EXPLORING 6TH GRADE STUDENTS' SCIENTIFIC EPISTEMOLOGICAL BELIEFS AND METACOGNITIVE AWARENESS REGARDING ACHIEVEMENT LEVEL

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF SOCIAL SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

YURDAGÜL BOĞAR

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF DOCTOR OF PHILOSOPHY
IN
THE DEPARTMENT OF MATHEMATICS AND SCIENCE EDUCATION

MAY 2018

Approval of the Graduate School of Social Sciences

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ABSTRACT

EXPLORING 6TH GRADE STUDENTS' SCIENTIFIC EPISTEMOLOGICAL BELIEFS AND METACOGNITIVE AWARENESS REGARDING ACHIEVEMENT LEVEL

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May 2018, 310 pages

This study served two purposes. The first purpose of the study was to detect scientific epistemological beliefs of 6th grade students with different achievement levels at middle school. The second purpose of the study was to detect their metacognitive awareness.

The present study has been carried out with "basic qualitative research method" which is one of qualitative research methods. The participants of this study consisted of 15 6th grade students. In determining the participants of the study, purposive sampling method has been used. The semi-structured interviews constituted the data collection tools of the study. Thematic analysis method was used to analyze the data.

Findings related to students' scientific epistemological beliefs; it shows us two themes as nature of knowledge and the nature of knowing, and four categories as certainty of knowledge, development of knowledge, source of knowledge, and justification for knowing appeared. Moreover, remarkable finding of the present study was that the middle school students with high, average and low levels of achievement have expressed their opinions mostly under the nature of knowledge theme.

Findings related to students' metacognitive awareness; it shows us two themes as knowledge of cognition and knowledge of regulation, and eight categories as declarative knowledge, procedural knowledge, conditional knowledge, planning, monitoring, evaluation, debugging and information management appeared. Furthermore, interesting finding of this study was that the middle school students with high, average and low levels of achievement have expressed their opinions mostly in the procedural knowledge category under the knowledge of cognition theme.

Keywords: 6th grade students, scientific epistemological beliefs, metacognitive awareness, achievement

ÖZ

6. SINIF ÖĞRENCİLERİNİN BİLİMSEL EPİSTEMOLOJİK İNANÇLARININ VE ÜSTBİLİŞSEL FARKINDALIKLARININ BAŞARI DÜZEYLERİNE GÖRE İNCELENMESİ

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Bu çalışma iki amaca hizmet etmektedir. Çalışmanın ilk amacı, farklı başarı düzeyinde olan ortaokul 6. sınıf öğrencilerinin bilimsel epistemolojik inançlarını belirlemektir. Çalışmanın ikinci amacı ise ortaokul 6. sınıf öğrencilerinin üstbilişsel farkındalıklarını saptamaktır.

Bu çalışma; nitel araştırma yöntemlerinden biri olan "temel nitel araştırma yöntemi" ile yürütülmüştür. Çalışmanın katılımcıları, 6. sınıfta öğrenim gören 15 öğrenciden oluşmaktadır. Çalışmanın katılımcılarının belirlenmesinde, amaçsal örneklem yönteminden faydalanılmıştır. Çalışmanın veri toplama araçlarını; yarı yapılandırılmış görüşmeler oluşturmaktadır. Verilerin analizinde tematik analiz yöntemi kullanılmıştır.

Öğrencilerin bilimsel epistemolojik inançlarına ilişkin bulgular; bilginin doğası ve bilmenin doğası olmak üzere iki tema, bilginin kesinliği, bilginin gelişimi, bilginin kaynağı ve bilginin doğrulanması olmak üzere dört kategori ortaya çıktığını göstermiştir. Ayrıca, bu çalışmanın dikkate değer bulgusu yüksek, orta ve düşük başarı düzeyine sahip ortaokul öğrencilerinin görüşlerini çoğunlukla bilginin doğası teması altında ifade ettikleri olmuştur.

Öğrencilerin üstbilişsel farkındalıklarına ilişkin bulgular; bilişin bilgisi ve bilişin düzenlenmesi olmak üzere iki tema, açıklayıcı bilgi, işlemsel bilgi, durumsal bilgi, planlama, izleme, değerlendirme, hata ayıklama ve bilgi yönetimi olmak üzere sekiz kategori ortaya çıktığını göstermiştir. Dahası, bu çalışmanın ilgi çekici bulgusu yüksek, orta ve düşük başarı düzeyine sahip ortaokul öğrencilerinin görüşlerini çoğunlukla bilişin bilgisi teması altında bulunan işlemsel bilgi kategorisinde ifade ettikleri olmuştur.

Anahtar Kelimeler: 6. sınıf öğrencileri, bilimsel epistemolojik inançlar, üstbilişsel farkındalık, başarı

I dedicate this thesis to my dearest parents

Cemile BOĞAR and Mevlüt BOĞAR

ACKNOWLEDGEMENTS

This dissertation was written in very difficult times. It is hard to believe that the time to write these lines has come after all that time when night and day mixed up. Even if only my name is written on the cover of the dissertation, it is very important for me to have the opportunity to mention my colleagues, friends and family who have had contributions and supports to my dissertation at every stage of it. I would like to thank each and every one of those who has contributed to this dissertation.

I would like to express my sincere gratitude towards my distinguished advisor Prof. Dr. Jale ÇAKIROĞLU, who at any stage of my work never hesitated to help and support me to become a good researcher with her consultancy, who never left my questions unanswered, and from whom I learned a lot; and towards my co-advisor Prof. Dr. Özgül YILMAZ-TÜZÜN, who shed light to my doctoral studies with her knowledge, whose disciplined work I take as a model, and from whom I learned so many things including what scientific culture means.

I would like to express my thanks to my committee members, Prof. Dr. Ceren ÖZTEKİN, Assoc. Prof. Dr. Sevgi KINGIR and Asst. Prof. Dr. Aybüke PABUÇCU, who contributed to my dissertation significantly with their precious opinions and feedbacks. Besides, I would like to thank to Prof. Dr. Semra SUNGUR who had significant contributions to the result part of my dissertation. I was always in her room and made me feel free to ask questions.

I want to thank 15-year friend Ayataç AYYILDIZ kindly for always giving me emotional support, being there for me every time I am bored, listening to me without getting sick or tired, and striving to show me that the glass is "full", not only in the dissertation process but in every phase of my life.

I owe a debt of gratitude to Prof. Dr. Olcay KANDEMİR, who always encouraged me in the process of the formation of this dissertation, whom I look up to for her personality, stand, and attitude, and who always made me feel her confidence in me.

I present my thanks to my dear friend Dr. Tuba ERDOL, who accompanied me during the difficulties in writing my dissertation, who helped me a lot in the process of qualitative analysis, and who answered my all questions patiently. In addition, I would like express my deepest gratitude to Dr. Ceyhun ALEMDAĞ, Asst. Prof. Dr. Gürsu AŞIK, Assoc. Prof. Dr. Demet KIRBULUT and Assoc. Prof. Dr. Mehmet Ali DOMBAYCI. They spend their precious time to analyze my dissertation data, their help was priceless and beneficial for me. I also would like to offer sincere thanks to Prof. Dr. Ömer GEBAN, Prof. Dr. Salih ÇEPNİ, Assoc. Prof. Dr. Nedim ALEV, Prof. Dr. Bülent GÜVEN, Assoc. Prof. Dr. Faik Özgür KARATAŞ and Asst. Prof. Dr. Yasemin TAŞ for their moral support, valuable advice and contributions while I was performing this study.

I especially would like to thank Prof. Dr. Sibel ERDURAN from Oxford University, whom I sometimes consulted about some steps of my dissertation and who provided valuable contributions, and Prof. Dr. Richard DUSCHL who is enshrined in our memories with his modesty, who is one of the exemplary scientists that lead the new researchers seeking to learn something, and who made time for me to share new ideas in the USA.

My sincerest thanks go to the Scientific and Technological Research Council of Turkey (TÜBİTAK), which has provided financial support to me through the Doctoral Research Scholarship Program with the 2214-A code which played an important role in the formation of my dissertation.

The best is saved for the last. I particularly extend my thanks to my mother Cemile BOĞAR and my father Mevlüt BOĞAR along with my sincerest kindness, who have contributed unconditional efforts and supported me morally and materially since the day I was born, whom I am sure I will never make it up to even if I work forever, who I know for sure, will be with me in every circumstance, who give me endless supports and never leave me alone, who have always helped me in my education life, and who have kept her fingers crossed for me. I cannot thank my siblings Filiz, Eşref, Merve and Zeynep enough for their warm love and help. I

would not feel this confident without your warm love and support. How much I participated in life, it is thanks to you. I am so glad to have you. In addition, my recently-born little nephew Ali who showed me what it means to be an aunt, welcome and so glad I have you.

All these people to whom a small thanking remains insufficient gave me much more important things than an academic title ever did.

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LIST OF ABBREVIATIONS

EBQ	Epistemological Beliefs Questionnaire
MAI	Metacognitive Awareness Inventory
MoNE	Ministry of National Education
NRC	National Research Council

CHAPTER 1

INTRODUCTION

In this section, firstly background information related to scientific epistemological beliefs, metacognitive awareness and relationships between scientific epistemological beliefs and metacognitive awareness are going to be explained. Later on, in accordance with the flow of narration, the purpose of the study, research questions, importance of the study, assumptions at the beginning of the study, limitations of the study and operational definitions of the main terms used in the study are going to be presented under headlines.

1.1. Background Information Related to Scientific Epistemological Beliefs

It is an undeniable fact that contemporary cultures and societies are in a fast development and change process. Globalization process beginning to dominate as a result of development and change process mentioned above showed its effect on not only economy, technology, politics but also education. This effect made possible basic assumptions, methods and strategies in education gradually change. Firstly, changes on basic structures of education showed its effect on teaching process and this caused educational programs to be revised. In this context, traditional teaching methods based on transferring the knowledge were left behind and constructivist teaching methods taking the learner at the center were adopted (Akgün & Gülmez, 2015; Demir & Akınoğlu, 2010). In adopted constructivist teaching methods; raising students as a questioning, capable of reaching the knowledge, having critical thinking and lifelong learning skills, being able to internalize science and use it in real life situations, being qualified in terms of cognitive, affective, social and cultural aspects constitutes the main purpose of the science education. In other words, it is aimed to make students acquire scientific literacy (Çalıklar, 2015; Çavuş, 2013; Kızıklı, 2016; Şahin-Pekmez, Aktamış, & Can, 2010). In general, scientific literacy is defined as individual's developing research and questioning, critical thinking, problem solving and decision-making skills, being individuals having lifelong learning skills and combination of ability, attitude, value, understanding and knowledge related to science which is necessary to sustain their curiosity about their environment and world (Ministry of National Education [MoNE], 2017). When scientific literate individuals' features are taken into consideration, it is highly important to analyze how do they define the knowledge they just come across, how do they associate it with the other information exist in their mind, how do they evaluate it, and how do they come to a conclusion (National Research Council [NRC], 2012). Right at this point, we come across epistemology and epistemological beliefs.

Epistemology concept; based on philosophy's knowledge problem, is defined as a philosophical field studying questions related to knowledge and analyzing the nature, structure, source, roots, value, criteria, validity and limits of knowledge (Aydın & Ertürk Geçici, 2017; Çüçen, 2005). Epistemology naturally asked a lot of questions taking knowledge at the center and individuals led their inner beliefs thanks to epistemology by trying to answer these questions. As a result of this process epistemological beliefs emerged. Epistemological beliefs are defined as individuals' subjective beliefs about their opinion of what the knowledge is, how do learning and knowing occur, precision's level, limits, organization and criteria (Deryakulu, 2014; Hofer, 2001; Kaleci, 2012; Koç-Erdamar & Bangir-Alpan, 2011; Tickle, Brownlee, & Nailon, 2005). On the other hand, according to Bolden and Newton's (2008) definition, introverted adoptions or seekings, accepted by the individual as absolute truth, defining how the individual perceives and interprets every incident, phenomenon, person or matter he/she experience in his/her life and defining how he/she should behave, constitute epistemological beliefs. Scientific epistemological beliefs, in the most general sense, include individuals' beliefs about what science is, its features, methods and how science should be taught (Deryakulu & Bıkmaz, 2003; Kurt, 2009).

Scientific epistemological beliefs, defining what scientific knowledge is, how does learning occur in this context, shortly perspective on scientific knowledge, affect students' decision-making process, their judgements, quality of thinking, thinking skills and their attitude and behaviors (Demir, 2009; Eroğlu, 2004; Evcim, Turgut, & Şahin, 2011). This qualifications and skills are densely affected by intellectual norms in communal living. For example, the place and time that we were born, the culture in which we live, the family that raises us, beliefs of our environment and relationships that we establish throughout our lives constitute the basis of rational forces forming our thoughts (Buğday, 2010; Oksal, Şenşekerci, & Bilgin, 2006). In other words, structuring a scientific knowledge includes a social process. That is to say, terms, models and ways of understanding the world are products of mankind formed as a result of scientists' mutual decisions. These can not be perceived directly by nature. It is not enough to provide students just phenomenon taking place in the world (explaining the phenomenon with the help of books or teachers) in order to teach students 'ways of understanding the world'. In other words, students want not only to hear the explanations by experts (teachers, books, movies, computer programs) but also practice to gain self-confidence by using their own ideas and throughout this practicing process, they try to understand scientific applications and scientific ways of thinking and they become familiar with them. When reasons of students' acquiring scientific knowledge are taken into consideration, using scientific knowledge in daily life, thinking the possibility of making mistakes, enriching the thought and interpreting the nature are said as justification (Evcim, 2010; Kaleci, 2012).

Epistemological beliefs are also effective on students' achievement (Deryakulu, 2004; Muis, Bendixen, & Haerle, 2006). In order to carry out comprehension, interpretation and evaluation stages after students encounter new information in school environment, they need to activate their cognitive and emotional processes. At this point, we come across epistemological beliefs. Because epistemological beliefs have a very important role in students' comprehending, understanding and constructing the knowledge (Deryakulu, 2004; Özkan, 2008; Schommer & Dunnell, 1997; Windschitl & Andre, 1998).

Studies conducted in order to detect individuals' scientific epistemological beliefs have been increasing rapidly both in our country and abroad (Aypay, 2011; Chan & Elliott, 2004; Deryakulu, 2014; Fırat, 2014; Hashweh, 1996; Hofer, 2001; Muis, 2004; Uysal, 2010). It can be stated that the reason behind the interest in scientific epistemological beliefs could be related to adopting post-positive scientific understanding emphasizing the importance and necessity of imagination, intuitions, individual beliefs, perspectives and effects of the society in which scientists live in the scientific research process instead of adopting traditional positive scientific understanding based on observations and controlled experiments which can be repeated by others (Buğday, 2010; Deryakulu & Bıkmaz, 2003; Kızıklı, 2016; Pomeroy, 1993).

1.2. Background Information Related to Metacognitive Awareness

In recent years, scientists have begun to urge upon how students reach the information rather than what they know. In other words, the subject being examined and wondered is not what the individuals learn but whether they know ways of learning to learn (Ayazgök, 2013; Bars, 2016; Boran, 2016; Çakıroğlu, 2007; Darling-Hammond, 2000; Göçer, 2014; Olğun, 2011; Pilten, 2008; Sarıkahya, 2017). ‘Learning to learn’ is of vital importance in terms of sustaining lifelong learning without any time constraint and adapting changing life conditions. Because students who learn how to learn know how to reach and learn a specific information and they know whether it is necessary to learn that information (Baltacı, 2009; Bars, 2016; Çınar, Teyfur, & Teyfur 2006; Doğan, 2009; Koç-Erdamar, 2007). In other words, they are individuals who can take responsibility for and can organize their own learning (Göçer, 2014). It is possible for students to take responsibility for their own learning if they gain both cognitive and metacognitive skills (Balcı, 2007; Boran, 2016; Demirci, 2016; Kaplan & Duran, 2015; Tunca & Alkın-Şahin, 2014). Metacognitive skills are pre-condition in learning to learn (Alemdar, 2009; Ayazgök, 2013; Pilten, 2008; Sapancı, 2012).

Metacognition is one of the most important concepts for individuals to be conscious of their personal characteristics, to take responsibility for their own learning, to have an idea on their features of knowing and learning to learn on their own (Atay, 2014; Baltacı & Akpınar, 2011; Göçer, 2014). The term took its place in the literature after development psychologist John Flavell had defined metacognition as individual’s having an idea of his/her cognitive structures and organizing these cognitive structures in 1970’s and it was defined by different researchers in different ways until present day (Akın, 2006; Borkowski, 1992; Chekwa, Mcfadden, Divine, & Dorius, 2015; Demircioğlu, 2008; Hofer, 2004; Schraw, 1994; Shore & Dover, 1987). For example, while Georghiades (2004) defined metacognition as individual's knowledge of his/her own mental process and directing this mental process, Gama (2004) defined it as thinking on thought or individual's knowledge of his/her cognition. On the other hand, according to Senemoğlu (2011), it was defined as individual's awareness of his/her ways of thinking and learning and being able to organize his/her learning effectively. When the related literature is examined, it is seen that there are a lot of definitions of metacognitive awareness just like metacognition (Balcı, 2007; Baykara, 2011; Borkowski, Carr, & Pressley, 1987; Boyce, VanTassel-Baska, Burruss, Sher, & Johnson, 1997; Flavell, 1979; Flavell, 2000; Gallagher, 1997; Livingston, 1997; Olğun, 2011; O'Neil & Abedi, 1996; Yussen, 1985). For example, Wilson (1999) defined metacognitive awareness as individual's awareness during the learning process and knowing personal learning strategies, his/her knowledge about the content knowledge and knowing what is done and what is not done. According to Papaleontiou-Louca (2003), metacognitive awareness was defined as a process including knowledge, perception, understanding and remembering. On the other side, Bağçeci, Döş and Sarıca (2011) defined it as individual's being aware of what he/she knows and he/she doesn't know, controlling his/her own mental process, taking learning responsibility, being aware of his/her learning strategies, evaluating, planning and watching his/her learning and using strategies of administering his/her knowledge.

In spite of many different definitions in the literature, in the basis of metacognitive awareness concept, concepts of conscious behavior, controlling him/herself, organizing and evaluating him/herself, planning, watching how he/she learns and learning to learn exist. In other words, the individual is aware of him/ herself and ways of learning (Akçam, 2012; Selçioğlu-Demirsöz, 2010). Besides, according to many researchers, metacognitive awareness consists of two main components (Mazzoni & Nelson, 1998; Metcalfe, 2000; Nelson & Narens, 1990; Schunk, 2008; Schraw & Dennison, 1994; Tobias & Everson, 1995). These are knowledge of cognition and regulation of cognition. Knowledge of cognition is related to knowledge acquired as a result of the cognitive process and knowledge of controlling cognitive process, but regulation of cognition is about whether cognitive goals are fulfilled or not and the process of controlling cognitive activities (Hangrove, 2007; Kaplan & Duran, 2015).

Metacognitive awareness is a kind of thinking system and it is a result of conscious thinking (Çakıroğlu, 2007). That's why, it requires having abilities to draw attention to the topic, dedicating him/herself to the topic, developing necessary attitudes about the topic, planning the topic in the mind, evaluating whether the plan works or not in the mind, changing and organizing failing parts constantly in the mind. All these cognitive competencies and skills constitute the basis of the thinking process and take part as a thinking language facilitating individual's thinking in accordance with the specific thinking dimension in all thinking dimensions. In this respect, metacognitive awareness is the basis of thinking and at the same time, it includes all thinking skills (Çakıroğlu & Ataman, 2008; Demir, 2014; Demirci, 2016; Karakelle & Saraç, 2010; McCormick, Miller, & Pressley, 1989; Tosun & Irak, 2008).

Students having metacognitive awareness also have acquired the ability to ask and answer the following questions below.

- What is my purpose to learn this topic?
- What kind of information do I have on this topic?
- From where can I find the information necessary for this topic?
- How long does it take for me to learn this topic?
- What kind of plans and strategies am I supposed to follow in order to learn this topic?
- How can I notice if I make a mistake?
- Are the processes suited to my expectations? If not, how should I change the plan? (Ayazgök, 2013; Huitt,1997).

Students with high-level metacognitive awareness use their inner energy for a work they do or a problem they work on, they have a positive attitude that they can achieve, they become motivated and develop attention (Veenman, Van Hout-Wolters, & Afflerbach, 2006). Moreover, these students are aware of how, when and why they use their existing cognitive features and learning strategies. They define their goals, they can make necessary plans to achieve their goals and after they become successful they can evaluate themselves. They see where they are and plan what they are going to do, they evaluate their plans, correct them and try again (Akçam, 2012; Çavuş, 2015; Kaplan, & Duran, 2015; Özsoy, 2007; Sarıkahya, 2017; Schraw & Dennison, 1994; Schraw & Graham, 1997; Veenman, Van Hout-Wolters, & Afflerbach, 2006). Additionally, they show high-level skills in evaluating others comprehension tolerantly, watching learning process constantly and flexible planning (Ayazgök, 2013; Lee & Baylor, 2006; Oliver & Herrington, 1995). In other words, students with high level of metacognitive awareness are the individuals that participate in learning process more, are able to make plans and apply and watch those plans he/she made, develop thinking skills, question every piece of information, self-inquire by including his/her previous knowledge in the process, are able to control him/herself and the process, are able to define his/her competencies and lacks, evaluate him/herself and what he/she has done, are able to sort his/her mistakes by distinguishing them and are able to operate his/her knowledge like a good leader. The individuals with these qualities are the expected and wanted individuals to take part in our society (Ayazgök, 2013; Çakıroğlu, 2007; Çavuş, 2015; Olğun, 2011, Özsoy & Günindi, 2011; Töremen, 2001).

Besides being accepted as an important part of successful learning, conceptual understanding and problem-solving skills (Boyce, VanTassel-Baska, Burruss, Sher, & Johnson, 1997; Çakıroğlu, 2007; Malkoç, 2011; Paul, 1992; Sbhatu, 2006; Senemoğlu, 2015), metacognitive awareness has also other benefits in terms of education. One of the most important educational benefits is that it contributes students to grow as independent individuals who control their own learning and learn how to learn (Çavuş, 2015; Papaleontiou-Louca, 2003). Moreover, it allows the learner to be aware of his/her way of thinking and while deciding how to study and it allows him/her, at the same time, to notice his/her cognitive strengths and weaknesses instead of focusing to learn just the material (Çeliköz, Erişen, & Şahin, 2016). In addition to these; while it gives students the opportunity to try whether or not they have learned, it gives information on how to watch the learning process and what steps should be taken if the learning has not occurred (Subaşı, 2000).

It is a commonly accepted thought that metacognitive awareness also has an effect on academic achievement (Alcı et al., 2010; De Backer, Van Keer, & Valcke, 2012; Mega et al., 2014; Pilten, 2008; Ruban & Reis, 2006; Schleifer & Dull, 2009). In conducted studies, the reason why students having high level of metacognitive awareness are successful is connected to their awareness of their own learning, their ability to guide these learnings (Senemoğlu, 2011), their ability to join learning processes and their ability to plan and evaluate learning process (Çakıroğlu, 2007). Besides, some researchers revealed that there were significant differences between metacognitive awareness of the students with high and low level of achievement (e.g., Alexander, Carr, & Schwanenflugel, 1995; Hannah & Shore, 1995; Schunk & Zimmerman, 1994; Sperling et al., 2004). When they were compared to students with low level achievement, those students having high level of achievement could better transfer a newly learned knowledge into new situations and incidents and use more different and newer learning strategies (e.g., Gurb, 2000; Hwang & Vrongistinos, 2002; Romainville, 1994). Additionally, students with high level of achievement have more qualified learnings compared to students with low level of achievement (Woolfolk, 1993).

1.3. Background Information Related to Relationships Between Epistemological Beliefs and Metacognitive Awareness

In the process of producing the knowledge, individuals are going to constitute a positive epistemological belief that knowledge can be acquired by learning, by being aware of his/her abilities and thoughts and using this awareness in controlling the work he/she does. Besides, a positive epistemological belief about knowledge can be acquired as a result of active struggle, can lead to individuals' focusing on their own thinking process, choosing the learning way they need, activating their inner energy, controlling their attention, planning, watching and evaluating the activities that they are going to do (Demir & Doğanay, 2009). That's why students' epistemological beliefs on how does the learning and knowing occur affect directly their comprehension of the knowledge and the kinds and levels of metacognitive awareness strategies they use during teaching process and using metacognitive awareness skills affect how learning could be developed effectively. Shortly, epistemological beliefs that are accepted as having an important effect on the learning process, have also an important effect on students' metacognitive awareness

(Desoete & Özsoy, 2009; Hacker & Dunlosky, 2003; Hofer, 2004; Huitt, 1997; Papaleontiou-Louca, 2003; Schommer-Aikins & Hutter, 2002). This interaction which clearly can be seen in the literature shows us that epistemological beliefs and metacognitive awareness can be conceptualized and studied together (e.g., Bromme et al., 2010; Cantwell, 2007; Cantwell, Scevak, & Parkes, 2010; Cantwell et al., 2012; Hofer, 2004; Kincannon, Gleber, & Kim, 1999; Kitchener, 1983; Veenman, Van Hout-Wolters, & Afflerbach, 2006). Additionally, in the literature there are studies emphasizing that there is a meaningful relationship between epistemological beliefs and metacognitive awareness (e.g., Başbay, 2013; Bendixen & Rule, 2004; Bromme, Kienhues, & Stahl, 2008; Dahl, Bals, & Turi, 2005; Deryakulu, 2004; Hofer, 2004; Muis, 2007; Özgelen, Yılmaz-Tüzün, & Hanuscin, 2010; Schommer, 1994; Wachsmuth & Leibham, 2007; Wyre, 2007).

Previous studies showed that students with developed epistemological beliefs know which information and at what level they know, which information they need in other words they use metacognitive awareness strategies more effectively in learning process and as a natural result of this they achieve higher academic achievement, they are able to understand their existing knowledge deeply, they can connect their previous and new information, they can understand the information, they develop positive attitude towards school, they believe in the benefits of education and they can present more qualified and sophisticated solutions to the complex problems (Altunay & Yalçınkaya, 2011; Bendixen & Rule, 2004; Cano, 2005; Dahl, Bals, & Turi, 2005; Demir, 2009; Deryakulu, 2004; Deryakulu & Büyüköztürk, 2005; Kardash & Howell, 2000; Paulsen & Feldman, 1999; Paulsen & Gentry, 1995; Pintrich & Schrauben, 1992; Ravindran et al., 2005; Schommer-Aikins & Hutter, 2002; Wyre, 2007).

1.4. Purpose of the Study

This study served two purposes. The first purpose of the study was to detect scientific epistemological beliefs of 6th grade students with different achievement levels at middle school. In other words, it was aimed to examine students' ways of acquiring scientific knowledge, their opinions of scientific knowledge and its tentative nature. The second purpose of the study was to detect their metacognitive awareness.

1.4.1. Research Questions

The research questions guiding the study were as follows:

Research Question 1 (RQ1): What are the 6th grade students' scientific epistemological beliefs regarding achievement levels?

Research Question 2 (RQ2): What are the 6th grade students' metacognitive awareness regarding achievement levels?

1.5. Significance of the Study

The sources of information that students come across have become diversified gradually. Parallel to this, it is observed that incorrect pieces of information are quickly acquired by the students both directly and through observation along with correct pieces of information. It is known that the knowledge students have is very important to understand new information and interactions besides every student constitutes his/her own knowledge with the help of their abilities and experiences (Kaymak, 2010; Özmen & Demircioğlu, 2003). According to Schommer (1994), while students with more experience believe that there is not absolute knowledge, great majority of the information has not been explored yet and great majority of the information continues to develop, students with less experience believe that very little of the information continues to develop and the knowledge is absolute. In other words, students' reaction against the knowledge and forming the knowledge in the brain occur in accordance with their beliefs in knowledge and knowing (Eroğlu & Güven, 2006; Fisher-Mueller & Zeidler, 2002). In this context, epistemological beliefs draw the researchers' attention and they are often studied (Akgün & Gülmez, 2015; Demir & Akınoğlu, 2010). However, there are fewer studies conducted on scientific epistemological beliefs compared to studies conducted on epistemological beliefs in the literature. In this sense, it can be said that there is an important absence of research subject. Hence, the present study aimed to fill this gap by studying middle school students, scientific epistemological beliefs.

Scientific epistemological beliefs affect an individual's acquiring and structuring the knowledge and they play an essential role in lifelong learning (Eroğlu & Güven, 2006; Hofer, 2001). Moreover, it is known that students with scientific epistemological beliefs are able to form more complex, deep and sophisticated thoughts and scientific epistemological beliefs are effective on individual's perspective of scientific knowledge, their level of participating in the lessons, academic achievements and their motivation. Generally, these beliefs start to shape during primary school ages (e.g., Buehl & Alexander, 2001; Cano & Cardelle-Elawar, 2004; Çavuş, 2013; Deryakulu & Büyüköztürk, 2005; Sadıç, Çam, & Topçu, 2012; Schraw, 2001). Additionally, there are some studies revealing that students' scientific epistemological beliefs are effective in high-level thinking skills such as learning, reasoning, critical thinking, decision-making, problem-solving and creativity (Aksan, 2009; Cano, 2005; Deryakulu, 2004; Kaymak, 2010; Phan, 2008; Phillips, 2001). All these determinations draw our attention to the importance of scientific epistemological beliefs in education and the need to study them.

When both national and international literature about scientific epistemological beliefs are examined, it can be observed that a great majority of these studies were conducted with teachers, university and high school students (e.g., Aksan & Sözer, 2007; Aypay, 2011; Demirel & Çam, 2016; Güven & Belet, 2010; Lee, Zhang, Song, & Huang, 2013; Meral & Çolak, 2009; Tsai & Chuang, 2005; Tsai et al., 2011; Terzi, Şahan, Çelik, & Zöğ, 2015; Yeşilyurt, 2013). However, a few number of studies conducted with middle school students were found (Boz, Aydemir, & Aydemir, 2011; Choi & Park, 2013; Demir, 2009; Evcim, 2010; Kaynar, Tekkaya, & Çakıroğlu, 2009; Schommer-Aikins et al., 2005). These studies on scientific epistemological beliefs were generally conducted by using quantitative research methods (e.g., Boz, Aydemir, & Aydemir, 2011; Chen & Pajares, 2010; Choi & Park, 2013; Kizilgunes, Tekkaya, & Sungur, 2009; Topçu & Yılmaz-Tüzün, 2009; Yenice & Ozden, 2013). Therefore, present study aimed to further insights into middle school students' scientific epistemological beliefs using qualitative research methods.

Academic achievement that refers to the performance which students show as a result of their conceptual understanding of the topic (Marshall & Dorward, 2000) comes in front of us as an important topic which is worth studying. Because in lots of studies conducted on epistemological beliefs and academic achievement, it was found that epistemological beliefs are related to students' academic achievement no matter which age group they are in (e.g., Koç-Erdamar & Bangir-Alpan; Önen, 2011; Schommer & Walker, 1997; Schommer-Aikins, Duell, & Hutter, 2005; Schommer-Aikins, Duell, & Barker, 2003; Schommer-Aikins & Hutter, 2002; Topçu & Yılmaz-Tüzün, 2009). It can be seen in the conducted studies that students with high level of achievement have sophisticated epistemological beliefs (e.g., Cano, 2005; Conley et al., 2004; Driscoll, 2012; Evcim et., 2011; Hofer, 2000; Muis et al., 2006; Ricco, et al., 2010; Ryan, 1984; Sadıç & Çam, 2015; Schommer, 1993b; Tsai, Ho, Liang, & Lin, 2011; Uysal, 2010). Besides, students having sophisticated epistemological beliefs and who are successful in terms of academic achievement use more and qualified learning strategies compared to the students with low level of achievement and naive epistemological beliefs. When the literature is taken into consideration, there are studies handling epistemological beliefs and students' achievement together (e.g., Akgün & Gülmez 2015; Aşut, 2013; Conley et al., 2004; Demirel & Çam, 2016; Ricco, et al., 2010 Yankayış, Güven, & Türkoğuz, 2014; Yeşilyurt, 2013). However, in the literature, studies conducted at middle school level and trying to define epistemological beliefs of the students having different levels of achievement in a qualitative way could not be found. This study is important for the literature in terms of this aspect. Moreover, it is important to detect students' epistemological beliefs so that they can be active learners and can be successful at different stages of their lives.

Metacognitive awareness is a topic whose importance in education has been rising gradually (e.g., Carin & Bass, 2001; Hartman, 2002; Llewellyn, 2005; Schraw, Crippen, & Hartley, 2006). The reason behind this is that it affects acquisition of knowledge, understanding, retention, applying the learnings, making decisions consciously, problem-solving and critical thinking (e.g., Aydemir, 2014; Sapancı, 2012; Solmaz, 2014). Moreover, metacognitive awareness enables students to control their learning process and products or self-regulation (Hartman, 1998). Besides, metacognitive awareness contributes to increase academic performance and high-level thinking (e.g., Atay, 2014; Bars, 2016; Desoete, Roeyers, & Buysse, 2001).

The student with high level of metacognitive awareness has knowledge of his/her cognitive system, structure and work. It is of vital importance that student is aware of his/her cognitive processes and can control these processes. Because student knows him/herself, evaluate what he/she has learned and what he/she has not learned accurately, knows his/her weak sides in learning, notices his/her learning style and can arrange his/her learning activities according to this (Çavuş, 2015; Demirci, 2016; Doğan, 2013; RincónGallardo, 2009; Tunca & Alkın-Şahin, 2014). Thus, student constructs his/her knowledge and executes learning by taking learning responsibility, can learn from his/her mistakes by self-evaluating. In other words, students' self-regulation, planning, overviewing and evaluating skills would be improved (Atay, 2014; Bars, 2016; RincónGallardo, 2009; Schraw & Dennison, 1994). When the students controlling, planning, overviewing and evaluating skills are improved, permanent and high-level learnings are going to be accompanied. Hence, conducted studies are likely to support this opinion (Azevedo, Greene, & Moss, 2007; Aydemir, 2014; Balcı, 2007; Bannert & Mengelkamp, 2008; Desoete, 2008; Kramarski, 2008; Shamir, Mevarech, & Gida, 2009; Vrugt & Oort, 2008).

When the related literature is examined, there are metacognitive awareness studies conducted with middle school students (e.g., Aktamış & Uça, 2010; Demirel & Arslan-Turan, 2010; Evran & Yurdabakan, 2013; Kahraman & Sungur, 2011; Koç & Karabağ, 2013; Memiş & Arıcan, 2013; Tüysüz, 2013; Yıldız & Ergin, 2007; Yıldız-Feyzioğlu & Ergin, 2012). However, the great majority of these studies were conducted with 8th and 7th-grade students by using quantitative research methods (e.g., Ayazgök, 2013; Bağçeci, Döş, & Sarıca, 2011; Duru, 2007; Spence, 1995; Ulu, 2011; White & Frederiksen, 1998). On the other hand, it has still been discussed whether using quantitative assessment tools in order to evaluate students' metacognitive awareness is suitable or not in the literature (Özcan, 2014). That's because, assessment tools that are used to define metacognitive awareness are in general structure, and they are incompetent in terms of revealing every one of the students' metacognitive awareness thoroughly (Panaoura & Philippou, 2003). Because students' metacognitive awareness depends on many variables which cannot be observed directly. By using qualitative research methods, the results of present study provide valuable information about 6th grade students' metacognitive awareness.

In the studies examining metacognitive awareness, the relation between students' academic achievement and metacognitive awareness comes in front of us as an important research topic. Because, according to some researchers; academic achievement and metacognitive awareness are connected to each other (e.g., Bağçeci, Döş, & Sarıca, 2011; Desoete & Roeyers, 2002; Garner & Alexander, 1989; Kruger & Dunning, 1999; Sawhney & Bansal, 2015; Turan & Demirel, 2010; Young & Fry, 2008). These researchers have argued that as academic achievement of students increases, their metacognitive awareness and metacognitive skills become more advanced (e.g., Bağçeci, Döş, & Sarıca, 2011; Cooper, 2008; Desoete & Roeyers, 2002; Case, Harris, & Graham, 1992; Kuiper, 2002; Sawhney & Bansal, 2015; Sperling et al., 2004; Young & Fry, 2008). In addition, students having high level of achievement can plan, overview, evaluate, think about their learning strategies and take responsibilities at every stage of the learning process, they are aware of what they know and do not know and all these factors enable them to have high level of metacognitive awareness (Everson & Tobias, 1998; Schraw & Dennison, 1994). Besides, students with high level of achievement show better performance, think more strategically compared to students with low level of achievement and as a result of these they have higher level of metacognitive awareness (Carrell, Gajdusek, & Wise, 1998; Coutinho, 2007; Garner & Alexander, 1989; Desoete, Roeyers, & Buysse, 2001). When the literature is taken into consideration, there are some studies examining students' academic achievement and metacognitive awareness together (e.g., Bağçeci, Döş & Sarıca, 2011; Coutinho, 2007; Ruban & Reis, 2006). However, in the literature, a study trying to define metacognitive awareness of the students, at middle school level, having different level of achievement in a qualitative way could not be found. In this context, this study carries a great importance for the literature.

As mentioned above, findings from various studies show us that both metacognitive awareness and scientific epistemological beliefs are effective in variables such as learning, decision making, problem-solving and academic achievement. Therefore, it is considered that the findings from this study are going to guide those researchers who are working on epistemological beliefs and metacognitive awareness and help them come up with new ideas for new studies. Besides, this study is also going to help teachers in terms of defining possible precautions against students having low epistemological beliefs and metacognitive awareness levels.

1.6. Assumptions of the Study

The study was conducted in accordance with the assumption stated below.

- Students participating in the study answer the interview questions sincerely, without being influenced by each other and objectively.

1.7. Limitations of the Study

It can be stated that the study has some limitations on the points that mentioned below.

- Findings of students' scientific epistemological beliefs and their metacognitive awareness are limited in qualitative data obtained through semi-structured interviews.
- This study was limited in the researcher's qualitative data analysis, research and interpretation skills.

