beliefs Inventory	Tuncay-Yuksel, Yilmaz-Tuzun & Zeidler (2015)	1	0.74	1	0.74
Hofer (2004)	Discipline-Focused Epistemological Beliefs Questionnaire	Akyürek (2018)	1	0.74	1	0.74
Hofer (2000)	General Epistemological Beliefs Questionnaire	Akyürek (2018)	1	0.74	1	0.74
Akyürek (2018)	Epistemik Muhakeme Ölçeği		2	1.48	2	1.48
Ünal-Çoban (2009)	Bilimsel Bilgiye Yönelik Görüş Ölçeği		1	0.74	1	0.74
Bilal (2010)	Bilimsel Bilginin Doğasına Yönelik (Epistemolojik) İnançlar Ölçeği		1	0.74	1	0.74
Kaymak (2010)	Fiziğe Ait Epistemolojik İnanıÇ Ölçeği		1	0.74	1	0.74
Bektaş (2011)	Epistemological Beliefs toward Chemistry and Chemistry Courses Questionnaire		1	0.74	1	0.74
Akyürek (2018)	Epistemolojik Karar Verme Ölçeği		1	0.74	1	0.74
Bayrak-Demir (2019)	Bilimsel Epistemolojik İnanç Ölçeği		1	0.74	1	0.74
Kaçar (2019)	Epistemolojik İnançlar Ölçeği		1	0.74	1	0.74
Kızkapan (2019)	Epistemolojik İnanç Ölçeği		1	0.74	1	0.74
Total			135	100	135	100

When the findings in Table 9 are examined, 28 different epistemological scales/surveys were used in postgraduate theses, 9 developed by the researchers and the remaining 19 by foreign researchers and adapted for use in Türkiye. The oldest epistemological beliefs scale/survey used in the theses analysed was developed by Schommer in 1990 and used by the researchers with a frequency of 26.67% (f=36). The most frequently used questionnaire in the theses is the Epistemological Belief Questionnaire developed by Conley and his colleagues with a frequency of 28.15% (f=38) and was first translated into Turkish by Özkan in 2008. The Epistemological Beliefs Questionnaire adapted by Özkan and developed by Conley his colleagues is the most preferred data collection tool with a frequency of 16.30% (f=22) among the scales/surveys adapted. This was followed by the Epistemological Beliefs Scale developed by Schommer (1990) and translated into Turkish by Deryakulu and Büyüköztürk was the most frequently used data collection tool to assess epistemological beliefs. According to Table 9, in the theses examined, it was seen that in addition to the epistemological beliefs scale/survey developed by researchers such as Schommer, Conley and his colleagues, which was used to evaluate the general epistemological beliefs of individuals, scales/surveys developed by researchers such as Elby, McCaskey, Lippmann, and Redish and Hofer, which are used to determine the epistemological beliefs specific to a field, were also used.

Moreover, the qualitative data collection tools used in the evaluation of epistemological beliefs in theses were analyzed and the related findings are presented in Table 10.

Table 10

Qualitative Data Collection Tools Used To Assess Epistemological Beliefs in The Analyzed Postgraduate Theses

Codes		f	%	f	%
Interview	Semi-structured	21	36.21	24	41.38
	Structured	3	5.17		
Document Analysis	Student Activities/Worksheet	5	8.62	13	22.41
	PISA Data	5	8.62		
	Lesson Plan	3	5.17		
Observation	Observation Form	4	6.90	7	12.07
	Researcher Observation	3	5.17		
Other Data Sources	Open-ended Questions	6	10.34	6	10.34
	Scenario	3	5.17	3	5.17
	Reflective Diaries	3	5.17	3	5.17
	Vignet	2	3.45	2	3.45
Total		58	100	58	100

When the findings in Table 10 were examined, it was determined that four different qualitative data collection techniques were used in the evaluation of individuals' epistemological beliefs in postgraduate theses. Among these techniques, 41.38% (f=24) interviews and 22.41% (f=13) document analysis were the most preferred techniques. Considering that individuals' epistemological beliefs should be examined in depth, scenarios (5.17%), reflective diaries (5.17%) and vignettes (3.45%) were the other preferred data collection tools.

