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Abstract

This study was conducted to investigate structural relations among preservice science teachers' scientific epistemological beliefs, epistemic emotions and argumentativeness. After validation of measurement results, a structural equation modeling analysis was implemented on the data covering 612 participants. Results showed that participants' epistemological beliefs significantly predicted their emotions and argumentativeness. Also, their epistemic emotions significantly predicted their argumentativeness. To illustrate, a preservice science teacher believing that knowing in science should be evidenced may feel herself excited if she encounters with opposite ideas. Then, this positive feeling together with her sophisticated epistemological beliefs may support her decisions to participate in argumentation processes. Considering these findings several implications were suggested.

Introduction

In this era, abundance of information has increased dramatically with the assistance of different types of technologies; however, people have been encountering difficulties about which information is true/valid (Güneş & Bahçivan, 2018). Existence of multiple sources of information, so possible conflictions, make people to focus on epistemic nature of information such as which information can be accepted as knowledge and how this knowledge can be justified. These processes of producing judgments about knowledge and knowing can be called as epistemic cognition (Muis, et al., 2015) and triggered many researchers to contribute into the research on personal epistemology.

Personal epistemology, as involving central beliefs, affects deeply people's learning, teaching and decision making processes (Hofer & Pintrich; 1997). In other words, epistemological beliefs seemed to be effective on science learners' and teachers' cognition (Bahcivan & Cobern, 2016; Cano, 2005; Chan & Elliott, 2004, Gok, 2018); therefore, responses to how people's epistemological beliefs affect their learning and teaching processes have still been scrutinized by different types of scientific approaches. This literature still lacks of evidential support in terms of external validation of results, especially within the aspect of epistemic emotions (Muis, et al., 2015). In this regard, querying possible effects of preservice science teachers' (PSTs') epistemological beliefs on their epistemic emotions may create invaluable opportunities in terms of generating contemporary educational designs for preservice and/or inservice science teachers. Because, epistemic emotions are accepted as powerful mediators between PSTs' epistemological beliefs and certain (educationally important) variables such as learning strategies and learning outcomes (Muis et al., 2015; Trevors et al., 2017).

In this study, PSTs' argumentativeness was focused for investigation of its relationships with their epistemological beliefs; because, just a limited number of researchers has already revealed that people's epistemological beliefs were related to their argumentation skills or their tendencies to participation in argumentation processes (e.g. Duschl & Osborne, 2002; Kuhn, 1993; Nussbaum & Bendixen, 2003). Today, educators accept argumentation, which is also connected to people's personal epistemology, as a higher order thinking skill (Kuhn, 2005; Moshman, 2004); however, scientific research evidencing this relationship has still been restricted. In other words, PSTs' epistemological beliefs may deeply affect their argumentativeness through activating their epistemic emotions. Argumentation is internationally accepted as a way of thinking skill and aimed to be developed through curricular implementations (Kuhn, 2005; 1993). Studying the relationships among PSTs' epistemological beliefs, epistemic emotions and argumentativeness may provide opportunities to

develop educational mediums supporting their argumentation skills more effectively. Additionally, such a study provides empirical evidence for previous theories in science education area. Considering these significant contributions, this study was conducted to examine the structural relationships among PSTs' epistemological beliefs, epistemic emotions and argumentativeness. In light of the purpose, this study will respond to the following research question:

- What are the relationships among PSTs' epistemological beliefs, epistemic emotions and argumentativeness?

Background

Epistemological Beliefs

Personal epistemology includes people's beliefs and positions about structure of knowledge and knowing (Hofer & Pintrich; 1997). Its centralized and directive position in human cognition made science teacher educators to probe personal epistemology (Bahcivan & Cobern, 2016; Brownlee, Boulton-Lewis, & Purdie, 2002). Research trends in this domain can be presented with 3 different approaches (Bahçivan, 2017). Perry (1970), architect of the first research trend called as developmental approach, has claimed that people's epistemological status follows 4 different stages: dualistic, multiplicity, relativism and commitment within relativism. Biological developments and social interactions trigger positive shifts within people's epistemological status from dualistic to commitment within relativism. To illustrate, an individual (most probably a child) in dualistic stage claims that every bits of knowledge is absolutely true or wrong and this situation does not change whereas a person in relativism stage asserts that accuracy of knowledge depends on a person's approach relating with that knowledge. Researchers following developmental approach mention that educational support can make positive shifts in people's personal epistemology (e.g. King & Kitchener, 2004).