1.8. Operational Definition of Important Terms

1.8.1. Epistemology

The root of the human knowledge is its nature, boundaries, methods and justifications (Hofer, 2002).

1.8.2. Epistemological Beliefs

It is the opinion an individual has about what knowledge is, the way it is acquired, its certainty level, boundaries and criteria (Hofer & Pintrich, 1997). According to Hofer (2000), these beliefs are multidimensional, naïve and sophisticated.

1.8.3. Scientific Epistemological Beliefs

It is the beliefs of individuals including what the nature, structure and content of science are, the features of science, methods used during science process and aspects of certainty, source, development and justification on how science should be taught to individuals (Conley et al., 2004).

1.9.4. Cognition

It is the whole of what humankind do about the events in the world and around them, by using their mental structures (Güven, 2004).

1.8.5. Metacognition

It is the necessity of how to use and organize an individual's own knowledge (Akturk & Sahin, 2011; Cao & Nietfeld, 2007).

1.8.6. Metacognitive Awareness

It is the skill of an individual's observation, organization, control, and awareness of his/her own thinking processes (Breed, Mentz, & Westhuizen, 2014; Flavell, 1979).

1.8.7. Achievement

It states the performance that students show as a result of their conceptual understanding of the subject (Marshall & Dorward, 2000).

CHAPTER 2

LITERATURE REVIEW

In this chapter, literature related to epistemological beliefs and metacognitive awareness and their utilization in education as an instructional objective will be reviewed in order to provide a basis for the study. In order to achieve this goal, the following aspects will be reviewed under three main headings within this chapter: Epistemological beliefs and metacognitive awareness. Moreover, some sub-headings will follow the main headings.

2.1. Epistemological Beliefs

From the first ages until today, the question of "what is knowledge?" has attracted many philosophers, scientists and pedagogues and it has been a question, which they were trying to answer. The term epistemology, which discusses the concept of knowledge and expresses the philosophy of science, was used for the first time in the middle of nineteenth century by James Frederick Ferrier (Cevizci, 2012). The term "epistemology" comes from the Greek "episteme", meaning "knowledge", and "logos", meaning "explanation". Epistemology is a field of philosophy which discusses and studies possibility, source, nature, limits and accuracy of knowledge as multidimensional (Buehl & Alexander, 2001). According to Hofer (2002), epistemology includes how individuals define, structure and justify knowledge and individuals' beliefs about the nature of knowledge. Decisions they took, final judgements they made and their behavior throughout their lives are the reasons of individuals' personal beliefs (Hofer & Pintrich, 1997). Beliefs, perceived as inner acceptances or suggestions which are assumed to be true without any doubt by the individual, determine how an individual perceives and interprets all kinds of events, facts, persons or objects that he/she has encountered in life and how he/she acts against it (Deryakulu, 2004).

Epistemological beliefs are defined generally as subjective beliefs that are related to the individual's knowledge acquisition and nature of knowledge (Hofer, 2002). These beliefs consist of core beliefs related to how an individual defines knowledge, how knowledge is acquired, how knowledge is preserved and what the limits of the knowledge are (Hofer & Pintrich, 1997; Hofer & Pintrich, 2002; Schommer, 1990; Schommer, 1994). Epistemological beliefs are also defined as an individual's control over knowledge and critical interpretation of knowledge (Schommer-Aikins & Hutter, 2002).

Epistemological beliefs have an effect on higher order thinking skills (Deryakulu & Büyüköztürk, 2002). At the same time, when epistemological beliefs are thought to be a process of perception, interpretation and internalization of knowledge, it is impossible for these beliefs to leave the attitudes and behaviors of the individual unaffected. This reveals the importance of epistemological belief development of the individual in developing positive attitudes and behavior (Brown & Cooney, 1982; Demir, 2010).

Pomeroy (1993) specified that research in the field of epistemological beliefs gain speed with the transition to a constructive or postmodern understanding of science that is shaped by subjective knowledge from experimental understanding under the influence of objective opinion (Meral & Çolak, 2009). According to traditional-experimenter positivist scientific understanding, scientific knowledge presents infallible correct answers obtained by universal methods, which are observation and experiment. However, according to constructivist scientific understanding, scientific knowledge is formed by scientists and it naturally contains their non-objective ideas. Therefore, they are accepted as temporary and changeable truths (Deryakulu, 2004).

Research results reveal that epistemological beliefs, which are accepted as individual characteristic, have a significant effect on learning. Epistemological beliefs of individuals affect learning approaches in topics regarding how the individual's attitude towards learning will be and at what level the individual will learn. Therefore, interest towards individuals' epistemological developments and beliefs among the pedagogues grows day by day (Hofer & Pintrich, 1997; Kardash & Scholes, 1996). Another reason of growing interest in scientific epistemological beliefs, on which it is worth doing research, is that while acquiring latest information, human mind interprets this information in terms of knowledge already acquired, and while knowledge has a changeable structure, beliefs have a more resisting structure against changes (Demir, 2012). On the other hand, because knowledge forms beliefs, knowledge is the indirect manifestation of information that a person has acquired throughout his/her life.

2.1.1. Epistemological Belief Theories

Researchers have developed different approaches related to epistemological beliefs. These approaches are mostly aimed at describing and measuring beliefs of students and teachers on knowledge and epistemological subjects. Theories developed for explaining individuals' epistemological beliefs are separated into two main groups in terms of their belief dimensions connected to each other: One-dimensional and multidimensional theories about knowing and learning (Duell & Schommer-Aikins, 2001). Indeed, theories in both groups are multidimensional because they both discuss mind complexity. Besides, the main difference between one-dimensional and multidimensional theories is their perspectives on the relation between belief dimensions. In one-dimensional epistemological belief theory, it is thought that if one of the dimensions develops, the others develop as well. However, in multidimensional theories, if one develops, others may or may not develop.

Psychological studies on epistemological developments began in 1970 with William Perry's study titled "Forms of Intellectual and Ethical Development in the College Years: A Scheme". Studies began with the leadership of Perry who helped other researchers interested in this field (Baxter Magolda, 1992; Belenky et al., 1986; King & Kitchener, 1994; Kuhn, 1991) in creating new forms (Hofer & Pintrich, 1997; Schommer, 1990). However, from 1960s until 1980s development stages of epistemological beliefs have appeared as one-dimensional (Bromme, 2005). In 1990s, with Schommer's studies, epistemological beliefs had a multidimensional structure view (Bromme, 2005). Data collection tools which are developed according to belief theories that are often used about knowing and learning in literature are indicated in Table 2.1.

Table 2.1. The Characteristics of Data Collection Tools on Epistemological Beliefs

Data Collection Tools on Epistemological Beliefs	Dimension
Checklist of Educational Views (Perry, 1968)	**One-dimensional**
Women's Ways of Knowing Interview (Belenky, Clincky, Goldberger & Tarule, 1986)	**One-dimensional**
Epistemic Doubt Interview (Boyes & Chandler, 1992)	**One-dimensional**
Measure of Epistemological Reflection (Baxter Magolda & Portefield, 1988; Baxter Magolda, 1992)	**One-dimensional**
Reflective Judgement Interview (King & Kitchener, 1994)	**One-dimensional**
Attitudes towards Thinking and Learning Serway (Galotti, Chinchy, Ainsworth, Lavin & Mansfield, 1999)	**One-dimensional**
Beliefs about Knowledge and Learning (Schommer, 1990)	**Multidimensional**
Beliefs about Knowledge and Learning (Jehng, Johnson & Anderson, 1993)	**Multidimensional**
Epistemic Belief Inventory (Schraw, Dunkle & Bendixen, 1995)	**Multidimensional**
Epistemological Understanding by Judgement Domain (Kuhn, Cheney & Weinstock, 2000)	**Multidimensional**

2.1.1.1. Perry's Epistemological Belief Theory (1970)

William Perry is one of the first researchers that studied individual's epistemological developments (Hofer & Pintrich, 1997). In the late 1960s, William Perry conducted a study where he interviewed mostly male students from Harvard University. In his study, he had 98 interviews with students. He studied students' change of belief in knowledge from the time they first attended to university until their last year in university (throughout four years) (Belenky, Clinchy, Goldgerger, & Tarule, 1986; Duell & Schommer-Aikins, 2001). In conclusion, it is inferred from the study that during their university education program, students have more sophisticated beliefs over time. In subsequent years, he expanded his studies to support his findings. Therefore, this time in a four-year period, he had 366 interviews with students (Duell & Schommer-Aikins, 2001). During the research, he collected data by students' answers to Checklist for Educational Views (CLEV) and open-ended interview questions. In conclusion, based on his findings, Perry developed "Intellectual and Ethical Development Model" which consisted of nine phases, which was also a significant starting point for the other researchers (Baxter Magolda, 1992; Belenky et al., 1986; King & Kitchener, 1994; Kuhn, 1991) who explain individuals' epistemological developments.

Based on his research findings, Perry (1970) explained individuals' epistemological development by four basic developmental categories which entail nine developmental phases: dualism, multiplism, relativism and commitment. Individuals who have developed a dualist point of view for the nature of knowledge believe that knowledge is absolute and accurate (it is right or wrong). In addition, they believe that true knowledge is formed and transmitted to masses by the experts. Individuals who develop a multiplist point of view over time believe that knowledge is neither absolute nor accurate, that experts' truth cannot be absolute, and also that they have the right to form their own opinions. Relativist individuals think that knowledge is structured actively and personally, and they perceive themselves as active meaning producers. Individuals in commitment phase still have the relativist point of view, and they believe flexibly but firmly in a certain point of view or opinion (Buehl & Alexander, 2001; Hofer & Pintrich, 1997; Önen, 2011; Schommer, 1990; Tanase & Wang, 2010).

2.1.1.2. Women's Ways of Knowing Model (1986)

In the late 1970s, Perry was criticized frankly and seriously because he worked with mostly male groups and he generalized results to all university students. In this context Belenky, Clinchy, Goldberger and Tarule (1986) intensified their studies on women and they tried to understand women's epistemological development. At the end of the research, Belenky and her colleagues created a model and they discussed women's epistemological development in five phases (Brownlee et al., 2002; Buehl & Alexander, 2001; Hofer & Pintrich, 1997). Women in silence phase believe that knowledge is accurate and absolute and only experts who have position as authority will know the truth. Women in the phase 2, named as received knowledge, believe that each question has only one answer, and they classify knowledge as right or wrong. The reason for this is that they believe the origin of knowledge is their own intuitions and individual experiences, and they also see learning as an accurate knowledge that is simply perceived and a heritage from experts. Women in subjective knowledge phase have reached the correct knowledge by using their intuitions and individual experiences. Therefore, their intuition and individual experience are the source of knowledge. Individuals in procedural knowledge phase often use systematic aspects of thinking, and they believe that knowledge is interpretable and cannot be absolute. Individuals in this phase interpret their experiences using variety of processes such as reasoning, systematic analyzing and critical thinking. In the last phase, which is constructed knowing, women believe that knowledge is fully constructed according to context (Hofer & Pintrich, 1997).

2.1.1.3. Epistemological Reflection Model (1987)

Marcia Baxter Magolda had an open-ended interview with 51 females and 50 male university students, and she applied the "Epistemological Reflection Scale" to participants. She created a four-step "Epistemological Reflection Model" based on her longitudinal work (Tanase & Wang, 2010). The epistemological reflection model was built on education through knowledge of learners (Hofer, 2001). In addition to this, epistemological reflection model discusses personal epistemology through the view of social constructivism and on a context-dependent level.

This model reflects four different epistemological beliefs, which are absolute, transitive, independent and contextual. Individuals with absolute beliefs, believe that knowledge is accurate, unchangeable, and that experts know all the answers. Individuals with transitional belief have started to discover that scientists are not able to know everything and knowledge cannot be accurate. Individuals with independent beliefs believe that experts are not the sole source of knowledge and that their views can at least be as valid as experts. Individuals with contextual belief look at events by creating their own perspectives. While doing this, they structure data in hand in their own contexts and point of views (Hofer & Pintrich, 1997; Schommer-Aikins, 2002).

2.1.1.4. Argumentative Decision-Making Model (1991)

Deanna Kuhn dealt with the individuals' way of thinking in their daily life and considers thinking as a reasoning which is based on arguments. In this context, Kuhn (1991) asked participants who consisted of children, youngsters and middle-aged people about current problems that did not have an exact solution, and she studied how individuals react to these uncertain questions. Even though the main objective of the research was exploring the reasoning process based on arguments, trying to understand how and why individuals are reasoning have also brought beliefs on knowledge into the forefront. Therefore, in her research Kuhn had focused on epistemological beliefs. The epistemological structures in Kuhn's (1991) research are largely like those specified structures in the research of researchers such as Perry (1970), Belenky and colleagues (1986) and Baxter Magolda (1992).

In Kuhn's (1991) model, epistemological views are grouped under three categories, namely absolutists, pluralists, and evaluators (Hofer & Pintrich, 1997). Later, by developing this model, the epistemological views are collected under four categories, and they are renamed as realists, absolutists, pluralists, and evaluators (Kuhn, 2005). According to Kuhn's (2005) model, in the pre-school period, the student is realistic. The thing that is seen is known. Knowledge is unstructured and taken from the outside as it is seen. Since the facts have copies, there is no inconsistency or contradiction in the beliefs of a child. The absolutists see knowledge as absolute and certain and think that the knowledge of the experts is the truth. Individuals in this category are sure about their individual opinions. The pluralists approach the experts with suspicion and reject the accuracy of the expert's knowledge because of the disagreements or discrepancies between them. All opinions may be valid. Emotions and thoughts prevail over the facts. Knowledge consists of opinions, not facts. They think that their own thoughts may be just as sensible or valid as experts'. Evaluators, on the other hand, refuse certain and absolute knowledge. However, they believe that expert's opinions may be relatively more accurate than their own opinion. However, they think that the accuracy of each opinion must be assessed by comparing with other views. The epistemological understanding in this stage consists of judgments that must be supported with different options, evidences and arguments.

2.1.1.5. The Reflective Judgement Model (1994)

Kitchener and King, in their long-term research, studied the individuals' ways of thinking (ages range from high school to elderly ages) while they were solving problems. Kitchener and King put forward an epistemological development model (King & Kitchener, 2004). The method that they used in their research is different from Perry's. They used the method of interview for belief research, but interview instruments consisted of four different fields such as science, social studies, history and biology that comprised of complex problems with six semi-structured questions (Duell & Schommer-Aikins, 2001).

King and Kitchener's reflective judgmental model is a sequential development model. This model consists of three basic stages and seven basic levels that define how individuals perceive and make sense of structural problems. The first three stages of this model include pre-reflective thinking, the fourth and fifth stages include quasi-reflective thinking, and finally the sixth and seventh stages include reflective thinking. Individuals in the pre-projection level believe that the information at the first step is certain and that the information can only be obtained directly by the individuals' perceiving by their sense organs. In addition, individuals in this level cannot perceive that there are problems without a correct answer. In the half-reflection level, it appears that certain knowledge is seen to be denied. Belief of knowledge is relative and that one cannot know something for certain. In the level of reflective thinking, it is thought that knowledge should be structured actively and contextually (Hofer, 2001; Hofer & Pintrich, 1997). Accordingly, in terms of the level of epistemological development, individuals in the first stage believe that knowledge is absolute and certain and that knowledge can be acquired through direct observation (sense organs). Individuals in the second stage believe that knowledge is absolute and certain, but knowledge can be acquired not only through direct observation, but also from experts. Individuals in the third stage believe that knowledge obtained from the experts is absolute and certain, and that personal beliefs or thoughts cannot be definite truths. Individuals in the fourth stage believe that information would never be absolute and certain. Individuals in the fifth stage believe that knowledge is specific in terms of context and subjective because of its dependence on individual perception and evaluation criteria. Individuals in the sixth stage believe that knowledge is structured individually, based on the evaluation of data obtained from various sources. Finally, individuals in the seventh stage believe that knowledge is a product of the process of effective individual search for data or evidence, regarding a subject or problem in question and evaluation of them (Duell & Schommer-Aikins, 2001; Schommer, 1994).

While the similarity of the reflective judicial model with the critical thinking approach is often emphasized, this model focuses on open-ended problem solutions rather than closed-ended, and because it centers on epistemological assumptions and contains stages of development, it significantly differs from the critical thinking approach (Hofer, 2001).

2.1.1.6. Schommer's Multi-Dimensional Epistemological Belief Model (1998)

Schommer (1990) stated that the epistemological belief is limited only by including beliefs in one dimension related to knowledge. Therefore, she moved the concept of epistemological belief from one-dimensional understanding of knowledge to a multi-dimensional system. According to Schommer, epistemological belief should not only include beliefs on knowledge, it must also include beliefs related to learning and learning ability that has a relation with the processes of the acquisition and use of knowledge. Schommer (1990), who benefited from previous research, created a theoretical five-dimensional epistemological belief model. Schommer (1990, 1998, 2002) firstly conceptualized the structure of epistemological beliefs as a five-dimensional structure that encompasses the beliefs related to a theoretical structure of knowledge also the speed and control of the learning process with its certainty and source. Schommer then developed an "Epistemological Belief Questionnaire" consisting of 63 items about these dimensions (Schommer, 1990, 1993b; Schommer & Walker, 1997). Then to test validity of this five-dimensional structure and after carrying out various researches to establish relationships with the learning process, Schommer presented that epistemological beliefs are composed of four independent dimensions: (1) Knowledge is simple, (2) Knowledge is certain, (3) Learning is quick and (4) Learning ability is innate. Also, Schommer presented that each dimension has different effects on learning (Brownlee, Boulton-Lewis, & Purdie, 2002; Buehl, 2003; Paulsen & Feldman, 1999; Schommer, 1990; Schommer, 1994; Schommer & Dunnell, 1994; Schommer-Aikins, Duell, & Barker, 2003).

The dimension of *knowledge is simple* indicates that the individual believes knowledge has a simple structure consisting of the unrelated accumulation of individual parts or it has a complex structure formed by associating parts with each other. The dimension of *knowledge is certain* indicates that individuals believe knowledge is absolute (right or wrong) or it is temporary right or wrong, according to context. The dimension of *learning is quick* contains beliefs on learning process speed and indicates individuals believe whether learning should actualize immediately, whether it will ever actualize or whether it will actualize over time. Finally, the dimension of *learning ability is innate* indicates individuals' believing whether learning is a genetically inherited and unchangeable ability or whether it is something that can be improved by education or experience. The dimension of *learning is quick* indicates individuals' believing whether knowledge will actualize immediately, whether it will ever actualize or whether it will actualize based on experiences and training in stages over time (Brownlee, Boulton-Lewis, & Purdie, 2002; Buehl, 2003; Howard, McGee, Purcell, & Schwartz, 2000; Paulsen & Feldman, 1999; Schommer, 1990; Schommer, 1994; Schommer & Dunnell, 1994; Schommer-Aikins, Duell, & Barker, 2003).

2.1.1.7. Other Epistemological Beliefs Approaches

In Social-Cognitive Motivation Theory developed by Dweck and Leggett (1988), there are two basic elements, namely beliefs and learners' goal orientations (Dupeyrat & Marine, 2005). According to Social-Cognitive Motivation Theory, learners who believe that intelligence can be improved and learners who believe that intelligence is a stable structure that cannot be improved will have different learning and motivational approaches.

Qian and Alvermann (1995) adopted Schommer's (1990) approach. However, in the light of findings from their research at secondary education level in which they investigated the relationships between epistemological beliefs and conceptual change and learned helplessness, they have specified epistemological belief dimensions such as learning ability, simplicity/certainty of knowledge and learning speed. "Learning ability" dimension refers to a persistent continuity of learning ability acquired through later experience instead of the belief that the individual's learning ability is inherently determined. The dimension of "Simplicity/certainty of knowledge" expresses continuity of belief that knowledge is organized complexly by related concepts, and it constantly improves. However, this dimension does not express continuing belief in 'knowledge is certain' and it is organized in simple pieces. "Speed of learning" dimension does not express continuing belief in the fact that learning should either actualize immediately or it should never actualize. However, it does express continuing belief in learning being gradational (Qian & Alvermann, 1995).

Kardash and Howell (2000) studied the epistemological beliefs of learners by adopting the approach of Schommer (1990) as Qian and Alvermann (1995). However, results of Kardash and Howell (2000) research, which is about the effects of university students' epistemological beliefs on cognitive and strategic processing processes, determined epistemological belief dimensions as "nature of learning", "speed of learning", "certainty of knowledge" and "avoiding from integration". In Kardash and Howell's (2000) approach, the dimension of nature of learning includes the dimensions of the source of knowledge and the control of the learning from the epistemological belief dimensions set by Schommer (1990). However, the dimension of speed of learning can be discussed within the nature of the learning which has been taken as a separate dimension. Another critical issue within this approach is avoiding integration. This dimension includes characteristics related to the organization of knowledge, but it differs from other approaches as it is discussed in the context of beliefs about the nature of learning.

2.1.2. Conley et al.'s Epistemological Belief Model

Conley, Pintrich, Vekiri and Hannison (2004) pointed out the concepts of "the nature of the knowledge" and "the nature of knowing" in the research. That is, Conley et al.'s (2004) epistemological belief model was built on epistemological understanding focusing on these two concepts. Conley et al.'s (2004) epistemological belief model are indicated in Table 2.2.

Table 2.2. Conley et al.'s Epistemological Belief Model

Dimensions	Sub-Dimensions
The nature of knowledge	Certainty of knowledge
	Development of knowledge
The nature of knowing	Source of knowledge
	Justification for knowing

Conley et al. (2004) pointed out two different dimensions under the concept of "the nature of knowledge". The first one is named as "certainty of knowledge". This dimension focuses on the degree to which the individual sees knowledge in terms of certainty and flexibility, and a continuous distribution is considered from the viewpoint of certain knowledge to the viewpoint of flexible knowledge. The second dimension, under the concept of "the nature of knowledge", is "development of knowledge". In this dimension, a continuous distribution was considered towards the understanding of knowledge points to a network of concepts that are highly related to one another instead of the understanding of knowledge being the accumulation or sum of the facts in a simple sense.

According to Conley et al.'s (2004) model, there are two different dimensions under the concept of "the nature of knowing". The first one is named "source of knowledge". In this dimension, a continuous distribution was presumed as in other dimensions, and it was believed that knowledge in the lower levels was authority-originated and transferable. In the upper levels, it is stated that individuals have belief that knowledge is constructed by themselves and through communicating with others. The second dimension under the concept of "the nature of knowing" is "justification for knowing". In this dimension, how individuals evaluate information claims, how they approach authority and expertise in the sense of proofing etc. are discussed. Therefore, they have put forward a four-dimensional structure in the sense of epistemological beliefs.

The four-dimensional model of Conley et al.'s is very useful both in defining epistemological beliefs and in determining the level individuals are and in terms of making classifications. Also, scientific epistemological belief scale is the scale that was developed based on this model and used extensively to measure epistemological beliefs in science education (Conley et al., 2004). This scale has been used by the developmentalists because it has the dimension of reasoning (Conley et al., 2004; Fruge & Ropers-Huilman, 2008; Kizilgunes, Tekkaya, & Sungur, 2009; Schommer & Walker, 1997). In addition, because this scale has multidimensional structure, it is accepted by the belief system perspective (Eren, 2006).

2.1.3. Development of Epistemological Beliefs

How epistemological beliefs can be changed or can be improved is crucial in terms of making the teaching-learning processes more effective and productive (Deryakulu, 2004). When the studies on epistemological beliefs were reviewed, it concluded that beliefs are not in invariant structure as assumed before, especially there is no single objective or reality that makes student active. Knowledge is structured by the student. Also, studies indicate that epistemological beliefs can be changed or improved by long-term and coherent teaching practices based on a constructive learning approach which emphasize that knowledge is structured by the student, and learning depends on the student's effort and participation.

2.1.4. National and International Studies on Epistemological Beliefs

When epistemological studies carried out in a wide process are examined, it is seen that studies on the determination of epistemological beliefs have rapidly increased in our country and abroad in recent years. Studies on epistemological beliefs are mostly done with students. Quantitatively it is highly anticipated the studies in this field seem too much rather than being an odd situation. Especially when constructivist approach's "learner-centered" philosophy is taken into consideration, this seems pretty important. In these studies conducted with students, epistemological beliefs were examined in terms of various variables such as academic achievement, gender, socio-economic level, age, parental education level, field of study, learning, thinking skills, reasoning, metacognitive awareness, critical thinking, problem-solving skills, conceptual change, research processes, instructional strategies, resistance to change, control orientation, learning styles (e.g., Bath & Smith, 2009; Brownlee, Purdie, & Boulton-Lewis, 2001; Cano, 2005; Gürol, Altunbas, & Karaaslan, 2010; Hofer & Pintrich, 1997; Marrs, 2005; Mason & Boscolo, 2004; May & Etkina, 2002; Phan, 2008; Qian & Alvermann, 1995; Sadıç, Çam, & Topçu, 2012; Schommer, 1998; Schommer-Aikins & Easter, 2006; Schreiber & Shinn, 2003; Trautwein & Lüdtke, 2007). In this context, prominent studies on epistemological beliefs of students and their results can be expressed as follows:

One of the most important cognitive variables affecting learning-teaching processes was epistemological beliefs. The findings of the study revealed that epistemological beliefs were an important element in the learning of students (e.g., Belet & Güven, 2011; Hammer & Elby, 2000; Harteis, Gruber, & Hertramph, 2010; Hofer, 2001; Hofer & Pintrich, 1997; Schommer-Aikins & Duell, 2013). As a result, there are many studies that examine the relationship between the academic achievement of students and their epistemological beliefs (e.g., Akgün & Gülmez 2015; Aydın & Ertürk Geçici, 2017; Cano, 2005; Chen & Pajares, 2010; Conley et al., 2004; Demirli, Türel, & Özmen, 2010; Elder, 1999; Evcim, Turgut, & Şahin, 2011; Green & Hood, 2013; Hofer, 2000; Muis & Franco, 2009; Özbay, 2016; Phan, 2008; Ricco et al., 2010; Sadıç & Çam, 2015; Schommer-Aikins et., 2003; Schommer-Aikins et., 2005; Schommer-Aikins & Hutter, 2002; Yankayış, Güven, & Türkoğuz, 2014; Yeşilyurt, 2013). Although the majority of the studies were carried out at the high and college school level, there are some studies conducted with middle school level.

In the studies done with middle school students, the achievement of the students' science class was considered in general. For example, Özbay (2016) conducted a study with junior high school students, used path analysis technique to examine the relation between students' academic achievement towards science, intellectual risk-taking behaviors and epistemological beliefs. As a result of the analysis, it was determined that the certainty, development and justification dimensions of the independent sub-divisions of scientific epistemological beliefs significantly predicted the academic achievement in the positive direction and that the academic dimension of the scientific epistemological beliefs also significantly predicted the negative achievement in the negative direction. Again, it was found that intellectual risk-taking skills, which are independent variables of students, had a positive effect on academic achievement. As a result of the study, it was determined that there is a causal relationship between scientific epistemological beliefs and intellectual risk-taking behaviors and science achievement. Likewise, studying on epistemological beliefs of 7th and 8th grade middle school students, Yeşilyurt (2013) found a significant difference in terms of scientific epistemological beliefs of students regarding all dimensions except for the knowledge production dimension. The study conducted by Uysal (2010) aimed at revealing the relationship between scientific epistemological beliefs and science class achievement of middle school students. The study has revealed that scientific epistemological beliefs directly affect the achievement of students. Similarly, Chen and Pajares (2010) found in their study that there was a relationship between science class achievement, motivation for science, and epistemological beliefs of sixth grade students and also in his study, Pamuk (2014) examined the relationship between student achievements in science class and variables such as constructivist learning perception, scientific epistemological beliefs. Study results revealed that the constructivist education environments of the students predicted their scientific epistemological beliefs and achievements. Furthermore, the study also revealed that the constructivist learning environments of students predict their scientific epistemological beliefs and achievements. Individuals with advanced scientific epistemological beliefs demonstrated high academic achievement.

Particularly, several national and international studies identified that advanced epistemological beliefs had an effect on or are related to the academic achievement of students (e.g., Chen & Pajares, 2010; Deryakulu, 2002; Kember, 2001; Koç-Erdamar & Bangir-Alpan, 2011; Schommer-Aikins, Duell, & Hutter, 2005; Stathopoulou & Vosniadou, 2007). Students with advanced epistemological beliefs adopt a deeper and more functional learning approach, use more effective and efficient learning strategies in response to difficult and complex academic tasks, and are more determined and persistent than students with undeveloped beliefs, thus, epistemological beliefs influence academic performance (Deryakulu, 2004). However, there were studies in the literature that showed that epistemological beliefs had little or no effect on academic achievement (e.g., Akgün & Gülmez, 2015; Aşut, 2013; Harteis, Gruber, & Hertramph, 2010; Peng & Fitzgerald, 2006; Strobel, Cernusca, & Jonassen, 2004; Trautwein & Lüdtke, 2007). For example, Akgün and Gülmez (2015) examined the effect of epistemological beliefs of high school students on the academic achievement of chemistry class. The research revealed that epistemological beliefs of students do not have a significant impact on the achievement of high school students. One of the reasons for this is that students who have undeveloped epistemological rhetoric (learning occurs quickly) perform better when examinations that measure the level of learning are at a level of knowledge and understanding (Mohamed & El-Habbal, 2013). Taken into account, studies showed that epistemological beliefs were directly or indirectly influenced by achievement and thus have a determinant influence on achievement (e.g., Aksan, 2009; Ayaz, 2009; Cano, 2005; Pamuk, 2014; Schommer- Aikins et al., 2005; Uysal, 2010; Windschitl & Andre, 1998).

Many researchers examined students' epistemological beliefs in terms of gender. However, in literature, the difference in epistemological beliefs by gender is not fully determined because there are mixed results-some researchers reported gender differences, others found none. For example, some researchers (e.g., Balantekin, 2013; Boz, Aydemir, & Aydemir, 2011; Demirel & Çam, 2016; Deryakulu & Büyüköztürk, 2005; Enman & Lupart, 2000; Islıcık, 2012; Kılıç, Sungur, Çakıroğlu, & Tekkaya, 2005; Kienhues, Bromme, & Stahl, 2008; Neber & Schommer- Aikins, 2002; Şeref, Yılmaz, & Varışoğlu, 2012; Tüken, 2010) found that girls had more advanced epistemological beliefs. For instance, in her study which was carried out to explain the effect of gender, grade level and scope of education on epistemological beliefs of middle school students, Kurt (2009) found that female students had advanced beliefs about the justification of knowledge than boys. The survey conducted by Topçu and Yılmaz-Tüzün (2009) with middle school students revealed that female students had more advanced epistemological beliefs than males. On the other hand, other studies reported that male students had more advanced epistemological beliefs (e.g., Chai, Khine, & Teo, 2006; Eroğlu & Güven, 2006; Köse & Dinç, 2012; Meral & Çolak, 2009; Sadıç, Çam, & Topçu 2012; Saunders et al., 1999; Wood & Kardash, 2002). For example, the study conducted by Sadıç et al. (2012) to determine the epistemological beliefs of 4th, 6th and 8th grade students in elementary education revealed that male students had more advanced epistemological beliefs about the sources of information, its invariance and justification than girls. There were also other studies indicating that there was no significant difference between gender and epistemological beliefs (e.g., Aydın & Ertürk Geçici, 2017; Başer-Gülsoy, Erol, & Akbay, 2015; Biçer, Er, & Özel, 2013; Burr & Hofer, 2002; Chan & Elliot, 2002; Chan & Sachs, 2001; Conley et al., 2004; Law, Chan, & Sachs, 2008; Mason & Boscolo, 2004; Sadıç & Çam, 2015; Schommer, 1990, 1993b; Strobel et al., 2004; Tüken, 2010; Tümkaya, 2012). For example, the study conducted by Aydın and Ertürk Geçici (2017) to reveal the relationship between epistemological beliefs of sixth grade students and gender did not reveal any significant difference. Similarly; Yiğit, Alev, Akşan, & Ursavaş (2010) did not find a significant difference between epistemological beliefs of boys and girls in their study conducted with middle school students. There may be many reasons for the difference between the results of the studies. These are thought to be due to differences in out-of-school experiences of students, differences in the experience of learning in life, use of different measurement tools, characteristics of research samples, class levels, cultural differences, and learning habits of students (Yiğit et al., 2010).

One of the variables related to epistemological beliefs of students is grade level. There are studies in the literature which argue that grade level is influential on epistemological beliefs (e.g., Biçer et al., 2013; Hallet et al., 2002; Jehng, Johnson, & Anderson, 1993; Ricco et al., 2010; Sadıç et al., 2012). Yankayış, Güven and Türkoğuz (2014) stated that the epistemological beliefs of middle school students at different grade levels showed significant differences. In his study conducted with middle school students, Balantekin (2013) determined that student views towards scientific knowledge become more and more stronger towards the upper class. Similar results were obtained by Kurt (2009) conducted with the 6th, 8th and 10th grade students. Kurt (2009) reported that 10th grade students had advanced epistemological beliefs than 6th and 8th grade students. In a similar vein, Aydemir et al. (2013) and Özkan (2008) found out that student views towards scientific knowledge were getting stronger towards a higher grade. Contrary to these results, there are studies that reached the conclusion that grade level variable did not cause any significant difference on epistemological beliefs (e.g., Eroğlu & Güven, 2006; Kurt, 2009; Meral & Çolak, 2009; Oguz, 2008; Paulsen & Wells, 1998; Strobel et al., 2004; Şeref, Yılmaz, & Varışoğlu, 2012; Yeşilyurt, 2013). For example, Yeşilyurt (2013) examined the epistemological beliefs of 7th grade and 8th grade students and found no difference between grade levels and epistemological beliefs of students. Again, in the study conducted by Boz et al. (2011), the epistemological beliefs of the 4th, 6th and 8th grade students of elementary school were compared at grade level. According to the results of the study, as the grade level increased, the beliefs of the students about the formation and justification of knowledge were found to be less developed. Similarly, the study covering epistemological development of high school and college students, Hallet et al. (2002) found that epistemological beliefs of high school students were more objectivist and less skeptical compared to those of college students. In the light of these findings, researchers concluded the hypothesis supporting the idea that student beliefs developed from simple to complex during their learning from high school to university. It is thought the differences obtained from the research results are related to the experiences in the learning process (Yiğit et al., 2010).

There are also studies in the literature that both investigate the epistemological beliefs and learning approaches of the students and how these two individual learning variables are related to each other or how they affect each other (e.g., Alemdağ, 2015; Aypay, 2011; Cano, 2005; Chan, 2003; Cheng et al., 2009; Dahl, Bals, & Turi, 2005; Deryakulu, 2004; Huglin, 2003; Kanadlı & Akbaş, 2015; Liang & Tsai, 2010; Muis & Franco, 2009; Rodríguez & Cano, 2006; Taşkın-Şahin, 2012; Zhu, Valcke, & Schellens, 2008). As an example of this work, with middle school students, Cano (2005) conducted a study to examine the epistemological beliefs and change in learning attitudes of students and to determine the impact of epistemological beliefs on learning approaches. The study result determined that epistemological beliefs of students change and epistemological beliefs directly and indirectly affected the learning approach. Tanriverdi (2012) studied the relationship between university students' epistemological beliefs and learning approaches and found that students who believe that learning is related to the study habits adopted a deeper study strategy while those who believe learning is innate adopted more superficial study strategies. Similarly, studies conducted by Phan (2008) and Taşkın-Şahin (2012) with university students were also been found to be influenced by epistemological beliefs as a predictor of learning approaches.

When studies on epistemological beliefs of students are examined, it is seen that epistemological beliefs also affect conceptual changes of students (e.g., Chan, 2003; Chan & Elliott, 2004; Deryakulu, 2002; Kaymak, 2010; Qian & Alverman, 1995; Qian & Alverman, 2000). For example, in their work, Qian and Alvermann (2000) examined earlier studies to find out the relationship between middle school students' epistemological beliefs about science and conceptual change learning. On the basis of studies in the literature, researchers found that firstly students had a naïve belief in the nature of science, and in particular of science, and of scientific facts. The results of the study showed that students with immature beliefs about science were less likely to develop an integrated understanding of certain scientific concepts and change these concepts once they are shaped. Researchers found that those with immature epistemological beliefs were less likely to push through difficulties and achieve conceptual change than those with more mature and complex beliefs. In other words, it was seen that development of students' epistemological beliefs and their conceptual changes alter proportionally.

Some investigations have been conducted that examine the relationship between technology use and epistemological beliefs (e.g., Bendixen & Hartley, 2003; Braten & Stromso, 2004; Elgatait, 2015; Forrester, 2006; Harteis, Gruber, & Hertramph, 2010; Karakuyu & Karakuyu, 2015; Lee, 2001; Liu & Tsai, 2008; Tolhurst, 2007). For example, the study conducted by Tolhurst (2007) concluded that the use of internet-supported activities in lessons result in positive effects of students' epistemological beliefs. Moreover, Başer-Gülsoy, Erol and Akbay (2015) stated that people with advanced epistemological beliefs used technology more frequently and for different purposes.

Studies investigating the effects of epistemological beliefs on problem solving skills are also present in the literature (e.g., Aksan, 2009; Aksan & Sözer, 2007; Gallagher, 2001; Muis, 2004; Muis, 2007; Öngen, 2003; Schommer-Aikins, 2002; Schommer-Aikins, Duell, & Hutter, 2005; Schraw, Dunkle, & Dennison, 1995). For example, Evcim, Turgut and Şahin (2011) investigated the relationship between the epistemological beliefs of 61 middle school students and their ability to solve everyday life problems. When the results of the research were evaluated, a significant relationship between the epistemological beliefs of the students and the level of solving their daily life problems were detected. Likewise, Yılmaz and Delice (2007) investigated the effect of students' epistemological beliefs on problem solving process among university students. The study results showed that students who believed that there is a single truth and had immature epistemological beliefs looked for a single answer to complex problems or adopted attitudes of others, yet not their own thoughts.

