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Do Epistemological Beliefs Predict Critical Thinking Dispositions?: A Cross-sectional Study with Turkish High School Students

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Abstract

This study aimed to investigate whether high school students' epistemological beliefs differ by gender and parents' educational background variables and if their epistemological beliefs are significant predictors of critical thinking dispositions. The data for this study were collected with UF/EMI Critical Thinking Disposition Instrument and Epistemological Belief Scale and it was carried out with 178 high school students. This study revealed that while gender did not significantly affect students' epistemological beliefs, parents' educational background significantly affected their epistemological beliefs. Students who have parents with higher educational degrees had more sophisticated epistemological beliefs. Besides, students' source, development, certainty, and justification scores significantly predicted their critical thinking dispositions and they together explained 24% of the total variance in students' critical thinking dispositions. Students' source, development, certainty, and justification scores were positively correlated to their critical thinking dispositions.

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INTRODUCTION

Epistemology deals with the nature, source, limits, and characteristics of the knowledge (Hofer & Pintrich, 1997). In epistemology, answers are sought for questions about knowledge structure, such as the source, reliability, limits, accuracy, and validity of knowledge (Demir & Acar, 2005). In short, epistemology is a discipline that investigates the nature of knowledge and knowing and seeks answers to questions about this subject. Therefore, epistemology is not only concerned with knowledge itself but also investigates the relationship between the knower and the known phenomenon. For this reason, it examines all features of the process of knowing and the structure of knowledge (Cevizci, 2012). Epistemological beliefs (EBs) refer to the individual's personal beliefs about these questions and characteristics (Schommer, 1994). The individual's beliefs about the source, scope, and criterion of knowledge constitute that person's EBs. In other words, EBs are all of the individual's beliefs about knowing and knowledge (Hofer & Pintrich, 1997). Therefore, EBs include not only subjective views on the structure of knowledge but also the individual's views on the learning process (Schommer, 1990). Schommer (1990) suggested that EBs can be categorized under two titles, namely, sophisticated and naïve EBs. Individuals with naïve EBs believe that knowledge is certain and it can be seen as a set of isolated facts. Also, they think that learning ability is genetically determined and it is quick. On the other hand, individuals with sophisticated EBs believe that knowledge is integrated conceptions and tentative. Besides, they think that the speed of learning is gradual and ability of learning can be developed through experience.

When it is accepted that the beliefs and attitudes of individuals can affect the decisions they make and the behaviors they display (Pajares, 1992; Brown & Cooney, 1982), being able to accurately determine individuals' beliefs about the structure of knowledge and knowing will be beneficial to develop teaching-learning processes in the classroom (Hofer & Pintrich, 1997). In addition, while EBs are a factor that affects students' understanding and learning skills (Müller, Rebmann, & Liebsch, 2008), they also affect the teaching activities that teachers put into practice in their classrooms (Lee et al., 2013; Chan & Elliott, 2004). Therefore, EBs that affect both students and teachers in a versatile way (Biçer, Er, & Özel, 2013) are a variable that should be taken into consideration in educational activities and need to be factored into the process to increase success (Brownlee, Purdie, & Boulton-Lewis, 2001).

EPISTEMOLOGICAL BELIEFS AND CRITICAL THINKING

According to Hofer and Sinatra (2010), there is a link between critical thinking (CT) and EBs, and EBs are related to the individuals' ability to be critical on the reasoning and judgments that they employ to acquire knowledge throughout their life. Therefore, it can be said that individuals with sophisticated EBs are likely to be more critical in the thinking process (Getahun, Saroyan, & Aulls, 2016). Similarly, many researchers (Schommer, 1990; Bendixen & Rule, 2004; Dahl, Bals, & Turi, 2005; Hofer, 2004) state that individuals with sophisticated EBs have higher CT skills and dispositions because it is a fact that higher-order thinking skills like CT are required to have sophisticated EBs (Bendixen & Hartley, 2003). In addition, the cognitive process, which includes thinking skills, is greatly affected by the individual's beliefs on the source of knowledge, how knowledge is formed, and the structure of knowledge, etc. (Hofer & Sinatra, 2010). In other words, individual's EBs significantly affect CT. A learning environment that enables students to analyze, evaluate and interpret their surroundings also allows students to develop their EBs (Kuhn & Dean, 2004; Bendixen & Rule, 2004). That is to say, a learning environment prepared to develop CT will also positively affect the way EBs are formed or improved (Valanides & Angeli, 2005). It is possible to say that individuals with high CT skills and dispositions have sophisticated EBs (Kuhn & Dean, 2004). Anderson-Meger (2014) also states that maturation in EBs has a positive effect on the improvement of CT. Kuhn (1999) discusses EBs under four headings as realistic, absolutist, pluralistic, and evaluative and states that there is a significant association between these beliefs and CT. According to Kuhn (1999), CT skills and