The second research trend, called as multidimensional perspective, in epistemology literature was proposed and evidenced firstly by Schommer (1990). Accordingly, people's personal epistemology covers their epistemological beliefs distributed to different dimensions (labeled as certainty, simplicity, source, quick learning and innate ability) which can be more or less independent (Schommer, 1994). Many researchers holding developmental perspective criticized the last two dimensions because of their relation to learning instead of knowledge/knowing. Schommer-Aikins (2004) adapted her approach considering these critics and stated that the first three dimensions were related to epistemology whereas the other two were related to learning. Also, she mentioned that the first three dimensions affect the forms of other two. People's epistemological beliefs in any dimension are accepted as expanding on a continuum from naïve to sophisticated in this trend. Naïve side refers to unqualified beliefs whereas sophisticated side corresponds to advanced epistemological beliefs (Sinatra, Kienhues & Hofer, 2014). To illustrate, naïve beliefs correspond to that knowledge is certain (certainty), involves isolated bits (simplicity) and constructed by authorities (source) such as scientists, teachers etc… whereas sophisticated epistemological beliefs refers that knowledge is changing, has a complex and related structure, and people are their own knowledge constructers.

The last research trend focuses on domain and/or context dependency of epistemological beliefs. According to this trend, people hold domain general epistemological beliefs which can present differentiations if measured topic (force, light, waves, etc…) or domain (mathematics, psychology, history, etc…) specific forms (Buehl, Alexander & Murphy, 2002). For example, PSTs might believe that physics involve more certain knowledge in comparison to biology (Bahçivan, 2016). Researchers also accept that contextual factors may be effective on differentiations in epistemological beliefs. For example, believing that knowledge about shape of Earth will change in future does not correspond to a sophisticated epistemological belief (Elby & Hammer, 2001).

Researchers claimed and presented evidences that PSTs' epistemological beliefs were central to their beliefs about learning and teaching (Brownlee, Boulton-Lewis, & Purdie, 2002; Hofer & Pintrich, 1997). The researcher (Bahcivan, 2014; Bahçivan, 2016; Güneş & Bahçivan, 2016) provided evidences confirming such relationships with independent research studies involving Turkish PSTs. In general, it can be mentioned that PSTs' sophisticated epistemological beliefs provide them to hold more constructivist conceptions of teaching and learning of science in comparison to naïve epistemological beliefs. In addition, certain researchers proved that university students holding more sophisticated epistemological beliefs got higher achievement scores in comparison to peers holding more naïve epistemological beliefs (e.g. Hofer, 2000). Finally, Muis (2007, 2008) showed that university students' epistemological beliefs predicted their self-regulated learning. In following studies Muis and her colleagues (2015) showed that university students' epistemological beliefs trigger their

epistemic emotions which, then, determine whether they adapt deep or surface processing learning strategies. Unexpected relations; on the other hand, was also observed in terms of relationships between PSTs' epistemological beliefs and learning/teaching conceptions and such results were clarified mostly based on cultural differences between western and eastern societies (Chan & Elliott, 2004; Hofer, 2008).

Epistemic Emotions

Epistemic emotions are defined as the emotions triggered by individuals' cognitive workloads resulting with epistemic ends (Muis et al., 2015; Pekrun & Linnenbrink-Garcia, 2012). In other words, epistemic emotions are apparent and functional when people's learning processes focus on epistemic results such as knowledge generation or justification (Pekrun, 2006).