In the literature, there are also studies investigating the effects of students' epistemological beliefs on variables such as fields of study (Averett & Arnd-Caddigan, 2014; Enman & Lupart, 2000; Ertekin, Dilmaç, Delice, & Aydın, 2009; Hofer, 2000; Liu & Tsai, 2008; Strobel, Cernusca, & Jonassen, 2004), achievement motivation (Buehl, 2003; Cavallo, Potter, & Rozman, 2004; Kizilgunes, Tekkaya, & Sungur, 2009), learning processes (Ravindran et al., 2005; Schreiber & Shinn, 2003), self-regulated learning (Muis, 2004; Paulsen & Feldman, 2005), reflective thinking (Phan, 2008), research skills (Karakuş & Aydoğdu, 2014; Whitmire 2003, 2004), intelligent executive skills (Lehrer, Schauble, & Lucas, 2008; Ryder & Leach, 2000), self-regulation skills (Magno, 2011; Özkan, 2008; Pamuk, 2014), self-esteem (Marrs , 2005; Özşaker, Canpolat, & Yıldız, 2011), socio-scientific decision making processes (Liu, Lin, & Tsai, 2011), attitude towards the school (Schommer & Walker, 1997), attitude towards science (Fulmer, 2014; Ozkal, Tekkaya, Cakıroglu, & Sungur, 2009), the nature of science (Adak & Bakır, 2017; Carey, Evans, Honda, Jay, & Unger, 1989; Lehrer, Schauble, & Lucas, 2008; Songer & Linn, 1991), learning of science concepts (Chan & Elliot, 2004; Liang & Tsai, 2010; Tsai et al., 2011) learning of physics (Cavallo, Potter, & Rozman, 2004; Hammer, 1994; Stathopoulou & Vosniadou, 2007), attitude towards physics (Kapucu & Bahçivan, 2015), physics expectation (Elby, 2001), acquisition of science experience (Kang, Scharmann, & Noh, 2005), science literacy (Sadıç & Çam, 2015), environmental literacy (Öztürk, 2009), the frequency of participation in laboratory activities (Ozbay & Köksal, 2015), genetic perceptions (Venville, Gribble, & Donovan, 2005), value preferences (Başçiftçi, Güleç, Akdoğan, & Koç, 2011), study strategies (Deryakulu, 2004; Schommer, Crouse, & Rhodes, 1992) thinking skills (Schommer-Aikins & Hutter, 2002; Valanides & Angeli, 2005), self-regulated learning strategies (Law, Chan, & Sachs, 2008; Paulsen & Gentry, 199; Paulsen & Feldman, 2007) and audit focus (Deryakulu, 2002).

It is also seen that scale development studies related to epistemological beliefs were conducted. When epistemological belief scale adaptation studies are examined; it is seen that Akçay et al. (2016) adapted the scale of Conley, Pintrich, Vekiri and Harrison (2004) to Turkish culture; Velipaşaoğlu and Musal (2012) adapted the scale of Chan and Elliott (2002, 2004); Aypay (2011) adapted the scale of Schraw, Bendixen and Dunkle (2002); Acat, Tüken and Karadağ (2010) adapted the scale of Elder (1999); Kaynar, Tekkaya and Çakıroğlu (2009) adapted the scale of Conley et al. (2004); Önen (2007) adapted the scale of Schraw, Dunkle and Bendixen (1995); Kılıç et al. (2005) adapted the scale of Rubba and Andersen (1978); while Deryakulu and Bıkmaz (2003) adapted the scale of Pomeroy (1993) to Turkish culture. The scale of Schommer (1990) was adapted to Turkish culture by different researchers such as Deryakulu and Büyüköztürk (2002-2005) and Karhan (2007). In addition to this, there are a few cases of scale development studies on our social, cultural and linguistic structure. In order to measure the central epistemological beliefs about learning-teaching processes of university students, Oksal et al. (2006) developed the Central Epistemological Beliefs Scale.

In the studies conducted on epistemological beliefs, it was revealed that these beliefs are not invariant, but a psychological feature that can develop over time and they may change. Moreover, main factors effecting the development of epistemological beliefs in this developmental process were also effective in factors such as mental development (Neber & Schommer-Aikins, 2002; Schommer, 1993a; Schommer & Dunnell, 1994), intelligence (Schommer & Dunnell, 1994, 1997), age (Burr & Hofer, 2002; Collins & Pinch, 1993; Kuhn, 1991; Weinstock, Neuman, &

Glassner, 2006; Yang & Tsai, 2010), parental education level and socio-economic level (Eroğlu, 2004; Jehng, Johnson, & Anderson, 1993; Ozkal, Tekkaya, Cakıroglu, & Sungur, 2009; Schommer, 1998, 1990; Topçu & Yılmaz-Tüzün, 2009) and the culture in which they are formed (Chan & Elliott, 2000; Reybold, 2002; Youn, 2000).

Bendixen and Rule (2004) also pointed out that metacognition plays a critical role in the developmental process of epistemological beliefs. For example, in the study of Bromme, Pieschl and Stahl (2010), epistemological beliefs were found to develop as the level of metacognitive awareness increases. Related studies (Bedel & Çakır, 2013; Belet & Güven, 2011, Dahl et al., 2005; Deryakulu, 2004; Göğebakan-Yıldız, Kıyıcı, & Altıntaş, 2016; Güven & Belet, 2010; Özgelen, Yılmaz-Tüzün, & Hanuscin, 2010; Sapancı, 2012; Wachsmuth & Leibham, 2007) emphasized that there is a relationship between metacognition and epistemological beliefs. Students with advanced epistemological beliefs use more in number and more qualified cognitive information processing strategies (Baltaci, Yildiz, & Özcakir, 2016; Lodewyk, 2007; Kardash & Howell, 2000). These students check what they learn in metacognitive teaching materials more frequently and correctly, and they develop more complex, profound and multifaceted thoughts (Deryakulu & Büyüköztürk, 2005). In addition to studies on epistemological beliefs and metacognitive variables, there are also epistemological beliefs, metacognition, and critical thinking studies. For example, in his study, Wyre (2007) examined epistemological belief, critical thinking and metacognition together and found that epistemological beliefs develop in an environment in which critical thinking was supported by metacognition. Başbay (2013) studied partial mediating effect of metacognitive awareness level in the relationship between critical thinking tendencies and epistemological beliefs of college students. The result of the study emphasized that metacognitive variable had the quality of partial mediating variable in the model in which the students' critical thinking tendency affected the epistemological beliefs. Another study by Öztürk (2011) examined the relationship between university students' critical thinking skills, epistemological beliefs and metacognitive awareness on socio-scientific issues.

Another view of the development of epistemological beliefs is that constructivist-based teaching methods may affect epistemological beliefs (Çetin-

Dindar, Kirbulut & Boz, 2014; Green & Hood, 2013; Muis & Duffy, 2013; Pamuk, 2014; Smith, Maclin, Houghton, & Hennessey, 2000; Tüken, 2010). For example, in her work with middle school students, Islıcık (2012) examined how the constructivist approach affected 8th grade students' philosophical views on science and scientific knowledge, that is, their scientific epistemological beliefs. As a result of the analysis, she found out a positive relationship between learning environments and epistemological beliefs. In another example, according to Chang (2005), using pedagogical tools (questions) in constructivist teaching, giving students the opportunity to think and class discussion, and doing practice based on real life activities led students to have more structured beliefs about the nature of teaching and learning and they had more advanced epistemological beliefs. In addition, Chang emphasized that in addition to conducting lessons with the constructivist approach, the measurement and evaluation process must also conform to the constructivist approach. Likewise, in instructional practices, constructive approaches such as giving speech to students on a specific topic, implementing integrative activities by dividing them into small groups (King et al., 2000; Leach, Hind, & Ryder, 2003) and creating a class discussion, and implementing the 5E learning cycle (Bektaş, 2011; Kaynar, Tekkaya, & Çakıroğlu, 2009) which is a constructivist approach, with an argumentation-based learning (Boran, 2014; Nussbaum, Sinatra, & Poliquin, 2008) and argumentation based inquiry (Tucel, 2016), inquiry or active based laboratory practices (Conley et al., 2004; Deniz, 2011; Huang, 2011; Keen-Rocha, 2008; Kizilgunes, Tekkaya, & Sungur, 2009; May & Etkina, 2002; Qian, & Alvermann, 2000; Roth & Roychoudhury, 1994), using time and space saving electronic resources such as video, audio, online discussion environments in lessons by applying a constructivist approach to instructional practices, helping to provide additional counseling and support for teachers (Chai, Teo, & Lee, 2010; Howard et al., 2000; Şengül-Turgut, 2007) collaborative learning (Baydar, 2015; Bergom, Wright, Brown, & Brooks, 2011; Çalıklar, 2015; Fırat, 2014; Keen-Rocha, 2008; Koç, Şimşek, & Fırat, 2013; Lee, 2001), classroom discussion (Kardash & Scholes, 1996), brainstorming and case studies (Çam & Geban, 2011) improve the epistemological beliefs of students. Moreover, writing diaries about their beliefs on learning and teaching (Dart et al., 1998), keeping diaries reflecting their own field experiences (Brownlee et al., 2001) also provides positive progress in the epistemological beliefs of students. The results of studies on the development of epistemological beliefs, exemplified above, are also important for this study.

2.1.4.1. Summary

When national and international studies were generally evaluated, various research findings revealed the relation and interaction of epistemological beliefs with cognitive, emotional and social variables. In studies investigating the epistemological beliefs of individuals, it was emphasized that epistemological beliefs did not have a fixed structure, a person carries a psychological feature and can change and progress throughout life in a positive sense. When studies were examined, it is seen that students with advanced epistemological beliefs used advanced cognitive and cognitive awareness learning strategies more effectively and efficiently. The studies revealed that students with developed epistemological beliefs showed a tendency to pursue their efforts to learn and as a natural result of this they achieved higher academic success. It is noteworthy that students with undeveloped or naïve epistemological beliefs were unable to use cognitive and cognitive awareness learning strategies, and thus, they fail. Moreover, students with advanced epistemological beliefs had a deeper approach to learning, and those with undeveloped epistemological or naïve beliefs preferred to memorizing. That is, student-centered methods effect the epistemological beliefs of students positively.

2.2. Metacognition and Metacognitive Awareness

The concept of metacognition emerged as a result of studies on how learning takes place in the human brain. In recent years, researchers interested in education have been especially curious about how the individual learns new knowledge and what kind of a learning process he/she goes through (Eggen & Kauchak, 2001). The concept of metacognition, first used by and added to literature by John Flavell in the early 1970s, was defined as information on the cognitive methods of a person and his/her productions related to it (Flavell, 1979). Therefore, it is the individual's awareness and thinking about their cognitive processes and strategies. The concept of metacognition has been described by many researchers, and concepts close to each other have been used for the description. For instance, Blakey and Spence (1990, p.1) defined metacognition as "thinking about thinking, to know what to know and what to not know". Welton and Mallan (1999) defined metacognition as a process in which students consciously control and direct their own thinking processes to think independently, and Martinez described metacognition (2006, p.966) as "control and monitoring of thought". According to these definitions, metacognition includes all stages that 'individuals experience before the learning process', 'during the process', and 'during the evaluation of the process'. Students' achieving metacognitive skills provides them with an idea of how they should behave in a new learning process, what and how much they need to study, how they should check the process, and how they should evaluate themselves at the end of the process (Akın, 2006).

Metacognitive awareness is the knowledge and control of individual's own thinking and learning activities (Kramarski et al., 2002). A very basic level of metacognitive awareness means that the individual is aware of his/her own thinking (Doğanay & Kara, 1995). This means, individuals are aware of their learning path and themselves. Metacognitive awareness being an abstract concept has led researchers to make different definitions of this concept and to make appropriate interpretations of the concept pursuant to research fields. Although there are some differences between the definitions given by researchers, it is emphasized that cognitive awareness is the control and regulation of one's cognitive processes. For example, Paris, Lipson and Wixon (1983) defined metacognitive awareness as being aware of one's own thoughts. Schraw and Dennison (1994) have described metacognitive awareness as individuals' planning, ranking, monitoring and better applying ability in a way that will directly boost their performance. In this context, metacognitive awareness may be defined as the work of acquiring and using the metacognitive thinking skills that an individual need throughout his/her life. Cognitive awareness also refers to the individual regulating his/her knowledge, learning processes, knowledge of cognitive and affective situations, conscious control and knowledge of the individual, learning processes, cognitive and affective situations (Papaleontiou-Louca, 2003).

Metacognitive awareness allows individuals to strengthen their high-level thinking skills, to have knowledge about their own cognition, to develop their individual assessment skills, to identify strategies that are the cause of success or failure, and to plan and monitor learning situations in a way that will enhance their performance (Schraw & Dennison, 1994). It is also considered as an element of effective learning (Çetinkaya & Erktin, 2002; Paris & Jacobs, 1984; Schraw & Graham, 1997).

2.2.1. Metacognition and Science Education

To provide students with the ability to conduct research is one of the main goals of science education. To achieve this goal, it is important to provide students with the ability to learn how to learn, to develop self-regulation skills about learning strategies and to provide students with the ability to recognize what they think (Soylu, 2004; Yıldız, 2008). The metacognition, which serves this purpose, enhances the students' attention towards lessons and affects the academic achievement positively (Akdur, 1996; Case et al., 1992; Çakıroğlu, 2007; Desoete & Roeyers, 2002; Flavell, Flavell, & Green, 2000; Manning & Payne, 1996; McDougall & Brady, 1998; Özsoy, 2007; Taraban, Rynearson, & Kerr, 2000; Victor, 2004). Besides, metacognition has an important effect on the knowledge of a person, on his/her own cognitive processes, on this knowledge controlling the cognitive processes (Flavell, 1987) and on cognitive process activities such as monitoring and organizing learning, problem solving, comprehending, reasoning, monitoring and organizing (Çetinkaya & Erktin, 2002; Metcalfe, 2000; Öz, 2005). In addition, when compared to other students, students with metacognitive skills are seen as students who are more aware of their weaknesses and strengths and who try to further develop their own learning skills. Researchers are emphasizing that in the learning process, effective and meaningful learning levels of students can be increased to the extent that their metacognitive awareness can be improved (Bransford, Brown, & Cocking, 2000; Jones, Farquhar, & Surry, 1995).

In the 1980s, when inquiry-based learning approach in science education became widespread, the concept of metacognition began to emerge (Carin & Bass, 2001; Hartman, 2002; Llewellyn, 2005; Schraw et al. 2006). In these studies, it has been indicated that inquiry-based learning approach is an effective learning approach in improving students' metacognitive skills. The importance and benefits of metacognition are put forward by these studies. However, it has been discussed in Turkey since the 2000s. Despite the abovementioned studies on metacognition, it seems that researchers still cannot have a common definition for metacognition. For that reason, it is significant to discuss the concept of metacognition in detail.

2.2.2. The Measurement of Metacognitive Awareness

One of the most important problems of measuring metacognitive awareness is the method that will be used for a valid and reliable measurement (Panaoura & Philippou, 2003) because it is a difficult process to measure metacognitive awareness (Desoete, 2008; Veenman et al., 2006). When the literature is analyzed, it is seen that different measurement techniques are developed. It is also observed that research have been done in order to criticize the validity and reliability of the developed tools (Veenman et al., 2005).

In order to measure metacognitive awareness, surveys, scales, interviews, think-aloud protocol, teacher evaluation scales, monitoring check-lists, online diaries, portfolios and calibration techniques, inventories are used (Karakelle & Saraç, 2007; Veenman et al., 2006; Yurdakul, 2004; Zimmerman & Martinez-Pons, 1990). Besides personal inventories, interviews, think-aloud protocols and teacher scale surveys (Desoete, 2007) are suggested techniques to measure metacognitive skills. In general, these techniques used for measuring and evaluating metacognitive awareness are divided into two groups: concurrent and non-concurrent techniques. Concurrent techniques are obtained by recording the performance of the individual concurrently while fulfilling a cognitive task. Self-evaluation surveys, think-aloud protocols and interview techniques are examples of concurrent techniques (Afflerbach, 2000; Özsoy, 2008; Yurdakul, 2004). Non-concurrent evaluation techniques are obtained by observing general characteristics of an individual's metacognitive skills and recording it in a different time than the performance. These techniques include evaluation techniques, interviews and teacher evaluation techniques (Karakelle & Saraç, 2010; Veenman et al., 2006; Yurdakul, 2004). While concurrent techniques evaluate the existing situation that is related to a specific metacognitive task, non-concurrent techniques evaluate typical situations. Additionally, it is stated in recent research that multi-method design techniques that include different techniques should be used (Desoete, 2008; Karakelle & Saraç, 2007; Veenmann et al., 2005).

When concurrent and non-concurrent techniques are taken into consideration, the most frequently used technique is the rating scales technique, since it is the least problematic among others in respect to both evaluation and application. The reason for this is that it provides scoring objectivity and is applicable to crowded groups in research for determining metacognition level or metacognitive awareness. On the other hand, there are some criticisms on rating scales. Especially, it is remarked that metacognitive techniques are not enough as they are based on the individual's declaration. Therefore, some researchers argue that most of the rating scales just evaluate metacognitive knowledge and other techniques are required for observation and control functions (Karakelle & Saraç, 2010; Pintrich, Walters, & Baxter, 2000). Another criticism is that rating scales are not divided into valid and reliable sub-dimensions or even when they are, same subjects may take place in different dimensions. This is explained as the relation between dimensions and scales are seen limited as they only determine the level of metacognitive knowledge or awareness (Karakelle & Saraç, 2007; 2010).

When the literature is taken into consideration, it is seen that Metacognitive Awareness Inventory (MAI), developed by Schraw ve Dennison (1994), is the most commonly used scaling technique (Küçük-Özcan, 2010). This scaling technique has two main parts, namely metacognitive knowledge and metacognitive regulation. Adopting the perspective of this scaling technique, Sperling, Howard, Miller and Murphy (2002) developed Jr MAI that has two versions measuring the metacognitive skills of secondary school students.

In order to develop a scale for measuring metacognitive awareness, Çetinkaya and Erktin (2002) aimed to identify the previously used measurement tools and their weaknesses. In this sense, they examined the skills that are to be evaluated as metacognitive. The researchers working in the field of mathematics and science evaluated these skills and put them in order of importance. For every skill, they analyzed the averages and used the highest average in the measurement process. At the end of the research, a survey-like scaling technique was developed that provides teachers with the opportunity to determine the situations where students show metacognitive characteristics. This scaling technique is formed with metacognitive field questions such as cognitive strategies, planning, monitoring, self-control, evaluation and awareness.

2.2.3. Metacognitive Models and Theories

Metacognition is a multidimensional structure that contains different types of information and processes. The fact that metacognition is a multidimensional structure provides researchers to present different taxonomies in identification and classification of information and processes. These techniques are explained below.

2.2.3.1. Flavell's Metacognitive Model

While Flavell was developing his metacognitive model, he was influenced by Jean Piaget's model and started from Piaget's "formal thinking phase". According to Flavell (1979), metacognitive knowledge consists of four stages, namely metacognitive experiences, activities and strategies, goals and tasks. Metacognitive information refers to individuals' belief in their learning, their desire for the way of learning, strategies to fulfill a task, and cognitive attempts and knowledge of the individual consists of variables such as functional information and strategical information (Cotterall & Murray, 2009; Flavell, 1979; Lai, 2011). According to Flavell (1979), metacognitive experiences are defined as "any awake consciousness that accompanies and belongs to a cognitive intervention and affective experience" (p.906). Activities and strategies are defined as cognition and behaviors to reach goals. Goals and duties are desires and results of a cognitive effort.

2.2.3.2. Brown's Metacognitive Model

According to Brown (1980), metacognition is divided into two main parts, namely the cognition of knowledge and the regulation of the cognition. The information of the cognition is divided into three categories as declarative knowledge, procedural knowledge and conditional knowledge. Declarative knowledge is about "knowing what", procedural knowledge is about "knowing how", conditional knowledge is about "knowing why" and "knowing when" (Brown,1987). The arrangement of the cognition is divided into three dimensions: planning, monitoring and evaluation.

2.2.3.3. Schraw and Moshman's Metacognitive Model

Going around Brown's model in detail, Schraw and Moshman (1995) put forward a new model. In Schraw and Moshman (1995) model, metacognition is divided into two: knowledge of the cognition and regulation of the cognition. The knowledge of the cognition is the same as Brown's (1980) model: declarative knowledge, procedural knowledge and conditional knowledge. The regulation of cognition consists of planning, monitoring and evaluation.

2.2.3.4. Jacobs and Paris's Metacognitive Model

Jacobs and Paris (1987) took metacognition into consideration under two sub-categories as self-evaluation and self-management. Self-evaluation is mainly based on the individual's personal thoughts and ideas (Akın, 2006), which means self-evaluation is similar to the structure that is named as cognition management information by researchers. On the other side, self-management is expressed as the behavioral demonstration of the things that the individual has learned. In other words, self-management is similar to the cognition management (Jacobs & Paris, 1987). Self-evaluation was divided into three categories: declarative knowledge, procedural knowledge and conditional knowledge. Also, self-management consists of three categories such as planning, evaluation and regulation.

2.2.3.5. Tobias and Everson's Metacognitive Model

Tobias and Everson's (2002) metacognitive model consists of planning, selecting strategies, evaluation of learning and monitoring the information. These stages are being monitored continuously. According to this model, the way an individual plan the information, the strategies that they use to learn, the way they evaluate the information and the way they monitor the information should be monitored continuously.

2.2.3.6. Nelson and Narens's Metacognitive Model

Identifying metacognition as controlling and monitoring cognitive development, Nelson and Narens (1990) presented an alternative model for metacognition (De Bruin, Thiede, Camp, & Redford, 2011; Kornell & Metcalfe, 2006). In Nelson and Narens' (1990) model, two levels that are related to each other are mentioned as senior level and target level. There is a symmetric relationship between these two levels and a two-sided information flow exists. In the information flow, if a problem occurs on target level, monitoring is activated; for senior level, the control system steps in to inform these levels. Nelson and Naren (1990) explained how these models are controlled and monitored in detail. In their explanation, three phases are mentioned about learning: acquisition of the information, storing it and checking it by recalling.

2.2.3.7. Efklides' Metacognitive Model

Efklides' (2008) metacognition model consists of many stages and explains the concept of metacognition in detail. According to this model, metacognition is divided into three categories, namely social, individual awareness and non-cognitive levels. Consisting of different levels, this model is also made up of different dimensions such as *Metacognitive Knowledge, Metacognitive Experiences and Metacognitive Skill.* Within this perspective, it differs from Nelson and Narens's metacognitive model. In this model, metacognitive information contains information about the duties, goals and strategies of the individual. Thanks to metacognitive experiences, individuals are becoming aware of when and where they should use the information. In other words, metacognitive experiences stand between the individual and duties. Metacognitive skills mean individual's selection of right strategies throughout the learning process.

2.2.4. Schraw's Metacognitive Model

Schraw's (1998) metacognitive model is adopted in the present study. According to Schraw (1998), metacognition is divided into two main areas: the regulation of cognition and knowledge of cognition. There are two important points about knowledge of cognition and regulation of cognition. The first one is that the two of them are related to each other. The second one is that both of them have a wide spectrum; as a result, it is domain-general by nature (Schraw, 1998; Akın, 2006).

2.2.4.1. Knowledge of Cognition

According to Schraw (1998, p.114), the knowledge of cognition is about "individual's own cognition and the general knowledge about what they know about the cognition". It includes three sub-categories, namely declarative knowledge, procedural knowledge and conditional knowledge.

2.2.4.1.1. Declarative Knowledge

Declarative Knowledge is the knowledge about the situations that individuals are affected by, its own cognitive system and what they know or don't know, or whether they do their own duty or not (Schraw, 2000). Declarative knowledge consists of all the knowledge that individual considers as writable, speakable or explainable. Within this sub-dimension, these explanations can be presented as examples: "I understand my intellectual strengths and weaknesses", "I am good at the organizing information", "I know what the teacher expects me to learn" (Schraw & Dennison 1994).

2.2.4.1.2. Procedural Knowledge

Procedural knowledge is the knowledge of how and in what way the individuals would apply their learning processes and their problem-solving strategies (Schraw & Dennison, 1994). As procedural knowledge provides individuals the knowledge of how to use the information and regulate it, those who have advanced procedural knowledge fulfill duties more automatically, have a wider strategy repertoire, and they have the higher possibility of using different strategical techniques while solving problems (Pressley et al., 1987; Schraw, 1998). "I try to use the strategies that have worked in the past", "I am aware of what strategies I use when I study", "I have a specific purpose for each strategy I use" can be shown as sample statements for this sub-dimension (Schraw & Dennison, 1994).

2.2.4.1.3. Conditional Knowledge

Conditional knowledge refers to the information that individuals have about their learning processes, when and why it is used and its limitations (Schraw & Dennison, 1994). Namely, it is the knowledge of how a thing is done, or whether it is done individually or not and in which situation it is done or not (Yıldız, 2010). As conditional knowledge helps to improve the selection of cognitive sources efficiently, to use strategies efficiently and to make changes according to the needs of conditional needs, individuals with high level of conditional knowledge are considered efficient enough to determine the most appropriate strategy in the learning process (Kyllonen & Woltz, 1989; Mclnerney & Mclnerney, 2013; Schraw, 2001). The expressions that are stated in this sub-dimension can be mentioned as “I learn best when I know something about the topic”, “I use different learning strategies depending on the situation”, “I can motivate myself to learn when I need to” (Schraw & Dennison, 1994).

2.2.4.2. Regulation of Cognition

According to Schraw (1998), the regulation of cognition is the behavior that controls the cognitive knowledge and consists of five main components, namely planning, information management strategies, monitoring, debugging and evaluation (Schraw & Dennison, 1994).

2.2.4.2.1. Planning

Planning consists of selecting the appropriate strategies, sorting them out and using the right sources for the performance, determining the goals and timing (Schraw & Moshman, 1995). In this sense, it is seen that planning includes recognizing the mission, planning the learning and using strategy stages (Saraç, 2010). In this sub-dimension, such statements as “I think about what I really need to learn before I begin a new task”, “I set specific goals before I begin a task”, “I ask myself questions about the materials, before I begin”, “I think of several ways to solve a problem and choose the best one” can be mentioned as examples (Schraw & Dennison 1994).

2.2.4.2.2. Information Management

Information Management consists of strategies and skills such as regulation, summarizing, detailing and selective focusing used in order to make the information more effective (Schraw, 2000). “I consciously focus my attention on important information”, “I slow down when I encounter important information”, “I draw pictures or diagrams to help me understand while learning”, “I focus on overall meaning rather than specifics" are statements that can be shown as an example of this sub-dimension (Schraw & Dennison, 1994).

2.2.4.2.3. Monitoring

Monitoring contains an individual's awareness of his/her performance while he/she is dealing with a specific work, controlling him/herself on a regular basis in the learning process, determining mistakes and understanding whether the course is understood or not (Akın & Abacı, 2011; Saraç, 2010; Schraw & Dennison, 1994). As monitoring skill helps individual regulate their cognitive process and decide whether they understand or not, it is seen as the main component for efficient learning (Saraç, 2010; Schraw, 1998). These expressions can be seen as an example: "I ask periodically if I am meeting my goals", "I consider several alternatives to a problem before I answer", "I periodically review to help me understand important relationships" (Schraw & Dennison, 1994).

2.2.4.2.4. Debugging

Debugging consists of the strategies that the individuals use for fixing the problems in understanding and performance (Schraw, 2000). "I change strategies when I fail to understand", "I stop and go back over new information that is not clear", "I stop and reread when I get confused" are sample expressions of this sub-dimension (Schraw & Dennison, 1994).

2.2.4.2.5. Evaluation

Evaluation is passing a general judgement by the individual on their learning productions, cognitive regulation process and effectiveness of strategies (Saraç, 2010; Schraw, Crippen, & Hartley, 2006; Schraw & Dennison, 1994; Schraw & Moshman, 1995). Evaluation is very important for the individual's future learning and regulations (Schraw & Dennison, 1994). Within the sub-dimension, "I ask myself if there was an easier way to do things after I finish a task", "I summarize what I have learned after I finish", "I ask myself how well I accomplish my goals once I am finished" are statements that can be given as examples (Schraw & Dennison, 1994).

2.2.5. National and International Studies on Metacognitive Awareness

Since Flavell's discovery of the term metacognition, research in the field of metacognitive awareness have increased rapidly (e.g., Başaran, 2013; Desoete, 2008; Doğanay Bilgi & Özmen, 2014; Downing, 2009; Efklides, 2008; Garrett, Mazzocco, & Baker, 2006; Göğebakan-Yıldız, Kıyıcı, & Altıntaş, 2016; Hamdan et al., 2010; Hong-Nam & Leavell, 2011; Kalkan & Cerit, 2007; Karaoğlan-Yılmaz, 2016; Kramarski, Mevarech, & Arami, 2002; Marge, 2001; Mega et al., 2014; Memiş & Arıcan, 2013; Nosratinia et al., 2014; Oktay & Çakır, 2013; Sarwar et al., 2009; Schraw, 2009; Teong, 2002; Victor, 2004). While research on metacognitive awareness have been carried out since 1978 abroad, in Turkey studies in this area have begun with the research that Yüzbaşıoğlu conducted in the field of "language teaching" in 1991. In terms of metacognitive awareness studies conducted with students in and out of the country, the relationship levels of metacognitive awareness were tried to be determined with many variables such as academic achievement, age, gender, class level, reading skill, learning level, attitude, perception, motivation, intelligence, problem-solving, responsibility, epistemological beliefs, motivation, socio-demographic variables, motivation, self-efficacy (e.g., Ateş, 2013; Bağçeci, Döş, & Sarıca, 2011; Demirel & Aslan-Turan, 2010; Emrahoğlu & Öztürk, 2010; Kiremitci, 2011; Pilten, 2008; Sarıkahya, 2017; Selçioğlu-Demirsöz, 2010; Takallou, 2011; Turan, 2013; Yavuz, 2009). In addition to the studies of relationship between metacognitive awareness and the various variables, it is also possible to find the studies conducted for the change, development or increase of metacognitive awareness in the literature (e.g., Annevirta & Vauras, 2006; Baylor, 2002; Conner, 2000; Demircioğlu, 2008; Deniz, 2017; Gönüllü, 2010; Hong-Nam & Leavell, 2011; Kuhn, 2000; Othman, 2010; Rosetta, 2000; Sezgin-Memnun & Akkaya, 2012) In this section, outcomes and results of the prominent metacognitive awareness studies conducted with the students were tried to be discussed.

When the relationship between metacognitive awareness and learning is taken into consideration, many researchers found out that metacognitive awareness had a positive effect on learning (e.g., Anderson & Nashon, 2007; Blank, 2000; Cornoldi, Carretti, Drusi, & Tencati, 2015; Efklides & Vlachopoulos, 2012; Georghiades, 2004; Hart & Memnun, 2015; Jou, 2015; Sandi-Urena, Cooper, & Stevens, 2011;

Shamir, Mevarech, & Gida, 2009; Vrugt & Oort, 2008; Wang, 2015). When metacognitive awareness of students develops, their effectiveness in the learning process increases (Akturk & Sahin, 2011; Azevedo, Greene, & Moos, 2007; Desoete, 2008; Jones, Farquhar, & Surry, 1995; King, 2003) and they use learning strategies effectively (Drmrod, 1990).

When the literature was examined, it is noteworthy that there was a great deal of studies that analyze the relationship between metacognitive awareness and achievement (e.g., Alcı & Yüksel, 2012; Bağçeci, Döş, & Sarıca, 2011; Canca, 2005; Carey et al., 2014; Cooper, 2008; Demirel & Arslan-Turan 2010; Gürşimşek, Çetingöz, & Yoleri, 2009; Mega et al., 2014; Memiş & Arıcan, 2013; Sen, 2012; Sperling et al., 2002; Tok, Özgan, & Döş, 2010; Zakaria et al., 2009; Zulkiply et al., 2008). Some studies showed that there was a significant relationship between metacognitive awareness and academic achievement, and also showed that academic achievement of students with high metacognitive awareness increases (e.g., Akçam, 2012; Alcı et al., 2010; Alemdar, 2009; Ayazgök, 2013; Carey et al., 2014; Coutinho, 2007; Çakır & Yaman, 2015; Emrahoğlu & Öztürk, 2010; Göçer, 2014; Karatay, 2010; Mega et al., 2014; Rahman et al., 2010; Rezvan, Ahmadi, & Abedi, 2006; Schleifer & Dull, 2009; Veenman et al., 2006; Young & Fry, 2008; Zimmerman, 2008). For example, as a result of the study conducted by Young and Fry (2008) analyzing the relationship between university students' metacognitive awareness and academic achievements, they found out that there was a significant relationship between participants' metacognitive awareness and academic achievements. A similar study was carried out by Bağçeci, Döş and Sarıca (2011) in Turkey. In this study, it was aimed to investigate the relationship between metacognitive awareness of the 7th grade students and their Level Placement Examination (SBS) and their year-end achievement scores. The study was conducted with 194 seventh grade students. Metacognitive Awareness Inventory (MAI) was used to determine the metacognitive awareness of the students. As a result of the study, it was determined that there was a significant relationship between the metacognitive awareness of the students and SBS achievements in a positive way. It was also found that there was a positive relationship between the metacognitive awareness of the students and the achievement scores at the end of the year. That is, those with higher levels of metacognitive awareness had higher levels of achievement, while those with lower levels of metacognitive awareness had lower levels of achievement. High metacognitive awareness results in high performance, and therefore metacognitive awareness affects the achievement positively. However, there are some studies which showing no significant relationship between metacognitive awareness and achievement (e.g., Tuncer & Doğan, 2016).

There are also studies investigating the relationship between students' metacognitive awareness and their gender. Some researchers (Akçam, 2012; Altındağ, 2008; Anadaraj & Ramesh, 2014; Bağçeci et al., 2011; Evran & Yurdabakan, 2013, İflazoğlu-Saban & Saban, 2008; Karatay, 2010; Martin et al., 2000; Selçioğlu-Demirsöz, 2010; Sen, 2012; Yavuz, 2009) found that girls had more advanced metacognitive awareness. For example, studies conducted by Evran and Yurdabakan (2013) on the levels of metacognitive awareness of 6th, 7th and 8th grade students in terms of various variables revealed that there was a meaningful difference in the students' metacognitive awareness levels in favor of the girls. Alongside, there are also studies that found that male students had more advanced metacognitive awareness (Akyolcu, 2013). On the other hand, there were also studies suggesting that there was no significant difference between metacognitive awareness and gender (e.g., Ayazgök, 2013; Bars, 2016; Baykara, 2011; Duran, 2011; O'Neil & Brown, 1998; Özsoy et al., 2010; Özsoy & Günindi, 2011; Padeliadu et al., 2002; Rahman et al., 2010; Sezgin-Memnun & Akkaya, 2009; Sperling, Howard, Miller, & Murphy, 2002; Tuzcuoğlu, 2014; Zakaria et al., 2009).

Another variable, whose relation with metacognitive awareness is analyzed, is class level. Some researchers (Akçam, 2012; Atay, 2014; Baysal, Ayvaz, Çekirdekçi, & Malbeleği, 2013; Evran & Yurdabakan, 2013; Özsoy & Günindi, 2011; Sezgin-Memnun & Akkaya, 2009; Sezgin-Memnun & Akkaya, 2012; Sperling, Howard, Miller, & Murphy, 2002; Yürüdür, 2014) found a meaningful relationship between metacognitive awareness of students according to grade levels. For example, in their studies, Baysal, Ayvaz, Çekirdekçi and Malbeleği (2013) examined whether metacognitive awareness levels of university students changed in terms of class level and they reached a conclusion that students had a high-level metacognitive awareness that differentiates by class level. On the other hand, some researchers

(Akyolcu, 2013; Baykara, 2011; Karadeniz Bayrak & Erkoç, 2008; Özsoy, Çakıroğlu, Kuruyer, & Özsoy, 2010; Temur, Kargın, Bayar, & Bayar, 2010) could not find a significant relationship between metacognitive awareness and class level.

There are also studies in the literature that have related issues between metacognitive awareness and age (Akyolcu, 2013; Ormond et al., 1991; Özsoy, Çakıroğlu, Kuruyer, & Özsoy, 2010; Stewart et al., 2007). Studies showed that metacognitive awareness developed with age, and that different elements had different developmental time frames (Akpunar, 2011; Hanten et al., 2004; Stewart et al., 2007). For example, the results of Gren and colleagues' study (2000) revealed that as learner's age increases, their levels of defining similarity and differences, recalling ways of thinking, use of mind, and use of mental words increase. In addition, researchers emphasized that metacognitive awareness could be learned. Likewise, Akpunar (2011) stated that metacognitive awareness develops from younger ages, depending on growth and development. However, Akpunar (2011) also stated that control and participation in the learning process takes place later.

There are studies that conclude that metacognitive awareness and intelligence are interdependent and that there is a meaningful relationship between these two variables (e.g., Alexander, Johnson, Albano, Freygang, & Scott, 2006; Rozencwajg, 2003; Veenman & Beishuizen, 2004; Veenman & Spaans, 2005; Veenman, Wilhelm, & Beishuizen, 2004). A large part of these studies examined the relationship between these two variables in different age groups. For example, Veenman, Wilhelm and Beishuizen (2004) found a significant positive correlation between intelligence and metacognitive awareness in all age groups in a cross-sectional survey conducted with 4th, 6th, and 8th grade and university students. In addition, it was found that gifted and talented students had higher metacognitive awareness and more effective use of metacognitive skills and strategies, although the number of studies that examine the metacognitive awareness of gifted and talented students in the literature is rather limited (Alexander, Carr, & Schwanenflugel, 1995; Boran, 2016; Dover & Shore, 1991; Kanevsky, 1992; Karakelle & Saraç, 2007; Kurtz & Borkowski, 1987; Schneider, Körkel, & Weinert, 1987; Sheppard, 1992). However, in some studies, it was concluded that metacognitive awareness and intelligence might be independent of each other and that there was no meaningful relationship between them (Allon, Gutkin, & Bruning, 1994; Coutinho, 2006; Karakelle, 2012). For example, in Dresel and Haugwitz's (2006) study, it was stated that there was a negative relationship between intelligence level and metacognitive awareness, thus indicating that metacognitive awareness decreases as intelligence score increases.