dispositions of people who have a realistic belief in epistemology are not sufficient. People with realistic EBs believe that truth can be known directly, and CT is unnecessary for them. An absolute EBs can form the basis for a higher level of CT. People with absolute EBs have a dual belief system which means information is either true or false. CT is used as a tool in making this decision. In pluralistic EBs, although CT skills are not sufficient, judgments, opinions, and discussions can be freely chosen. According to people who have pluralistic EBs, the reality or accuracy of information depends on the belief of the individual. Therefore, CT is unnecessary at this point as well. Evaluative EBs is a stage in which claims and judgments are evaluated in the context of discussion and evidence. At this stage, CT is used as a tool for comprehension and understanding skills, and the EBs with the highest CT skills and dispositions are the evaluative EBs.

In the literature, we can find numerous studies concluding a significant relationship between EBs and metacognition (Adak, 2016; Bendixen & Rule, 2004, Dahl, Bals & Turi, 2005), mental risk-taking (Özbay, 2016), reflective thinking (Ekici, 2018), problem-solving (Hacıömeroğlu, 2011; Chan, 2007; Kutluca, 2018), thinking styles (Schommer & Hutter, 2002), and self-regulation (Braten & Stromso, 2005; Neber & Schommer, 2002; Pintrich, 2004; Green & Azevedo, 2007). In a similar vein, many studies in the literature have concluded that EBs and CT are significantly related to each other (Wyre, 2007; Başbay, 2013; Hyytinen et al., 2014; Koyunlu Ünlü & Dökme, 2017; Şıvgın, 2019). Also, there are many previous studies concluding that CT skills and dispositions increase in parallel with the maturation of EBs (King & Kitchener, 2004; Kuhn, 2005). Therefore, it is possible to say that as individuals' EBs mature, their CT skills and dispositions tend to develop (Bok, 2006; Kuhn, 1999). Wyre (2007) carried out a study which aimed to examine the effect of learning activities designed to develop CT skills on CT skills and EBs with 681 university students and concluded that the learning activities significantly improved the students' CT skills and EBs. According to Wyre (2007), when the individual starts to think about his/her thinking process, he/she will have more sophisticated EBs. Başbay (2013) also aimed to test the relationship between CT dispositions and EBs with structural equation modelling and concluded that students' CT dispositions affect EBs. In their study, Hyytinen et al. (2014) concluded that EBs and CT skills are intertwined and affect each other. Similarly, Koyunlu Ünlü and Dökme (2017), who carried out a study with 447 undergraduate students to examine the relationship between EBs and CT skills, concluded a significant, positive, and strong relationship between CT skills and EBs. Şıvgın (2019) conducted a study with 1205 high school students to investigate the association between high school students' EBs and CT and concluded that CT and EBs are significantly related. While students with naive EBs think that knowledge has a definite and unquestionable structure, students with sophisticated EBs believe that knowledge is not certain, changeable, and falsifiable (Barzilai & Zohar, 2012). Therefore, it can be said that more sophisticated EBs lead the way to higher CT skills and dispositions.

In short, EBs that affect many higher-order thinking skills also affect CT. CT and EBs, which are in mutual interaction, affect each other. Therefore, it is possible to say that people with sophisticated EBs will have high CT dispositions and skills (King & Kitchener, 2004; Kuhn, 2005; Bok, 2006; Getahun, Saroyan, & Aulls, 2016).