The integrative model of personal epistemology proposed by Bendixen and Rule (2004) argues that when people encounter cognitive incongruence between their current knowledge and presented ones they may experience epistemic doubt. Then, this process triggers epistemic emotions such as worried and anxious. However, Muis and her colleagues (2015) proposed that epistemic emotions were activated not only during cognitive incongruities but also cognitive congruities might be taken into consideration. More specifically, the researchers proposed that when nature of task/learning was coherent with individuals' epistemic beliefs; that is when then there was cognitive congruity, people's epistemic beliefs positively predicted their positive epistemic emotions (such as curiosity and interested) whereas negatively predicted their negative epistemic emotions (such as bored and confused). This expectation was verified with a sample of undergraduate students. Accordingly, participants' epistemic beliefs predicted their epistemic emotions which, then, predicted their learning strategies and learning outcomes (Muis et al., 2015). Similarly, Trevors et al. (2017) showed that when university students were confronted with conflict texts (about climate change), their epistemic beliefs activated epistemic emotions which then predicted students' learning outcomes. In this regard, epistemic emotions, by certain researcher groups, are accepted as a one sided mediator from epistemological beliefs to teaching/learning variables. As presented here, limited number of scientific research (Muis et al., 2015; Trevors et al., 2017) have shown that epistemological beliefs activate individuals' epistemic emotions which, then, shape individuals' teaching/learning conceptions.

Argumentativeness

Argumentation can be defined as a process of refuting or supporting claims by utilizing evidences (Bricker & Bell, 2008). Therefore, argumentation is actually accepted as the way of development for scientific knowledge (Osborne, Erduran & Simon, 2004). This critical connection between argumentation process and development of scientific knowledge as well as vitality of learners' argumentation skills for their scientific literacy qualifications (Driver, Newton & Osborne, 2000) have made science educators to develop argument-based teaching-learning designs (e.g. Osborne, Erduran & Simon, 2004; Namdar & Shen, 2016; Sampson, Grooms, & Walker, 2011). The types of these designs are beyond the scope of this study.

Despite of its popularity among science educators, very few studies showed that students might not prefer to participate in an argumentation process (Nussbaum & Bendixen, 2003). An individual's tendency related to participation in an argumentation process is called as argumentativeness (Infante & Rancer, 1982). Infante and Rancer (1982) defined two opposite sides (dimensions) regarding people's argumentativeness: argument approach and argument avoidance. Accordingly, an argument approach individual holds positive feelings when s/he participates in argumentation processes; on the other hand, an argument avoidance individual feels negative emotions if s/he has to participate in such a process. Therefore, if a PST's argumentativeness is categorized as argument avoidance, s/he tries to be far away from any types of argumentation process. In this situation, argument avoidance can be accepted as an obstacle in terms of development of a PST's argumentation and scientific literacy skills. Nussbaum & Bendixen (2003) showed that undergraduate students' epistemological beliefs were related to their argumentativeness; however, the literature has still lacks of evidence supporting such a relationship. On the other hand, argumentation can also be accepted as a constructivist way of learning science since it provides individuals to assert and validate their own ideas considering the scientific support and evidence. Moreover, scientific results covering Turkish preservice or inservice science teachers suggest that participants' sophisticated epistemological beliefs make them to hold constructivist conceptions of teaching and learning (Bahcivan & Cobern, 2016; Güneş & Bahçivan, 2018). In this regard, it can be expected that Turkish PSTs' sophisticated epistemological beliefs may trigger their argumentativeness positively.

The Proposed Model

As mentioned above, this study was conducted to investigate relationships among PSTs' epistemological beliefs, epistemic emotions and argumentativeness. Considering the scientific literature research hypotheses (expectations) were, firstly, drawn. And then, a structural model, represented in Figure 1, was proposed.