It is possible to see the studies in which problem-solving and metacognitive awareness were investigated together (e.g., Aydemir & Kubanç, 2014; Balcı, 2007; Cozza & Oreshkina, 2013; Desoete, Roeyers & Buysse, 2001; Doğan, 2013; Gartmann & Freiberg, 1994; Gürşimşek, Çetingöz, & Yoleri, 2009; Kapa, 2001; Karakelle, 2012; Kiremitci, 2011; Kramarski, 2004; Kramarski, Mevarech, & Arami, 2002; Meijer, Veemen, & Wolters, 2006; Pilten, 2008; Pugalee, 2001; Rudder, 2006; Schurter, 2001; Swanson, 1990; Teong, 2003; Yimer & Ellerton, 2006). In many studies that it was found that there was a meaningful and positive relationship between these two variables and the students with higher metacognitive awareness level had a more positive problem-solving than the students with lower metacognitive awareness level (e.g., Alcı et al., 2010; Bakioğlu et al., 2015; Balcı, 2007; Bars, 2016; Boran, 2016; Christoph, 2006; Coutinho, Wiemer-Hastings, Skowronski, & Britt, 2005; Day, Espejo, Kowollik, Boatman, & McEntire, 2007; Goos et al., 2002; Howard, McGee, Shia, & Namsoo, 2000; Kiremitci, 2011; Metallidou, 2009; Nair & Ramnarayan, 2000; Öztürk, 2009; Teong, 2003; Woo, Harms, & Kuncel, 2007; Vukman, 2005). For example, in Boran's (2016) study on the effects of metacognitive awareness and critical thinking tendencies on perceived problem-solving skills of gifted and talented students, it was found that the perceptions of metacognitive awareness, critical thinking tendencies and problem-solving skills of gifted and talented students were high. The structural model developed based on the relationship between metacognitive awareness of gifted and talented students, their tendency to think critically, and the sub-dimensions of problem-solving skills is confirmed. The findings of this model revealed that gifted and talented students, along with metacognitive awareness, tend to solve the problem with their critical thinking instead of avoiding the problem when they face it. A similar study was conducted by 638 university students by Anandaraj and Ramesh (2014). The study examined the relationship between problem-solving skills and metacognitive awareness by using semi-experimental design. Data of the study were collected by using metacognitive awareness inventory and solving skills test of physics problem. At the end of the study, researchers emphasized that there was a positive relationship between problem solving ability and metacognitive awareness. As a result, individuals with high metacognitive awareness are individuals who are aware of their own learning, what they are doing, in which stage they are in a problem-solving process and how much they know in the process of problem-solving (Akyolcu, 2013).

Studies (Alcı & Yüksel, 2012; Bars, 2016; Cera et al., 2013; Çikrıkci, 2012; Keskin, 2014; Landine & Steward, 1998; Nosratinia et al., 2014; Rahimi & Abedi, 2014; Sapancı, 2012; Tuncer & Doğan, 2016; Yailagh et al., 2013; Yürüdür, 2014) also revealed that there was a significant relationship between self-efficacy and metacognitive awareness. For example, Yürüdür (2014) found that there was a significant relationship between metacognitive awareness and self-efficacy levels of university students as a result of a study of university students' perceptions of metacognitive awareness and self-efficacy levels. Students with higher self-efficacy perceptions are more likely to use metacognitive awareness strategies (Pintrich & De Groot, 1990), and students having lower self-efficacy and depending on external evaluation have lower metacognitive awareness (Garner & Alexander, 1989; Kleitman & Stankov, 2007).

Apart from the variables mentioned above, it is also possible to find studies examining the relationship between variables such as socio-economic status (Akçam, 2012; Akyolcu, 2013; Evran & Yurdabakan, 2013; İflazoğlu-Saban & Saban, 2008), course-study strategies (Doğanay & Demir, 2011; Gurb, 2000; Hwang & Vrongistinos, 2002), questioning styles (Kramarski, 2008; O'Neil & Brown, 1998), pedagogies (Hall et al., 1999), motivation towards science (Atay, 2014), environmental attitude (Malkoç, 2011), attitude towards technology (Bakioğlu et al., 2015; Tunca & Alkın-Şahin, 2014), decision making processes (Batha & Carroll, 2007; Mason & Santi, 1994; Ormond, Luszcz, Mann, & Beswick, 1991), intelligent executive (Göçer, 2014; Mevarech & Fridkin, 2006; Mevarech & Kramarski, 2003), epistemological beliefs (Güven & Belet, 2010; Jena & Ahmad, 2013; Topçu & Yılmaz-Tüzün, 2009) and the metacognitive awareness of students. Moreover, it is possible to find studies analyzing the impacts of metacognitive awareness strategies on regulation of cognition (Mevarech & Amrany, 2008), satisfaction (Weaver, 2012), perception (Sandall, Mamo, Speth, Lee, & Kettler, 2014), conceptual persistence (Alemdar, 2009; Georghiades, 2004) and language teaching (Garrett, Mazzocco, & Baker, 2006; Kramarski & Hirsch, 2003; Peymanfar, 2010). In addition, scale development (Blum & Staats,1999; O'Neil & Abedi, 1996; Schraw & Dennison, 1994; Sperling et al., 2002), scale adaptation (Akın, Abacı, & Çetin, 2007; Çetinkaya & Erktin, 2002; Namlu, 2004; Soydan, 2001) and meta-analysis studies (Hattie, 2009; Zohar & Barzilia, 2013) related to metacognitive awareness have been carried out, although they are few in number compared to other studies.

Finally, it was seen as a result of researches that different teaching methods and techniques such as cooperative learning (Goos & Galbraith, 1996; Kaya, 2013; Olğun, 2011; Sandi-Urena, Cooper, & Stevens, 2011), problem based learning (Demirel & Arslan-Turan, 2010; Kiremitci, 2011; Kuvac, 2014), inquiry based computer assisted teaching (White & Frederiksen, 1998), constructivist based learning (Yurdakul, 2004; Yurdakul & Demirel, 2011), case study method (Fırat-Durdukoca, 2017), project based learning (Başbay, 2007), computer based learning (Ersoy, 2013; Kapa, 2001; Olgun, 2006), web-based collaborative inquiry learning (Raes et al., 2012), using science diary (Çavuş, 2015), science writing heuristic (Tucel, 2016; Ulu, 2011), web based learning (Bannert & Mengelkamp, 2008), metaphor supported teaching (Sillman & Dana, 1999), classroom discussion (Goos & Galbraith, 1996; Mason & Santi, 1994), cognitive coaching (Demir, 2009), conceptual change based teaching (Yıldız, 2008), concept map (Akdur, 1996; Martin et al., 2000) were used for the detection, identification and development of metacognitive awareness of students, and these teaching methods and techniques increase metacognitive awareness. However, it was also determined as a result of investigations that teaching methods and techniques such as creative drama (Selçioğlu-Demirsöz, 2010), technology supported brain-based learning (Oktay & Çakır, 2013; Oktay-Esen, 2014), web-based teaching (Baltacı & Akpınar, 2011), brainstorming (Duru, 2007) and inquiry-based learning (Çakar, 2013; Çakar-Özkan & Talu-Bümen, 2014) did not any cause a change or influence on the metacognitive awareness of the students.

2.2.5.1. Summary

In general terms, metacognitive awareness was found to be influential in the acquisition of knowledge as well as effective learning, critical thinking, reasoning, problem solving, and social interaction skills as much as knowledge structuring, comprehension, recalling and practicing learnings. In addition to this, an individual can control how he/she learns with metacognitive awareness, develop self-regulation and control skills, and choose a facilitative way to reach its goals. Alongside, while it was examined whether metacognitive awareness could be improved or not, in the light of the recent study results showing that metacognitive awareness could be improved, it was stated with the researchers that this improvement was important in learning and various life skills if it is improved in a more conscious and deliberately organized activities.

CHAPTER 3

METHODOLOGY

In this chapter, methods used for the study were explained in detail. This chapter consists of information about ‘Restatement of the Purpose and Research Questions’, ‘Research Design’, ‘Participants and Selection’, ‘Instruments’, ‘Data Collection Procedure’, ‘Data Analysis Procedure’, ‘Role of the Researcher’, ‘Trustworthiness of the Study’ and ‘Ethics’.

3.1. Restatement of the Purpose and Research Questions

The main purposes of this study were to determine scientific epistemological beliefs and metacognitive awareness of 6th grade students with different achievement levels. With this aim, the research questions guiding this study were:

RQ1. What are the 6th grade students’ scientific epistemological beliefs regarding achievement levels?

RQ2. What are the 6th grade students’ metacognitive awareness regarding achievement levels?

3.2. Research Design

The present study was based on qualitative research approach. Qualitative research is a research method encompassing many concepts and it is based on various disciplines such as sociology, anthropology, philosophy, linguistics etc. and is practiced in many fields such as education, health, literature, psychology, politics etc. In qualitative research, a process aimed at revealing the events and problems in their natural settings in a realistic and holistic manner is carried out (Denzin & Lincoln 2013; Lichtman, 2010; Merriam, 2015; Yıldırım & Şimşek, 2016). The common purpose of qualitative research in all these disciplines and practice areas is to understand the research subject in a detailed, in-depth and multifaceted way (Creswell, 2009; Lodico et al., 2010; Yıldırım & Şimşek, 2016). According to Ary, Jacobs, Razavieh and Sorenson (2010), the purpose of qualitative research is to view a holistic picture and depth instead of data analyses in numerical forms. There are several different types within qualitative research. Merriam (2015) has specified the frequently used qualitative research types as “basic qualitative research”, “phenomenology”, “grounded theory”, “ethnography”, “discourse analysis” and “critical qualitative analysis”. All qualitative research types are concerned extensively with how understandings are structured and how people make sense of their lives and experiences (Creswell, 2009; Leedy & Ormrod, 2005; Maxwell, 2013; McLean, Jensen, & Hurd, 2007). In other words, all qualitative research types have descriptive and interpretive characteristics (Bogdan & Biklen, 2007; Lichtman, 2010; Marshall & Rossmann, 1999; Merriam, 2015).

The present study was carried out with “basic qualitative research method” which is widely used in education field and which is based on constructivism and nourished by phenomenology and symbolic interaction. In this study, the basic qualitative research design was used to determine the 6th grade students’ scientific epistemological beliefs and their metacognitive awareness and to detect the relationship between the students’ scientific epistemological beliefs and their metacognitive awareness. Merriam (2015) described basic qualitative research as a research method used by researchers investigating how individuals interpret their experiences in life, what kind of emotions they have, and how they perceive and shape the world. Starting from this description, the purpose of a researcher performing a basic qualitative research is to reveal the perceptions of the participants on a problem, phenomenon or concept and to interpret them in a holistic and comprehensive manner (Creswell, 2009; Mack, Woodsong, Macqueen, Guest, & Namey, 2005; Merriam, 2015; Merriam & Tisdell, 2016). That is, in basic qualitative research, the researcher is interested in the understandings, perspectives, beliefs of the participants on a specific phenomenon and the meanings they ascribe to that phenomenon (Atlheide & Johnson, 2013; Bogdan & Biklen, 2007; Corbin & Strauss, 2008; Percy et al., 2015; Richards & Morse, 2007; Swanson & Holton, 2005). It is argued by researchers that qualitative research is helpful in education field (Lodico et al., 2010; Merriam, 2015; Yin, 2014). One of the most significant benefits of the basic qualitative research is that it enables more in-depth understanding with holistic, descriptive and rich explanations than that provided by data (Merriam, 2015; Miles, Huberman, & Saldana, 2014; Yin, 2014).

In basic qualitative research, the researcher is the primary tool for the collection of data (Creswell, 2009; Merriam, 2015). As the primary tool for the collection of data, the researcher assumes the responsibility of verifying of the correctness and the clearness of data besides collecting them (Creswell, 2012; Merriam, 2015). Researchers employing the basic qualitative research method collect the data via interviews, observations or document analysis and they analyze them deductively. They reach themes as a result of the analysis and present the results in a descriptive way (Baxter & Jack, 2008; Merriam, 2015; Percy et al., 2015). Also, basic qualitative analysis design is flexible, and the participants are selected using purposive sampling method (Baxter & Jack, 2008).

3.3. Participants and Selection

The participants of this study consisted of 15 6th grade students who were in a public school in the city center of Ankara in the 2015-2016 academic year. Seven of the students who participated were females and eight of them were males. In determining the participants of the study, purposive sampling method, which is a non-random sampling method, has been used. Purposive sampling method is a significant sampling method type which is used in explanatory-informative research or field research and it enables in-depth study of cases which are considered to have rich information content (Miles & Huberman, 1994; Neuman, 2014; Patton, 2014; Yıldırım & Maşeroğlu, 2016; Yıldırım & Şimşek, 2016). In this context, the power of purposive sampling is caused by the emphasize it puts on in-depth understanding (Neuman, 2014). With this sampling method, the researcher can select the work group needed for a specific purpose or for the subject he/she is focusing on (Cohen, Monion, & Morrison, 2007; Neuman, 2014; Patton, 2014; Punch, 2013). There are specific subtypes within purposive sampling method (Merriam, 2015; Patton, 2014; Yıldırım & Şimşek, 2016). One of these is the “criterion sampling” method which was employed in choosing the participants for this study. In criterion sampling method, the participants are selected according to a predetermined range of criteria depending on the purpose of the research (Büyüköztürk et al., 2012; Creswell, 2007; Merriam, 2015; Yıldırım & Şimşek, 2016). The criterion or the criteria mentioned here can be originally developed by the researcher or a previously prepared criteria list may be used (Büyüköztürk et al., 2012; Creswell, 2007; Erkuş, 2011; Yıldırım & Şimşek, 2016). In this context, some criteria were taken into consideration for selecting the participants in the present study. The first of these criteria was the grade level. It was considered that it would be beneficial to work with 6th grade students in this study and they were included in the scope of the research. The second criterion was to choose the 6th grade students from the students of the same school and same class. The third and last of the criteria were the achievement level of the students. There are 32 students receiving education in the classroom that were chosen for the study. Eight of these students' science lesson school report grades in the last semester were 5, 11 students' science lesson school report grades were 3 and 6 students' science lesson school report grade were 1. Besides, while choosing the 15 students (5 having high level of achievement, 5 having average level of achievement and 5 having low level of achievement) having the science lesson school report grades as in the example, the researcher gathered detailed information by talking to students' science teacher. Because teacher of the lesson is the person who knows the students in that classroom, best. For instance, while choosing 5 of them among the 8 students having 5 as science lesson school report grade, factors such as their level of participation during the lessons, whether they are going to answer the research questions or not were taken into consideration. Afterwards, 5 of them out of the 8 students having 5 as science lesson school report grade in the previous semester, 5 of them out of the 11 students having 3 as science lesson school report grade and 5 of them among the 6 students having 1 as science lesson school report grade were chosen. 3 students having 2 as science lesson school report grade and 4 students having 4 as science lesson school report grade were not included in the study. In the study, the opinions of the teachers on the students and their school report grades were reviewed and 5 students with a high level of achievement, 5 students with an average level of achievement and 5 students with a low level of achievement were chosen. In the selection of the participants, these three criteria determined were considered together.

In qualitative research, the number of participants in the participants selection process is still a controversial issue and a common point has not been reached yet. For example, while Vagle (2014) has argued that there is no standard in determining the number of participants in qualitative research, some researchers (Creswell, 2007; Polkinghorne, 1989) have argued that the number of participants could vary between 5 and 25. There are also researchers who emphasize that the number of participants should not be too many and that if the number of participants is increased too much, this would make the analyses and in-depth research related to the subject difficult (Dukes, 1984; Güler, Halıcıoğlu, & Taşğın, 2013; Yıldırım & Şimşek, 2016). Also, it is underlined that too many participants do not guarantee that more information related to the subject tackled in the study will be acquired and that what is important for the researcher is to reach the information he/she needs in line with the purpose of the study (Baş & Akturan, 2013; Lincoln & Guba, 1985). When the participants start to repeat the same discourse or when new and different opinions do not emerge anymore, it is understood that the researcher has reached the information he/she needs for his/her purpose (Güler, Halıcıoğlu, & Taşğın, 2013). This process is named as data saturation by Glaser and Strauss (1967). In this study, it was considered that data saturation would be ensured with the 15 students who conformed with the predetermined criteria and who wanted to participate in the study voluntarily.

The middle school of the participating students was a double-shift schooling institution of the Ministry of National Education where the students came from families of low or moderate socio-economic levels. In the school, there were 7 classrooms for each grade (6th, 7th and 8th grade) making 21 classrooms in total, a library, an indoor sports hall, a science laboratory and a computer laboratory. According to the information taken from the school administration, class sizes varied between 28 and 32 students. In the decision to perform the study with the students in this school, the presence of a convenient environment in this school to carry out the study in an appropriate way (science laboratory) and the statements of the school administrators expressing that the study to be performed would have positive contributions for the students have been influential.

In qualitative research, sampling is done to get detailed and in-depth information on people, events or situations, and the representative power of the sample reached is ignored (Creswell, 2007; Lincoln & Guba, 1985; Miles & Huberman, 2015; Yıldırım & Şimşek, 2016). In other words, in qualitative research, studies are done on a small number of samples or a small number of situations. The cases to be studied are chosen because they contain rich information and because they are elucidative and the sample to be chosen does not aim to make generalizations from a sample to a universe, but to gain insight about a phenomenon (Lincoln & Guba, 1985; Miles & Huberman, 2015; Patton, 2014). Thus, unlike quantitative studies, the purpose of qualitative studies is not to make generalizations, but to make analysis, explanation and interpretation by taking in-depth information from a small number of information sources (Johnson, 2014; Miles & Huberman, 2015; Patton, 2014). In this context, making a generalization from the results obtained from this study was out of question.

3.4. Instruments

In this study, it was intended to determine 6th grade students' scientific epistemological beliefs and their metacognitive awareness and to explore the relationship between their scientific epistemological beliefs and metacognitive awareness. With this aim, the semi-structured interviews constituted the data collection tools of the study. The data collection tools used in accordance with the research questions of the study are given in Table 3.1.

Table 3.1. Interview Protocols in Relation to Research Questions

Research Question	Interview Protocol
1. What are the 6th grade students' scientific epistemological beliefs regarding achievement levels?	Semi-Structured Interview Protocol for Middle School Students' Scientific Epistemological Beliefs
2. What are the 6th grade students' metacognitive awareness regarding achievement levels?	Semi-Structured Interview Protocol for Middle School Students' Metacognitive Awareness

3.4.1. Semi-Structured Interview

Interview is one of the qualitative data collection tools used in determining the experiences, information, attitudes, emotions and opinions of individuals through open-ended questions (Fraenkel et al., 2012; Hatch, 2002; Lodico et al., 2010; Patton, 2014; Sönmez & Alacapınar, 2013; Yıldırım & Şimşek, 2016). When compared with the other qualitative data collections tools, interview is the most frequently used data collection tool (Fraenkel et al., 2012; Hatch, 2002; Merriam, 2015). This is so because the interviews are very powerful in revealing the opinions, experiences and emotions of the individuals and they take talking, which is the most prevalent type of communication, as the basis (Creswell, 2007; Marshall & Rossmann, 1999; Stake, 2010; Yıldırım & Şimşek, 2016). Three types of interviews, namely structured, semi-structured and unstructured interviews, are mentioned in the literature (Denscombe, 1998; Glesne, 2011; McMillan & Schumacher, 2010; Merriam, 2015). Structured interviews are those interviews in which the questions to be asked are previously determined, the questions are asked to the interviewed individuals one by one and the interview does not go beyond the predetermined questions (Yıldırım & Şimşek, 2016). In this type of interview, the researcher asking the questions cannot change or rearrange the questions even partially. An unstructured interview on the other hand is a type of interview in which there are no predetermined questions; in this interview type, the researcher tells about his/her research subject during the interview and tries to get the opinions of the interviewed individual by informal conversations (Yıldırım & Şimşek, 2016). In the third type of interview, which is semi-structured interview, there are pre-determined questions, but the order of the questions may be altered, or additional questions may be asked during the interview depending on the answers of the participants (Berg & Lune, 2012; Büyüköztürk et al., 2012; Glesne, 2011; Scott & Usher, 2011). With this technique, the researcher may rearrange some of the questions discussed (Berg & Lune, 2012; Glesne, 2011; Sönmez & Alacapınar, 2013).

In the present study, semi-structured interview, which is one of the interview types discussed above, was used. The purpose of the study and the flexibilities offered for the researcher by the semi-structured method have played an important role in choosing this method. In semi-structured interviews, the researcher may repeat the questions that are not understood or misunderstood by the student; he/she can ask the questions in a different way and because there is no necessity to ask the questions according to a predetermined order of priority, he/she can change the order of the questions depending on the answers of the student or can ask additional questions to get more in-depth answers. In this way, the researcher may reveal the opinions of the student and the reasons underlying these opinions clearly and in a detailed manner (Altunışık et., 2010; Aytar, 2011; Barbour & Schostak, 2005; Büyüköztürk, et al., 2009; Hill, Thompson, & Williams, 1997; Merriam, 2015; Tinsley, 1997; White & Gunstone, 1992; Yıldırım & Şimşek, 2016; Zengin, 2015). Furthermore, semi-structured interview technique guides the researcher clearly and provides reliable and comparable qualitative data (Altunışık et., 2010; Cohen & Crabtree, 2006; Yıldırım & Şimşek, 2016).

When preparing the questions in the semi-structured interview forms, Yıldırım and Şimşek (2016)'s suggestions have been taken into consideration and attention was paid:

1. to ask clearly expressed questions that can easily be understood by the participants,
2. to create alternative questions to express each question in a different way,
3. to prepare tips related to the questions asked,
4. to ask open-ended questions.
5. to avoid general and abstract questions,
6. to prepare questions encouraging explanation and detailed expression of opinions,
7. to avoid leading questions,
8. to avoid asking multi-dimensional questions (several questions at a time),
9. to arrange the order of the questions from the general to the specific,
10. to write questions from various types (Yıldırım & Şimşek, 2016).

3.4.1.1. Semi-Structured Interview Protocol for Middle School Students' Scientific Epistemological Beliefs

In preparing the interview protocol for scientific epistemological beliefs, the related literature was considered. In this context, when preparing the interview questions, the survey questions related to scientific epistemological beliefs, which were originally developed by Conley and colleagues (2004) and translated to Turkish by Kurt (2009) were employed. This survey tries to define students' scientific epistemological beliefs in four dimensions as certainty of knowledge, development of knowledge, source of knowledge and justification for knowing. Originally developed by Conley and her colleagues (2004), it consists of 26 items. Certainty of knowledge dimension consists of 6 items (item 2, item 7, item 12, item 16, item 20 and item 23), development of knowledge dimension consists of 6 items (item 4, item 8, item 13, item 17, item 21 and item 25), source of knowledge dimension consists of 5 items (item 1, item 6, item 10, item 15 and item 19) and justification for knowing dimension consists of 9 items (item 3, item 5, item 9, item 11, item 14, item 18, item 22, item 24 and item 26). By the researcher, 16 open-ended questions in total were prepared, 4 questions measuring certainty of knowledge dimension, 4 questions measuring development of knowledge dimension, 4 questions measuring source of knowledge dimension and 4 questions measuring justification for knowing dimension and while preparing aforementioned questions, it was taken into account that the questions were appropriate to the study's aim. Whilst preparing the interview questions, for the certainty of knowledge dimension item 2, item 12, item 20 and item 23 were used. For instance, in the original survey an item for the certainty of knowledge dimension was stated as "Once scientists have a result from an experiment that is the only answer", however in order to adapt it to interview questions it was stated as "Is a result taken by scientists from an experiment the only answer of that experiment?". Item 4, item 13, item 17 and item 21 were used for the development of knowledge dimension. For example, in the original survey one of the items related to the development of knowledge dimension was stated as "Some ideas in science today are different than what scientists used to think", hence to adapt the item as an interview question it was stated as "Are some scientific thoughts in our day different from those considered by scientists in the past? If they are different, where do these differences stem from?". Item 1, item 6, item 10 and item 19 were used for the source of knowledge dimension. As an example, in the original survey the item for the source of knowledge stated as "Everybody has to believe what scientists say" was stated as "Do you think that everyone should believe in what the scientists say? Why?" as an interview question. And finally, for the justification for knowing dimension, item 9, item 14, item 22 and item 24 were used. For instance, in the original survey, the item for the justification for knowing dimension was stated as "Good ideas in Science can come from anybody, not just from scientists" but it was stated as "Do you think that bright ideas in science come only from scientists or can they come from anyone? Can you explain your answer with an example?" whilst adapting it as interview question.

After the interview questions were prepared, expert opinion was taken to determine if there was something that could not be understood about the questions or if the questions were clear enough. One of the experts who was offered for consideration has a doctorate in Philosophy and currently he is working at a state university as an Associate Professor Doctor, and another expert took her bachelor degree from Department of Teaching Philosophy and completed her doctorate in Educational Sciences, she is currently working as Doctor Research Assistant at a state university. The validity of the appearance and the scope of the questions was tried to be ensured with resort to expert opinion. After taking opinions of the people who are experts in their fields, some of the interview questions were changed in terms of the way how they were asked. To set an example, in the beginning the question which had been planned to ask as "Do you think that are there any differences between some of the scientific thoughts of present day and the thoughts put forward by the scientists of centuries ago? If your answer is yes, what is the reason?" was changed after receiving experts' opinions as "Are some scientific thoughts in our day different from those considered by scientists in the past? If they are different, where do these differences stem from?". Besides, although it was not full-scale, some questions were changed in terms of language, expression and content. For instance, the question of "Do you think that only scientists know what is correct in science? Why?" was changed as "Do you think that only scientists know what is correct in science for certain? Why?", the expression of 'for certain' was added in accordance with experts' opinions after the question had been presented for expert thoughts. Necessary rearrangements were done on the questions in line with expert opinion and the questions were prepared for the pilot study. The pilot study of the semi-structured interview protocol was performed in the fall semester of the 2015-2016 academic year with 6 volunteer students in the 6th grade. The students who participated in the pilot study were not taken into the group for the main study.

The interviews during the pilot study were carried out in the science laboratory which was a place with a quiet environment where the students could feel comfortable. It was told by the researcher to the students that the questions that were not understood could be repeated and that they could take time to think about the questions. Also, the researcher made extra explanations during the study when necessary and ensured that the students expressed their ideas more clearly. When giving the extra information, the researcher avoided leading the students in any way. The interviews that lasted about 30-45 minutes for each student were recorded by a voice recorder by taking consent from the students. With the pilot study, the researcher has gained experience for the interview to be done for the main study and acquired an understanding on the time needed for the questions to be comprehended by the students and the time needed to carry out the interview. Furthermore, the pilot study has played a deterministic role for the researcher in deciding on the route to be taken in analyzing the data. With the findings obtained from the pilot study carried out with 6 middle school students, necessary corrections and changes were done in the interview questions and the questions were put into their final form. Thus, the validity and reliability of the interview questions were ensured. The principal interview was performed using the final questions with 15 volunteer students-7 girls and 8 boys-in the 6th grade. The interview questions used in the study are given in Appendix C.

3.4.1.2. Semi- Structured Interview Protocol for Middle School Students' Metacognitive Awareness

To prepare interview protocol for metacognitive awareness, related literature was examined. In this context, the survey questions related to metacognitive awareness originally developed by Schraw and Dennison (1994) and translated to Turkish by Akın and colleagues (2007) were used in preparing the interview questions. This survey consists of two dimensions as knowledge of cognition and regulation of cognition and every dimension has sub-dimensions in its own. Under the dimension of knowledge of cognition, there are three sub-dimensions as declarative knowledge, procedural knowledge and conditional knowledge, and under the dimension of regulation of cognition, there are five sub-dimensions as planning, monitoring, evaluation, debugging and information management (Schraw & Dennison, 1994). Originally developed by Schraw and Dennison, this survey consists of 52 items. Declarative knowledge dimension of this survey consists of 7 items (item 5, item 12, item 16, item 17, item 20, item 32 and item 46), procedural knowledge dimension consists of 4 items (item 3, item 14, item 27 and item 33), conditional knowledge dimension consists of 6 items (item 10, item 15, item 18, item 26, item 29 and item 35), planning dimension consists of 7 items (item 4, item 6, item 8, item 22, item 23, item 42 and item 45), monitoring dimension consists of 7 items (item 1, item 2, item 11, item 21, item 28, item 34 and item 49), evaluation dimension consists of 6 items (item 7, item 19, item 24, item 36, item 38 and item 50), debugging dimension consists of 5 items (item 25, item 40, item 44, item 51 and item 52) and information management dimension consists of 10 items (item 9, item 13, item 30, item 31, item 37, item 39, item 41, item 47 and item 48). By the researcher, 16 open-ended questions were prepared in total, 6 questions measuring cognition of knowledge (2 questions for declarative knowledge, 2 questions for procedural knowledge and 2 questions for conditional knowledge) and 10 questions measuring regulation of cognition (2 questions for planning, 2 questions for monitoring, 2 questions for evaluation, 2 questions for debugging and 2 questions for information management), by taking into consideration that the questions were appropriate to the aim of the study.

Whilst preparing the interview questions, for the dimension of declarative knowledge, item 20 and item 46 were used. For example, in the original survey one of the items for declarative knowledge dimension was stated as “I have control over how well I learn”, but in order to adapt it to interview questions it was stated as “Do you check how well do you learn the subjects taught during science lessons? If you do, how do you do that?”. For procedural knowledge dimension, item 3 and item 27 were used. For instance, in the original survey, one of the items for procedural knowledge dimension was stated as “I am aware of what strategies I use when I study”, yet so as to adapt it to interview questions it was stated as “Are you aware of what kind of strategies you apply when you study science lesson? If you have strategies, what are these learning strategies?”. For conditional knowledge dimension, item 15 and item 26 were used. For example, in the original survey one of the items for conditional knowledge was stated as “I learn best when I know something about the topic”, however it was stated as “Do you think you learn better when you have knowledge about the subject from previous learning experiences? If your answer is yes, how do you learn better?” in order to adapt it to interview questions. For planning dimension, item 6 and item 23 were used. For instance, in the original survey the item for planning dimension was stated as “I think about what I really need to learn before I begin a task” but it was stated as “Do you think about what will you need in order to learn better before you start doing a task? If you think, could you please give examples?” to adapt it to interview questions. For monitoring dimension, item 34 and item 49 were used. For example, in the original survey one of the items for monitoring dimension was stated as “I ask myself questions about how well I am doing while I am learning something new”, hence in order to adapt it to interview questions it was stated as “Do you ask questions to yourself about how you can learn better while learning new things? If you do, what kind of questions do you ask?”. For evaluation dimension, item 36 and item 24 were used. For example, in the original survey one of the items related to evaluation dimension was stated as “I summarize what I have learned after I finish”, however so as to adapt it to interview questions it was stated as “Do you summarize what you have learned after you complete your study? If you summarize, what do you take in consideration?”. For debugging dimension, item 25 and item 51 were used. As an example, in the original survey one of the items related to debugging dimension was stated as “I stop and go back over new information that is not clear”, but to adapt it to interview questions it was stated as “If you could not understand a new information, would you stop studying and take it from the beginning? Or, what would you do?”. And finally, for information management dimension, item 37, item 47 and item 48 were used. For instance, in the original survey, one of the items related to information management dimension was stated as “I try to break studying down into smaller steps” and “I focus on overall meaning rather than specifics, however in order to adapt it to interview questions it was stated as “While studying lesson, do you focus on general definitions rather than specific definitions by breaking your studies into small steps? Why?”.

After this, expert opinion was taken to understand if the prepared interview questions could be understood thoroughly or if there was anything ambiguous about them. One of the experts who was offered for consideration has a doctorate in Chemistry Education and she studied metacognitive awareness in her thesis, she is currently working as Associate Professor Doctor at a state university in Şanlıurfa. Another expert has his doctorate in Mathematics Education and studied metacognitive awareness his Doctorate thesis, currently he is working at a foundation university as Assistant Professor Doctor in İstanbul. The aim of taking expert opinion was to maintain the validity for the appearance and scope of the study. After taking opinions of the people who are experts in their fields, some of the interview questions were changed. These changes include grammar, meaning and content. For example, in the beginning the question which had been planned to ask as "Do you take a break and check what you are doing during science education? If your answer is yes, how?" was changed after receiving experts' opinions as "Do you take a break in order to check what you are doing and whether you have learned the subject or not during science lessons? If your answer is yes, how?" To set another example, in the beginning the question which had been planned to ask as "Do you learn better when you know something about science topics? If your answer is yes, how?" was changed after receiving experts' opinions as "Do you think you learn better when you have knowledge about the subject from previous learning experiences? If your answer is yes, how do you learn better?". In accordance with the expert opinion, some necessary changes were made on the questions so that they could be adequate for the pilot study. The pilot study of the semi-structured interview protocol was carried out in the fall semester of the 2015-2016 academic year and 6 volunteers 6th grade students participated in it. The students interviewed in the pilot study were not included in the main study. Science laboratory was chosen for the interviews of the pilot study because it was a quiet and comfortable place for the students. The students were informed by the researcher beforehand that in the interview they could ask for the repetition of the questions which they could not understand and that there were time allowances for them to think about the questions. For the answers to be clearly expressed by the students, the researcher made additional statements during the interview to explain the questions when necessary and in doing this, leading the students in any way was avoided. The interviews with each student lasted about 30-

45 minutes and by taking the consents of the students, voice recording of the interviews was done. The benefits of the pilot study for the researcher were multiple: the experience obtained through the pilot study for the main study, gaining an idea on the time needed to make the students understand the questions and to carry out the interview, and getting an idea on what kind of a route should be taken in the analysis of the data were among these benefits. The questions of the principal interview were changed, corrected and finalized and their validity and reliability were ensured by taking the findings of the pilot study with the 6 middle school students into consideration. The principal study was performed by asking the final interview questions to 15 volunteer students in the 6th grade-7 girls and 8 boys. The interview questions used in the study are given in Appendix D.

3.5. Data Collection Procedure

Before data collection, first necessary permission was obtained from the Human Subjects Ethics Committee of Middle East Technical University in 2015. Then, necessary permissions about the application from Ankara Governorship and District Directorate of National Education were taken (See Appendix B). However, owing to the fact that some changes were made in the research questions, research method and content, some changes and revisions were made in the permission which had been received from the Human Subjects Ethics Committee of Middle East Technical University in 2015, in 2017 it was obtained again (See Appendix A). After the authorization process was completed, the researcher visited the school, and she introduced herself to the principal and vice principal of the school and gave them information on the purpose and the content of the study. During this meeting with the principal and the vice president, the authorization petitions taken from the Human Subjects Ethics Committee of Middle East Technical University and from the Ministry of National Education were submitted to the school administration.

In the study, two different semi-structured interview protocols developed by the researcher were used in the collection of data. Both interview protocols were designed by the researcher in the fall semester of the 2015-2016 academic year and have been applied for the next term to 15 volunteer students of the 6th grade during the February and March of 2016. In the interview protocols, there were questions to be asked to the students in accordance with the purpose of the study. The researcher went to the schools of the students for the interviews and carried out one-to-one and face-to-face interviews with each student. Because it was important for the researcher to have a quiet and illuminated setting for the interviews, all interviews were performed in the science laboratory. In these interviews that were carried out in the science laboratory, to create a setting in which they could feel comfortable and secure, it was asked from the students to determine the interview date and time. In general, an interview schedule in accordance with the availability status of the 15 6th grade students' lessons were created. After the necessary interview schedule was completed, the interviews were started. To conform to the rules of ethics and transparency, each student was given explanatory information on the purpose and the content of the study prior to the interviews. Furthermore, for the students to reflect their own perspectives and opinions in their answers, they were guaranteed orally that the answers given to the questions in the interviews would be kept confidential, that they would not be judged in any way because of their opinions, that their answers would not be used for any purpose except this study and their identities would not disclosed (nicknames were to be used). Also, the students were told that they could answer the questions in the way they wanted by assuring them that there were no wrong or right answers for the questions, that even their opinions that they regarded as the most trivial or the most insignificant were very important, that they had no time limitations, that the questions that could not be understood could be repeated and that explanations could be given if the questions were not clear enough. In addition to these, the students were informed that they could leave the study at any time and that there would be no sanction imposed for this behavior. At the beginning of the interview, instead of starting the interview questions directly, the researcher paid attention to have a general conversation on daily issues and thus, both maintaining mutual trust between the researcher and the student and receiving easy and sincere answers from the students were ensured. Nevertheless, the researcher was careful about developing the process in a controlled manner and not deviating from the purpose of the study. At the end of the questions, each student was asked by the researcher if there was something that he/she would like to add and after that, the interview was ended by thanking the student. Each individual interview lasted 35-45 minutes approximately and the total duration of the study was 1081.97

minutes. In the data collection process of this study, because the data saturation and adequacy had priority, it was considered that the durations of the interviews were appropriate. Finally, all semi-structured interviews carried out in the data collection process were recorded by voice recorder with consent from the students to prevent data loss and to reach the data instantly when needed. Then, in the analysis stage of the data, these recordings were all transcribed literally, word-for-word (extreme reactions, laughing, shouting, etc.).