EPISTEMOLOGICAL BELIEFS, GENDER, AND EDUCATIONAL BACKGROUND OF FATHER AND MOTHER

Previous literature on gender differences in EBs reported conflicting results across different samples. While some studies concluded EBs did not significantly differ by gender (Trautwein & Lüdtke, 2007; Bakır & Adak, 2014; Buehl, Alexander, & Murphy, 2002; Youn, Yang, & Choi, 2001; Taşkın, 2021; Koç & Memduğoğlu, 2017; Kaya & Ekiçi, 2017; Chan & Elliott, 2002; Kazu & Erten, 2015; Elmalı & Yıldız, 2017; Schommer et al., 1997), there are also some other studies reported that gender significantly affected EBs (Özkal et al., 2017; Bendixen, Schraw, & Dunkle, 1998; Neber & Schommer, 2002; Schommer & Dunnell, 1994; Hofer, 2000; Aslan, 2017). Similarly, if the existing literature is investigated, it can be seen that there are some previous studies found that father and mother's educational background (EDB) was a significant variable that affected EBs (Schommer, 1990;

Bozpolat & Durdu, 2020; Yankayış, Güven, & Türkoğuz, 2014; Kırbaşlar, Arıca, & Barış, 2021). However, there are also some other contradictory studies reported that parents' EDB did not significantly affect EBs (Bakır & Adak, 2014; Koç Erdamar & Bangir Alpan, 2011; Eroğlu & Güven, 2006).

In short, it can be said that gender and father and mother's EDB are widely examined demographic variables within the context of EBs and the previous literature over gender and father and mother's EDB differences on EBs revealed inconsistent results across different countries and samples although huge body of literature indicated no significant effect of gender on EBs. According to Pintrich (2002), gender may not significantly affect EBs when EBs are measured in terms of specific sub-dimensions instead of more holistic and general ways of thinking. Therefore, no significant gender differences in EBs of students are expected in this study because the scale used to measure EBs of students has four sub-dimensions and EBs are investigated in terms of these sub-dimensions. When it is compared with gender differences, there are fewer studies (e.g. Bozpolat & Durdu, 2020; Yankayış, Güven, & Türkoğuz, 2014; Kırbaşlar, Arıca, & Barış, 2021; Bakır & Adak, 2014) investigating father and mother's EDB differences on EBs. Therefore, it can be said that there is a clear need to examine the effect of parents' EDB on EBs. Schommer (1990) stated that students who have more educated parents are possibly exposed to more substantial scientific resources at home or in school and have more chance for independence. Besides, more educated parents can provide the necessary support and guidance in social and cultural environments for their children. Therefore, it is expected that in this study that father and mother's EDB will have a significant effect on students' EBs and students with more educated parents will have more sophisticated EBs.

THE CURRENT STUDY

Although there are many correlational studies examining the relation between EBs and CT, the studies aiming to investigate the predictability of EBs on CT dispositions are scarce. The correlational studies have a limitation that makes it impossible to say the direction of the relationship between two variables. Although the previous correlational studies are essential because they provide evidence regarding the relationship between EBs and CT, these studies are limited to say the direction of this relationship. Therefore, investigating the predictability of EBs on CT dispositions is important. Although there are a few studies examining the predictive power of EBs on CT dispositions in the literature, majority of them were conducted with university students. Therefore, it can be said that this study is essential and differs from the other previous studies because it aims to provide additional evidence regarding the predictive power of high school students' EBs on their CT dispositions. Besides, although gender and parents' EDB are widely examined demographic variables with EBs studies, previous studies over gender and parents' EDB differences on EBs revealed contradictory results that let the researcher to investigate the effect of gender and parents' EDB on EBs in this study. So, this study aimed to determine whether high school students' EBs are significant predictors of their CT dispositions and whether their EBs significantly differ by gender and parents' EDB variables. Therefore, the following questions were sought:

1. Do high school students' EBs significantly differ by their gender?
2. Do high school students' EBs significantly differ by their father and mother's EDB?
3. Are high school students' scores on Epistemological Belief Scale sub-dimensions (source, certainty, development, and justification) significant predictors of their CT dispositions?