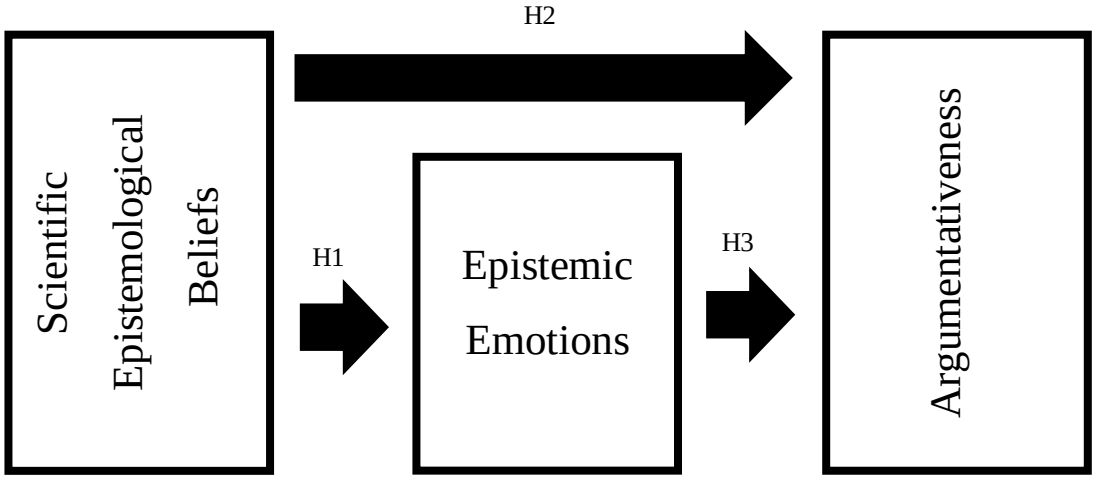

Figure 1. The proposed model

Considering its centrality in human cognition as well as limited evidence observed within different samples (covering especially university students) it is hypothesized that PSTs' scientific epistemological beliefs predict their epistemic emotions [H1] (Muis et al., 2015; Trevors et al., 2017). More specifically, PSTs' sophisticated epistemological beliefs are expected to trigger positive emotions when they encounter opposing ideas at the same time. A PST holding sophisticated epistemological beliefs admits that knowledge is not certain and reaching to truth needs further justifications within different types of evidences. This awareness may motivate that PST by activating positive emotions. On the other hand, a naïve epistemology will trigger the negative (or deactivating) emotions in argumentation processes. Furthermore, PSTs' scientific epistemological beliefs are hypothesized to directly affect their argumentativeness [H2] (Bahcivan & Cobern, 2016; Güneş & Bahçivan, 2018). Based on the literature, stressing effects of people's epistemological beliefs on their learning/teaching preferences, it can be expected that a PST holding sophisticated epistemological beliefs may prefer to participate in argumentation processes for validation of information. On the other hand, a PST holding naïve epistemological beliefs most probably prefers to be far away from argumentation; because, s/he believes that s/he knows the best. Finally, considering the limited evidence regarding the relationships between university students' epistemic emotions and learning outcomes, it is hypothesized that PSTs' epistemic emotions predict directly their argumentativeness [H3]. Positive epistemic emotions can be expected to trigger people's argumentativeness (argument approach); because, positive epistemic emotions motivate people to prefer deep processing learning strategies (Muis et al., 2015; Trevors et al., 2017). Argumentation is already deep processing learning strategy for scientists. On the other hand, negative epistemic emotions most probably deactivate PSTs in terms of deep processing learning strategies or direct them into surface processing learning strategies. This process most probably results with that PSTs holding negative epistemic emotions prefer to be far away from argumentation, because of their argument avoidance trait.

Method

This study has an associational research design; because, the main problem of the study is querying structural relations among PSTs' scientific epistemological beliefs, epistemic emotions and argumentativeness (Fraenkel, Wallen & Hyun, 2011).

Participants

To reach the maximum number of participation, a convenience sampling was implemented (Creswell, 2008). 612 Turkish PSTs (503 female, 106 male, 3 unmarked) from 6 state universities participated in the study. Ages

were observed between 19-25 (M=20.81 and Sd=1.21). All the participants were undergraduate students at department of science teacher education. Of them, 122 were 2nd year, 300 were 3rd year and 188 were last year students (2 of them left year box as unmarked). Graduates of this department apply Turkey Ministry of National Education to be attained as a middle school science teacher, if they got a sufficient score from public personnel selection examination.