3.6. Data Analysis Procedure

Qualitative data analysis is the researcher's process of making inferences from the data he/she has obtained (Patton, 2014; Tesch, 1990). In this context, qualitative data analysis in a study also means diversity, flexibility and creativity (Merriam, 2015). The data of this study aiming to determine 6th grade students' scientific epistemological beliefs and their metacognitive awareness and to explore the relationship between their scientific epistemological beliefs and metacognitive awareness, have been analyzed by employing thematic analysis method which is a qualitative analysis method. Thematic analysis is described differently by different researchers. For example, according to Lapadat (2010), thematic analysis is described as the very close investigation of a text for recurrent themes, subjects and relationships by using the basic analytic strategy called coding. Also, according to these researchers, thematic analysis is not a research method, but an analysis and synthesis strategy used as a part of the process of meaning production in many research methods (Lapadat, 2010, p. 926). According to Liamputtong (2009)'s definition, it is the creation of a thematic framework for analysis and the description of the data in the light of this framework, the exploration of the cause and effect relationship between the findings depending on the described data and the interpretation of the relationships observed by the researcher. Thematic analysis which was defined differently by different researchers in the literature can be applied both in a deductive and inductive way (Ersoy, 2016; Frith & Gleeson, 2004). In deductive thematic analyses, a coding schema is formed before the data are coded and the data are coded according to this schema. Accordingly, the analyses performed display progression from the general to the specific (Çetin, 2016). Moreover, in this analysis process, while data may be created according to the themes revealed by the research questions, they may also be presented by considering the questions or dimensions used in the interview process (Yıldırım & Şimşek, 2016). In inductive thematic analysis, defined theme and categories have a strong relationship with the data (Patton, 2014). Thus, in inductive thematic analysis, the data are coded notwithstanding the researcher's analytic prejudices or a pre-existing code scheme (Thomas, 2003).

Thematic analysis begins with known or expected themes. However, new themes may emerge during theme coding. In other words, thematic analyses start with the existing themes and continue with the creation of new themes. The coding process characterizes the stage of the production of the ideas and concepts from the raw data, and the codes emerge from the data although they start with previously known or expected themes (Given, 2008; Glesne, 2011; Liamputtong, 2009; Merriam, 2015). Also, it may be possible to make some numerical analyses on the data (e. g., frequency, percentage) during thematic analysis but the basic aim here is not to reach conclusions only through numbers (Yıldırım & Şimşek, 2016). The main purpose is to create themes, patterns and processes related to the research subject, to make comparisons and to develop theoretical explanations (Glesne, 2011) and to present a descriptive and realistic picture to the reader (Yıldırım & Şimşek, 2016).

In this study, primarily, it was attempted to focus on the views of the participants directly by ignoring as much as possible the prejudices, perspectives, hypotheses and information possessed by the researcher (Katz, 1987) to investigate the data with an open perspective and to understand the answers of the students given to the interview questions fully. After this was ensured, the interviews, which were performed and recorded through semi-structured interviews, were transmitted to the electronic environment in written form without any change and the transcripts produced in this way were prepared for analysis. The printout of the interview records was 218 pages in total. After the printout of the data was taken, the data were read by the researcher repeatedly and internalized. Then, the words, the sentences and the paragraphs in the printed data were determined and marked for coding, and the coding stage was started. According to Glesne (2011), coding to search for the themes and patterns in the data is seen as one of the most important stages of the thematic analysis. This is so because the coding of the data contributes to the reading of all data coded in the same way and to understanding and conceiving what is in the essence of the code. After this stage, a list of the revealed codes was formed by gathering together the coding procedures done and thereafter these codes were also grouped according to the relationships and similarities between them. The codes were gathered under different themes or subthemes according to their status of relativity with each other. This process was the thematic coding stage. In this stage, assistance was received from experts who had qualitative studies on epistemological beliefs and metacognitive awareness and this was for ensuring consistency between independent encoders. During this procedure, interviews corresponding to 20-25% of all interviews (Gay, 1987) were coded by expert external coders determined by neutral appointment. To give information about the coders, one of the coders has doctorate in Mathematics Education, studied metacognitive awareness in his thesis, besides he has qualitative studies in this field and currently working at a foundation university in Istanbul as Doctor Assistant Professor. Another coder has his doctorate in Physical Education, studied scientific epistemological beliefs in his thesis by using qualitative research method and currently working at a state university in Trabzon as Dr. Research Assistant. In other words, a part of the interviews related both to scientific epistemological beliefs and to metacognitive awareness (20-25%) was coded by expert external coders and the reliability formula recommended by Miles and Huberman (1994) was used for the reliability measurement of the research. For reliability, the formula of Reliability = Opinion Alliance / Opinion Alliance + Opinion Separation X 100 has been applied on the coding made by both researchers (Miles & Huberman, 1994, p. 64). Percentage of agreement between two encoders for scientific epistemological beliefs is calculated as 91%. Percentage of agreement is calculated as 87% between two encoders related to the metacognitive awareness. Reliability has been achieved in terms of data analysis since 80% or more compliance percentage was sufficient. After this stage, the frequencies pertaining to codes were calculated and by creating tables, it was attempted to form meaningful integrities. After the coding and classification procedure was completed and the frequencies were calculated, direct quotations from the discourse of each student were included to ease the understanding and interpretation of the data that have become meaningful integrities. According to Patton (2014), direct quotations are the basic source of the data; by in-depth analysis of these people’s worlds, they reveal the ideas and experiences pertaining to these worlds. Therefore, notable expressions, i.e. quotations of the students, were transmitted without any change.

3.7. Context of the Study

Under this study, semi-structured interviews were conducted outside of school hours. The interviews were conducted in the science lab of the practice school. All interviews were conducted within the hours that participants had declared suitable. Individual interviews were conducted with 15 students and recorded by using sound recording. Before conducting the interviews with the students, the researcher had met with their science teacher and gathered information about the students and how the lesson is taught. According to the obtained information, the teacher teaches the lesson by using various methods and techniques such as argumentation, inquiry, problem-based teaching, experiment, simulation, question and answer. Actually, the teacher stated that when she gives homework, she tries to give homeworks that ensure students prepare a material and present this material or homework to their friends inside the classroom.

3.8. Role of the Researcher

Performing a qualitative study is not only analyzing the qualitative data, coding and theming the data and making direct quotations from the discourse of the participants. When carrying out a qualitative study, the research question should be taken into consideration as well and all processes of the study need to be planned very well (Akar, 2016). In this context, the role possessed by the researcher to plan and carry out the study has a considerable significance because the explanations made by the researcher on his/her position in the study will guide the way for other researches working on the same or similar subjects and it will make them have opinions on the roles they will assume (Cropley, 2002; Patton, 2014; Yıldırım & Şimşek, 2016). In the present study, the researcher has played a significant role in issues such as taking permission for the study and maintaining contact with the administrative board of the school of practice for the study. Furthermore, the researcher has prepared the interview questions aiming to reveal the scientific epistemological beliefs and metacognitive awareness of the students within the scope of this study and has conducted one-to-one interviews with students. In the interview stage aiming to reveal the scientific epistemological beliefs and metacognitive awareness of the students, the researcher has adopted a neutral role. She has also played an active role in the stages of recording the semi-structured interviews, providing the written printouts, analyzing and interpreting them. Thus, the researcher has taken part in all stages of the study.

3.9. Trustworthiness of the Study

Validity concept expresses the precise measurement of the thing which is aimed to be measured by the measuring device and the objective manifestation of the study results by the researcher (Kirk & Miller, 1986; LeComte & Goetz, 1982; Stiles, 1993; Yıldırım & Şimşek, 2016). In other words, validity means the correctness of the study results (Yıldırım & Şimşek, 2016). Reliability concept on the other hand is defined as the acquisition of similar results when the same study is repeated with a similar sample in another setting. This means that it is a concept related to the repeatability of the study results (LeComte & Goetz, 1982; Yıldırım & Şimşek, 2016). Validity and reliability concepts used in quantitative research methods are named with different concepts in qualitative research methods in accordance with their post-positivist nature (Lincoln & Guba, 1985). Internal validity, external validity, internal reliability and external reliability concepts which are used in quantitative research methods correspond to credibility, transferability, dependability and confirmability concepts respectively in qualitative research methods (Merriam, 2015; Miles & Huberman, 1994).

3.9.1. Credibility

Credibility is a concept related to whether the findings and results that were obtained from the study by the researcher and his/her interpretations based on these reflect the truth or not (Creswell & Miller, 2000; Yıldırım & Şimşek, 2016). In qualitative research, because the reality under research is not unique or objective, ensuring credibility depends on the researcher's interpretation of his/her findings and the opinions of the participants without distorting them (Yıldırım & Şimşek, 2016). According to Merriam (2015), there are six strategies to establish the credibility in the qualitative study: Peer review, triangulation, researcher position, member checking and adequate engagement in data collection and negative case analysis. In this study, member checking, researcher position and peer review were used to ensure the credibility. According to Glesne (2011), member checking refers to a process which is “to make sure you are representing them and their ideas accurately” (p.32). Moreover, member checking has two main purposes: The first purpose is to assess intentionality of participants. The second purpose is to offer opportunity for participants to correct their errors (Lincoln & Guba, 1985). Researcher position is one of the most important factors in ensuring the credibility of the study (LeCompte & Goez, 1982; Yıldırım & Şimşek, 2016). Also, description and explanation of the researcher position clearly in a study would be instructive and helpful for other researchers working on similar subjects. In the present study, the researcher had the position of a person collecting and analyzing the data and presenting the findings obtained. In this study, the researcher has paid attention to focus on the opinions of the students and to be objective by abstaining from her own emotions, opinions, experiences and prejudices during the data collection and data analysis process. Furthermore, the researcher has adopted an impartial and objective attitude during the face-to-face interviews she carried out with the students; she avoided leading the students and tried to be an active listener without interrupting the students and to reveal the subject with all its dimensions by asking probing questions and making explanations about the questions when necessary. Additionally, the researcher has adopted an encouraging role for the students to express their views and opinions easily during interviews. Another method used in this study to enhance credibility is peer review. Peer review is described as the assessment process of the study by an individual, group or committee familiar to the subject, field and research methodology (Merriam, 2015). In the present study, to verify whether her findings were compatible with real data, the researcher has taken opinion from the researchers with knowledge and experience for carrying out qualitative research and with publications on the subjects studied by the researcher.

3.9.2. Transferability

According to Merriam (2015), transferability refers to external validity, and external validity is related to the generalization of research findings. Moreover, Merriam (2015) states that there are differences between quantitative study and qualitative study in terms of the generalizability of the study. While there is a concern for the generalizability of the results in quantitative studies, there is no such concern for qualitative studies and what is being attempted is to understand and to describe a specific case (Merriam, 2015). In this context, the transferability of the research findings depends on the adequate description of the data it is based on (Patton, 2014; Seidman, 1998; Silverman, 2011; Yıldırım & Şimşek, 2016). Detailed description technique has been used to enhance the transferability feature of this study. Description is the arrangement of raw data with the concepts and themes revealed and its transfer to the reader by the researcher without interpretation (Yıldırım & Şimşek, 2016). Also, to ensure transferability, the participants of the study, the number of participants, information pertaining to participants and to how are they are selected, data collection tools, data collection process and data analysis process have been explained in detail. Moreover, to enhance the transferability of the study, criteria sampling method, which is a purposive sampling method, has been used. According to researchers, purposive sampling is one of the most important factors in ensuring the transferability in qualitative research (Creswell & Miller, 2000; Erlandson, Harris, Skipper, & Allen, 1993; Neuman, 2014; Patton, 2014; Silverman, 2011). In addition to these, it was tried to enhance the transferability of the study by giving a place to direct quotations in the findings section of the study to reflect the original views and opinions of the participants. Direct quotations are considered as practices enhancing the transferability of a study (Christensen et al., 2015; Neuman, 2014; Yıldırım & Şimşek, 2016).

3.9.3. Dependability

Dependability is considered as the indicator of being able to reach similar results in the studies repeated at different times by the same researcher or different researchers by using the same data collection and analysis methods with the same participants (Marshall & Rossmann, 1999; Merriam, 2015; Miles & Huberman, 1994). Merriam (2015) highlights that researchers use a number of ways to establish dependability in a qualitative study. One of the most efficient ways of enhancing dependability in qualitative studies is to use “consensus between encoders”, in other words “coding reliability”, based on the use of multiple encoders for the analysis of data that has been transcribed to written form (Miles & Huberman, 1994; Silverman, 2011; Yıldırım & Şimşek, 2016). Therefore, to enhance the dependability of the data in this study, after the analysis of the data obtained from the semi-structured interviews, the opinions of two researchers, who were experts in the field and in qualitative analysis, were taken to determine the representation status of the data by the codes. In accordance with this aim, the coding list consisting of some chosen themes and interview transcriptions were sent to the researchers, who were from two different universities, via e-mail. These researchers were asked to approve with a check mark (√) if the codes and themes in the lists were appropriate and if not, to write the most appropriate theme or code. After the opinions of the researchers were taken in this way, the researchers and the researcher came together and made discussions at different times on the codes on which there was divergence and a consensus was reached. Then, the researcher calculated the coding reliability of this study by using the formula *Reliability = Opinion Alliance / Opinion Alliance + Opinion Separation X 100]* recommended by Miles and Huberman (1994, p.64). As a result, it was detected that dependability was ensured between the researchers and the researcher to a great extent.

The setting in which the measuring device was applied for each individual is another factor influencing dependability (Miles & Huberman, 1994). In this context, the setting in which the interviews were performed was the science laboratory for each student. Also, a full description of the researcher in the research is regarded as a very important point for dependability (Patton, 2014; Yıldırım & Şimşek, 2016). In this context, the role and the perspective of the researcher in this study and her approach towards the research have been described in detail. Finally, the researcher has reviewed each data group repeatedly and given place to repeated analyses. Analysis dependability within the study was tried to be ensured this way.

3.9.4. Confirmability

Confirmability refers to objectivity (Lincoln & Guba, 1985). To ensure confirmability in this study, the names of the students who were the sources of data were kept confidential and explanations were made on the role of the researcher in the study, the setting in which the interviews were carried out and the duration of the interviews. Also, the conceptual framework and hypotheses of the study were presented in detail. Furthermore, clear and comprehensible explanations were given on which methods were used during data collection and analysis processes, how interviews were carried out, what the interview questions were, how documents were analyzed and how the results obtained were combined and presented. In addition to these, opinions were exchanged with people who were experts in the field during the study about the subject of the research, data collection, data analysis and reporting. Finally, the semi-structured interviews that had been recorded by a voice recorder were transcribed and the transcribed interview printouts and the themes and codings that were acquired as a result of the analysis were saved in the electronic medium so that they could be investigated later.

3.10. Ethics

There are three important issues in this situation such as protecting the participant from harm, ensuring the confidentially of the data and avoiding the deception of subjects (Fraenkel & Wallen, 2006; Merriam, 2015; Piper & Simons, 2005).

3.10.1. Protecting participants from harm

"It is a fundamental responsibility of every researcher to do all in his or her power to ensure that participants in a research study are protected from physical or psychological harm, discomfort, or danger that may arise due to research procedures." (Fraenkel & Wallen, 2006, p.56).

In any research study, every researcher should have an important responsibility to guarantee that the participants of study are protected from psychological and physical harm. In this study, there was not any situation to create a risk for the participants. They were informed that their answers to the questions would not be graded in any course. In addition, because the sample was selected conveniently, a consent form was filled out. Therefore, nobody would participate unwillingly.

3.10.2. Ensuring confidentiality of research data

"Once the data in a study have been collected researchers should make sure that no one else (other than perhaps a few key research assistants) has access to the data" (Fraenkel & Wallen, 2006, p.56). In this study, the participants were informed that their responses would be kept only by the researcher and would not be shared by making any links to their identities. Moreover, students were given nicknames, since using real names of the students who attend the classes would not be ethically appropriate.

3.10.3. Deception of subjects

"Sometimes it is better to deceive subjects than to cause them pain or trauma, as investigating a particular research question might require" (Fraenkel & Wallen, 2006, p.57). Any deception issue is not appeared in this study. In addition to the ethical issues addressed, research studies might be discussed in terms of their strengths and limitations.

CHAPTER 4

RESULTS

In this section, the findings obtained as a result of the data analysis of the semi-structured interviews performed with the students and the interpretations done in accordance with these findings are given. In the presentation of these findings and interpretations, the headings were created by taking the research questions as the base.

4.1. Findings and Interpretations about the First Research Question

In this subsection, the findings obtained from the semi-structured interviews performed with 15 6th grade students and interpretations of these were discussed to find the answer to the first research question of this study which was “What are the scientific epistemological beliefs of 6th grade students with different achievement levels?”.

In the study, the data related to the scientific epistemological beliefs of students who were chosen by taking the previous semester science grades as the base and who had high (5), average (5) and low (5) achievement levels were analyzed by thematic analysis and the themes, categories and frequencies of each code formed as a result of the analyses were presented in tables. These frequencies demonstrate how many times each opinion was repeated. Furthermore, direct quotations from the students were also included in the findings. When giving direct quotations from the students, their interesting sentences were quoted with their rights and wrongs without making any change. Also, because it would not be ethically correct to use their real names, the students were given nicknames when making direct quotations. The names at the end of the students’ statements are their nicknames.

Findings related to students' scientific epistemological beliefs; it shows us two themes as nature of knowledge and the nature of knowing, and four categories as certainty of knowledge, development of knowledge, source of knowledge, and justification for knowing appeared. When these categories are examined separately; codes of *dogmatic* and *skeptical* appeared in certainty of knowledge category; codes of *knowledge or ideas in science can change* and *knowledge or ideas in science cannot change* appeared in development of knowledge category; codes of *authority, scientific method, experience,* and *reasoning* appeared in source of knowledge category and codes of *experiments, observation, proof, conducting research,* and *authority* appeared in justification for knowing category. The findings related to the students' scientific epistemological beliefs are given under the three subheadings specified below.

4.1.1. Scientific Epistemological Beliefs of the Students with a High Level of Achievement

The findings about the scientific epistemological beliefs of the students with a high level of achievement are given in Table 4.1. The categories and codes pertaining to each theme were considered in detail and the findings were presented.

Table 4.1. Theme, Category, Code and Frequency Table Related to Scientific Epistemological Beliefs of the Students with a High Level of Achievement

	f
1. The Nature of Knowledge [Theme]	
1.1. Certainty of Knowledge [Category]	**18**
1.1.1. Dogmatic (Absoluteness of truth) [Code]	5
1.1.2. Skeptical (Truth is not absolute) [Code]	13
1.2. Development of Knowledge [Category]	**19**
1.2.1. Knowledge or ideas in science can change [Code]	14
1.2.2. Knowledge or ideas in science cannot change [Code]	5

f: It states how many times 5 students with high level of achievement repeated the related theme, category and code in total.

Table 4.1. Theme, Category, Code and Frequency Table Related to Scientific Epistemological Beliefs of the Students with a High Level of Achievement (Continued)

	f
2. The Nature of Knowing [Theme]	
2.1. Source of Knowledge [Category]	**14**
2.1.1. Authority [Code]	8
2.1.2. Scientific Method [Code]	4
2.1.3. Reasoning [Code]	2
2.2. Justification for Knowing [Category]	**18**
2.2.1. Experiment [Code]	12
2.2.2. Observation [Code]	1
2.2.3. Proof [Code]	2
2.2.4. Conducting research [Code]	3

f: It states how many times 5 students with high level of achievement repeated the related theme, category and code in total.

As seen in Table 4.1, the responses given to semi-structured interview questions by students with a high level of achievement were collected under 2 themes, namely the nature of knowledge and the nature of knowing. Under the nature of knowledge, there were two categories which were the certainty of knowledge and the development of knowledge. The total frequency of the codes in these two categories was f (37) with f (18) in the certainty of knowledge category and f (19) in the development of knowledge category. There were two categories under the nature of knowing and these were the source of knowledge and justification for knowing. The sum of the frequencies in the codes in these two categories was f (32) with f (14) in the source of knowledge category and f (18) in the justification for knowing category. According to this, it was understood that students with a high level of achievement reported more opinions under the nature of knowledge theme when compared with the nature of knowing theme.

4.1.1.1. Theme 1: Nature of Knowledge

According to Table 4.1., the opinions of the middle school students with a high level of achievement related to the certainty of knowledge category were coded as *dogmatic* and *skeptical*. When the frequencies of these codes were examined, it was seen that most recurrent code was *skeptical* with f (13) and the other code, which was *dogmatic* code, repeated 5 times with f (13).

Sample expressions for *"dogmatic"* code and the students making these statements were given below.

> *In fact, it is related to the question that you have just asked because if there is only a single result, all of them would think of the same thing and would do the same thing.* (Bahadır)

> *There may be different ways, but the result would be the same. This means that there is a single result, but it may be done by different means.* (Buse)

> *Because for example if a friend finds 15 in a problem and we find 18, its result can't be 18 or 15, there should be a single solution.* (Sude)

Sample expressions for *"skeptical"* code and the students who made these statements were given below.

> *For example, sometimes there is more than one answer in the subjects of our lessons.* (Bahadır)

> *Actually, there must be many things that we don't know because scientists question this way, but I don't believe that they can really question everything. They cannot question so many things. There must certainly be undiscovered things, maybe they will be discovered.* (Buse)

> *Because by conducting different experiments we can get different results. It is more reasonable to carry out several experiments rather than a single one.* (Gamze)

> *No, there is not a single correct answer to all the questions in science. I mean for example, there may be two or three answers to a math question and there may be two or three ways. There is not a single correct answer.* (Meltem)

Scientists argue among themselves, they find the proof and then they postulate. They assert their claims. Every scientist may have a different opinion. After the claim of the proof is calculated and the evidence is found, the true answer will emerge. If a scientist says something, his/her addressee may suggest something else or may say something different. (Meltem)

If for example a scientist finds a different answer, another scientist may make another remark, in other words, all of them may change. There is nothing like there should be the same result. (Sude)

In summary, the 6th grade students with a high level of achievement reported more opinions related to "*skeptical"* code with f (13) than the ones they stated related to "*dogmatic"* code with f (5) in the certainty of knowledge category. In other words, the expressions of the students with a high level of achievement were mostly in line with the idea that there were no invariable facts for scientific knowledge. Thus, it is concluded that students with a high level of achievement had sophisticated scientific epistemological beliefs in general in the certainty of knowledge category.

By considering Table 4.1., the opinions of the middle school students with a high level of achievement pertaining to the development of knowledge category were coded as *knowledge or ideas in science can change,* and *knowledge or ideas in science cannot change*. When these codes were examined, it could be seen that *knowledge or ideas in science can change* code with f (14) was the most recurrent code. Besides these most recurrent code, the frequency of *knowledge or ideas in science cannot change* was f (5).

Some expressions of the students related to *"knowledge or ideas in science can change"* code were given below.

For example, because the technology has developed, old knowledge may change now when it is reviewed again. (Bahadır)

Some scientific thoughts in our day may sometimes be different from the thoughts that scientists previously had. This may be due to technology. (Sude)

Scientific knowledge has to change because sometimes some information may not be correct. They review the information they previously had and if this *information is wrong, they regain information with technology. That's it.* (Bahadır)

Scientific knowledge changes but it changes in this sense: for example, in the past, they used wired things as brooms, but this has changed; there are electronic vacuum cleaners now. This was thought and discovered by scientists. This changes our life. This changes our time, too. We can waste our time in sweeping, but this is faster with electronic vacuum cleaner. (Meltem)

Yes, some scientific thoughts in our day may be different from those that the scientists previously had. These differences are caused by the progress in science. (Bahadır)

For example, there may be some things that are unknown about the universe or about the black holes because these cannot be answered by scientists, either. This is because they cannot observe them closely. However, knowledge may change with scientific progress.(Bahadır)

Now people get more education and know more and only a few people knew things in the past but now many things are known by everyone. (Buse)

Yes, they change. They used to believe that the World was not round but now we know that the World is round. This means that they change. (Buse)

For example, the scientific knowledge of 100 years ago and that of today are different. I mean, in my opinion, scientific knowledge may change because we make an experiment, the result is different in one experiment and same in three experiments. Then, the result of those three experiments is more correct. (Buse)

I think there are too many questions that cannot be answered even by scientists because they too encounter a question they do not know the answer of. They do research to find the answer and they reach a conclusion by doing all that they can. Scientific knowledge changes.(Gamze)

Some of the expressions related to *"knowledge or ideas in science cannot change"* code were given below.

Scientists understand better with technological developments, but scientific knowledge does not change. They can understand better, I mean this is more reasonable.(Gamze)

> *Because of scientific knowledge. This is almost the same with the previous question. Scientific knowledge is still scientific knowledge. It was the same 50 years ago and will be the same 50 years later. If there is a proof of scientific thought, no one can change it.* (Meltem)

In brief, while the frequency of the *knowledge or ideas in science cannot change* code was f (5), the frequency of the *knowledge or ideas in science can change* code in the development of knowledge category for students with a high level of achievement was f (14). This finding revealed that students with a high level of achievement have mostly expressed opinions favoring the changeability of scientific knowledge. At this point, it may be emphasized that students with a high level of achievement have sophisticated scientific epistemological beliefs in general in the development of knowledge category.

4.1.1.2. Theme 2: Nature of Knowing

Taking the findings in Table 4.1. into consideration, the ideas of the middle school students with a high level of achievement related to source of knowledge category were expressed by coding them as *authority, scientific method* and *reasoning*. By examining the frequencies of these codes, it could be seen that the most recurrent code was *authority* code with f (8). *Scientific method* code was the second most recurrent code and the frequency of this code was f (4). Besides these most recurrent codes, the frequency of the *reasoning* code was f (2).

Notable statements of some students about the "*authority"* code were given below.

> *I believe in scientific books. Because they always have proofs. For example, once I read a book. It was called "Crazy Discoverers" or "Crazy Scientists". It had humor in general and it explained things with proofs. It told us about the scientist, about the proof in the experiment; if it didn't prove, no one would believe it because for example, no one believed that the world was round in the beginning but then they found the proofs.* (Bahadır)

> *Everything the teacher says is correct because he/she wouldn't give us incorrect information.* (Gamze)

It's not only the scientists that I believe. For example, let me give an example from the wars. Our grandfathers, our veterans have fought in those wars, but they weren't necessarily scientists. However, they may know what is in a war, what its content is. Because the scientists have not lived there or have not seen them, they may sometimes give misinformation. (Meltem)

Scientists know everything exactly and I believe them because they work on things related to that subject, they do experiments. They don't give an answer by saying, "in my opinion", they give precise and clear answers because they have done research and found the hundred percent correct answer. (Gamze)

Everything the teacher says is correct. I cannot make an objection to my teacher. If he/she says it, it is correct. (Bahadır)

Some remarks of the students related to *"scientific method"* code were quoted below.

Everyone does not have to believe what the scientists say. They can do things as they wish by themselves. They do experiments, they do research and I think they can reach the same results. (Gamze)

It's not only the scientists who know what is correct in science because we are also making experiments here now, we can know the results. I don't think that scientists should know all the time. (Sude)

Others may also know that something is right because by making simple experiments on that subject, others may also understand what is right in a subject. In other words, it is not only the scientists who know what is correct in science. (Bahadır)

Expressions of the students related to *"reasoning"* code were presented below:

It is not an obligation for everyone to believe what the scientists say because everyone has an idea or opinion of himself/herself." (Buse)

We can believe the scientific books, but we don't have to believe them. I mean we don't have to feel obliged. You and I might have different opinions, we might think of different things. (Meltem)

Consequently, while the sum of the frequencies of the *scientific method* code with f (4) and *reasoning* code with f (2) is f (6) in the source of knowledge category for students with a high level of achievement, the frequency of the *authority* code was f (8). According to this finding, the students with a high level of achievement believe that the source of knowledge was created and produced by authorities such as scientists, teachers, books, family elders. In other words, students with a high level of achievement have naïve scientific epistemological beliefs.

With the findings obtained from Table 4.1., the opinions of the 6th grade students with a high level of achievement pertaining to justification for knowing category were coded as *experiment, observation, proof* and *conducting research*. By examining the frequencies of these codes, it was detected that the most recurrent code was *experiment* code with f (12). *Conducting research* code was the second most recurrent code and it was seen that the frequency of this code was f (3). Apart from these two most recurrent codes, the frequency of the *proof* code was f (2) and the frequency of the *observation* code was f (1).

Some quotations of the students in relation to *"experiment"* code were as follows:

> *Scientists maintain the correctness of their ideas with multiple experiments. Then, they look at the result and test it again and again from time to time.* (Bahadır)
>
> *It is more reasonable to do a lot of experiments and to find multiple answers because in this way they can make comparisons; if they do one experiment, what they get is not always its result because they might get a different result with a different experiment.* (Gamze)
>
> *Good deductions in science depend on many different experiments. An experiment does necessarily give us a correct result; experiments may yield different results. Only if all of many experiments yield the same result.* (Buse)
>
> *What we do in an experiment may differ depending on the material but if we try with other materials etc., we may find a common result.* (Bahadır)
>
> *Good deductions in science depend on proofs obtained from many different experiments because there is nothing like getting the result in the first trial.* (Sude)

The expressions of the students related to both "*experiment*" and *"proof"* codes were as follows:

> *If you give some information but if you can't prove it and you don't do an experiment about it, that information is baseless, and no one believes it, but if you prove it and your claim comes out to be true, that information is correct.* (Bahadır)

> *For example, we question with experiments and actually these experiments show us the right way better. Then, it becomes really proven. Thus, we can learn more from the experiments. Thus, we can get more information from the experiments. In other words, doing experiments is an important part of scientific studies.* (Buse)

The student remark related to both *"experiment"* and *"conducting research"* codes was as follows:

> *Scientists carry out experiments to test thoughts or information. They do different experiments. Then, they may do research from different books. I mean by asking each other. This may be the process.* (Gamze)

A student made a statement about both *"experiment"* and *"observation"* codes as follows:

> *Some of them can test the scientific knowledge by experiments. Some do it with experiments and some with observation etc. I think that way.* (Sude)

In summary, because the sum of the frequencies of the *experiment* f (12), *conducting research* f (3), *proof* f (2) and *observation* f (1) codes was f (18) for students with a high level of achievement in the justification for knowing category and because the *authority* code was not mentioned in any way, it may be argued that students with a high level of achievement had sophisticated scientific epistemological beliefs in justification for knowing category in general.

4.1.2. Scientific Epistemological Beliefs of the Students with an Average Level of Achievement

The findings about the scientific epistemological beliefs of the students with an average level of achievement are given in Table 4.2. The categories and codes pertaining to each theme were considered in detail and the findings were presented.

Table 4.2. Theme, Category, Code and Frequency Table Related to Scientific Epistemological Beliefs of the Students with an Average Level of Achievement

	f
1. The Nature of Knowledge [Theme]	
1.1. Certainty of Knowledge [Category]	**15**
1.1.1. Dogmatic (Absoluteness of truth) [Code]	5
1.1.2. Skeptical (Truth is not absolute) [Code]	10
1.2. Development of Knowledge [Category]	**10**
1.2.1. Knowledge or ideas in science can change [Code]	4
1.2.2. Knowledge or ideas in science cannot change [Code]	6
2. The Nature of Knowing [Theme]	
2.1. Source of Knowledge [Category]	**9**
2.1.1. Authority [Code]	6
2.1.2. Experience (The senses) [Code]	1
2.1.3. Reasoning [Code]	2
2.2. Justification for Knowing [Category]	**7**
2.2.1. Authority [Code]	2
2.2.2. Experiment [Code]	5

f: It states how many times 5 students with average level of achievement repeated the related theme, category and code in total.

In Table 4.2., the answers given to semi-structured interview questions were gathered under two themes, which were the nature of knowledge and the nature of knowing. Certainty of knowledge and development of knowledge were two categories under the nature of knowledge theme. With certainty of knowledge category f (15) and development of knowledge f (10), the sum of the frequencies of the codes in this category was f (25). Source of knowledge and justification for knowing on the other hand are two categories under the nature of knowing theme. Source of knowledge category f (8) and justification for knowing category f (7) made up a total f (16). In other words, it was seen that more opinions were stated under the nature of knowledge theme by students with an average level of achievement.

4.1.2.1. Theme 1: Nature of Knowledge

Under the light of the findings in Table 4.2., the opinions of middle school students with an average level of achievement related to certainty of knowledge category were coded and presented as *dogmatic* and *skeptical*. When the frequencies of these codes were considered, *skeptical* code with f (10) was seen to be the most recurrent code. The *dogmatic* code, which was the other code, repeated 5 times with f (5).

Sample expressions related to "*dogmatic*" code and the students who expressed these were presented below.

> *Because everything would change if there was more than one answer. For example, it is like this in our science lessons; it is like this in all lessons. In mathematics, etc. For example, in mathematics, 7 times 3 is 21. If the answer is 21, the answer cannot be 22 or 23. It must be 21. This means it has only one answer.* (Onur)

> *The things we did in the experiment… We put the ball and it just stayed up; this means that it has a single answer. It did not go to the bottom because it had a mild cavity, that's why.* (Merve)

> *They do many different experiments. For example, they do experiments much different from that experiment, but they find the same result again.* (Onur)

Sample statements and students making these statements were given below for *"skeptical"* code.

> *You do an experiment and they tell that the single answer for the experiment is this but someone else does the experiment with other devices and tells that*

> *the answer for it is his/her answer. In other words, there isn't a single answer; there are different ones.* (Erkan)

> *There are so many lessons in all science such as physics and biology that scientists can't know all of them. I think that there are some things that they don't know.* (Merve)

> *One man says, 'this is right', and the other man says, 'you're wrong'. He says that his may be more correct.* (Erkan)

> *For example, because they are scientists, they do more research as days go by and I think they give different answers as they learn.* (Merve)

> *Scientists do not always agree on what is correct because sometimes the scientists say that bread is harmful and sometimes they say that it is not. It changes continually.* (Yusuf)

As a result, 6th grade students with an average level of achievement reported more opinions related to "*skeptical"* code f (10) in the certainty of knowledge category when compared to opinions related to "*dogmatic*" code f (5). This demonstrates that most of the students with an average level of achievement argue that it was not possible to talk about absolute truth in scientific knowledge. In the light of this, it was detected that the students with an average level of achievement had sophisticated scientific epistemological beliefs in general in the certainty of knowledge category.

As a result of the evaluation of the findings in Table 4.2., the opinions of the middle school students with an average level of achievement which were related to development of knowledge category were given by coding them as *knowledge or ideas in science can change,* and *knowledge or ideas in science cannot change*. When the frequencies of these codes were considered, it is seen that the most recurrent code was *knowledge or ideas in science cannot change* code with f (6). The frequency of the *knowledge or ideas in science can change* was f (4).

Some quotations of the students about the *"knowledge or ideas in science can change"* were as follows.

> *Some of the scientific thoughts nowadays are different from those thoughts the scientists had in the past because technology has progressed.* (Batuhan)

> *Because the World is changing. Technology has developed, and different things started to emerge. We can say that there are flying cars in the World, which is something different from the past.* (Erkan)

> *For example, there weren't such fast cars 50 years ago, but they are being produced now. As you mentioned, there are ultrasound devices, sonars and everything.* (Onur)

Some prominent expressions of the students related to the *"knowledge or ideas in science cannot change"* code were given below.

> *Scientific knowledge does not change. For example, when we do an experiment, it is always the same. For example, that ball does not get bigger as years go by; it stays the same. It always stays the same when we do the same experiment.* (Merve)

> *Scientific knowledge does not change. Just like the question you have previously asked; if it is like that, everything has a single answer. However, if there is a single answer, scientific knowledge does not change.* (Onur)

> *If something is done and it has an answer, the answer persists. When we do the same thing again, we get the same result.* (Yusuf)

In summary, because the frequency of *knowledge or ideas in science cannot change* code was f (6) while the frequency of *knowledge or ideas in science can change* in the development of knowledge category was f (4), it could be concluded that the students with an average level of achievement mostly believed that scientific knowledge would not change and they expressed opinions in accordance with this. In other words, it could be argued that students with an average level of achievement had naïve scientific epistemological beliefs in the development of knowledge category in general.

4.1.2.2. Theme 2: Nature of Knowing

In accordance with the findings obtained from Table 4.2., the opinions of the middle school students with an average level of achievement were presented by coding them as *authority*, *experience* and *reasoning*. It could be seen that *authority* was the most recurrent code when the frequencies of these codes were examined, and its frequency was f (6). Besides this most recurrent code, the frequency of the *reasoning* code was f (2) and the frequency of *experience* code was f (1).

Statements of some students related to *"authority"* code were given below.

> *In the science classes, everything the teacher says is correct because they are science teachers; they have studied all the subjects at university and graduated. They know everything about science.* (Merve)

> *I believe what is written in science books. The book is written correctly.* (Yusuf)

> *All people should believe what the scientists say because they are scientists.* (Merve)

Expressions of the students related to *"reasoning"* code were presented below.

> *I sometimes believe what is written in scientific books. Let's say that there is a snake with a length of 40 meters in scientific books; I never believe this because a 40 meters-snake has never been seen.* (Erkan)

> *Not all people have to believe what the scientists say. They can produce logic and strategies themselves. They don't have to conform to what the scientists say.* (Onur)

The student remark related to *"experience"* code was presented below.

> *Because Newton was also a child. He was not a scientist at that time, but he tried to make inventions by himself. For example, the man on whose head an apple fell found gravity.* (Erkan)

In brief, in the source of knowledge category, while the sum of frequencies for *reasoning* f (2) and *experience* f (1) codes was f (3) for the students with an average level of achievement, the frequency of the *authority* code was f (6). According to this finding, the students with an average level of achievement believed that the source of knowledge was authorities such as scientists, teachers, books or family elders. Thus, it could be emphasized that students with an average level of achievement had naïve scientific epistemological beliefs in general in the source of knowledge category.

The opinions of the 6th grade students related to the justification for knowing category were coded as *experiment* and *authority* according to the findings in Table 4.2. By considering the frequencies of these codes, the most recurrent code was observed to be *experiment* code with f (5) and the other code, which was *authority* code repeated 2 times with f (2).

Some notable statements of the students related to *"experiment"* code were as follows:

> *One experiment and another are justifications of each other. First, we do that. We carry out a couple of more experiments to check if we did something wrong. Thus, we make its justification and then we understand. We find the right way.* (Onur)

> *There may be two or three experiments to check the accuracy of the answer.* (Yusuf)

> *There may be more than one way to test knowledge because by making different experiments, maybe different results may be found or maybe the same result may be found.* (Erkan)

Statements of the students about the "*authority"* code were as follows:

> *Because the scientists know everything in the World, they can also check if the scientific knowledge is correct or not.* (Merve)

> *For example, the information that cannot be tested by a scientist may be checked by a science teacher.* (Batuhan)

To sum up, it could be said that the 6th grade students with an average level of achievement stated more opinions related to "*experiment*" code with f (5) in the justification for knowing category while the number of opinions related to "*authority*" code with f (2) was less. This means that most of the statements of the students with an average level of achievement thought that scientific information could be verified by experiments. Thus, it was concluded that the students with an average level of achievement had sophisticated scientific epistemological beliefs in general in the justification for knowing category.