METHOD

A cross-sectional survey design was used in this non-experimental quantitative study. In a cross-sectional survey design which aims to depict what already exists in the population (Setia, 2016), the data are collected from participants at a specific point in time (Lavrakas, 2008). The

dependent variable was high school students' CT dispositions while predictor variables of the study were students' scores on source, certainty, development, and justification sub-dimensions of the Epistemological Belief Scale (EBC).

STUDY GROUP

This study was conducted with 178 students (100 female, 78 male) studying in two high schools in a city in the northern part of Turkey using a convenient sampling method. The mean age of them was 14.52 (SD=0.55) and their age ranged between 13 and 16. 52.8% and 47.2 of the students were 9^{th} and 10^{th} grade students, respectively. Before the study, a-priori power analysis was carried out with G*Power 3 software program (Faul et al., 2007) and it revealed that the minimal sample size needed to conduct a linear multiple regression analysis in this study (alpha=0.05; power=0.95; 4 predictor variables) to have a medium effect size (f^2=0.15) would be 129. Therefore, we can say that the sample size of 178 was very good for this study with four predictor variables, namely, source, certainty, development, and justification.

DATA COLLECTION TOOLS

UF/EMI CRITICAL THINKING DISPOSITION INSTRUMENT (CTDI)

CT dispositions were determined by CTDI developed by Irani et al. (2007) and adapted into Turkish by Kılıç and Şen (2014). CTDI has 25 items and three sub-dimensions. Reliability values of the sub-dimensions of CTDI ranged from 0.70 to 0.88 and it was calculated as 0.89 for the total instrument. Also, for this study, Cronbach's alpha values were calculated as 0.86, 0.62, and 0.70 for engagement, maturity, and innovativeness sub-dimensions, respectively. Besides, Cronbach's alpha value for the total instrument was calculated as 0.89 in this study.

EPISTEMOLOGICAL BELIEFS SCALE (EBS)

EBS, developed by Conley et al. (2004) and adapted into Turkish by Evcim (2010), was used to determine students' EBs. EBS has four sub-dimensions, namely, source (4 items), certainty (7 items), development (6 items), and justification (8 items). The reliability coefficients were 0.80, 0.78, 0.71, and 0.71 for certainty, justification, source, and development sub-dimensions, respectively. Also, the reliability estimates calculated for the sub-dimensions for this study ranged from 0.68 to 0.86.

DATA COLLECTION

Ethical committee approval was got from ZBEU (No: 120863 dated 31.12.2021) and the data were collected in the fall term of 2021-2022 academic year. All high schools were visited by the researcher to collect the data. All students were informed of privacy and confidentiality issues and their right to withdrawal from the study. The instruments were completed in about 25-30 minutes.

DATA ANALYSIS

Firstly, each variable was checked to see if there were any missing data and no missing data were observed. Then, the normality of the data was checked with skewness and kurtosis values and it was seen that the data had normal distribution (See Table 1). After that, outliers per variable were checked by Z transformation and Mahalanobis Distance (Mahalanobis D^2) scores were used to determine multivariate outliers. Z-scores and Mahalanobis Distance scores indicated that the dataset had no influential outliers. The possibility of high correlation among the predictor variables were checked by investigating Pearson correlation, CI, VIF, and tolerance values and no high correlation was seen among the predictor variables. Also, before conducting MANOVA, Henze-Zirkler test was used to investigate multivariate normality and it was seen that the data has multivariate normality. Besides, Box's M test results showed that covariance between the groups was equal (Box's M=150.920; p>0.01). The collected data were analysed with independent samples t-test, MANOVA test, Pearson correlation, and multiple linear regression with enter method. SPSS 20 statistical software was used for all of the analyses.