Discussion and Conclusion

The research on epistemological beliefs in the field of science education in Türkiye begins with a Master's thesis written by Çalışkan and published in 2004 at the Middle East Technical University. The first doctoral theses on epistemological beliefs in science education started with the studies

conducted by Öztuna-Kaplan, published at Marmara University in 2006; and Eren, published at Abant İzzet Baysal University in 2006. After these first published theses, there was a rapid increase in the number of theses on epistemological beliefs in 2007, 2010, 2013, 2014 and the following years and it continues to increase. Üztemur, Sevigen, Arıkan, and Çelik (2021) examined the articles and theses on epistemological beliefs in educational sciences in Türkiye between 2002 and 2020 and reported that there has been a significant increase in the number of studies on this subject in recent years. Similarly, Kalınkara and Özek (2021) noted that these had been an increase in the number of epistemological researches in the last five years as a result of their study examining the researches on epistemological beliefs in educational research in CoHE Thesis Centre, Dergi Park, ERIC databases between 2016-2020. Unlike these, Lee et al. (2021), as a result of their systematic review analysis research on measuring epistemologies in science education between 2010-2019, stated that the number of studies on this subject hade increased and continues to increase. In the light of all these, it can be said that the number of theses/researches on epistemological beliefs in science education will increase when the developments in science education and information and communication technologies and the needs of today's people are taken into consideration.

In the theses analyzed within the scope of the research, three main categories were generally focused on. In this context, three categories were taken into consideration in the process of examining the aims of theses on epistemological beliefs. The results obtained within the scope of the aims of the theses are given below.

In some of the theses in which epistemological beliefs were considered as an independent variable, the effects of inquiry-based learning method supported by motivation, scientific epistemological beliefs and metacognition factors on middle school students' conceptual understanding, views on the nature of science, epistemological beliefs, attitudes towards science, creative writing and metacognitive skills were investigated (Savaş, 2020). In other theses, it was aimed to investigate the effects of epistemologically enriched teaching method (Özmen, 2017), epistemologically and metacognitively enhanced 7E learning (Yerdelen-Damar, 2013) and epistemologically enriched argumentation method (Kızkapan, 2019) on high school and middle school students' epistemological beliefs and academic achievement. Moreover, theses in which epistemological beliefs were considered as a dependent variable focused on the effects of some learning-teaching methods on epistemological beliefs. In this context, the effect of inquiry-based learning method on epistemological beliefs was the most common topic (Cin, 2018; Göreci-Keskin, 2019). Then, in the second stage, it was aimed to investigate the effect of argumentation-based inquiry method on students' epistemological beliefs (Özcan, 2019; Tucel, 2016). The effects of argument-driven inquiry method (e.g. Kaçar, 2019), STEM applications (e.g. Solmaz, 2022) and augmented reality applications (e.g. Altıntaş, 2018), which are current learning-teaching methods in science education, on students' epistemological beliefs were investigated. It can be said that this result is in parallel with the literature. In the literature, many researchers have conducted research on the effect of argumentation-based learning (e.g. Alt & Kapshuk, 2022; Noroozi & Hatami, 2018), inquiry-based learning method (e.g. Koutsianou & Emvalotis, 2021; Wu & Wu, 2011; Zhao, He, Liu, Tai & Hong, 2021), STEM applications (e.g. Adebusuyi, Bamidele & Adebusuyi, 2022; Wan, So & Hu, 2021) on epistemological beliefs. In this context, it can be said that international literature is closely followed in graduate studies conducted in Türkiye and similar publications are published almost simultaneously with the international literature. However, the small number of theses on this subject can be considered as a limitation for research in Türkiye.