4.1.3. Scientific Epistemological Beliefs of the Students with a Low Level of Achievement

The findings about the scientific epistemological beliefs of the students with a low level of achievement were given in Table 4.3. The categories and codes pertaining to each theme were considered in detail and the findings were presented.

Table 4.3. Theme, Category, Code and Frequency Table Related to Scientific Epistemological Beliefs of the Students with a Low Level of Achievement

	f
1. The Nature of Knowledge [Theme]	
1.1. Certainty of Knowledge [Category]	**9**
1.1.1. Dogmatic (Absoluteness of truth) [Code]	4
1.1.2. Skeptical (Truth is not absolute) [Code]	5
1.2. Development of Knowledge [Category]	**9**
1.2.1. Knowledge or ideas in science can change [Code]	6
1.2.2. Knowledge or ideas in science cannot change [Code]	3
2. The Nature of Knowing [Theme]	
2.1. Source of Knowledge [Category]	**9**
2.1.1. Authority [Code]	7
2.1.2. Scientific Method [Code]	2
2.2. Justification for Knowing [Category]	**7**
2.2.1. Authority [Code]	4
2.2.2. Experiment [Code]	3

f: It states how many times 5 students with low level of achievement repeated the related theme, category and code in total.

According to Table 4.3., the answers of the students with a low level of achievement to the semi-structured interview questions were presented under nature of knowledge and nature of knowing themes. Two categories under the nature of knowledge theme were certainty of knowledge and development of knowledge. The frequencies of the codes in these categories were f (9) in the certainty of knowledge category and f (9) in the development of knowledge category making f (18) as the total frequency for the codes in these two categories. Under nature of knowing theme, there were two categories, and these were source of knowledge and justification for knowing. Source of knowledge category had f (9) and justification for knowing category had f (7) and the sum of the frequencies of the codes in these two categories was f (16). According to this, it may be claimed that students with a low level of achievement expressed more opinions under the nature of knowledge theme.

4.1.3.1. Theme 1: Nature of Knowledge

The opinions of the middle school students with a low level of achievement related to certainty of knowledge category were coded as *dogmatic* and *skeptical* in the interviews and they are given in Table 4.3. When the frequencies associated with these codes were checked, it was seen that the most recurrent code was *skeptical* code with f (5). The other code was *dogmatic* code with f (4).

Students' prominent opinions related to *"dogmatic"* code were as follows:

> *There is a single correct answer for all the questions in science. Because they found it at one time. Just like the discovery of gravity.* (Erdal)

> *There is a single correct answer. For example, 2 times 2 is four, this means 2 times 2 is again four or 2 times 4 is eight, 4 times 2 is again eight. It's like this. The result is the same answer, a single answer but it may be reached through different means.* (Aleyna)

> *Some scientists always agree with each other. For example, together they do research on a subject, they both achieve success on that subject; this means they agree.* (Kurtuluş)

Some opinions related to the "*skeptical"* code given by students were quoted below.

> *Scientists might not know everything about science. That's because the technology was not so good in the past; it developed gradually, it even got quite faster, etc. We even progressed to 4.5 G today.* (Aleyna)
>
> *There isn't a rule for scientists to know everything. I think normal people may also know the answers to some questions and things like that.* (Betül)
>
> *I don't think that everything about science is known; perhaps we might discover many different animals.* (Kurtuluş)
>
> *Scientists cannot know everything. There are things left that they do not know. There may be things that they couldn't find and left to coming generations. There may be things they left to coming generations.* (Erdal)

These findings revealed that in the certainty of knowledge category, the number of expressions of the 6th grade students with a low level of achievement were quite close to each other in the "*skeptical"* code with f (5) and in the "*dogmatic*" code with f (4). Thus, it may be argued that students with a low level of achievement had naïve scientific epistemological beliefs in the certainty of knowledge category in general.

As can be understood from the findings in Table 4.3., the opinions of the middle school students pertaining to development of knowledge category were coded as *knowledge or ideas in science can change,* and *knowledge or ideas cannot change*. When the frequencies of these codes were reviewed, it was seen that *knowledge or ideas in science can change* was the most recurrent code and that the frequency of this code was f (6). The frequency of the *knowledge or ideas in science cannot change* code was f (3).

Some statements of the students about *"knowledge or ideas in science can change"* code were as follows:

> *For example, even the telephones were not present in the past, now they have developed so much. Not only the telephone but everything has developed. I*

just gave it as an example. I mean the technology has progressed very much. (Aleyna)

The opinions of the scientists and scientific knowledge change with technological developments. (Erdal)

Some scientific thoughts in our day are different from those considered by the scientists in the past because they didn't live such a long time ago. (Erdal)

The opinions of the scientists are changing because they think of newer things about the future. Like producing a lot of cars. They think about such things. (Yağız)

Scientific knowledge has to change because human brain is developing by time, it is trying to take some steps. For example, we can see it in the videos sometimes. The scientists have given up on telephones. iPhone only works with telephones. Other brands try to make robots or other things; they try to make them a part of our lives. (Erdal)

The opinions expressed by students about *"knowledge or ideas in science cannot change"* code were as follows:

Scientific knowledge does not change. Let me give an example from Edison again. Edison found the lamp but found it with a few filaments. There are still lamps in our day and they are different lamps, but they use the same filaments. (Aleyna)

It doesn't change. The World is round, they can't say that the World is a square because everyone knows that the World is round, they've been aware of this since a long time ago because astronauts have been sent to the space. (Erdal)

I don't think the thoughts of scientists change. If he/she did a very good research and if he/she understood the subject very clearly, I don't think it will ever change. (Kurtuluş)

In brief, the frequency of the *knowledge or ideas in science can change* code was f (6). The frequency of the *knowledge or ideas in science cannot change* code on the other hand was f (3). This finding revealed that students with a low level of achievement mostly used statements expressing the possibility of changeability in scientific knowledge, so it could be said that students with a low level of achievement had sophisticated scientific epistemological beliefs in the development of knowledge category in general.

4.1.3.2. Theme 2: Nature of Knowing

The opinions of the middle school students with a low level of achievement related to source of knowledge category were coded as *authority* and *scientific method* in accordance with the findings in Table 4.3. When the frequencies of these codes were considered, it could be seen that *authority* was the most recurrent code with f (7). The second code in this category was *scientific method* code and its frequency was f (2).

Prominent expressions of some students related to *"authority"* code were as follows:

> *Everything the teacher says is correct because the teachers know everything. They know better than us. They teach us because they know.* (Yağız)
>
> *I usually believe most of the things written in the scientific books. The people who wrote them have really done research on that subject. They have questioned if it really works and then turned it into a book.* (Kurtuluş)
>
> *If that scientist is very famous and very successful in his/her work, we believe him/her. If he/she is very good in his/her work, he/she becomes famous.* (Aleyna)
>
> *I believe what is written in scientific books because they were written by scientists.* (Erdal)

Statements related to *"scientific method"* code were expressed by students as such:

> *No, some people carry out a very good research, too. It doesn't have to be a professor; an ordinary person, for example a teacher goes and does research on that subject. He/she finds information on that subject. He/she presents it to people.* (Kurtuluş)
>
> *I don't think that all people can believe what the scientists say. For example, there is no such thing as the scientists will not do any mistakes. When*

scientists think about something, for example, Kurtuluş may think differently. We can reach different information by doing experiments. (Betül)

Consequently, in the source of knowledge category, the frequency of *scientific method* code was f (2) while the frequency of *authority* code was f (6). This finding supported the idea that the students with a low level of achievement saw the authorities such as scientists, teachers and books as the source of knowledge. As a result, it could be said that in the source of knowledge category, students with a low level of achievement had naïve scientific epistemological beliefs in general.

By taking the findings in Table 4.3. into consideration, related to justification for knowing category the opinions of the 6th grade students with low achievement level were given by coding them as *authority* and *experiment*. Evaluation of the frequencies of these codes revealed that the most recurrent code was *authority* code with f (4) and the other code, the *experiment* code repeated 3 times with f (3).

Students have made expressions related to *"authority"* code and some of these were given below:

For example, when the scientists carry out experiments on television, people may look at these experiments and test the scientific knowledge from these." (Betül)

An ordinary person cannot justify scientific knowledge, but an educated man can. (Erdal)

Opinions and knowledge may be tested by many ways in scientific studies. For example, we look it up in a book or in a computer or we may go to a forest if we are searching for something about the animals. I think we can test information from there, too. (Kurtuluş)

Some remarks of students related to *"experiment"* code were presented below:

I think they do many different experiments for good deductions in science. For example, they might take a plant. They pour something on the plant, they watch if the plant will dye; they pour something else on another plant; they watch what will happen to that plant. (Kurtuluş)

> *There would be no science without experiments because experiments show if the knowledge is correct or not.* (Yağız)

In summary, the frequency of opinions related to "*authority*" code given in the justification for knowing category by 6th grade students with a low level of achievement was f (4) and this number was bigger than the number of opinions related to the *"experiment*" code with f (3). This means that most of the opinions expressed by the students with a low level of achievement tend to accept that scientific knowledge can be verified through authority. Hence, it was concluded that students with a low level of achievement had naïve scientific epistemological beliefs in general in the justification for knowing category.

4.2. Findings and Interpretations of the Second Research Question

In this subsection, findings and interpretations obtained from semi-structured interviews conducted with 15 students in 6th grade was given place in order to answer the second research question "What are the metacognitive awareness of 6th grade students with different achievement levels?".

In the study, data about metacognitive awareness of the students having high (5), average (5) and low (5) level of achievement were analyzed by using thematic analysis, and students were chosen by taking their previous semester Science lesson grades. Frequencies of every code, category, and theme appearing as a result of the study were presented as tables. These tables show us how many times every single opinion is repeated. Moreover, direct quotations from students were included in the findings. While presenting direct quotations from students, interesting sentences quoted without any changes and without looking whether they were correct or not. Besides, students were given nicknames while quoting their sentences because giving their names would be inconvenient in terms of ethical point of view. Names at the end of the students' sentences represent their nicknames.

Findings related to students' metacognitive awareness; it shows us two themes as knowledge of cognition and knowledge of regulation, and eight categories as declarative knowledge, procedural knowledge, conditional knowledge, planning, monitoring, evaluation, debugging and information management appeared. When these categories examined separately; codes of *being interested/inclination, curiosity, remembering the knowledge* and *being active* in declarative knowledge category; codes of *asking questions, doing researches, doing tests, reading, memorizing, making connections, doing experiments, explaining to him/herself, drawing pictures, writing, summarizing, watching videos, rehearsal, listening, gamification* and *animation* in procedural knowledge category; codes of *using different learning strategies* and *being motivated* in conditional knowledge category; codes of *defining goals, choosing suitable sources, choosing suitable strategy/method or way* and *reviewing* in planning category; codes of *evaluating whether he/she has understood or not, evaluating how he/she can learn better* and *summarizing* in evaluation category; codes of *getting help* and *reading parts that he/she couldn't understand again* in debugging category; and in information management category codes of *focusing on important information, dividing the study into small steps, focusing on the meaning of new information, focusing on general meanings, focusing on special meanings* and *drawing pictures in order to help to learn* appeared.

4.2.1. Metacognitive Awareness of the Students with a High Level of Achievement

The findings of metacognitive awareness of the students with a high level of achievement were given in Table 4.4. Findings were presented by handling in detail categories and codes belonging to every single theme.

Table 4.4. Theme, Category, Code and Frequency Table Related to Metacognitive Awareness of the Students with a High Level of Achievement

	f
1. Knowledge of Cognition [Theme]	
1.1. Declarative Knowledge [Category]	**11**
1.1.1. Being interested/Inclination [Code]	6
1.2.2. Curiosity [Code]	1
1.2.3. Remembering the knowledge [Code]	2
1.2.4. Being active [Code]	2
1.2. Procedural Knowledge [Category]	**34**
1.2.1. Asking questions (to him/herself or to the teacher) [Code]	4
1.2.2. Doing researches (book, internet etc.) [Code]	2
1.2.3. Doing tests [Code]	7
1.2.4. Reading (book, notebook etc.) [Code]	4
1.2.5. Memorizing [Code]	1
1.2.6. Making connections [Code]	1
1.2.7. Doing experiments [Code]	1
1.2.8. Explaining to him/herself [Code]	2
1.2.9. Drawing pictures [Code]	2
1.2.10. Writing [Code]	5
1.2.11. Summarizing [Code]	2
1.2.12. Watching videos [Code]	2
1.2.13. Rehearsal [Code]	1
1.3. Conditional Knowledge [Category]	**24**
1.3.1. Using different learning strategies [Code]	20
1.3.2. Being motivated [Code]	4

f: It states how many times 5 students with high level of achievement repeated the related theme, category and code in total.

Table 4.4. Theme, Category, Code and Frequency Table Related to Metacognitive Awareness of the Students with a High Level of Achievement (Continued)

	f
2. Regulation of Cognition [Theme]	
2.1. Planning [Category]	**11**
2.1.1. Defining goals [Code]	1
2.1.2. Choosing suitable sources [Code]	2
2.1.3. Choosing suitable strategy/method or way [Code]	6
2.1.4. Defining necessary materials [Code]	2
2.2. Monitoring [Category]	**4**
2.2.1 Asking him/herself questions [Code]	1
2.2.2. Reviewing [Code]	3
2.3. Evaluation [Category]	**13**
2.3.1. Evaluating whether he/she has understood or not [Code]	7
2.3.2. Evaluating how he/she can learn better [Code]	2
2.3.3. Summarizing [Code]	4
2.4. Debugging [Category]	**9**
2.4.1. Getting help [Code]	6
2.4.2. Reading the parts that he/she couldn’t understand again [Code]	3
2.5. Information Management [Category]	**13**
2.5.1. Focusing on important information [Code]	3
2.5.2. Dividing the study into small steps [Code]	3
2.5.3. Focusing on the meaning of new information [Code]	1
2.5.4. Focusing on general meanings [Code]	2
2.5.5. Focusing on special meanings [Code]	1
2.5.6. Drawing pictures in order to help to learn [Code]	3

f: It states how many times 5 students with high level of achievement repeated the related theme, category and code in total.

In the light of the findings in Table 4.4., the answers of students having a high level of achievement to the semi-structured interview questions were presented by compiling under two themes as knowledge of cognition and regulation of cognition. Under the knowledge of cognition theme; there were three categories as declarative knowledge, procedural knowledge, and conditional knowledge. Having values of declarative knowledge f (11), procedural knowledge f (34) and conditional knowledge f (24); the sum of frequencies of codes in these three categories was f (69). Under the theme of regulation of cognition; there were five categories as planning, monitoring, evaluation, debugging and information management. Planning f (11), monitoring f (4), evaluation f (13), debugging f (9) and information management f (13), the sum of frequencies of codes in these five categories was f (50). According to these findings, it can be put forward that students having a high level of achievement stated their opinions more under the theme of knowledge of cognition.

4.2.1.1. Theme 1: Knowledge of Cognition

According to the findings taken from the table 4.4., thoughts of students having a high level of achievement related to declarative knowledge category were given by coding as *being interested/inclination*, *curiosity*, *remembering the knowledge* and *being active*. When the frequencies of these codes were examined, it was detected that the most repeated code is *being interested/inclination* and its frequency was f (6). Apart from the most repeated code; it was seen that codes of *being active* and *remembering the knowledge* had equal frequencies and every frequency of these codes was f (2). On the other hand, code of *curiosity* was the least repeated one and its frequency was f (1).

The most prominent student opinions related to code of *"being interested/inclination"* were presented below.

> *I listen to the topics that I am interested better, I participate in the lessons more when those topics are being covered and I learn better. In other words, I do not guess the meaning, I can express it clearly because I learn it better.* (Gamze)

> *For example, sound. I am more interested in this topic when it's compared to chemistry or physics. I think I learn better. There may be some complications for example milk's turning into yogurt, getting a haircut, things like that. I know actually but when you want to answer instantly, you may be confused while thinking about the answer. But Light and Sound topic is interesting for me and I have learned it better.* (Meltem)

> *As an example, I can say Light and Sound topics since I am interested in these topics, I know the significant information on these topics.* (Buse)

For instance, I love Light topic teacher. During Light topic, we studied reflection of the light and drawing lines and these were really easy. I love easy topics more thus I learn them better. (Bahadır)

For example, density. I really loved it. It was a topic that I loved and I learned it better. I learned it better because I loved to listen to it. (Gamze)

Students thoughts about the code of *"remembering the knowledge"* were presented below.

I think I learn the topics that I have a previous knowledge better teacher. For instance, in the 5th-grade, we studied Light and Sound topic, now I know them and it is not necessary for me to study them again. I learn better when I recall that information that I learned. Moreover, I can study other lessons. (Buse)

I have just talked about it. I have talked about Sound topic. We had some information about it, we studied it in 5th-grade. Actually, in 4th-grade, we talked about it a little but we didn't study in details. We studied it in 5th-grade. That's why I knew that the sound expands in waves in a linear way. And you asked us that what had we known about this topic. In other words, I learned the topic better by recalling my previous information. (Meltem)

Students' opinions about the code of *"being active"* were presented below.

For instance, I raise my hand in the lesson, you ask questions to us and we answer these questions. On the other hand, some other teachers do not let me participate in the lessons enough but you do, that's why I learn better during your lessons because I participate in Science lessons actively. (Buse)

I am always active during the lessons. I always raise my hand to participate in every topic or I do it without raising my hand. Because of it, I speak constantly and I believe I am active during the lessons, take responsibilities and learn better. (Meltem)

Students' thoughts related to the code of *"curiosity"* were presented below.

When I was a little boy, and my brother was at the age of me, I was curious about his Science lesson. I remember the Light topic from that time. I was curious about that topic then. Thus, I have learned the Light topic better teacher. (Bahadır)

According to the findings taken from the table 4.4., thoughts of students having a high level of achievement related to procedural knowledge category were given by being coded as *asking questions, doing researches, doing tests, reading,* *memorizing, making connections, doing experiments, explaining to him/herself, drawing pictures, writing, summarizing, watching videos* and *rehearsal.* When frequencies of these codes were taken into consideration, it was found that the most repeated code was *doing tests* with the frequency of f (7). Moreover, it can be seen that the other code that is repeated most is *writing* and its frequency was f (5). Apart from these codes of *asking questions* and *reading* had equal frequencies and their frequency was f (4). Additionally; codes of *doing researches, explaining to him/herself, drawing pictures, summarizing* and *watching videos* had equal frequencies again with the frequency of f (2); yet codes of *memorizing, making connections, doing experiments* and *rehearsal* share the frequency of f (1) and they were the least repeated codes in this category.

Some opinions of the students related to code of *"doing tests"* were as follows:

> *One of the strategies that I have been using is doing tests. Before I take an exam, I do tests. I do it a lot. My mother also insists on this topic.*(Bahadır)
>
> *When I am trying to learn something, the strategy that I use is doing tests, teacher.* (Buse)
>
> *For example, I use doing tests as a strategy of learning.* (Gamze)
>
> *I learn by doing tests, which means using doing tests strategy.* (Sude)

Some of the prominent statements of the students about the code of *"writing"* were as follows:

> *The other learning strategy that I have been using is studying by writing.* (Buse)
>
> *For instance, I always study for my exams by writing. It is easier to remember when you write. I think it is more efficient studying with this strategy.* (Meltem)

The prominent statements of the students related to code of *"reading*" were as follows:

> *For example, as a learning strategy, at first, I study by reading the course book for ten minutes. Then I read some other books.* (Bahadır)

One of the learning strategies that I use is reading the book. (Gamze)

Some thought of students related to code of *"asking questions"* were as follows:

For instance, at first, I ask questions about the topic to others. I try to understand. I mean I try to understand the topic by asking questions. I use this strategy. (Bahadır)

I have just said. I put the notebook of the lesson in front of me. Then I close it and ask myself questions about the topic. I use this strategy in order to learn. (Meltem)

I ask questions by myself and prepare lots of answers. I try to learn by using this strategy. (Sude)

Students' statements about the code of *"doing researches"* were as follows:

One of the strategies that I use when I learn something is doing researches on the internet. (Bahadır)

I do researches from the books, I use this strategy most when I learn. (Gamze)

Students' statements related to the code of *"explaining him/herself"* were as follows:

I can tell you that about learning strategy teacher. When I get home, I explain the topic on my own, I used to do it before and now I do the same. (Buse)

Teacher I explain the topic or the lesson myself. I think this is a strategy because it seems more logical and I understand easily. (Buse)

Students' statements related to the code of *"drawing pictures"* were as follows:

For example, during Math lessons, when I'm working on a question, I usually try to solve it by drawing pictures. I learn easily by using this strategy. (Gamze)

For instance, when I explain a topic myself I draw a model of a cell. I explain it with the help pf that model. I try to use this strategy. (Buse)

The opinion of the student related to the code of *“summarizing”* was as follows:

> *Generally, I write summaries. That is to say, I use summarizing as a strategy of learning.* (Gamze)

Statement of the student related to the code of *“watching videos”* was as follows:

> *I watch videos related to Science topics on the internet. I can make a strategy by keeping those videos in my mind.* (Sude)

Student’s statement related to the code of *“memorizing”* was as follows:

> *Teacher, I try to memorize the topic. However, I try this learning strategy rarely.* (Bahadır)

Student’s thought related to the code of *“making connections”* was as follows:

> *I try to make connections between the topics. My mother and father taught me, teacher. They are also teachers, they told me to use this strategy because there is a connection between every topic.*(Bahadır)

Student’s statement related to the code of *“doing experiment”* was as follows:

> *For instance, teacher I try to do experiments on a topic at home. Learning by doing experiments is a good strategy.* (Bahadır)

Student’s statement related to the code of *“rehearsal”* was as follows:

> *When I come home, I rehearse the topics. I use this learning strategy constantly.* (Sude)

When the findings in the table 4.4. are examined, thoughts of students having a high level of achievement related to conditional knowledge category were given by being coded as *using different learning strategies* and *being motivated*. When the frequencies of these codes were taken into consideration, it was detected that the most repeated code was *using different learning strategies* with the frequency of f

(20). And the other code except the previous one, *being motivated* had the frequency of f (4).

Some of the significant statements of the students about the code of *"using different strategies"* were as follows:

> *For instance, by repeating the things that we wrote in our notebooks or by checking from the book, I can understand whether I have learned or not.* (Bahadır)

> *For example, when I get home I lecture myself in order to learn whether I have learned or not. Also, I can understand that by doing tests.* (Buse)

> *I generally summarize and then I compare my summaries with my notes, in this way I can understand whether I have learned or not. I also do tests in order to evaluate how much I have learned.* (Gamze)

> *In order to check how much I have learned, first of all, I ask myself question about that topic. I evaluate my own knowledge, I mean I evaluate whether I have learned or not. Then I do a test on the topic. It shows me if I have learned or not. My mistakes are my lacks.* (Meltem)

> *I have a board at home. I do calculations on the board. I do tests and check whether I have learned or not. I can understand by practicing at home.* (Sude)

Some of the prominent opinions of the students related to the code of *"being motivated"* were as follows:

> *Sometimes I do not want to study, then I tell myself to study. I study then it ends. For instance, after I reach the half of a topic, even if I get bored I persuade myself to study by saying I have come this far I can finish it quickly and I study.* (Buse)

> *I motivate myself by saying in the future this information is going to be necessary.* (Gamze)

Shortly, sum of codes' frequencies in declarative knowledge category under the theme of knowledge of cognition was f (11), sum of codes' frequencies in procedural knowledge category was f (34) and sum of codes' frequencies in conditional knowledge category was f (24); thus, it can be concluded that students with high level of achievement stated their opinions most in procedural knowledge and least in declarative knowledge category.

4.2.1.2. Theme 2: Regulation of Cognition

As it can be understood from the findings in Table 4.4., thoughts of students having a high level of achievement related to planning category were given by being coded as *defining goals, choosing suitable sources, choosing suitable strategy/method or way* and *defining necessary materials.* When the frequencies of these codes were taken into consideration, it could be seen that the code of *choosing suitable strategy/method or way* was the most repeated code with the frequency of f (6). Apart from the most repeated code, it was detected that the codes of *choosing suitable sources* and *defining necessary material*s shared the frequency of f (2), and the frequency of the code of *defining goals* is f (1).

Some sample statements about the code of *"choosing suitable strategy/method or way"* and by which student were these statements expressed were defined below.

> *For instance, when I try to solve a problem, I think of different ways. Firstly, I ask for others, later on, I try to solve it with the help of the formula by reading the course book. I make connections between the problem that I solved before and the problem that I am currently trying to solve. Then I choose the easier one.* (Bahadır)

> *For example, I am going to solve questions about density topic. Dividing, multiplication, I choose the easiest way, the way that I know I am not going to waste time. Of course, there are several ways but I follow the way that I know.* (Buse)

> *When I try to solve a problem, I choose the easiest and the most rational way. That's why instead of dealing with long calculations, we can do it in a short way.* (Gamze)

> *Especially in Math, there are alternative ways. But I choose the way that I can understand better, the way that I feel close.* (Meltem)

Some sample statements about the code of *"choosing suitable sources"* and by which student were these statements expressed were defined below.

> *Before I begin a task, I think of the sources that I am going to need and where I am going to learn that information. Besides, I think of where I am going to do my researches.* (Gamze)

Before I learn something, I think that I need to go online, I need that source. (Sude)

Some sample statements about the code of *"defining necessary materials"* and by which student were these statements expressed were defined below.

Let's suppose we are going to do an activity or an experiment. First, I think. I think what equipment I am going to need. (Meltem)

Even you, teacher, give us a project, first of all, I think of the materials which I am going to use during my work and prepare them. Then I do it. (Buse)

The statement about the code of *"defining goals"* and by which student was that statement expressed were defined below.

I make a plan for the difficult topics. I think of my purposes. I mean I define my goals when I make a plan. But when the topic is easy or when I know it, I do not make lots of plans. (Buse)

When the findings in the table 4.4. were taken into consideration, thoughts of students having a high level of achievement related to monitoring category were given by being coded as *asking him/herself questions* and *reviewing.* When the frequencies of these codes were examined, it was found that the most repeated code is a *reviewing* with the frequency of f (3). Aside from that most repeating code, the code of *asking himself/herself questions*, the other code of the category, had the frequency of f (1).

Some of the prominent statements related to the code *"reviewing"* were given below.

During Science lessons, I take a break and review whether I have learned or not. (Bahadır)

For example, when I study at home, I read and read and read and I feel like I didn't understand at all then I reach to the half of my study I try to lecture myself from the beginning. I review it by explaining the part that I have studied to myself. (Buse)

Student's statement about the code of *"asking him/herself questions"* was given below.

When I learn something, I take a break and I ask myself questions about which points I have learned or I haven't learned. (Meltem)

Under the light of the findings taken from table 4.4., thoughts of middle school students having a high level of achievement related to evaluation category were coded as *evaluating whether he/she has understood or not*, *evaluating how he/she can learn better* and *summarizing*. When the frequencies of these codes were analyzed, it was detected that the most repeated code was *evaluating whether he/she has understood or not* and its frequency was f (7). Apart from the most repeated code, frequencies of the codes of *summarizing* and *evaluating how he/she learns better* were f (4) and f (2).

Sample statements about the code of evaluating *"whether he/she has understood or not"* and by which student were these statements expressed were presented below.

After the topics are finished, I do tests. So, I can evaluate whether I have understood or not. (Gamze)

I have a board at home. I do calculations about the topics that we have learned in our lessons on the board. Then I do tests. In that way, ı can evaluate whether I have understood or not. (Sude)

For instance, after the topic which we study in our Science lesson is finished, I lecture myself about that topic at home. Thus, I can evaluate whether I have learned or not. (Buse)

For example, I have just talked about it. After I complete my study, I evaluate whether I have understood or not. I usually do this teacher. (Bahadır)

Sample statements related to the code of *"summarizing"* and by which student were these statements expressed were presented below.

During Science lessons, I prepare summaries after every topic. (Gamze)

After I complete my study, I summarize what I have learned. I am careful about to prepare my summary shortly and neatly. I do this in order to remember more. If it is short, it is easier to remember. (Buse)

For instance, I study my lessons, after I complete my study, I prepare a summary of what I have learned. When I summarize, I write down the important points. (Meltem)

Statements related to the code of *"evaluating how he/she can better learn"* and by which student are these statements expressed were presented below.

> *For example, after I finish my study, I evaluate myself about how I could have learned better.* (Sude)

> *After I complete my study, I think about how I could have learned better.* (Buse)

According to the Table 4.4., thoughts of middle school students having a high level of achievement related to debugging category were coded as *getting help* and *reading the parts that he/she couldn't understand again.* When the frequencies of these codes were examined, it could be clearly seen that the most repeated code was *getting help* and its frequency was f (6). The other code, *reading the parts that he/she couldn't understand again* was stated twice and its frequency was f (2).

Some of the statements of the students about the code of *"getting help"* were as follows:

> *Teacher, for instance, one of my friends can easily understand not only Science lesson but the other lessons. Sometimes our teachers explain the topic in a difficult way but they explain to me the easy way and quickly. That's why when I don't understand I ask help from my friends.* (Bahadır)

> *When I do not understand I ask help from my teachers and sometimes from my sister.* (Buse)

> *Usually, we ask the points that we haven't understood each other with Buse, Sude, Buse, Gamze we already hang around like that. I ask them the points I haven't understood and they ask me. We get help from each other.* (Meltem)

> *I usually ask help from my teachers when I do not understand.* (Sude)

Some of the students' statements related to the code of *"reading the parts that he/she couldn't understand again"* were as follows:

> *Teacher, if I understand the beginning, I do not go back. If I haven't understood the beginning and if I have a problem in the middle, I try to understand by reading those parts. If I can't understand at all, I go back again and take from the beginning. I think that obviously there is a problem in the beginning, I haven't understood those parts.* (Buse)

> *I wouldn't call it taking from the beginning, I read the parts that I couldn't understand again and again. What I am trying to say is If I haven't understood a topic or information, I read that part. If I understand I continue from where I have left.* (Gamze)

> *If I don't understand a point, I do not go back. I read the part that I haven't understood and I try to understand.* (Sude)

When the findings in Table 4.4., thoughts of students with high level of achievement related to information management category were given by being coded as *focusing on important information, dividing the study into small steps, focusing on the meaning of new information, focusing on general meanings, focusing on special meanings* and *drawing pictures in order to help to learn.* When the frequencies of these codes were taken into consideration, it can be seen that there are three most repeated codes and these codes were *focusing on important information, dividing the study into small steps* and *drawing pictures in order to help to learn.* Each of these three codes shared the frequency of f (3). Aside from these codes; *focusing on general meanings*, *focusing on special meanings* and *focusing on the meaning of new information* had the frequencies f (2), f (1) and f (1) in order. In other words, both the code of focusing on special meanings and the code of focusing on the meaning of new information had equal frequencies.

Some of the prominent statements of the students about the code of *"focusing on important information"* were as follows:

> *I draw my attention to the specific information which our teacher mentioned in our lesson. Actually, my thoughts generally stick there.* (Bahadır)

> *For instance, I underline the important parts when I study teacher, later on when our teacher teaches us those parts I can understand if they are really important or not. In other words, I always focus on the important parts.* (Sude)

Some of the significant statements of the students concerning the code of *"dividing the study into small steps"* were as follows:

> *I divide my studies into small steps when I study. Because when I try to learn all of them I get confused. I learn step by step.* (Bahadır)

When I study lesson, I try to learn by dividing the parts that I am supposed to learn into small steps depending on how difficult the topic is. (Buse)

Some of the prominent statements of the students related to the code of *"drawing pictures in order to help to learn"* were as follows:

During Math lesson, when I try to solve a problem I usually draw pictures. It is easier for me to learn that way. But I do not do this during Science lessons. (Gamze)

I draw a picture in order to make my learning easier. Especially I draw pictures and figures during Math lessons in order to understand. I draw things including fractions. I draw numerical axis. (Meltem)

Students' statements related to the code of *"focusing on general meanings"* were as follows:

I focus on general definitions known by everyone. At least they are easy to remember. (Buse)

For instance, general definitions are easier to remember. I think general definitions of chemical transformation are more important than specific definitions. Also, general definition, which is known by everyone, is easier to remember. They ask them in the tests or exams. We study specific definitions of course but general definitions are more important. (Meltem)

Student's statement related to the code of *"focusing on special meaning"* was as follows:

When I study, I usually focus on specific meanings and definitions. Because in my opinion, Specific definitions are important. (Gamze)

Student's statement about the code of *"focusing on the meaning of new information"* was as follows:

For example, when I learn something new, I focus on that information. I concentrate on there. (Bahadır)

As a result, given the fact that sum of frequencies of codes in the planning category under the theme of regulation of cognition was f (11), and sum of frequencies of codes in the monitoring category was f (4), sum of frequencies of codes in the evaluation category was f (13), sum of frequencies of codes in the debugging category was f (9) and sum of frequencies of codes in the information management category was f (13), it can be said that students with high level of achievement expressed their opinions in evaluation and information management categories most and least in monitoring category.

4.2.2. Metacognitive Awareness of the Students with an Average Level of Achievement

The findings about metacognitive awareness of the students with an average level of achievement were given in Table 4.5. Findings were presented by handling in detail categories and codes belonging to every single theme.

Table 4.5. Theme, Category, Code and Frequency Table Related to Metacognitive Awareness of the Students with an Average Level of Achievement

	f
1. Knowledge of Cognition [Theme]	
1.1. Declarative Knowledge [Category]	**7**
1.1.1. Being interested/Inclination [Code]	4
1.2.2. Curiosity [Code]	1
1.2.3. Remembering the knowledge [Code]	1
1.2.4. Being active [Code]	1
1.2. Procedural Knowledge [Category]	**15**
1.2.1. Asking questions (to him/herself or to teacher) [Code]	3
1.2.2. Doing tests [Code]	3
1.2.3. Reading (book, notebook etc.) [Code]	1
1.2.4. Writing [Code]	2
1.2.5. Rehearsal [Code]	2
1.2.6. Listening [Code]	1
1.2.7. Gamification [Code]	2
1.2.8. Animation [Code]	1
1.3. Conditional Knowledge [Category]	**12**
1.3.1. Using different learning strategies [Code]	9
1.3.2. Being motivated [Code]	3

f: It states how many times 5 students with average level of achievement repeated the related theme, category and code in total.

Table 4.5. Theme, Category, Code and Frequency Table Related to Metacognitive Awareness of the Students with an Average Level of Achievement (Continued)

	f
2. Regulation of Cognition [Theme]	
2.1. Planning [Category]	**8**
2.1.1. Defining goals [Code]	1
2.1.2. Choosing suitable sources [Code]	3
2.1.3. Choosing suitable strategy/method or way [Code]	3
2.1.4. Defining necessary materials [Code]	1
2.2. Monitoring [Category]	**3**
2.2.1. Asking him/herself questions [Code]	2
2.2.2. Reviewing [Code]	1
2.3. Evaluation [Category]	**3**
2.3.1. Evaluating how he/she can learn better [Code]	1
2.3.2. Summarizing [Code]	2
2.4. Debugging [Category]	**10**
2.4.1. Getting help [Code]	10
2.5. Information Management [Category]	**4**
2.5.1. Dividing the study into small steps [Code]	1
2.5.2. Focusing on general meanings [Code]	1
2.5.3. Focusing on special meanings [Code]	1
2.5.4. Drawing pictures in order to help learning [Code]	1

f: It states how many times 5 students with average level of achievement repeated the related theme, category and code in total.

Given the findings in Table 4.5., the responses of the students with an average level of achievement to semi-structured interview questions were collected under two themes: knowledge of cognition and regulation of cognition. Under the knowledge of cognition theme; there were three categories; declarative knowledge, procedural knowledge and conditional knowledge. With declarative knowledge f (7), procedural knowledge f (15) and conditional knowledge f (12), the sum of the frequencies of the codes in these three categories was f (34). Planning, monitoring, evaluation, debugging and information management were five themes under the regulation of cognition theme. With planning f (8), monitoring f (3), evaluation f (3), debugging f

(10) and information management f (4); the sum of the frequencies of the codes in these five categories was f (28). In other words, it appeared that students with an average level of achievement reported more opinions under the theme of knowledge of cognition.

4.2.2.1. Theme 1: Knowledge of Cognition

As can be understood from the findings of Table 4.5., the beliefs of middle school students with an average achievement about the category of declarative knowledge category were coded as *being interested/inclination, curiosity, remembering the knowledge* and *being active.* When the frequencies of these codes were considered, it was seen that the most repeated code was *being interested/inclination* and the frequency of this code was f (4). The frequencies of the other three codes except for *being interested / inclination* code were equal, and the frequency of each was f (1).

Below were descriptions of the students for the *"being interested/inclination"* code.

> *Sexual reproduction and asexual reproduction subjects were my best courses because I was interested in them. I think we made a poster about it. It is still at home.* (Erkan)

> *I can say I have an interest in the subject of density. I was also interested in physical and chemical changes, and I can understand those topics better.* (Merve)

> *I love to learn by reading rather than by writing.* (Batuhan)

> *For example, I like the topic of flowers in the science course. I like to learn things like the inner parts of the flowers. I learn better about the things I love. I learned the subject of flowers. In science lessons, we learn them.* (Onur)

The expression of the student for the code *"curiosity"* was presented below.

> *I am curious about rays and light and so I learn that subject better than the rest.* (Batuhan)

The statement of the student for "*remembering the knowledge*" was presented below.

When I get familiar with the subjects, I remember them better and I learn better. That's why I learned better about the things that I used to study in the past. (Batuhan)

The expression for the *"being active"* code was presented below.