The instrument

The instrument comprised of three different scales preceded by a demographic part which asked for participants' school, age, gender, year of school. Following sections give details about the scales.

Scientific Epistemological Beliefs Scale

Conley, Pintrich, Vekiri and Harrison (2004) developed this scale to measure elementary students' scientific epistemological beliefs. The scale involved 26 5-point Likert items (1=strongly disagree to 5= strongly agree) distributed to 4 dimensions; certainty (6 items; e.g. scientific knowledge is always true), source (5 items; e.g. everybody has to believe what scientists say), development (6 items; e.g. ideas in science sometimes change) and justification (9 items; e.g. ideas in science can come from your own questions and experiments). Participants' item scores in certainty and source dimensions were recoded back so that higher scores from this scale corresponded to sophisticated epistemological beliefs whereas lower scores corresponded to naïve epistemological beliefs. The scale was adapted into Turkish with a sample of Turkish PSTs by Bahcivan (2014) who reported acceptable fit indices ($\chi 2/df=1.44$, CFI=0.95, TLI=0.93 and RMSEA=0.04) and Alpha reliabilities changing between 0.66-0.82. In this study, a confirmatory factor analysis (n=612) was conducted for validation purposes since it was adapted previously (Tabachnick & Fidell, 2013). One item from certainty dimension was eliminated because of factor loading score lower than 0.40 (Shevlin & Miles, 1998). The results showed that measurement results have acceptable fit indices ($\chi 2/df=1.89$, CFI=0.95, TLI=0.94 and RMSEA=0.03) as well as factor loading values between 0.44-0.74. Alpha reliability scores were calculated as .75, .78, .69 and .84 respectively for certainty, source, development and justification dimensions.

Epistemic Emotions Scale

This scale was developed by Pekrun, Vogl, Muis & Sinatra (2017) to measure university students' epistemic emotions during epistemic activities. Originally, it involves 3 Likert items (1 for not at all and 5 for very strong) for each dimension of surprise, curiosity, enjoyment, confusion, anxiety, frustration and boredom so that there are 21 items distributed to 7 dimensions in the scale. Items were represented by adjectives.

Adapting the scale, 21 items (adjectives) were, firstly, translated into Turkish by the researcher with assistance of one specialist from each of Turkish and English languages. The researcher and the English language specialist realized a back translation procedure which eliminated 5 items from the translated version. Turkish language specialist examined and approved this decision. The reason for elimination of items was repetition of same adjectives as if they were different. After this translation period, the researcher got 16 items distributed to curiosity, enjoyment, confusion, anxiety, frustration and boredom dimensions. Confusion and frustration were represented by 2 adjectives whereas the others were represented by 3 adjectives. A principal component analysis (n=612) with varimax rotation was preferred for validation purposes (Tabachnick & Fidell, 2013), because there were not any previous results related to this scale; therefore, the theory underlying epistemic emotions is completely new for a Turkish sample. The KMO measure of sampling adequacy index was observed as 0.86, and Bartlett's test of sphericity was significant, chi-square (2460, $p < 0.0001$). Various verifications such as eigenvalue > 1, scree plots and communality value > 0.5 were effective on the statistical decisions related to exploratory factor analysis. 3 items were eliminated because of factor loading values lower than 0.5. Therefore, a 2-factor solution, explaining the 52% of the variance, was obtained. Factor loadings were observed between 0.55-0.79. The first factor labelled as positive emotions (5 adjectives: curious, interested, inquisitive, amazed and excited) whereas the second as negative emotions (8 adjectives: bored, confused, anxious, frustrated, worried, muddled, monotonous and nervous). Positive emotions dimension comprised the feelings motivating a person to solve a cognitive (or epistemic) dissonance; on the other hand, negative emotions dimension involved the emotions deactivating a cognitively/epistemologically dissonant person. Alpha reliability values were calculated as .74 and .85 respectively for positive and negative emotion dimensions.