Determining the level/status of epistemological beliefs of a certain sample/study group in science education is preferred as a research aim in graduate theses. At this point, topics such as determining the epistemological beliefs of teachers, pre-service teachers and students, whether their epistemological beliefs differ according to demographic characteristics, examining the contribution of

pedagogical understandings of the nature of science and the use of practical studies to the development of pre-service teachers' epistemological beliefs, examining the written argumentation skills of pre-service teachers with different epistemological beliefs on socioscientific issues have been investigated in theses. For example, Sönmez (2015) aimed to determine the epistemological belief systems of science teachers and their teaching on socioscientific issues in his thesis. In another example, Öztuna-Kaplan (2006) investigated the reflection of pre-service science teachers' epistemological beliefs on their teaching practices. When the studies in the international literature are examined, most researchers have conducted studies on epistemological beliefs and socioscientific (e.g. Baytelman, Lordanou & Constantinou, 2020; Liu, Lin & Tsai, 2011) and pedagogical content knowledge (e.g. Bahcivan & Cobern, 2016; Xiong, Ching Sing, Tsai & Liang, 2022) issues. It can be said that this result is in line with the literature.

In postgraduate theses investigating epistemological beliefs in science education, the relationship between gender and epistemological beliefs was mostly investigated. Then, the other variables that have been investigated the most are academic achievement (e.g. Durmaz, 2017), teachers' seniority/profession expressions (e.g. Karhan, 2007), teachers' branches, graduated school type and age, science literacy (e.g. Zeybekoğlu, 2019). Moreover, although rarely, the relationship between epistemological beliefs and variables such as argumentation quality/discussion tendencies, teachers' teaching styles, problem solving skills, informal reasoning, metacognitive skills, emotional intelligence, and epistemological beliefs have been the subject of study in theses. When the international literature on this subject was examined, studies investigating the relationship between epistemological beliefs and students' conceptual understanding and learning strategies (e.g. Lee et al., 2016) and metacognitive skills (e.g. Mason & Bromme, 2010) were found. In these theses, mostly general and personal epistemological belief scales/surveys were used to examine the relationship between epistemological beliefs of large samples and other variables. Based on this situation, it can be said that there is a need for studies that address the relationship between domain-focused and practical epistemological beliefs and other variables rather than general and personal epistemological beliefs.

Moreover, as mentioned above (about the aims of the theses), the effect of a teaching method on the development of epistemological beliefs in experimental studies on epistemological beliefs in science education or the relationship between epistemological beliefs and science learning outcomes in survey studies have been proven with empirical data (e.g. Cin, 2018; Kaçar, 2019). However, although the research results of the theses examined within the scope of this research are not included, some theses contain findings that there is no relationship between epistemological beliefs and science learning outcomes or that the learning-teaching method does not improve epistemological beliefs (For example, Solmaz, 2022). This is thought to be due to the difficulties in defining advanced or sophisticated epistemological beliefs (Sandoval, 2005) or the fact that low scores on the scales are considered as naive and high scores as sophisticated epistemological beliefs (Lee et al., 2016). Based on this, it can be said that it is difficult to make a generalisation about the results on epistemological beliefs in science education and therefore more research is needed in this field.

When the 149 postgraduate theses examined within the scope of the research were analysed according to research methods, it was understood that approximately 25% of them were correlational survey, approximately 25% were quasi-experimental with pretest-posttest control group and approximately 12% were mixed research design. For example, Özbay (2016) examined the relationship between epistemological beliefs and cognitive risk taking, and Şıvgın (2019) examined the relationship between epistemological beliefs and scientific process skills. In another example (experimental study), Göksu (2011) investigated the effect of inquiry-based learning method on epistemological beliefs, Yerdelen-Damar (2013) investigated the effect of epistemologically and metacognitively improved 7E model on epistemological beliefs. An example of theses adopting the mixed research method is