I did most of the experiments last year. For example, I was bringing ice from the house, I was bringing a lighter. I do better when I do the experiments actively, I learn better. (Erkan)

Taking Table 4.5. into account, the opinions of the middle school students with an average level of achievement about the procedural knowledge category were coded as *asking questions, doing tests, reading, writing, rehearsal, listening, gamification* and *animation.* When the frequencies of these codes were examined, it can clearly be seen that there were two most recurrent codes which were *asking questions* and *doing tests* codes, and that the frequency of each of these codes was f (3). Besides these most recurrent codes, the frequencies of *writing, rehearsal,* and *gamification* codes are equal, and the frequency of each code was f (2). The frequencies of *reading, listening* and *animation* codes were f (1) and these were the codes which were expressed the least number of times in this category.

Some of the students' statements pertaining to *"asking questions"* code were as follows:

I ask myself questions. Then I answer. This is the strategy that I use the most. (Merve)

Last year, we had a box of cards at home with questions written on the cards. My mother was picking cards from the box and she was asking me the question from those cards. I studied science in this way. (Erkan)

Some of the expressions of the students about the *"doing tests"* code were as follows:

This year, the strategy I use the most is to take tests. (Erkan)

As a learning strategy, I take tests. (Merve)

The student statement for the *"writing"* code was as follows:

I write on a piece of paper, then I study what I wrote. I generally use this strategy. (Yusuf)

The statements of the students of the *"rehearsal"* code were as follows:

I try the strategy of rehearsal what I wrote in the science lesson. (Yusuf)

I rehearse, then it comes to my mind, I try this strategy. (Merve)

The expression of the student regarding the *"gamification"* code was as follows:

For example, while learning something, I try to transform the lesson into something like a game. I try to make it fun. This means to turn it into something not boring and to gamify it. I already use this strategy sometimes. (Onur)

For the *"reading"* code, the expression of the student was as follows:

I use the strategy of learning by reading. (Batuhan)

For the *"listening"* code, the expression of the learner was:

I try the learning strategy of listening to the teacher in class. (Merve)

The expression of the student for the *"animation"* code was as follows:

I revive the questions in my mind. For example, my instructor says that a car is traveling at a speed of 100 km per hour, so I try to animate it in my mind. I'm trying to use this animation strategy. (Onur)

With the findings obtained from Table 4.5, the opinions of the middle school students with an average level of achievement on the category of conditional knowledge were coded as *using different learning strategies* and *being motivated*. When the frequencies of these codes were considered, it was detected that the most frequently used code was the *using different learning strategies* code and its frequency was f (9). The other code in this category other than this code was the *being motivated* code and its frequency was f (3).

Some of the expressions of the students for the *"using different learning strategies"* code were as follows:

By solving tests and rehearsing the subject, I check how well I learned it. (Merve)

For example, by rehearsing the lesson that we had on that day, listening to the teacher at school and taking the tests related to the subject, I check what I learned. (Onur)

By rehearsing the subject, which we have studied here, in the study hour and by summarizing it in the other class, I check whether I have learned or not. (Yusuf)

For the *"being motivated"* code, some prominent examples of the students' statements were as follows:

If I cannot find the answers to the questions, I continue. I motivate myself. I tell myself that I will find it. I try to remember the answer and I motivate myself by saying that I will find the answer. (Onur)

I tell myself, 'You studied before and learned'. I motivate myself in this way. (Batuhan)

As a result, under the knowledge of cognition theme, the sum of the frequency of codes in the declarative knowledge category was f (7), the sum of the frequencies of the codes in the procedural knowledge category were f (15), and the sum of the frequencies of the codes in the conditional knowledge category were f (12). Thus, we can say that students with an average level of achievement were reported opinions pertaining mostly to the procedural knowledge category and the least number of views were reported on the declarative knowledge category.

4.2.2.2. Theme 2: Regulation of Cognition

As can be seen from the findings in Table 4.5., the opinions of the students with an average level of achievement pertaining to the planning category were coded and presented as *defining goals, choosing suitable sources, choosing suitable strategy/method or way* and *defining necessary materials*. By considering the frequencies of these codes, it was detected that there were two most recurrent codes which were *choosing suitable sources* and *choosing suitable strategy/ method or way* codes and the frequency of each of these codes was f (3). Besides these most recurrent codes, the frequencies of *defining goals* and *defining necessary materials* codes are equal and the frequency of each was detected to be f (1).

Some of the expressions of the students related to *"choosing suitable strategy/ method or way"* code were given below.

> *I choose different ways to solve a problem. For instance, I choose the shortest way. However, this sometimes changes; if the longer is better, I choose it.* (Erkan)
>
> *For example, when transforming the kilometers to meters per second, there is a way taught by the teacher, but I do it by another way using logic. I mean that I try out different ways in solving a problem.* (Merve)

Students' statements related to *"choosing suitable sources"* code were given below.

> *For example, before I start doing my homework, I think that I need internet and sources.* (Batuhan)
>
> *Source books. Before I start learning something, I need some books related to science and a notebook.* (Merve)
>
> *For example, let's say that we are about to learn the particles etc. in the flowers. Then, I will need sources for research, books on that subject and informative sources for the experiments I will conduct.* (Onur)

A student expressed his opinion related to *"defining goals"* code as such:

> *I make a plan first and while making this plan, primarily, I list my goals. First, I do this and then I finish my task and work.* (Batuhan)

The opinion of a student related to the *"defining necessary materials"* code was given below.

> *First, I think about which materials I will use in what I will do. Cardboard, scissors, adhesives, etc. I already do it this way all the time.* (Erkan)

In accordance with the findings obtained from Table 4.5., the opinions of the middle school students with an average level of achievement related to the monitoring category were coded and expressed as *asking him/herself questions* and *reviewing.* By examining the frequencies of these codes, it was detected that the most recurrent code was *asking him/herself questions* code and that its frequency was f (2). The other code besides this most recurrent code is *reviewing* code and its frequency was f (1).

Statements related to *"asking him/herself questions"* code and the students who made these statements were given below.

> *For example, while I 'm learning these subjects, I sometimes stop and ask myself questions and I understand whether I've learned the subject or not.* (Merve)

> *Just like the questions you ask in class, I also ask myself questions. For example, while I'm learning something in class, I stop and ask myself questions about what I learned.* (Onur)

The expression of the student related to *"reviewing"* code and the student who made this expression were given below.

> *For example, while learning something in science, I make a pause and I make a review to see if I have understood it or not. I make this review also when I'm learning something in the study hour.* (Yusuf)

By assessing Table 4.5., the opinions of the middle school students with an average level of achievement related to the evaluation category were coded and expressed as *evaluating how he/she can learn better* and *summarizing*. When the frequencies of these codes were examined, it could be seen that *summarizing* code was more recurrent and that its frequency was f (2). The frequency of *evaluating how he/she can learn better* code on the other hand was detected to be f (1).

The expressions of the students related to *"summarizing"* code were given below.

> *I make a summary after I learn the subjects. In summarizing, I try to write the things which I think are important and things that I have underlined previously.* (Merve)

> *After I finish studying, I make a summary of what I have learned.* (Batuhan)

The expression of one student related to *"evaluating how he/she can learn better"* code was given below:

> *I usually think about how I could have learned a subject better after we finish studying that topic.* (Erkan)

By considering the findings in Table 4.5., the opinions of the middle school students with an average level of achievement about the debugging category were coded as *getting help* and the frequency of this code was f (10).

Some prominent expressions of the students related to *"getting help"* code were given below:

> *For example, because Bahadır is good in subjects, I ask Bahadır to help me when I do not understand a subject.* (Batuhan)

> *When I don't understand while I'm learning something, I read the place that I don't understand once more from the beginning. If I don't understand again, I ask someone.* (Erkan)

> *I also ask the teacher the questions that I cannot understand, the questions that I get stuck upon and cannot understand.* (Merve)

> *For example, I couldn't understand the physical and chemical changes in science, I ask my desk mate Betül. I ask Miray. They try to help me. I may also ask you.* (Onur)

> *When I don't understand a subject, I ask my friends Sude and Buse because they are hardworking. (Merve)*

> *I sometimes ask my desk mate for help when I don't understand something.* (Yusuf)

> *I ask my mother and my older sister when there is a question that I don't understand.* (Merve)

> *I ask my teacher about the things that I don't know or understand. I don't ask the things I know.* (Yusuf)

By examining the findings in Table 4.5., the opinions of the middle school students with an average level of achievement related to information management category were coded and presented as *dividing the study into small steps, focusing on general meanings, focusing on special meanings* and *drawing pictures in order to help learning*. When the frequencies of these codes were considered, it was detected that there was no most recurrent code, that the frequencies were all equal and that the frequency of each was f (1).

The student who expressed an opinion related to *"dividing the study into small steps"* code said:

I divide all the subjects one by one. Under the divided subjects, I write the key words of that subject. I mean I do it like this when I study. (Onur)

The expression of a student related to *"focusing on general meanings"* code was given below.

When I'm studying, I mostly focus on general descriptions because if we look at the whole, we can understand it all at once. (Erkan)

The statement of a student related to *"focusing on special meanings"* code was as follows:

When I'm learning something or studying, I first focus on special descriptions because special descriptions are more important. (Batuhan)

The student expression about the *"drawing pictures in order to help learning" code was given below.*

I draw pictures to facilitate learning because pictures explain better. (Erkan)

In summary, under the regulation of cognition theme, the sum of the frequencies of the codes in the planning category was f (8), the sum of the frequencies of the codes in the monitoring category was f (3), the sum of the frequencies of the codes in the evaluation category was f (3), the sum of the frequencies of the codes in the debugging category was f (10) the frequency of the code in the information management category was f (4) so it could be said that the students with an average level of achievement expressed their opinions mostly in the debugging category while they had the least number of opinions in the monitoring and evaluation categories.

4.2.3. Metacognitive Awareness of the Students with a Low Level of Achievement

The findings about metacognitive awareness of the students with a low level of achievement were given in Table 4.6. Findings were presented by handling in detail categories and codes belonging to every single theme.

Table 4.6. Theme, Category, Code and Frequency Table Related to Metacognitive Awareness of the Students with a Low Level of Achievement

	f
1. Knowledge of Cognition [Theme]	
1.1. Declarative Knowledge [Category]	**7**
1.1.1. Being interested/Inclination [Code]	5
1.2.2. Remembering the knowledge [Code]	2
1.2. Procedural Knowledge [Category]	**14**
1.2.1. Doing tests [Code]	3
1.2.2. Reading (book, notebook etc.) [Code]	2
1.2.3. Doing experiments [Code]	1
1.2.4. Writing [Code]	2
1.2.5. Rehearsal [Code]	3
1.2.6. Listening [Code]	3
1.3. Conditional Knowledge [Category]	**9**
1.3.1. Using different learning strategies [Code]	6
1.3.2. Being motivated [Code]	3
2. Regulation of Cognition [Theme]	
2.1. Planning [Category]	**4**
2.1.1. Choosing suitable strategy/method or way [Code]	2
2.1.2. Defining necessary materials [Code]	2
2.2. Monitoring [Category]	**5**
2.2.1. Asking him/herself questions [Code]	4
2.2.2. Reviewing [Code]	1
2.3. Evaluation [Category]	**6**
2.3.1. Evaluating whether he/she has understood or not [Code]	3
2.3.2. Summarizing [Code]	3
2.4. Debugging [Category]	**11**
2.4.1. Getting help [Code]	9
2.4.2. Reading the parts that he/she couldn’t understand again [Code]	2
2.5. Information Management [Category]	**1**
2.5.1. Focusing on general meanings [Code]	1

f: It states how many times 5 students with low level of achievement repeated the related theme, category and code in total.

As can be seen in Table 4.6., the answers of low-achievers to semi-structured interview questions were collected under two themes: knowledge of cognition and regulation of cognition. Under the knowledge of cognition theme, there were three categories, namely declarative knowledge, procedural knowledge, and conditional knowledge. The sum of the frequencies of the codes in these three categories was f (30) with declarative knowledge f (7), procedural knowledge f (14) and conditional knowledge f (9). There were five categories under the regulation of cognition theme and these were planning, monitoring, evaluation, debugging and information management. The sum of the frequencies of codes in these five categories was f (27) with planning f (4), monitoring f (5), evaluation f (6), debugging f (11) and information management f (1). In the light of these findings, it was detected that the students with a low level of achievement reported more opinions under the knowledge of cognition than under the regulation of cognition theme.

4.2.3.1. Theme 1: Knowledge of Cognition

Under the light of the information that we can gain from Table 4.6., the ideas of middle school students with a low level of achievement about the declarative knowledge were presented with the codes of *being interested/inclination* and *remembering the knowledge*. When the frequencies of these codes were considered, it was seen that the most repetitive code was *being interested / inclination* code and its frequency was f (5). The other code; *remembering the knowledge* was repeated 2 times and f (2) was revealed.

Sample sentences for the *"being interested/inclination"* code and the students who have made these statements were shown below.

> *I learned the subject of light and voice, I learned the chemical and physical changes. These subjects were topics of my interest. We did an experiment and learned how to swim a ping pong ball and a raisin with carbonated water and so forth.* (Betül)

> *For instance, I was interested in force and movement. At first, I was interested in pictures and so on. Then I started to understand and learned better after doing experiments with our teacher. I also had an interest in electricity.* (Erdal)

> *For example, I was interested in the subject of light.* (Kurtuluş)

Here were the expressions for the *"remembering the knowledge"* code and the students who made these expressions.

> *I knew the concepts of force and movement in the fourth grade. For instance, these topics were stuck in our minds after our teachers gave some examples when we were talking about force and motion. Our teacher said that you were applying a force when you push a desk, for example. For this reason, I learned better this year because I remembered.* (Erdal)

> *For example, there was Newton and I learned about him in the past. Then I learned the similar concepts better in the class by remembering the information that I learned earlier.* (Betül)

According to the results of table 4.6., the opinions of the middle school students with a low level of achievement about the category of procedural knowledge were coded as *doing tests, reading, doing experiments, writing, rehearsal and listening*. When the frequencies of these codes were taken into account, it was seen that the mostly repeated codes were the *rehearsal* and *listening* codes, and the frequency of these codes was f (3). The most frequently repeated codes after these codes were *doing tests, reading and writing* codes and the frequency of each of these codes was f (2). The frequency of the *doing experiments* code was f (1).

Some statements of the students on the *"rehearsal"* code were given below.

> *Rehearsing at home.* (Aleyna)

> *I rehearse what I write. For me, the strategy is usually to review. Mostly, I review.* (Kurtuluş)

Some expressions of the students related to the "listening" code are given below.

> *I use the strategy of listening to the teacher very well.* (Betül)

> *How can I say, to understand better, I usually listen to my teacher well when the teachers are doing experiments.* (Kurtuluş)

The statements of the students regarding the code *"doing tests"* were given below.

I use the strategy of doing some tests. (Yağız)

If I understand the subject, I do some tests on that subject. (Kurtuluş)

The expressions of the students about the *"reading"* code were given below.

I read the book from the beginning to the end. (Aleyna)

I read the book as a strategy, I read it when my teacher gives me homework, but also, I read the topics once, twice or three times when I have a hard time to understand the subjects. (Erdal)

The statements of the students with regard to the *"writing"* code were given below.

I use the strategy of rewriting things which I have previously written in my notebook. (Aleyna)

Imm, as a learning strategy, I rewrite important parts of what I have written in my notebook on another page. (Aleyna)

The statement of the student regarding the code *"doing experiments"* was given below.

I usually try to do the experiment which I see in the book. (Erdal)

When the findings in Table 4.6. were examined, the perspectives of middle school students with a low level of achievement related to the category of conditional knowledge were coded as *using different learning strategies* and *being motivated*. When the frequencies of these codes were considered, it was seen that the most recurrent code was the *using different learning strategies* code and its frequency was f (6). The other code, *being motivated* code, recurred 3 times and its frequency was f (3).

Some expressions of the students on *"using different learning strategies"* code were given below.

I open my notebook, sometimes I read the places that I do not understand to check how much I have learned, and then I try to remember the experiments that we have done at school. (Erdal)

For example, I read the books to check whether I understand the subject or not. For instance, about the subject of light, I read my notes that I wrote in my notebook in order to understand the topic of light. I do some tests and check the results to see if I understood it well or not.(Kurtuluş)

By repeating what you have told us, I check whether I learned or not. I also check what I have learned from your lectures by solving tests about the topics. (Yağız)

Some of the expressions of the students on the *"being motivated"* code are given below.

For instance, I say, 'Erdal, you can do it.' Sometimes, I say this to myself when I do not know something. For example, to do things that I do not understand completely, I tell myself, 'If you force yourself, you can do it. Try to work hard, get it into your brain.' (Erdal)

For instance, when I learn something, I say, 'I can achieve this,' to myself. (Betül)

In brief, under the knowledge of cognition theme, the sum of the frequencies of codes in the declarative knowledge category was f (7), the sum of the frequencies of the codes in the procedural knowledge category was f (13) and the sum of the frequencies of the codes in the conditional knowledge category was f (9) so it can be stated that the low-achievers reported their opinions mostly in the procedural knowledge category.

4.2.3.2. Theme 2: Regulation of Cognition

Considering the findings in Table 4.6., the ideas of the middle school students in the planning category were coded as *choosing suitable strategy/method or way* and *defining necessary materials.* When the frequencies of these codes were examined, it was detected that they recurred 2 times in each of the two codes and there was no most recurrent code; the frequency of each code was f (2).

The statements of the students regarding the code *"choosing suitable strategy/method or way"* were presented below.

When I solve a problem, I prefer the way which is the most correct way. (Erdal)

> *For example, I think like this when I solve a problem: I ask myself if it is better to review the subject or if it would be better to do a test or if it would be better to listen to the teacher.* (Kurtuluş)

The student expressions related to *"defining necessary materials"* code were given below.

> *For example, when we began to study light, I thought, "Do I need a laser or something like that. Or do I need something like a lamp?"* (Kurtuluş)

> *For instance, I think I need some tools and some short or long information about the topic.* (Erdal)

According to the findings based on Table 4.6., the opinions of the middle school students with a low level of achievement about the monitoring category were coded as *asking him/herself questions* and *reviewing*. When the frequencies of these codes were considered, the most repetitive code was the *asking him/herself questions* code, and its frequency was f (6). The frequency of the *reviewing* code, the other code of the category, was f (1).

Some statements of the students about the *"asking him/herself questions"* code were given below.

> *When I learn something, I ask myself if it is better do it in this way or not and to work from this side or not.* (Aleyna)

> *First of all, I ask myself if I have understood the subject or not. If I have, I study a little bit by myself. To understand it better, if I could not understand it, I try to learn it by working a little harder.* (Kurtuluş)

> *When I learn something new, I ask myself some questions such as: should I do it this way or not? Should I do it this way or can I learn it better if I do it in the other way."* (Erdal)

The statement of the student regarding the *"reviewing"* code was presented below.

> *I pause during the learning process and review the things that were written by my teacher for about 10 minutes to check what I learned and what I did not.* (Kurtuluş)

In the light of the findings obtained from Table 4.6., the opinions of the middle school students with a low level of achievement about the evaluation category were coded as *evaluating whether he/she has understood or not* and *summarizing*. When we looked at the frequencies of these codes, it was seen that none of the frequencies of the codes were bigger than the other and that the frequencies were equal. The frequencies were equal and f (3) in both codes.

The expressions of a student regarding the code *"evaluating whether he/she has understood or not"* were presented below.

> *I read such books, for example, to know if I have understood the topic or not.* (Kurtuluş)

> *I usually pay attention to find out if I understood the subject or not.* (Kurtuluş)

Some statements of the students on the *"summarizing"* code were presented below.

> *I summarize what I learned after I complete my study. For example, when summarizing, I do not write everything about a topic but write down what I have in mind.* (Betül)

> *After completing my study, I sometimes summarize and sometimes I don't summarize at all. As I summarize, I pay attention to the most important words, for instance, my teacher says that a millipede has forty feet. I pay attention to the things my teacher emphasizes.* (Erdal)

According to Table 4.6., the middle students with a low level of achievement had opinions pertaining to debugging category that were coded and presented as *getting help* and *reading the parts that he/she could not understand again.* When the frequencies of these codes were checked, it was clear that the most frequent code was *getting help* code and its frequency was f (9). The other code, *reading the parts that / he could not understand again*, was expressed twice and its frequency was f (2).

Some expressions of the students related to the *"getting help"* code were presented below.

> *If I do not understand, I go back to my teacher and ask if he/she could explain the subject to me.* (Aleyna)

Sometimes, I ask my teachers the things that I do not understand. (Betül)

If I do not understand, first, I ask for help from the girls because they are more hardworking. Then I want help from boys. (Erdal)

For instance, if I do not understand a subject at all, I go to Batuhan and tell him that I do not understand the subject, so I ask him for a favor to explain me the lessons. Batuhan is a close friend of mine. (Kurtuluş)

I sometimes ask my friends about the subjects that I do not understand. (Yağız)

If I cannot understand, I ask my teacher or friends. (Erdal)

As can be seen from the findings of Table 4.6., the thinking about information management category of middle school students with a low level of achievement was coded as *focusing on general meanings,* and the frequency of this code was f (1).

The expression of the student related to "*focusing on general meanings"* code was presented below.

I focus on general definitions while studying. When I say general definitions, I mean what everyone knows. The general definition is easier because everyone knows it. (Erdal)

In summary, since the sum of the frequencies of the codes in the planning category was f (4), the sum of the frequencies of the codes in the monitoring category was f (5), the sum of the frequencies of the codes in the evaluation category was f (6), the sum of the frequencies of the codes under the debugging category was f (11) and the frequency of the code in the information management category was f (1) under the regulation of cognition theme, it can be said that the low-achievers reported opinions mostly on the debugging category, while they reported the least number of opinions in the information management category.

CHAPTER 5

CONCLUSION, DISCUSSION AND RECOMMENDATIONS

In this section, the results of the study were presented and discussed in the light of the findings and related literature findings. While these results and discussions were presented, titles were formed based on research questions. In addition, based on the results obtained, some suggestions were made for similar and new research which might be done in the future.

5.1. Conclusion and Discussion on the First Research Question

In the first research question of the study, it was attempted to determine the scientific epistemological beliefs of the 6th grade students with different levels of achievements. One of the results obtained from the qualitative findings related to the scientific epistemological beliefs of the students was that while the middle school students with a high level of achievement had sophisticated scientific epistemological beliefs in general in the certainty of knowledge, development of knowledge and justification for knowing categories, they had naïve scientific epistemological beliefs in the source of knowledge category. In other words, while the scientific epistemological beliefs of the middle school students with a high level of achievement had a sophisticated level in three of the four categories, they had a naïve level in one category. This result of the research supports the suggestion in the literature that the scientific epistemological beliefs of the students may have different levels of development for different dimensions (Schommer, 1990; Schommer, 1994; Songer & Linn, 1991; Yenice & Ozden, 2013). In the literature, there are also results that do not support the outcome of this study. For example, in her master's thesis, Tüken (2010) has revealed that students with a high science lesson achievement had more developed epistemological beliefs in general in all dimensions of scientific epistemological beliefs. However, in the present study, it was observed that the students with a high level of achievement did not have sophisticated epistemological beliefs in all dimensions of their scientific epistemological beliefs. In a similar vein, as a result of their study, Aydın and Ertürk Geçici (2017) found that while the scientific epistemological beliefs of the 6th grade students were at an average level in the source of knowledge and development of knowledge dimensions, they were at a sophisticated level in the justification for knowing dimension. In a similar study, Boz et al. (2011) reached the conclusion that the students had naïve epistemological beliefs in the certainty of knowledge and source of knowledge dimensions while having sophisticated beliefs in the development of knowledge and justification for knowing dimensions. The result of Boz et al.'s (2011) study was in line with the results of the categories of the present study except the certainty of knowledge category. In another study, Evcim et al. (2011) explored the scientific epistemological beliefs of the middle school students in four dimensions, namely certainty of knowledge, development of knowledge, source of knowledge and justification for knowing, and they reached the conclusion that while students with a high level of science lesson achievement had more sophisticated epistemological beliefs in the certainty of knowledge, source of knowledge and justification for knowing dimensions, they had naïve or less sophisticated epistemological beliefs in the development of knowledge dimension. This result complies with two categories of the study that was carried out (certainty of knowledge, and justification for knowing) but does not comply with the other two categories (development of knowledge and source of knowledge) because in the present study, students with a high level of achievement had sophisticated scientific epistemological beliefs in the development of knowledge category and naïve scientific epistemological beliefs in the source of knowledge category.

Based on the result that students with a high level of achievement had sophisticated scientific epistemological beliefs in general in the certainty of knowledge, development of knowledge and justification for knowing categories, it can be said that the students did not believe in the presence of a single de facto truth, that they had a modern understanding of scientific knowledge and thought that the opinions of scientists could change, and that they believed in the justification of scientific knowledge. Also, the reason for the students with a high level of achievement to have sophisticated scientific epistemological beliefs in the justification for knowing category may be interpreted as their understanding of the importance of conducting experiments in science and of the necessity to conduct not just one experiment but several experiments to reach the answer. The result that displayed that the students with a high level of achievement had naïve scientific epistemological beliefs in general in the source of knowledge category was not an expected result. It may be argued that the reason for this was the similar social environment for the students. The social environment in which the students lived was an environment where the positions of authority such as the teachers, scientists, etc. are greatly valued and respected. Thus, the students learned from their families, friends, relatives etc. that people such as teachers, scientists, etc. were in positions of authority and valued these people greatly. Naturally, this may be interpreted as leading them to see people such as teachers, scientists, etc. as the source of knowledge.

Another result of this study was that while the middle school students with an average level of achievement had sophisticated scientific epistemological beliefs in the certainty of knowledge and justification for knowing categories in general, they had naïve scientific epistemological beliefs in the development of knowledge and source of knowledge categories. Based on this, it may be interpreted that middle school students with an average level of achievement thought that the scientific knowledge did not have an absolute and single answer and that the scientific information that was reached had to have a justification. This means that the scientific epistemological beliefs of the students with an average level of achievement had a sophisticated level in two of the four categories while they had a naïve level in the other two categories. This result is in accordance with the result in the literature suggesting that while the scientific epistemological beliefs of students may be sophisticated for some dimensions, they may be naïve for others (Boz et al., 2011; Schommer, 1990; Schommer & Walker, 1997). In other words, the scientific epistemological beliefs of the students have a multi-dimensional structure and there is no necessity for an accordance to exist between these dimensions (Schommer, 1994; Schommer et al., 1992). Also, it was seen that Boz and colleagues (2011) reached similar conclusions in their study in which they explored the scientific epistemological beliefs of the 4th, 6th, and 8th grade students. In their study, Boz and colleagues (2011) have reached the conclusion that while the middle school students had naïve scientific epistemological beliefs in the source of knowledge and certainty of knowledge categories, they had sophisticated scientific epistemological beliefs in the development of knowledge and justification for knowing categories. In other words, it may be said that the students had different development levels for the different sub-dimensions of the scientific epistemological beliefs. Furthermore, the result suggesting that the middle school students with an average level of achievement had sophisticated scientific epistemological beliefs in the certainty of knowledge category does not comply with the results of Demirel and Çam's (2016) study because in their study, Demirel and Çam (2016) reached the conclusion that the university students with an average level of achievement had naïve scientific epistemological beliefs in the certainty of knowledge dimension. In addition, the present study findings indicating that students with an average level of achievement had naïve scientific epistemological beliefs in the source of knowledge category does not comply with the result of Sadıç and Çam's (2015) study because in their study, they reached the conclusion that the students had sophisticated scientific epistemological beliefs in the source of knowledge dimension of the scientific epistemological beliefs. In other words, it can be argued that the students did not prefer authorities such as the teachers and the books as the source of the scientific knowledge and that they regarded their reasoning by structuring the knowledge in their minds as the source of knowledge.

In the literature, there are also studies in accordance with the result that students with an average level of achievement had naïve scientific epistemological beliefs in the source of knowledge category (Boz et al., 2011; Saunders, 1998; Tüken, 2010). For example, in his study, Saunders (1998) has detected that the students strongly believed that the knowledge was acquired by authority and that they had naïve scientific epistemological beliefs in the source of knowledge category as a consequence. The reason for the middle school students with an average level of achievement to have naïve scientific epistemological beliefs may be their lack of active participation in the learning process and in the in-class activities because according to Lehrer, Schauble and Lucas (2008), students who do not participate actively in the learning process and in in-class activities have a greater tendency to adopt the opinion that knowledge originates from an authority such as a teacher. In addition to these, results of the present study are consistent with Yankayış and colleagues' (2014) study result regarding sophisticated scientific epistemological beliefs in the justification for knowing category, but inconsistent with the results regarding naïve scientific epistemological beliefs in the development of knowledge category. In their Yankayış et al. (2014) have concluded that the students had sophisticated scientific epistemological beliefs both in development of knowledge and justification for knowing dimensions. In a similar vein, some studies results are not consistent with the present study results regarding naïve scientific epistemological beliefs in the development of knowledge category (e.g., Kurt, 2009; Muşlu, 2008; Savaş, 2011; Smith, Maclin, Houghton, & Hennessey, 2000; Tüken, 2010). For example, in their study, Smith and colleagues (2000) have reached the conclusion that the students had sophisticated scientific epistemological beliefs in the development of knowledge category. It may be argued that the students who have sophisticated scientific epistemological beliefs in the development of knowledge category believe that knowledge has a dynamic and changeable structure. In addition to these, in her study, Özbay (2016) has reached conclusions suggesting that students who believed that the source of scientific knowledge depended on factors such as books and authority, that is students with naïve scientific epistemological beliefs in the source of knowledge dimension, also had naïve scientific epistemological beliefs in the certainty of knowledge, development of knowledge and justification of knowledge dimensions. While this result is compatible with the result of the present study suggesting that students with an average level of achievement had naïve scientific epistemological beliefs in the development of knowledge and source of knowledge categories, it does not comply with the result that these students had sophisticated scientific epistemological beliefs in the certainty of knowledge and justification for knowing categories. The naïve scientific epistemological beliefs of the students with an average level of achievement in the development of knowledge category may result from the definition of the scientific knowledge because beginning from the moment the students are included in the education process, they are exposed to information telling that scientific knowledge is an unchanging law both in their school lives and in their social lives. This situation may have led the students to think that scientific knowledge is unchangeable. Also, the result displaying that while the students with an average level of achievement had naïve scientific epistemological beliefs on the changeability of scientific knowledge, they had sophisticated scientific epistemological beliefs on the absence of a single and absolute truth in science forms a contradiction within itself.

For the middle school students with a low level of achievement, the conclusion that was reached was that they had sophisticated scientific epistemological beliefs in general in the certainty of knowledge and development of knowledge categories in general while they had naïve scientific epistemological beliefs in the source of knowledge and justification for knowing categories. To put it differently, the scientific epistemological beliefs of the middle school students with a low level of achievement were at a sophisticated level in two of the four categories while they were at a naïve level in two of them. This result is in accordance with the results of the studies of Schommer et al. (1990, 1994) and Hofer and Pintrich (1997, 2002). In these studies, it is emphasized that the scientific epistemological beliefs do not display a vertical development and that the students who display sophisticated scientific epistemological beliefs in some dimensions may display naïve scientific epistemological beliefs in others. In a similar vein, the study of Aydemir, Aydemir and Boz (2013) are in parallel with the result that the students had more than one subdimension of epistemological beliefs at the same time and that some sub-dimensions of epistemological beliefs are more developed than the others. In addition to these studies, the conclusion that epistemological beliefs may be at different levels for different dimensions was reached in other studies, too (e.g., Buehl & Alexander, 2001; Hofer, 2000; Saunders, 1998; Schommer, 1993; Schommer, 2008; Yenice & Ozden, 2013). It is possible to encounter findings similar to and different from the results of the present study in the literature. For example, the result suggesting that the students with a low level of achievement had sophisticated scientific epistemological beliefs in the certainty of knowledge category is not in accordance with the result of Trautwein and Lüdtke’s (2007) study because they indicated that individuals displaying a low level of achievement had strong beliefs regarding the certainty of knowledge. Similarly, in the present study, the result suggesting that the students with a low level of achievement had sophisticated scientific epistemological beliefs in the certainty of knowledge category does not comply with the result of Sadıç, Çam and Topçu's (2012) study because these researchers have reached the conclusion that elementary students believed the presence of certainty of knowledge and that they had naïve scientific epistemological beliefs in the certainty of knowledge category. Also, the result suggesting that the low achievers had naïve scientific epistemological beliefs in the source of knowledge category complies with the results of Tüken's (2010) study because in her study, Tüken (2010) has obtained a result suggesting that students saw authority figures such as the books and teachers as the source of scientific knowledge. There are also other studies supporting the result of the present study in the literature (e.g., Boz et al., 2011; Roth & Roychoudhury, 1994; Saunders, 1998; Savaş, 2011). The result of these studies is that the students saw the authorities such as the books and teachers as the source of the knowledge and this is in accordance with the result of the present study. According to the result of this study, it may be argued that the students believed that knowledge cannot be produced and created by people themselves and that the knowledge of people who are considered to be authorities cannot be questioned. In addition to these, the result of the present study suggesting that the students with a low level of achievement had sophisticated scientific epistemological beliefs in the certainty of knowledge and development of knowledge categories and naïve scientific epistemological beliefs in the source of knowledge and justification for knowing categories is parallel with the certainty of knowledge and development of knowledge dimensions in Gök's (2014) study but it does not comply with the source of knowledge and justification for knowing categories. The result showing that students with a low level of achievement had sophisticated scientific beliefs can be interpreted as a sign of the students' beliefs that scientific knowledge may change and that scientific knowledge may be developed by correlating the scientific knowledge with each other. Moreover, the result suggesting that low achievers had naïve scientific epistemological beliefs in the justification for knowing category does not comply with the findings of Carey, Evans, Honda, Jay and Unger's (1989) study which concluded that most of the 7th grade students had sophisticated scientific epistemological beliefs in the testing of scientific knowledge, that is in the justification for knowing dimension of the scientific epistemological beliefs. Besides the study of Carey and colleagues (1989), there are other studies in the literature that do not comply with the result of the present study (e.g., Muşlu, 2008; Tsai, 2003).

The result showing that the students with a low level of achievement had sophisticated scientific epistemological beliefs in general in the certainty of knowledge and development of knowledge categories while they had naïve scientific epistemological beliefs in the source of knowledge and justification for knowing categories may have been caused by various reasons. In her study, Deryakulu (2004) has argued that the scientific epistemological beliefs of individuals may be at different levels of development for different dimensions and she collected the factors influencing the creation of these epistemological beliefs under the headings of mental development, education level, age, education area, family and culture. The reasons for the differences in the scientific epistemological beliefs of the students were not the subject of the present study so they were not studied, but considering that the ages and the education levels of the students are the same, the differences in the sub-dimensions of the scientific epistemological beliefs may be interpreted as originating from their family and culture.

An interesting result of this study was that the students with high, average and low achievement levels had sophisticated scientific epistemological beliefs in general in the certainty of knowledge category while these students having three different levels of achievement had naïve scientific epistemological beliefs in the source of knowledge category in general. In other words, while the students with high, average and low levels of achievement did not believe in general that the scientific knowledge had a certain and single answer, they accepted authority (book, teacher, etc.) as the source of knowledge. This result of the present study does not comply with the result of Aydın and Ertürk Geçici’s (2017) study because these researchers have reached the conclusion that the level of achievement was influential especially on the source of knowledge dimension of the scientific epistemological beliefs. Furthermore, this result of the present study does not comply with the results of Topçu and Yılmaz-Tüzün’s (2009) or Schommer’s (1993b) studies because both studies have reached the conclusion that the students with a high level of achievement had more sophisticated scientific epistemological beliefs. Similarly, the results obtained from the findings of the study of Conley et al. (2004) have revealed that students with a high level of achievement had more sophisticated scientific epistemological beliefs. In parallel with the results of these studies, there are other studies reaching conclusions suggesting that the students with a high level of achievement had more sophisticated scientific epistemological beliefs (e.g., Bendixen & Hartley, 2003; Cano, 2005; Deryakulu & Öztürk, 2005; Islıcık, 2012; Lodewyk, 2007; Özkan, 2008; Pamuk, 2014; Schommer, Crouse, & Rhodes, 1992; Schommer-Aikins, Duell, & Hutter, 2005; Schommer-Aikins, Mau, Brookhart, & Hutter, 2000; Schreiber & Shinn, 2003; Yeşilyurt, 2013). Also, there are studies that comply with this finding of the study as well as the ones that do not comply with it (Akgün & Gülmez, 2015; Belet & Güven, 2011; Erdem, 2008). For example, in Erdem's (2008) study with university students and in Yeşilyurt's (2013) study with elementary school students, the researchers have reached the conclusion that scientific epistemological beliefs did not change according to academic achievement variable. Similarly, in the study conducted by Akgün and Gülmez (2015), a conclusion suggesting that the achievement levels of the students did not have a predictive effect on their scientific epistemological beliefs was reached. Another study was carried out by Tümkaya (2012) and it was concluded that the level of achievement did not cause a significant difference on the three dimensions of scientific epistemological beliefs. The reason for the result suggesting that the level of achievement did not have a deterministic influence on the students especially in the certainty of knowledge and source of knowledge category may be originating from the group of participants in the study.

There may be various reasons for the students with high, average and low levels of achievement to have naïve epistemological beliefs in the source of knowledge category. One of these reasons may be the lack of a complete and correct implementation of the constructivist approach during the education processes of the students. In other words, the students may not have completely adopted the necessity to access and configure information themselves. Another reason is the development of dialogue between the teachers and students. When there is too much dialog between the teachers and students, the students respect their teachers more and this may lead to an increase in their trust in their teachers and in the books, they use in class. This may be interpreted as the students' seeing their teachers and books as the primary sources in acquiring knowledge. Another reason may be the lack of active participation of the students in the learning process and in in-class activities.

One of the notable results of this study was that while the students with high and low achievement levels had sophisticated scientific epistemological beliefs in general in the development of knowledge category, the students with an average level of achievement had naïve scientific epistemological beliefs in the development of knowledge category. In other words, the result suggesting that the students with a low level of achievement thought that scientific knowledge can change in general and that they had sophisticated epistemological beliefs in the development of knowledge category, and that the students with an average level of achievement had naïve scientific epistemological beliefs was not an expected result.