Argumentativeness Scale

The scale was developed by Infante and Rancer (1982) to measure PSTs' argumentativeness. It originally involves 20 5-point Likert items (1=strongly disagree to 5= strongly agree) distributed to 2 dimensions which are argument approach (e.g. I am energetic and enthusiastic when I argue) and argument avoidance (e.g. After I finish an argument, I promise myself that I will not get into another). Higher scores from argument approach items corresponded to willingness to participate in argumentation or feeling positive emotions while in an argumentative process whereas higher scores from argument avoidance items corresponded to getting far away from argumentation processes because of negative feelings related to this process. The scale was previously adapted into Turkish by Author (under review) who reported Alpha reliability scores as .79 and .80 respectively for argument approach and argument avoidance dimensions. Author (under review) also reported that 2 items were eliminated from each dimension because of factor loading scores lower than 0.40. Therefore, adapted version of this scale involved 16 items in total. In this study, a confirmatory factor analysis (n=612) was applied on results of the adapted version for validation purpose (Tabachnick & Fidell, 2013). Accordingly, one item from argument avoidance dimension was eliminated because of factor loading score lower than 0.40 (Shevlin & Miles, 1998). Validation analysis showed that the results of scale presented good fit ($\chi 2/df=1.99$, CFI=0.97, TLI=0.96 and RMSEA=0.04). Additionally, the scale presented Alpha reliability scores as .78 and .83 respectively for argument approach and argument avoidance dimensions.

The Procedure

Before data collection, participants were informed about the aims of the study, and then the instruments were distributed. The last part of the instrument involved the epistemic emotions scale which was distributed to participants immediately after reading an epistemic scenario. This scenario represented counter claims, about nourishment, supported by scientific evidence. It was an extended version of the one developed by Kuhn, Iordanou, Pease and Wirkala (2008). The reason for utilization of the scenario was to trigger a cognitive (so epistemic) activation. Implementation was realized during regular course times of participants and took approximately 25 minutes. At the end of the data collection, data was entered into SPSS Program.

Data Analyses

Data analyses of the study were divided into three parts. Firstly, validation of the results was examined through factor analyses. Confirmatory factor analyses were conducted (through AMOS) if the scale was already implemented within the similar sample of participants whereas exploratory factor analysis was utilized for the adaptation of epistemic emotions scale (Tabachnick & Fidell, 2013). Secondly, Cronbach's Alpha reliability scores were calculated for each dimension of the scales by using SPSS program. Thirdly, structural equation modelling analysis was conducted through AMOS to respond the research question of the study.

Results

The proposed relations presented in Figure 1 were examined through a structural equation modeling analysis (n=612). The model had an acceptable fit in according to certain fit indices such as $\chi 2/df=1.96$, CFI=0.88, TLI=0.87 and RMSEA=0.04. Structural relations which were statistically significant were presented in Figure 2.

The results showed that participants' epistemological beliefs in certainty, development and justification dimensions significantly predicted their epistemic emotions. More specifically, PSTs' sophisticated epistemological beliefs in certainty dimension were positively related to their positive epistemic emotions ($\beta=0.11$, $p<0.05$) whereas negatively related to negative epistemic emotions ($\beta=-0.11$, $p<0.05$). Additionally, PSTs' sophisticated epistemological beliefs in development dimension seemed to positively related to negative epistemic emotions ($\beta=0.21$, $p<0.05$). Also, PSTs' sophisticated epistemological beliefs in justification dimension were positively related to their positive epistemic emotions ($\beta=0.20$, $p<0.001$) whereas negatively related to negative epistemic emotions ($\beta=-0.22$, $p<0.001$). Furthermore, according to the results PSTs' epistemological beliefs seemed to significantly relate to their argumentativeness. For example, sophisticated epistemological beliefs in source dimension were negatively related to argument avoidance ($\beta=-0.17$, $p<0.001$). In addition, sophisticated epistemological beliefs in certainty dimension positively predicted argument approach ($\beta=0.15$, $p<0.001$); on the other hand, negatively predicted argument avoidance ($\beta=-0.19$, $p<0.001$). Moreover,