Table 1. *Skewness and Kurtosis Values for All Measured Variables*

	Skewness		Kurtosis	
	Statistic	Std. Error	Statistic	Std. Error
Engagement	-0.124	0.182	-0.310	0.362
Maturity	-0.038	0.182	0.456	0.362
Innovativeness	-0.121	0.182	-0.482	0.362
CTDI total score	0.004	0.182	-0.290	0.362
Source	0.442	0.182	-0.387	0.362
Development	-0.302	0.182	-0.584	0.362
Certainty	0.016	0.182	-0.340	0.362
Justification	-0.643	0.182	0.013	0.362

RESULTS

RESULTS ON PUBLICATION BIAS

Descriptive statistics of sub-dimensions of the EBS and the results regarding the gender differences are shown in Table 2.

Table 2. *Descriptive Statistics for the EBS Sub-dimensions*

	Total Sample (n=178)		Female (n=100)		Male (n=78)			
	$\overline{X}$	sd	$\overline{X}$	sd	$\overline{X}$	sd	$t_{(178)}$	p
EBS sub-dimensions								
Source	3.62	0.51	3.60	0.50	3.66	0.53	-0.813	0.41
Development	4.09	0.54	4.05	0.48	4.14	0.60	-1.118	0.26
Certainty	3.79	0.43	3.80	0.40	3.78	0.46	0.247	0.80
Justification	4.18	0.53	4.15	0.48	4.22	0.58	-0.902	0.36

Table 2 shows that high school students had highly sophisticated beliefs about source ($\overline{X}$ =3.62), development ($\overline{X}$ =4.09), certainty ($\overline{X}$ =3.79), and justification ($\overline{X}$ =4.18) of knowledge and learning. Also, it was found out that students' source sub-dimension (t_{178}=-0.813, p>0.05), development sub-dimension (t_{178}=-1.118, p>0.05), certainty sub-dimension (t_{178}=0.247, p>0.05), and justification sub-dimension (t_{178}=-0.902, p>0.05) scores did not differ by gender though male students presented slightly higher scores for each sub-dimension.

Table 3. *MANOVA Test Results Regarding EBS Sub-dimensions*

Effect		Value	F	Hypothesis df	Error df	p	η^2
Intercept	Wilks' Lambda (λ)	0.009	4185.312	4.00	154.000	0.00	0.99
Mother's EDB	Wilks' Lambda (λ)	0.814	2.046	16.00	471.115	0.01	0.05
Father's EDB	Wilks' Lambda (λ)	0.760	2.764	16.00	471.115	0.00	0.06
Mother's EDB* Father's EDB	Wilks' Lambda (λ)	0.619	1.645	48.00	595.263	0.00	0.11

Note: Mother's EDB=mother's educational background; Father's EDB=father's educational background

MANOVA test results indicated that EBS sub-dimensions scores significantly differed by students' mother's EDB (λ=0.814; $F_{(178)}$=2.046; p<0.05; η^2=0.05), father's EDB (λ=0.760; $F_{(178)}$=2.764; p<0.05; η^2=0.06), and mother's EDB *father's EDB (λ=0.619; $F_{(178)}$=1.645; p<0.05; η^2=0.11).

Table 4. *MANOVA Test Results Regarding EBS Sub-dimensions*

Source	Dependent variable	Sum. of squares	df	Mean square	F	p	η^2
Mother's EDB	Source	2.830	4	0.707	3.718	0.00	0.08
	Development	2.305	4	0.576	2.616	0.03	0.06
	Certainty	0.286	4	0.071	0.446	0.77	0.01
	Justification	3.482	4	0.870	4.299	0.00	0.09
Father's EDB	Source	3.956	4	0.989	5.197	0.00	0.11
	Development	3.331	4	0.833	3.780	0.00	0.08
	Certainty	2.157	4	0.539	3.368	0.01	0.07
	Justification	2.298	4	0.574	2.837	0.02	0.06
Mother's EDB* Father's EDB	Source	4.268	12	0.356	1.869	0.04	0.12
	Development	3.210	12	0.268	1.215	0.27	0.08
	Certainty	3.550	12	0.296	1.848	0.04	0.12
	Justification	8.631	12	0.719	3.553	0.00	0.21