Kaçar's (2019) study investigating the effect of argument-driven inquiry method on epistemological beliefs. This result is in line with the findings of Kalınkara and Özek (2021), who stated that relational survey and quasi-experimental designs were more prominent in the studies they examined. Lee et al. (2021) reported that quantitative research methods were mostly used in the articles they analyzed. Moreover, another issue that draws attention in the theses is that mixed research (including both qualitative and quantitative data collection process) is rarely used in such a variable where it is difficult to evaluate the change or development in epistemological beliefs with only one data collection tool or only quantitative data collection tools. Moreover, while it is a known fact that longitudinal research should be conducted for the change and development of participants' epistemological beliefs, it was understood that only one of the theses examined utilised the longitudinal research method (e.g. Doğan, 2014). In this context, it can be said that there is a need for new research on epistemological beliefs in which more qualitative (longitudinal research etc.) or both qualitative and quantitative (mixed research etc.) research methods are adopted.

Considering the sample distribution of the postgraduate theses examined within the scope of the research, it was concluded that they mostly worked with secondary school students, science teachers and pre-service science teachers. For example, Solmaz (2022) worked with fifth grade students, Kaçar (2019) with seventh grade students, Keçebaş (2022) and Keskin (2022) with pre-service science teachers, Hiğde (2014) and Sünger (2007) with science teachers. Moreover, in some of the theses examined, school managers (e.g. Özkan-Hıdıroğlu, 2016) and parents (e.g. Kılıç, 2020) were also included in the sample, although rarely in correlational surveys involving teachers from different branches or in theses where parents' attitudes and students' epistemological beliefs were tried to predict. Moreover, the number of participants constituting the sample/study groups of the theses was examined in the study and it was concluded that the number of participants was mostly 100 and over. This result is consistent with the research results of Üztemur et al. (2021), Kalınkara and Özek (2021) and Lee et al. It can be said that the sample distribution and size of the analyzed theses are compatible with the research methods and scale types used in the theses. Because when the theses were evaluated in general, it was observed that personal epistemological beliefs were studied on epistemological beliefs in science education in Türkiye. This can be considered as an incentive for researchers to conduct more correlational survey studies and to work with larger samples. However, as researchers such as Hamilton and Duschl (2017), Hofer (2000) and Hofer and Pintrich (1997) stated, focusing on domain-focused epistemological beliefs rather than general epistemological beliefs is more prominent in epistemological beliefs in science education. If researchers conduct new studies focusing on domain-oriented epistemological beliefs, it is thought that both the sample type and the number of participants included in the sample will change over time.

Moreover, when the data collection tools used in the evaluation of epistemological beliefs in the theses were analysed, the results were in line with the research method adopted in the theses. In other words, epistemological beliefs scale/survey, which is a quantitative data collection tool, was used in the majority of the analyzed theses. This result is in line with the results of Lee et al. (2021), Kalınkara and Özek (2021) and Üztemur et al. At this point, it was determined that the Epistemological Beliefs Questionnaire developed by Conley et al. (2004) and adapted into Turkish for the first time by Özkan (2008) was mostly used in the theses. This result is in line with the result of Lee et al. Lee et al. also concluded that Conley at al. (2004) scales were mostly used in science education in terms of epistemological beliefs. The scale developed by Conley et al. (2004) was developed to measure the epistemological beliefs of middle school students. In fact, this result is not surprising. Because when the international and Turkish literature on epistemological beliefs in science education is examined, it is mostly examined the development of middle school students' epistemological beliefs or the relationship between their beliefs and other variables (See Figure 4 and Lee et al., 2021). In the analysed theses, another data collection tool most commonly used to measure epistemological beliefs