PSTs' sophisticated epistemological beliefs in justification dimension were also positively related to argument approach (β=0.38, p<0.001) whereas negatively related to argument avoidance (β=-0.19, p<0.001). When it comes to relations among PSTs' epistemic emotions and argumentations, results revealed that epistemic emotions significantly predicted argumentativeness. Accordingly, PSTs' positive epistemic emotions (curious, interested, inquisitive, amazed and excited) felt after reading the epistemic scenario positively predicted their argument approach (β=0.20, p<0.001) whereas negatively related to argument avoidance (β=-0.13, p<0.05). Also, their negative epistemic emotions (bored, confused, anxious, frustrated, worried, muddled, monotonous and nervous) seemed to positively related to argument avoidance (β=0.14, p<0.05).

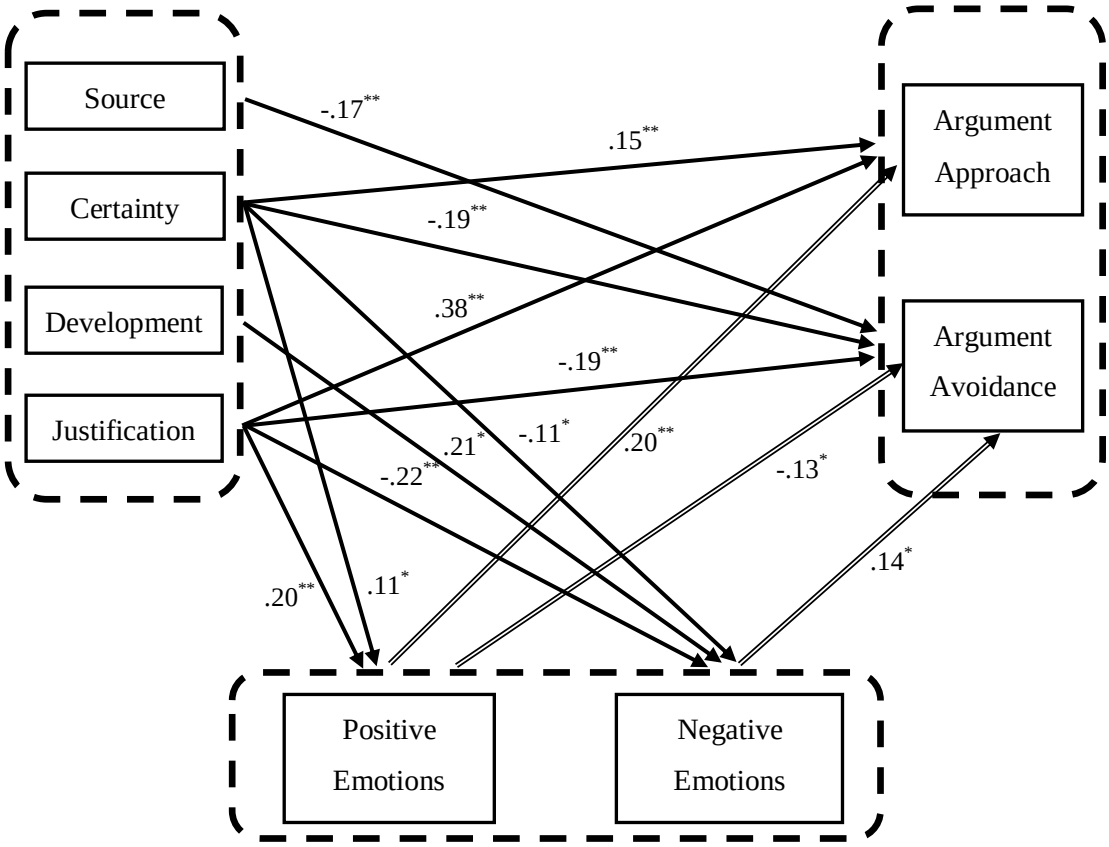

Figure 2. Statistical model (∗p < 0.05, ∗∗p < 0.001)