Note: Mother's EDB=mother's educational background; Father's EDB=father's educational background

Students' source scores ($F_{(178)}$=3.718; p<0.05; η^2=0.08), development scores ($F_{(178)}$=2.616; p<0.05; η^2=0.06), and justification scores ($F_{(178)}$=4.299; p<0.05; η^2=0.09) significantly differed according to students' mother's EDB variable while their certainty scores ($F_{(178)}$=0.446; p>0.05; η^2=0.01) did not significantly differ. Also, students' source scores ($F_{(178)}$=5.197; p<0.05; η^2=0.11), development scores ($F_{(178)}$=3.780; p<0.05; η^2=0.08), certainty scores ($F_{(178)}$=3.368; p<0.05; η^2=0.07), and justification scores ($F_{(178)}$=2.837; p<0.05; η^2=0.06) significantly differed according to students' father's EDB variable. Besides, students' source scores ($F_{(178)}$=1.869; p<0.05; η^2=0.12), certainty scores ($F_{(178)}$=1.848; p<0.05; η^2=0.12), and justification scores ($F_{(178)}$=3.553; p<0.05; η^2=0.21) significantly differed by their mother's EDB*father's EDB variable while their development scores ($F_{(178)}$=1.215; p>0.05; η^2=0.08) did not significantly differ. So, we can say that both mother's and father's EDB were significant variables which can affect their EBS sub-dimensions scores with an intermediate effect based on Cohen's (1988) classification. However, mother's EDB *father's EDB variable affected high school student's justification sub-dimension scores with a large effect (η^2=0.21) based on Cohen's (1988) classification. Students who have parents with higher educational degrees possessed more sophisticated EBs.

Table 5. *Pearson Correlation Results among the Sub-dimensions of CTDI and EBS*

	Maturity	Innovativeness	Source	Development	Certainty	Justification
Engagement	0.530**	0.754**	0.300**	0.291**	0.254**	0.328**
Maturity	1	0.538**	0.275**	0.368**	0.225**	0.329**
Innovativeness	-	1	0.274**	0.359**	0.278**	0.347**
Source	-	-	1	0.296**	0.422**	0.314**
Development	-	-	-	1	0.227**	0.677**
Certainty	-	-	-	-	1	0.191*

Note: ** p< 0.01; * p< 0.05

As presented in Table 5, all of the sub-dimensions of CTDI and EBS were correlated to each other.

Table 6. *Multiple Linear Regression Results between CT Dispositions and Source, Development, Certainty, and Justification Scores*

	B	Std. Error	β	t	p
Constant	1.450	0.348	-	4.169	0.00
Source	0.138	0.069	0.152	1.999	0.04
Development	0.162	0.079	0.187	2.055	0.04
Certainty	0.165	0.080	0.152	2.063	0.04
Justification	0.162	0.080	0.185	2.023	0.04

$R=0.490$, $R^2=0.240$, $F_{(4, 177)}= 13.648$, $p<0.01$

As shown in Table 6, the regression model was significant ($F_{(4,177)}=13.648$, $p<0.01$). Also, it was found out that source ($\beta=0.152$, $t_{(178)}=1.999$, $p<0.05$), development ($\beta=0.187$, $t_{(178)}=2.055$, $p<0.05$), certainty ($\beta=0.152$, $t_{(178)}=2.063$, $p<0.05$), and justification ($\beta=0.185$, $t_{(178)}=2.023$, $p<0.05$) scores significantly predicted CT dispositions ($R=0.490$, $R^2=0.240$, $p<0.01$). Source, development, certainty, and justification together explained 24% of the total variance in students' CT dispositions. In addition to these, development ($\beta=0.187$) was the significant predictor which had the greatest effect on CT dispositions. Justification ($\beta=0.185$), source ($\beta=0.152$), and certainty ($\beta=0.152$) followed it.