is the Epistemological Belief Questionnaire developed by Schommer (1990) and adapted into Turkish by Deryakulu and Büyüköztürk (2002). Üztemur et al. (2021) concluded that the most preferred epistemological beliefs scale in the field of educational sciences is the scale developed by Shommer (1990) and adapted to Turkish culture by Deryakulu and Büyüköztürk (2022). Moreover, Shommer's (1990) scale is the most preferred scale in international literature (Schraw, 2013). The reason for this may be thought to be that personal epistemology has more than one dimension, people have different epistemological beliefs in each of these dimensions, and Schommer (1990) was the first to demonstrate that these can be measured with the scale developed in the field of educational sciences. Moreover, since Schommer's (1990) scale can be easily applied to samples at different levels and both Schommer's (1990) and Conley et al.'s (2004) scales facilitate data collection from large masses, it can be thought that researchers resort to these scales to evaluate people's general epistemological beliefs. Moreover, it was concluded that in the analyzed theses, different from the scales used to determine general epistemological beliefs, the scales of epistemological beliefs specific to a certain field were also used to determine domain-oriented epistemological beliefs. For example, the Discipline-Focused Epistemological Beliefs Questionnaire developed by Hofer (2004) and adapted into Turkish by Akyürek (2018), The Maryland Physics Expectations Survey-II developed by Elby, McCaskey, Lippmann, and Redish and adapted into Turkish by Yerdelen-Damar, Elby, and Eryilmaz (2012).

In addition, it was understood that qualitative data collection tools were used to determine epistmeological beliefs in a very low percentage of the theses examined. Among these qualitative data collection tools, it was concluded that the most preferred interview (structured and semi-structured) technique (Doğan, 2014; Kaçar, 2019; Savaş, 2020). In addition, scenarios (e.g. Sicimoğlu, 2022; Sönmez, 2015), reflective diaries (e.g. Akpınar, 2018; Kaçar, 2019) and vignettes (e.g. Keskin, 2020) have been preferred to examine epistemological beliefs in depth, although rarely. When the international literature was examined, it was understood that similar findings were obtained with the results in the Turkish sample. Many researchers have used different techniques such as observation (Mortimer & Araújo, 2014; Russ, 2018), interview (Quan & Elby, 2016; Shubert & Meredith, 2015), draw-write-explain (Brownlee, Curtis, Spooner-Lane & Feucht, 1997; Üztemur & Dinç, 2018) and scenarios (Holschuh, 1998; Kuhn et al., 2000; Sandoval & Cam, 2011) to determine epistemological beliefs qualitatively. In the analyzed theses, it is thought that the reason why researchers use qualitative data collection tools less frequently is that qualitative data collection requires a long time and human effort, and the collected qualitative data are difficult to code and analyze. However, there is a need for more qualitative (Berland & Crucet, 2016; Lee et al., 2021) and domain-focused epistemological beliefs scales/surveys (Jaber & Hammer, 2016; Lee & Tsai, 2012) to measure epistemological beliefs that are discipline-specific and vary according to the scientific practices experienced rather than general epistemological beliefs. Therefore, further research can be conducted to build a bridge between real life and school science practices and epistemological beliefs. Moreover, data collection tool development studies can be conducted to overcome the gaps in qualitative data collection tools and domain-focused scales in measuring epistemological beliefs.

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Appendix: CoHE National Thesis Center Analyzed Thesis No

153530	187309	191708	201693	210276	211317	217994	217995	217998
219319	231558	238269	241433	250701	250719	255234	262933	264102
264119	264715	265534	266400	268848	277712	277976	286216	298432
300616	317163	321084	327571	328846	336035	336336	338278	338353
350922	357094	357097	357116	358212	368170	372294	372302	377618
377626	377842	377880	379893	379965	381617	383506	388190	396653
407537	415917	418208	426181	429399	429427	430051	433698	436956
439183	439250	439267	443448	446025	446847	451210	454677	461905
462317	481519	483724	484452	504666	505017	511929	512583	513234
515712	529997	531985	532205	534461	538163	539269	542404	542419
548764	551517	553609	564161	564537	564967	566363	566572	571145
572523	578206	581723	582421	583186	584240	587216	590356	592742
593223	599618	600008	600603	600624	603307	605378	608814	609952
610692	613616	624852	628496	628585	628837	636277	640967	650992
653128	655520	658788	662366	663104	665779	666843	667025	681970
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763027	769697	771300	772283	776884				