Discussions

The results of the study showed that Turkish PSTs' epistemological beliefs might have a centralized position in terms of their learning-teaching science conceptions as well as their (hot) cognition. In this regard, the results were observed as mostly coherent with the previous researchers (Güneş & Bahçivan, 2018; Hofer & Pintrich, 1997). More specifically, sophistication of Turkish PSTs' scientific epistemological beliefs in certainty and justification dimensions were observed as positively predicted their positive epistemic emotions. These results are coherent with limited evidences presented in the literature (Muis et al., 2015; Trevors et al., 2017). On the other hand, participants' scientific epistemological beliefs in source dimensions were not significantly related to their epistemic emotions. Also, sophisticated epistemological beliefs were observed as positively related to negative epistemic emotions. These results are opposite to the expectations proposed by the researcher; however, the reason of such inconsistencies can be clarified by possible effects of cultural differences on the results (Chan & Elliott, 2004; Hofer, 2008).

When it comes to the relationships between PSTs' scientific epistemological beliefs and argumentativeness, it can be mentioned that the results were more consistent with the researcher's expectations in comparison to previous ones. Accordingly, participants' sophisticated beliefs in certainty and justification dimensions significantly and positively related to their argument approach trait. Additionally, as expected, their sophisticated epistemological beliefs in source, certainty and justification dimensions were significantly and

negatively predicted their argument avoidance trait. These results can be supported by the researcher's (Bahcivan & Cobern, 2016; Güneş & Bahçivan, 2018) previous studies. He found that Turkish preservice and in-service science teachers' epistemological beliefs guide them to adapt constructivist conceptions during learning and teaching activities whereas naïve epistemological beliefs generally fostered traditional conceptions. Argumentation processes actually represent characteristics of constructivist conceptions related to teaching/learning science; because, argumentation involves constructing claims and providing evidences by active participations of individuals. Therefore, the relationships between a PST's epistemological beliefs (sophisticated-naïve) and conceptions of teaching-learning conceptions (constructivist-traditional) can also be expected between a PST's epistemological beliefs and argumentativeness (argument approach-argument avoidance). Limited amount of evidence is also coherent with this result (Muis et al., 2015). These researchers found that university students' sophisticated epistemological beliefs predicted their selection of deep processing learning strategies. Argumentation can also be accepted as a deep processing learning strategy in terms of science educators.

Finally, as expected, PSTs' positive epistemic emotions (curious, interested, inquisitive, amazed and excited) predicted their argument approach trait positively whereas the same emotions negatively predicted their argument avoidance trait. Also, their negative emotions (bored, confused, anxious, frustrated, worried, muddled, monotonous and nervous) seemed to be significantly and positively related to their argument avoidance trait. More specifically, Turkish PSTs' positive epistemic emotions may activate and motivate them to participate in argumentation processes where as their negative epistemic emotions may deactivate them in terms of participation in argumentation processes. This result is also coherent with the findings of previous researchers (Muis et al., 2015; Trevors et al., 2017) who found that individuals' epistemic emotions are effective on their choice learning strategies and learning outcomes.

Conclusions and Implications

Considering the results and the discussions presented above, it can be concluded that Turkish PSTs' scientific epistemic beliefs are effective on their epistemic emotions and argumentativeness. Also, PSTs' epistemic emotions are effective on their argumentativeness. Several implications can be presented for science educators and following researchers. Firstly, considering evidence provided by the research regarding the central position of PSTs' scientific epistemological beliefs in according to their epistemic emotions and argumentativeness, supporting PSTs' epistemological development during teacher education periods can be suggested. As science teacher educators, we should attempt to creative designs providing this support. In addition, the results contribute positively to limited amount of evidence presenting effects of PSTs' emotions on their cognition. Therefore, educational designs being developed for science teacher education or professional development programs should not neglect PSTs' or in-service science teachers' emotions to be more effective on their argumentation skills. Finally, investigation the reasons of such relationships (presented in this study) by qualitative designs (especially grounded or case study designs) can be suggested for following researchers. Because, we are still far away the reasons of these relationships, so most probably we should needs to benefit from different variables in the (proposed) research models. By means of this way, we can catch a more holistic picture, and then, we can create more effective designs and courses for science teacher education programs.

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