CT dispositions= 1.450 + 0.138*source + 0.162*development + 0.165*certainty + 0.162*justification

DISCUSSION, CONCLUSION AND IMPLICATIONS

This study revealed that students had sophisticated EBs regarding source, development, certainty, and justification of knowledge and learning. Also, high school students' EBs regarding source, development, certainty, and justification sub-dimensions did not significantly differ by gender. When the existing literature over EBs is investigated, it can be seen that some previous studies found that gender was not a significant variable that can affect EBs (Bakır & Adak, 2014; Taşkın, 2021; Conley et al., 2004; Koç & Memduğoğlu, 2017; Kaya & Ekiçi, 2017; Schommer et al., 1997; Trautwein & Lüdtke, 2007; Youn, Yang, & Choi, 2001; Kazu & Erten, 2015; Elmalı & Yıldız, 2017). On the contrary, other studies reported that gender was a significant variable that affects EBs (Özkal et al., 2017; Bendixen, Schraw, & Dunkle, 1998; Neber & Schommer, 2002; Schommer & Dunnell, 1994; Hofer, 2000; Aslan, 2017). Therefore, it can be said that most of the studies, including this one, revealed that gender was not a significant variable that affects EBs. However, there are also other studies indicating gender was a significant variable that can affect individuals' EBs. We can say that further studies regarding the effect of gender on EBs should be carried out because of these inconsistent results of previous research.

Also, this study revealed that high school students' EBS sub-dimensions scores significantly differed by mother's EDB with an intermediate effect based on Cohen's (1988) classification except for certainty sub-dimension scores. Also, students' all EBS sub-dimensions scores significantly differed by father's EDB with an intermediate effect based on Cohen's (1988) classification. Besides, students' all EBS sub-dimensions scores significantly differed by mother's EDB*father's EDB variable except for development sub-dimension scores. While mother's and father's EDB variable significantly affected students' source and certainty sub-dimensions scores with an intermediate effect, it significantly affected their justification sub-dimension scores with a large effect based on Cohen's (1988) classification. It was found out that students who have parents with higher educational degrees had more sophisticated EBs. This finding may be attributable to the fact that students with more educated parents are more likely to be exposed to more substantial scientific resources in their home or school and they have more chance for independence (Schommer, 1990). Also, their parents can provide the necessary support and guidance in social and cultural environments for them. There

are some previous studies found that father and mother's EDB was a significant variable that affected EBs (Schommer, 1990; Bozpolat & Durdu, 2020; Yankayış, Güven, & Türkoğuz, 2014; Kırbaşlar, Arıca, & Barış, 2021). Therefore, we can say that the result of this study was confirmed by previous research although there are also some other contradictory studies reported that parents' EDB did not significantly affect EBs (Bakır & Adak, 2014; Koç Erdamar & Bangir Alpan, 2011; Eroğlu & Güven, 2006).

It was also found that students' source, development, certainty, and justification scores significantly predicted CT dispositions, and they together explained 24% of the total variance in students' CT dispositions. In their study aiming to examine the relationship between CT and EBs, Chan, Ho, and Ku (2011) concluded that EBs were the significant predictors of CT, and they together explained %11 of the variance in CT. According to Chan, Ho, and Ku (2011) sophisticated EBs predicted higher CT. Also, Koyunlu Ünlü and Dökme (2017) who investigated the relationship between CT dispositions and EBs of science teachers' candidates concluded a moderate correlation between EBs and CT dispositions. In their study investigating the relationship between EBs, CT dispositions, and metacognition via structural equation model, Akbay, Akbay and Başer Gülsoy (2018) concluded that EBs significantly predicted CT dispositions. Similarly, Şıvgın (2019) concluded that EBs were significantly correlated to CT dispositions in her study. Besides, Başbay (2013) carried out a study with 425 university students to examine the relationship between CT dispositions, EBs, and metacognitive awareness and concluded a significant association between CT dispositions and EBs. In addition to these, there are also other studies (Hyytinen et al., 2014; Rott, 2021; Rott & Leuders, 2017; Wyre, 2007; Kandemir & Eğmir, 2020) concluding that there was a significant association between CT and EBs. Therefore, we can say that the results of this study are in line with the results of previous research.

Previous research, including this study, indicated that EBs were significant predictors of CT dispositions. EBs have determinative effects on various variables such as individuals' ability of comprehension, their preferred study strategies, the effort and time they spend for learning, the way they interpret the new information they encounter for the first time and most importantly higher-order thinking skills like CT, creative thinking, or problem-solving (Brownlee, Purdie, & Boulton-Lewis, 2001; Tolhurst, 2007; Chan, 2007). Also, many researchers have the same idea that sophisticated EBs are a prerequisite for an individual to engage in CT (Bendixen & Rule, 2004; Dahl, Bals, & Turi, 2005; Hofer, 2004; Gallagher, 1998; Jones & Merritt, 1999) because sophisticated EBs constitute a basis for the flexible thinking which is a must for CT (Chan, Ho, & Ku, 2011). Therefore, it can be inferred that the individuals who have naive EBs will probably show poor CT performance. It can be said that sophisticated EBs lead to more-developed cognitive strategies for learning and naive EBs can be related to a less need for cognition which shows us the strong relationship between CT and EBs (Kuhn & Weinstock, 2002). According to Hofer and Sinatra (2010), the cognitive process, which includes higher-order thinking skills like CT, is highly affected by the individual's beliefs about the source, development, certainty, and justification of the knowledge and learning. In other words, EBs can highly affect individuals' CT skills and dispositions. Individuals with sophisticated EBs tend to be more critical in the thinking process (Getahun, Saroyan, & Aulls, 2016), and more sophisticated EBs have positive effect on the development of CT skills and dispositions (Anderson-Meger, 2014).

The beliefs in knowledge being fixed and absolute which are associated with naive EBs lead to unwillingness to participate in thinking and to be open-minded. Individuals with naive EBs will have a failure in performing good CT performance because drawing reasonable conclusions and making sound inferences are dependent on an adequate consideration of all kinds of viewpoints and arguments when facing a controversial issue and close-minded individuals with an absolutist thinking style as a result of naive EBs will probably focus only on his/her own viewpoint and the evidence that supports this viewpoint while ignoring the counterarguments which do not support his/her viewpoint and position. This can be shown as an explanation of why more sophisticated EBs predicted higher CT

dispositions which is an essential result of this study because a good critical thinker should be open-minded, confident to reason, intellectually curious about new challenges and new knowledge, willing to employ reasoning skill, and be able to effectively consider all viewpoints (Irani et al., 2007). However, the individuals with naive EBs about knowledge and learning have a single-perspective approach to problems, arguments, and issues, and they are unwilling to consider counterarguments. This lack of multiple perspectives and having a fixated perspective hinder the ability to produce, evaluate, and judge alternatives which results in poor CT performance.

In short, this study revealed that while gender is not a significant variable that can affect students' EBs, EDB of father and mother is a significant variable that can affect their EBs. Students who have parents with higher educational degrees also have more sophisticated EBs. Besides, students' source, development, certainty, and justification scores significantly predicted students' CT dispositions. These results of this study are confirmed by previous research and are in line with the theoretical background.

LIMITATIONS AND IMPLICATIONS FOR OTHER STUDIES

Although this study has some important results regarding the relationship between students' EBs and CT dispositions, it has several limitations. Firstly, the sample of the study can be shown as a limitation because this study was carried out with students studying in high school in a city in the northern part of Turkey. Therefore, it would be a great idea to examine the predictability of EBs on CT dispositions with other sample groups and compare the results with this study. Secondly, the data for this current study were collected with only self-report quantitative tools. Self-report quantitative tools can be influenced by social desirability. Therefore, data collection tools are the second limitation of the study. Other studies using qualitative or mixed methods can be carried out to have better understanding of the association between EBs and CT dispositions.

This study also has some important implications. It was found that high school students' EBs were significant predictors of their CT dispositions. This result emphasized the importance of EBs on CT dispositions. Therefore, it can be suggested that EBs should be implemented during the effort to enhance CT dispositions because any efforts to mature EBs will also have a positive effect on CT dispositions.

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Author(s) declare that they have no conflict of interest.

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