Another remarkable result of the present study was that the middle school students with a high level of achievement had sophisticated scientific epistemological beliefs in three (certainty of knowledge, development of knowledge and justification for knowing) categories, middle students with an average level of achievement had sophisticated epistemological beliefs in two (certainty of knowledge and justification for knowing) categories and the students with a low level of achievement had sophisticated epistemological beliefs in two (certainty of knowledge and development of knowledge) categories of the scientific epistemological beliefs. As a consequence, this may be interpreted as the high-achievers having sophisticated beliefs in a greater number of dimensions of the scientific epistemological beliefs when compared to students with an average or low level of achievement.

Finally, as a result of the findings obtained from the middle school students, it can be concluded that the scientific epistemological beliefs may be collected under two themes, which are the nature of knowledge and nature of knowing, and that the students with high, average and low levels of achievement have expressed their opinions mostly under the nature of knowledge theme.

5.2. Conclusion and Discussion on the Second Research Question

The purpose of the second research question was to determine the metacognitive awareness of the 6th grade students with different levels of achievement. According to the results obtained from the qualitative findings related to the metacognitive awareness of the middle school students, it was concluded that the middle school students with a high level of achievement expressed the greatest number of opinions in the procedural knowledge category under the knowledge of cognition theme while they expressed the greatest number of opinions in the evaluation and information management categories and the least number of opinions in the monitoring category under the regulation of knowledge theme. This conclusion of the present study is not in accordance with the result of Aydemir's (2014) study because in his study, Aydemir (2014) indicated that the metacognitive awareness of the students was more in the planning and monitoring categories when compared with the evaluation category. However, the result showing that the students with a high level of achievement expressed the greatest number of opinions in the evaluation category under the regulation of knowledge theme does not comply with the result of the study conducted by Tok and colleagues (2010) because in their study, they have found a meaningful correlation between the evaluation category and academic achievement. In this study, it was an expected result for the evaluation category to be one of the categories in which the students with a high level of achievement expressed the greatest number of opinions and in accordance with this result, it may be argued that high achievers evaluated their own performances and this result may be interpreted as being due to the evaluation of the high achievers on their own performances and on whether they have learned or not, whether they have understood the subject or not. Furthermore, in the literature, a more developed metacognitive awareness in the evaluation dimension is interpreted as the capacity of the students to plan their learning procedure and learning tasks and to distinguish between the important and unnecessary information; a more developed metacognitive awareness in the evaluation dimension is interpreted as the students' ability to evaluate their learning (e.g., Altındağ & Senemoğlu, 2013; Aydemir, 2014; Drmrod, 1990). In addition to these, the reason for the middle school students to express opinions mostly under the procedural knowledge category under the knowledge of cognition theme may be interpreted as their adequacy in their learning and in the strategies to be used in the learning process.

According to the other conclusions obtained from the research, the middle school students with an average level of achievement expressed their opinions mostly in the procedural knowledge category and the least number of opinions in the declarative knowledge category under the knowledge of cognition theme and they stated their opinions mostly in the debugging category and the number of their opinions were least in the monitoring and evaluation categories under the regulation of knowledge theme. This result of the present study complies with some parts of the results of Kuvaç's (2014) study while it does not comply with other parts. In the quantitative study she has conducted, Kuvaç (2014) has reached the conclusion that the highest metacognitive awareness was in the declarative knowledge dimension. This conclusion does not comply with the conclusion of the present study suggesting that the students with an average level of achievement expressed opinions mostly in the procedural knowledge category but Kuvaç's (2014) conclusion asserting that the lowest metacognitive awareness was in the evaluation dimension complies with the conclusion that students with an average level of achievement expressed the least number of opinions in the evaluation category. The expression of opinions mostly in the procedural knowledge category under the knowledge of cognition theme by middle school students with an average level of achievement may be interpreted as their awareness of the strategies while learning something new or while studying, and the expression of the least number of opinions in the evaluation and monitoring categories under the regulation of knowledge theme may be interpreted as the inadequacy of the students to evaluate their learning and to follow-up their learning or performances.

Another conclusion of the study was that while the middle school students with a low level of achievement expressed the greatest number of opinions in the procedural knowledge category and the least number of opinions in the declarative knowledge category under the knowledge of cognition theme, their opinions were mostly in the debugging category and the least number of opinions were in the information management category under the regulation of knowledge theme. This result of the present study, does not comply with the result of Aydemir's (2014) study because in her study, she has concluded that the metacognitive awareness of students was more in the conditional knowledge category and explained the reason for this as the interpretation and usage of the declarative and procedural knowledge together by the students in the conditional knowledge. A similar conclusion was also reached in Brown's (1987) study. The reason for the middle school students with a low level of achievement to express the greatest number of opinions under the procedural knowledge category under the knowledge of cognition theme may be interpreted as their awareness of the strategies used in learning something new and in studying and their high level of awareness in choosing the most suitable strategy in learning or understanding a subject. It may be argued that the reason for the expression of the least number of opinions in the declarative knowledge category under the knowledge of cognition theme is their unawareness of their personal skills and of their powerful and weak characteristics.

One of the interesting results of this study was that metacognitive awareness of students gathered under two themes and these were knowledge of cognition and regulation of cognition themes and that the middle school students with high, average and low levels of achievement expressed their opinions mostly in the procedural knowledge category under the knowledge of cognition theme. This result does not comply with the results of some studies in the literature (e.g., Akçam, 2012; Alcı & Yüksel, 2012; Bağçeci, Döş, & Sarıca, 2011; Balcı, 2007; Carey et al., 2014; Case, Harris, & Graham, 1992; Coutinho, 2007; Desoete & Roeyers, 2002; Desoete, Roeyers, & Buysse, 2001; Evran & Yurdabakan, 2013; Garner & Alexander, 1989; Goos, Galbraith, & Ranshaw, 2002; Kaya & Fırat, 2011; King, 2003; Mega et al., 2014; Mevarech & Amrany, 2008; Rezvan, Ahmadi, & Abedi, 2006; Rudder, 2006; Topçu & Yılmaz-Tüzün, 2009; Vadhan & Stander, 1994; Young, 2010; Young & Fry, 2008; Zimmerman, 2008). In these studies, it is emphasized that there is a close relationship between the metacognitive awareness and achievements of students. In other words, a conclusion suggesting that the students with a high level of achievement had higher levels of metacognitive awareness was reached. For example, in the studies by Young and Fry (2008) and Coutinho (2007) with university students, it was detected that the metacognitive awareness levels of the students with a higher level of achievement were higher. Similarly, in the study conducted by Bağçeci and colleagues (2011) with 7th grade students, it was detected that the high-achievers had high metacognitive awareness. According to these results, an interpretation suggesting that high achievement is a precursor of metacognitive awareness may be made. However, in the present study, the students have revealed their metacognitive awareness mostly at the procedural knowledge level although these students had different levels of achievement. In the literature, there are also studies emphasizing that the relationship between the levels of metacognitive awareness and achievement levels is small or non-existent and complying with the conclusion of the present study (Brown, 1987; Kıngır & Aydemir, 2012; Schraw, Crippen, & Hartley, 2006; Sperling et al., 2002; Weissbein, 1996). For example, Kıngır and Aydemir (2012) have found that there was no relationship between the chemistry lesson achievements of the students and the metacognitive awareness components in the study they carried out with high school students. As the reasons for this, easy access to the sample of the study, carrying out the study using a limited sample and the usage of different measuring methods in the measurement of academic achievement were given. Similarly, Sperling et al. (2002) have detected a quite small relationship between academic achievement and metacognitive awareness in the study they conducted. Therefore, the results of the abovementioned study support the conclusion of the present study. Also, although the students with high, average and low levels of achievement have expressed more opinions in the procedural knowledge category among the dimensions of metacognitive awareness, students with high and average levels of achievement have expressed more opinions in this category when compared with the students with a low level of achievement. This conclusion obtained from the present study is in line with the results obtained from the studies of Biryukov (2004), Demir (2013), Desoete, Roeyers and Buysse (2001), Doğanay and Demir (2011), and Whimbley and Lochhead (1986). The awareness of the students with high and average levels of achievement of their own learning processes and their knowledge on how to use these learning processes may be a reason for using the metacognitive strategies more.

When the conclusions in the categories under the regulation of cognition theme are evaluated according to the achievement levels of students, it was detected that both the students with an average level of achievement and those with a low level of achievement expressed their opinions mostly in the debugging category whereas the students with a high level of achievement made statements expressing opinions mostly in the evaluation and information management categories and the number of opinions were equal in these two categories. The result showing that the students with average and low levels of achievement expressed the greatest number of opinions in the debugging category under the regulation of cognition theme may be interpreted as these students' being aware of their mistakes in learning and their attempt to understand the things they could not understand by getting help from people such as teachers, friends and family in order to correct these mistakes. On the other hand, the result indicating that the students with a high level of achievement had expressed their opinions mostly in the evaluation and information management categories under the regulation of cognition theme can be interpreted as the ability of the students to evaluate whether they have learned or not, that is to make a self-assessment, and to manage knowledge by correlating the old and new information. Furthermore, while the least number of opinions expressed were in the monitoring category for the students with both high and low levels of achievement, the category in which the students with a low level of achievement expressed the least number of opinions was the monitoring category. In addition to these, while the least number of opinions were expressed in the information management under the regulation of cognition theme, information of management category was one of the categories in which the greatest number of opinions was expressed by the students with a high level of achievement. These results were among the interesting results of this study.

5.3. Implications of the Findings

The results yielded by this study show that the scientific epistemological beliefs of the 6th grade middle school students may be at different levels of development for different dimensions. Thus, actions should not be taken with the assumption that all students' scientific epistemological beliefs have the same level of development in the education-training process and scientific epistemological beliefs should be considered as one of the important individual differences. Such an initiative is quite important in ensuring a more effective and healthy communication with middle school students and in fulfilling the education and training processes in a more efficient and productive manner.

The outcomes of the research display that the metacognitive awareness of 6th grade middle school students may be at different levels of development for different dimensions. Thus, the metacognitive awareness should not be considered to have the same level of development for all students in the education-training process. Therefore, metacognitive awareness, which is one of the individual differences of students, should be taken into consideration during the process of creation and development of the programs and in the formation of activities in the lessons.

When the environment of the students is considered as an important influence on their epistemological beliefs, it can be said that the teacher factor is important and that the epistemological beliefs of the teachers may lead the development of the epistemological beliefs of the students because the scientific epistemological beliefs of teachers considerably influence their education and training activities in the class as much as they influence factors such as their use of teaching methods and techniques, their management of the class, what they focus on learning and so on. This indirectly influences students' level of scientific epistemological beliefs. The beliefs of the teachers, which determine to what extend they are prone to change, constitute substantially the basis for reasons that may impede the reforms to be made in the education field. For this reason, in order to organize the educational program implemented by the Ministry of Education in a way to develop the epistemological beliefs of the students, it is also necessary to know the scientific epistemological beliefs of also the teachers and to make arrangements or programs to improve their scientific epistemological beliefs.

Teachers who will be responsible for the students to gain metacognitive awareness should have more information and experience in this subject. Hence, guidance activities, courses and in-service training seminars should be organized for teachers on how to activate students' metacognitive awareness processes. Regardless of the number of years they have been in the profession, it should be imperative for all teachers to participate in these activities and seminars. In this way, in the lessons they teach at their schools, teachers may have knowledge about how students can bring out and develop their metacognitive awareness levels and they can contribute to the raising of generations with high metacognitive awareness.

For the students to have a high level of scientific epistemological beliefs, textbooks need to be prepared by an approach that takes the aspects related to the certainty, source, developmental dimension and justification of scientific knowledge into account. In the textbooks and workbooks, if such an understanding, which acknowledges the fact that scientific knowledge goes through changes in the historical process and that knowledge that was regarded as correct in the past or today might not be accepted as correct knowledge in the future, is incorporated, this would enable individuals to question the certainty of knowledge, observe the origin of its source, analyze the developmental structure of knowledge and determine whether the scientific knowledge is verifiable or not.

In this study, it was observed that the students responded to the interview questions asked by the researcher when sufficient time was given to them. Based on this, the researchers should give each student enough time to think about the questions that were asked. What is important here is that, rather than the quick response of some students, all students should think about the question and give their opinions. Furthermore, in order to reveal the scientific epistemological beliefs and the metacognitive awareness levels, the researcher who collects data through interview questions should encourage students to explain their individual views and make sure that the students with negative metacognitive awareness and scientific epistemological beliefs feel appreciated and respected by the researcher.

It is suggested that curriculum developers who develop Science Education Programs should give more space to both scientific epistemological beliefs and metacognitive awareness in preparing student learning outcomes. In addition, these structures should be included in the course content for the students to have a high level of scientific epistemological beliefs and metacognitive awareness. These arrangements should follow a gradual structure according to the developmental characteristics of the students.

To enhance the students' levels of planning, monitoring, debugging, information management and evaluation, a suitable classroom setting should be prepared for the students to express their thoughts and opinions freely, criticize the opinions of others in a scientific way and use their research skills. In this manner, not only the metacognitive awareness levels of the students will increase, but also the students will be able to carry this awareness to all dimensions of their lives. Also, they will be not trouble makers but problem-solvers, a helpful part of the society as people who are self-reliant and who know what they have and what they lack as fully self-confident individuals.

Moreover, to ensure that students are aware of their knowledge and their ways of constructing knowledge, teacher-centered approach should be abandoned, and textbooks should not be regarded as the main source of the education. Instead, alternative activities in which the students can design their own learning process enabling them to take responsibility for their own learning and to achieve the goals they specify by themselves should be created.

The use of the interview questions on scientific epistemological beliefs and metacognitive awareness, which were developed by the researcher in this study, with larger groups of participants may contribute to the reliability and validity of these data collection tools.

5.4. Recommendations for Future Studies

The following suggestions were made under the light of the findings and the results which were obtained from this research.

- The data in this study were collected from an area in Ankara. The same study can be done in the future in different regions of Turkey and Ankara by keeping the same context of the study. Findings and results of this study can be compared with findings and results to be obtained.

- Participants of this research were middle school students in a public school. Research on scientific epistemological beliefs and metacognitive awareness may be carried out in schools with different conditions (schools that lack science laboratories, schools which are unable to benefit from information technology, private schools, etc.) and in different physical conditions (science laboratories, information technology classes, etc.) to compare how these conditions influence the scientific epistemological beliefs and metacognitive awareness of the students. In addition, the scientific epistemological beliefs and metacognitive awareness of middle school students in different school types (e.g. public, private) can be qualitatively compared.

- This study was conducted only with 6th grade middle school students and the scientific epistemological beliefs and metacognitive awareness of these students were determined by using qualitative research method. By keeping the same context in this study, qualitative data may be collected also from the 7th and 8th grade middle school students and the scientific epistemological beliefs and metacognitive awareness of the students at different grade levels may be compared qualitatively. Furthermore, qualitative studies in which it is attempted to determine the scientific epistemological beliefs and metacognitive awareness of the students at different levels of education (elementary school, high school and university) may be designed. Thus, the scientific epistemological beliefs and metacognitive awareness of students with different levels of education may be compared and similarities and differences may be revealed. In this way, both a more comprehensive image on which levels of education influence the the scientific epistemological beliefs and metacognitive awareness of the students in what ways and for which dimensions may be obtained and whether there is a critical stage for the development of scientific epistemological beliefs and metacognitive awareness may be questioned comprehensively.

- In the future studies, the scientific epistemological beliefs and metacognitive awareness of teacher candidates at different universities, teachers teaching at different types of schools or faculty members working at different universities may be handled.

- The possible future research about the scientific epistemological beliefs and metacognitive awareness of the students by handling scientific epistemological beliefs and metacognitive awareness together may include more details with the addition of data collection tools such as observation, video recording, etc. rather than including only the interviews.

- In this study, where the scientific epistemological beliefs and the metacognitive awareness structures were analyzes together, basic qualitative research method was used. Conducting other studies in which qualitative research methods other than this method are used may be helpful in acquiring other findings.

- In the conducted study, both scientific epistemological beliefs and metacognitive awareness of middle school students were tried to be determined by using qualitative research methods. In future research, scientific epistemological beliefs and metacognitive awareness of middle school students can be determined using both qualitative and quantitative research methods.

- In the present study, students' epistemological beliefs and metacognitive awareness were examined using qualitative research methods. In subsequent studies, the reasoning skills and ontological beliefs may be included.

- The precautions that may be taken to develop the skills of students with low levels of both scientific epistemological beliefs and metacognitive awareness can be explored by future studies.

- In the current study, in determining both the scientific epistemological beliefs and the metacognitive awareness, the interview questions prepared by the researcher by reviewing the literature in this field were used. There are no original adequate data collection tools to determine the middle school students' scientific epistemological beliefs and metacognitive awareness in Turkey. Therefore, data collection tools that may be used with the purpose of determining the scientific epistemological beliefs and the metacognitive awareness of students may be developed and studies may be conducted with these data collection tools.

- In this study, data were collected by interviewing 15 students one-by-one in a public school. Although the in-depth analysis carried out within the scope of the present study gave meaningful results, the number of interviewed students in the study may be increased in prospective studies by keeping the same context and the results of those studies may be compared with the results of the present study to see if they yield the same results.

- Longitudinal studies that adopt qualitative research methodology may be conducted in the future with middle school students whose scientific epistemological beliefs and metacognitive awareness were determined in the present study. Thus, any change in their scientific epistemological beliefs and metacognitive awareness may be detected. Furthermore, comparisons may be done with the findings and the results obtained.

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APPENDICES

APPENDIX A

PERMISSION OBTAINED FROM APPLIED ETHICS RESEARCH CENTER

UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
APPLIED ETHICS RESEARCH CENTER

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
MIDDLE EAST TECHNICAL UNIVERSITY

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ÇANKAYA ANKARA/TURKEY
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Sayı: 28620816 / 519

07 KASIM 2017

Konu: Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi: İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Prof.Dr. Jale ÇAKIROĞLU ve Prof.Dr. Özgül YILMAZ-TÜZÜN ;

Danışmanlığını yaptığınız doktora öğrencisi Yurdagül BOĞAR'ın **"Bilimsel Argumantasyon Aracılığıyla Öğrencilerin Bilimsel Akıl Yürütme Becerilerinin, Bilimsel Epistemolojik İnançlarının ve Üstbilişsel Farkındalıklarının Değerlendirilmesi"** başlıklı araştırması İnsan Araştırmaları Etik Kurulu tarafından uygun görülerek gerekli onay **2015-EGT-156** protokol numarası ile **07.11.2017 – 30.06.2018** tarihleri arasında geçerli olmak üzere verilmiştir.

Bilgilerinize saygılarımla sunarım.

Prof. Dr. Ş. Halil TURAN
Başkan V

Prof. Dr. Ayhan SOL
Üye

Prof. Dr. Ayhan Gürbüz DEMİR
Üye

BULUNAMADI
Doç. Dr. Yaşar KONDAKÇI
Üye

Doç. Dr. Zana ÇITAK
Üye

Yrd. Doç. Dr. Pınar KAYGAN
Üye

Yrd. Doç. Dr. Emre SELÇUK
Üye

APPENDIX B

PERMISSION OBTAINED FROM MINISTRY OF NATIONAL EDUCATION

T.C.
ANKARA VALİLİĞİ
Milli Eğitim Müdürlüğü

Sayı : 14588481-605.99-E.1285443 04.02.2016
Konu : Araştırma İzni

........................İLÇE MİLLİ EĞİTİM MÜDÜRLÜĞÜNE

İlgi: a) MEB Yenilik ve Eğitim Teknolojileri Genel Müdürlüğünün 2012/13 nolu Genelgesi.
b) ODTÜ'nün 08/01/2016 tarihli ve 95 Sayılı yazısı.

Orta Doğu Teknik Üniversitesi Eğitim Bilimleri Ana Bilim Dalı İlköğretim programı doktora öğrencisi Yurdagül BOĞAR'ın **"Argumantasyon Tabanlı Sorgulamacı Yaklaşım Aracılığıyla Öğrencilerin Bilimsel Akıl Yürütme Becerilerini, Kişisel Epistemolojilerinin ve Üstbilişsel Farkındalıklarının Değerlendirilmesi"** konulu araştırma kapsamında çalışma yapma talebi Araştırma Komisyonumuzca incelenmiş olup; ilçenize bağlı ekli listede belirtilen okullarda çalışmanın yapılması Müdürlüğümüzce uygun görülmüştür.

Görüşme formunun (4 sayfa) uygulama yapılacak sayıda araştırmacı tarafından çoğaltılarak, araştırmanın ilgi (a) genelge çerçevesinde, ilçe milli eğitim müdürlüklerinin sorumluluğunda okul ve kurum yöneticileri de uygun gördüğü takdirde gönüllülük esasına göre uygulanmasını rica ederim.

Müberra OĞUZ
Müdür a.
Şube Müdürü

EK:
1-Görüşme formu (4 sayfa)
2-Okul listesi (1 sayfa)
DAĞITIM:
Yenimahalle-Çankaya
Keçiören

Konya yolu Başkent Öğretmen Evi arkası Beşevler ANKARA
e-posta: istatistik06@meb.gov.tr
Ayrıntılı bilgi için
Tel: (0 312) 221 02 17/135

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T.C.
ÇANKAYA KAYMAKAMLIĞI
İlçe Milli Eğitim Müdürlüğü

Sayı :78520003/605.99/1292475
Konu :Araştırma İzni -

04.02.2016

İLGİLİ OKUL MÜDÜRLÜKLERİNE

İlgi :a) MEB Yenilik ve Eğitim Teknolojileri Genel Müdürlüğünün 2012/13 nolu Genelgesi.
b) ODTÜ'nün 08/01/2016 tarihli ve 95 Sayılı yazısı.
c) İl Milli Eğitim Müdürlüğü'nün 04/02/2016 tarihli ve 14588481/605.99/E. 1285443 sayılı yazısı.

Orta Doğu Teknik Üniversitesi Eğitim Bilimleri Ana Bilim Dalı İlköğretim programı doktora öğrencisi Yurdagül BOĞAR'ın **"Argumantasyon Tabanlı Sorgulamacı Yaklaşım Aracılığıyla Öğrencilerin Bilimsel Akıl Yürütme Becerilerini, Kişisel Epistemolojilerinin ve Üstbilişsel Farkındalıklarının Değerlendirilmesi"** konulu araştırma kapsamında okulunuzda anket uygulaması İl Milli Eğitim Müdürlüğünün ilgi(c) yazıyla ile uygun görülmüştür.

Anket formunun(4 sayfa) uygulama yapılacak sayıda araştırmacı tarafından çoğaltılarak, araştırmanın ilgi(a) Genelge çerçevesinde, okul müdürlüğünün sorumluluğunda okul ve kurum yöneticileri uygun gördüğü takdirde gönüllülük esasına göre uygulanmasını rica ederim.

Hasan Hüseyin ÖZİPEK
Müdür a.
Şube Müdürü

EK:
1-Görüşme formu (4 sayfa)
2-Okul listesi (1 sayfa)
3-İlgi (c) yazı (1 sayfa)

Namık Kemal Mah. 95.Cad: No:7/B Kızılay/ANKARA
Elektronik Ağ: www.meb.gov.tr
e-posta: cankaya06_strateji@meb.gov.tr

Ayrıntılı bilgi için: SİBEL AKYOL YILDIRIM
Tel: (0 312) 4186875/144
Faks: (0 312) 4192784-85

APPENDIX C

INTERVIEW PROTOCOL FOR MIDDLE SCHOOL STUDENTS' SCIENTIFIC EPISTEMOLOGICAL BELIEFS

Sevgili öğrenci,

Ben Orta Doğu Teknik Üniversitesi İlköğretim Fen Bilgisi Eğitimi bölümünde doktora yapmaktayım. Bilimsel epistemolojik inançlarınıza ilişkin görüşlerinizi öğrenmek istiyorum. İstediğiniz zaman görüşmeyi yarıda kesebilir, beğenmediğiniz sorular hakkında görüş belirtmeyebilirsiniz. Kişisel bilgileriniz ve davranışlarınız hakkındaki görüşleriniz kesinlikle gizli tutulacaktır.

Teşekkür ederim.

Yurdagül Boğar

ODTÜ Doktora Öğrencisi

Bilimsel Epistemolojik İnançlara İlişkin Görüşme Soruları

1. Bilimde bütün soruların tek bir doğru yanıtı mı vardır? Böyle düşünmene sebep olan nedir?
2. Bilim insanları bilim hakkında her şeyi bilir mi? Daha fazla bilinecek bir şey kalmamış mıdır? Neden?
3. Bilim insanlarının bir deneyden aldığı sonuç, o deneyin tek yanıtı mıdır? Başka yanıtları olabilir mi? Örnek verebilir misin?
4. Bilim insanları bilimde neyin doğru olduğu konusunda her zaman aynı fikirde midirler? Niçin?
5. Günümüzdeki bazı bilimsel düşünceler, bilim insanlarının daha önce düşündüklerinden farklı mıdır? Eğer farklı ise, bu farklılaşma neden kaynaklanmaktadır?
6. Bilim insanlarının bile yanıtlayamayacağı bazı sorular var mıdır? Örneklerle açıklar mısınız?
7. Bilimsel düşünceler bazen değişir mi? Yoksa hiçbir şekilde değişmez mi? Neden?
8. Yeni buluşlar örneğin teknolojik ilerlemeler veya yeni bilimsel bilgiler ile bilim insanlarının daha önce doğru olarak düşündükleri şeyler değişir mi? Peki sizce değişmesi mi gerekir değişmemesi mi? Neden?
9. Sizce, tüm insanlar bilim insanlarının söylediklerine inanmak zorunda mıdır? Neden?
10. Bilimsel kitaplarda yazanlara inanır mısın? Neden?
11. Fen bilimleri dersinde, öğretmenin söylediği her şey doğru mudur? Neden öyle düşünüyorsun?
12. Bilimde neyin doğru olduğunu sadece bilim insanları mı kesin olarak bilirler? Neden?
13. Bilimsel çalışmalarda düşüncelerin veya bilgilerin test edilebilmesi için birden fazla yol olabilir mi? Neden böyle olduğunu düşünüyorsun?
14. Deney yapmanın bilimsel çalışmaların önemli bir parçası olduğunu söyleyebilir miyiz? Neden?
15. Sence, bilimdeki parlak fikirler sadece bilim insanlarından mı gelir? Yoksa herhangi birinden de gelebilir mi? Cevabını örnek vererek açıklar mısın?

16. Bilimdeki iyi çıkarımlar, birçok farklı deneyin sonucundan elde edilen kanıtlara mı yoksa bir deneyin sonucundan elde edilen kanıtlara mı dayanır? Cevabını gerekçesiyle birlikte açıklar mısın?

Interview Questions on Scientific Epistemological Beliefs

1. In science, is there a single correct answer for each question? What makes you think that way?
2. Do scientists know everything about science? Is there nothing left to know? Why?
3. Is a result taken by scientists from an experiment the only answer of that experiment? Can there be other answers? Can you give an example?
4. Do scientists always agree on what is correct in science? Why?
5. Are some scientific thoughts in our day different from those considered by scientists in the past? If they are different, where do these differences stem from?
6. Are there some questions that cannot be answered even by scientists? Can you explain with examples?
7. Does scientific ideas sometimes change? Or is it invariable? Why?
8. Do the things considered to be correct in the past change with new discoveries such as new technological developments or with new scientific information? In your opinion, should they change or not? Why?
9. Do you think that everyone should believe in what the scientists say? Why?
10. Do you believe what is written in scientific books? Why?
11. In the science lessons, is everything told by the teacher correct? Why do you think so?
12. Do only the scientists know exactly what is right and what is wrong? Why?
13. Can there be more than one way to test the thoughts and knowledge in scientific studies? Why do you think so?
14. Can we say that conducting experiments is an important part of the scientific studies? Why?
15. Do you think that bright ideas in science come only from scientists or can they come from anyone? Can you explain your answer with an example?
16. Do good deductions in science depend on proofs acquired from the results of many different experiments or to proofs obtained from the result of one experiment? Can you explain your answer with its justification?

APPENDIX D

INTERVIEW PROTOCOL FOR MIDDLE SCHOOL STUDENTS' METACOGNITIVE AWARENESS

Sevgili öğrenci,

Ben Orta Doğu Teknik Üniversitesi İlköğretim Fen Bilgisi Eğitimi bölümünde doktora yapmaktayım. Üstbilişsel farkındalığınıza ilişkin görüşlerinizi öğrenmek istiyorum. İstediğiniz zaman görüşmeyi yarıda kesebilir, beğenmediğiniz sorular hakkında görüş belirtmeyebilirsiniz. Kişisel bilgileriniz ve davranışlarınız hakkındaki görüşleriniz kesinlikle gizli tutulacaktır.

Teşekkür ederim.

Yurdagül Boğar

ODTÜ Doktora Öğrencisi

Üstbilişsel Farkındalıklara İlişkin Görüşme Soruları

1. Fen bilimleri dersinde işlenen konuları ne kadar iyi öğrendiğini kontrol eder misin? Eğer kontrol edersen bunu nasıl yaparsın?
2. Fen bilimleri dersinde ilgi duyduğun konuları daha iyi mi öğrenirsin? Örneklerle açıklar mısın?
3. Fen bilimleri dersinde gerekirse önceden kullandığın öğrenme stratejilerini dener misin? Bu öğrenme stratejileri nelerdir?
4. Fen dersine çalışırken ne tür stratejiler kullandığının farkında olur musun? Varsa bu öğrenme stratejileri nelerdir?
5. Fen konuları ile ilgili önceden bir şeyler bildiğin zaman daha iyi öğrenir misin? Eğer cevabın evet ise nasıl daha iyi öğrenirsin?
6. Fen bilimleri dersinde ihtiyacın olan bilgiyi öğrenmek için kendini motive eder misin? Peki fen derslerinde aktif görev almanın seni motive edeceğini düşünüyor musun?
7. Bir göreve başlamadan önce onu öğrenmen için nelere ihtiyacın olduğunu düşünür müsün? Düşünüyorsan örnek verir misin?
8. Bir problemi çözmek için farklı yollar düşünüp hem de bu yollardan en iyisini seçebilir misin? Cevabın evet ise örnek verir misin?
9. Fen öğrenimi sırasında ara verip ne yaptığınızı, konuyu öğrenip öğrenmediğinizi düzenli olarak kontrol eder misiniz? Cevabınız evet ise nasıl?
10. Yeni bir şey öğrenirken nasıl daha iyi öğrenebileceğine iliksin kendine sorular sorar mısın? Sorarsan ne tür sorular sorarsın?
11. Çalışmalarını tamamlamadan önce amaçlarıma daha başarılı bir biçimde nasıl ulaşabileceğini kendi kendine sorar mısın?
12. Çalışmanı tamamladıktan sonra öğrendiklerini özetler misin? Eğer özetlersen nelere dikkat edersin?
13. Fen öğrenimi sırasında anlayamadığınız bir şey olduğunda arkadaşlarınızdan yardım ister misiniz?
14. Eğer yeni öğrenilen bir bilgiyi anlayamazsan çalışmayı bırakıp başa mı dönersin? Ya da ne yaparsın?

15. Öğrenmeni kolaylaştırmak için resim ve diyagramlar çizer misin? Eğer çizersen daha çok hangisini çizersin? Resim mi diyagram mı?

16. Ders çalışırken, yapacağınız çalışmaları küçük adımlara ayırıp, özel tanımlardan daha çok genel tanımlara mı odaklanırsınız? Niçin?

Interview Questions on Metacognitive Awareness

1. Do you check how well do you learn the subjects taught during Science lessons? If you do, how do you do that?
2. Do you think you learn the subjects that you are interested better in Science lessons? If so, could you please explain by giving examples?
3. If necessary, do you try learning strategies that you tried before? What are these learning strategies?
4. Are you aware of what kind of strategies you apply when you study science lesson? If you have strategies, what are these learning strategies?
5. Do you think you learn better when you have knowledge about the subject from previous learning experiences? If your answer is yes, how do you learn better?
6. Do you motivate yourself in order to learn the information that you need during science lessons? And do you think that participating in Science lessons actively could motivate you?
7. Do you think about what will you need in order to learn better before you start doing a task? If you think, could you please give examples?
8. Could you think of different ways to solve a problem and choose the best way? If your answer is yes, could you please give examples?
9. Do you take a break in order to check what you are doing and whether you have learned the subject or not during Science lessons? If your answer is yes, how?
10. Do you ask questions to yourself about how you can learn better while learning new things? If you do, what kind of questions do you ask?
11. Do you ask yourself how you can achieve your goals in a more successful way before you complete your studies?
12. Do you summarize what you have learned after you complete your study? If you summarize, what do you take in consideration?
13. Do you ask for help from your friends when you do not understand a point?
14. If you could not understand a new information, would you stop studying and take it from the beginning? Or, what would you do?

15. Do you draw pictures and diagrams in order to make your learning easier? If you draw, which one do you draw more? Picture or diagram?

16. While studying lesson, do you focus on general definitions rather than specific definitions by breaking your studies into small steps? Why?

APPENDIX E

TRANSLATED INTERVIEW QUOTATIONS

1. Quotations Taken from Certainty of Knowledge Category

In fact, it is related to the question that you have just asked because if there is only a single result, all of them would think of the same thing and would do the same thing. (Bahadır)	Aslında hocam biraz önce sorduğunuz soru ile bağlantılı çünkü eğer tek bir sonuç varsa hepsi aynı şeyi düşünür, aynı şeyi yapar hocam. (Bahadır)
There may be different ways, but the result would be the same. This means that there is a single result, but it may be done by different means. (Buse)	Hocam yollar farklı olabilir ama aynı sonuç çıkar. Hocam yani bir tek sonucu vardır ama farklı yollarla yapılabilir. (Buse)
Because for example if a friend finds 15 in a problem and we find 18, its result can't be 18 or 15, there should be a single solution. (Sude)	Çünkü hocam mesela bir problemde bir arkadaşımız 15 bulursa biz 18 buluyorsak mesela, onun sonucu 18 veya 15 değil de bir tane bir şey olması lazım. (Sude)
For example, sometimes there is more than one answer in the subjects of our lessons. (Bahadır)	Hocam mesela bizim işlediğimiz konularda birden fazla doğru yanıt olabiliyor. (Bahadır)
Actually, there must be many things that we don't know because scientists question this way, but I don't believe that they can really question everything. They cannot question so many things. There must certainly be undiscovered things, maybe they will be discovered. (Buse)	Hocam yani aslında bilmediğimiz birçok şey vardır bizimde çünkü hocam bilim insanları böyle sorgularlar ama hocam gerçekten her şeyi sorgulayacaklarına inanmıyorum hocam. Sorgulayamazlar o kadar çok şeyi de. Bulunmayan şeyler vardır elbet yani bulunacaktır belki. (Buse)
Because by conducting different experiments we can get different results. It is more reasonable to carry out several experiments rather than a single one. (Gamze)	Çünkü farklı deneyler yaparak farklı sonuçlar alabiliriz. Bir deney değil de birden çok deney yapmamız daha mantıklı. (Gamze)

No, there is not a single correct answer to all the questions in science. I mean for example, there may be two or three answers to a math question and there may be two or three ways. There is not a single correct answer. (Meltem)	Hayır bilimde bütün soruların tek bir doğru yanıtı yoktur. Yani mesela bir matematik sorularının cevaplarında da iki üç tane cevabı olabilir iki üç yolu da olabilir. Tek bir doğru yanıtı yoktur. (Meltem)
Scientists argue among themselves, they find the proof and then they postulate. They assert their claims. Every scientist may have a different opinion. After the claim of the proof is calculated and the evidence is found, the true answer will emerge. If a scientist says something, his/her addressee may suggest something else or may say something different. (Meltem)	Bilim insanları aralarında tartışırlar, kanıtı bulurlar sonra öne sürerler. İddialarını ortaya atıyorlar. Her bilim insanının farklı bir görüşü olabilir. Kanıtını iddiasını ölçtükten sonra delili de bulduktan sonra zaten gerçek cevap ortaya çıkar. Bir bilim insani bir şey diyorsa, karşısındaki farklı bir şey önerebilir farklı bir şey diyebilir. (Meltem)
If for example a scientist finds a different answer, another scientist may make another remark, in other words, all of them may change. There is nothing like there should be the same result. (Sude)	Hocam mesela bir bilim adamı başka yanıt buluyorsa oradan başka bir bilim adamı yorum yapabilir yani hepsi değişebilir. İlla aynı sonuç olacak diye bir şey yok. (Sude)
Because everything would change if there was more than one answer. For example, it is like this in our science lessons; it is like this in all lessons. In mathematics, etc. For example, in mathematics, 7 times 3 is 21. If the answer is 21, the answer cannot be 22 or 23. It must be 21. This means it has only one answer. (Onur)	Çünkü hocam daha birden fazla yanıtı olursa her şey karışır hocam. Mesela hocam biz fende de öyle her derste öyle. Matematikte falan, matematikte hocam mesela 7 kere 3, 21 deriz orada. Orada 21 se hocam, başka yanıtta mesela nasıl desem 22 çıkamaz sonuç. 23 çıkamaz. Mecburen 21 olacak. Yani tek bir cevabı vardır. (Onur)
The things we did in the experiment… We put the ball and it just stayed up; this means that it has a single answer. It did not go to the bottom because it had a mild cavity, that's why. (Merve)	Hocam mesela bizim deneyde yaptığımız şey, biz topu koyduk sadece yukarı da kaldı yani tek bir yanıtı vardır. Dibe inmedi çünkü hafif boşluğu var o yüzden. (Merve)
They do many different experiments. For example, they do experiments much different from that experiment, but they find the same result again. (Onur)	Hocam başka başka deneyler yaparlar. Mesela hocam o deneyin çok değişiğini yaparlar ama yine aynı sonucu bulurlar. (Onur)
One man says, 'this is right', and the other man says, 'you're wrong'. He says that his may be more correct. (Erkan)	Bir adam bu doğru der, diğer adam yanılıyorsun der. Diyelim ki bu daha doğru olabilir der. (Erkan)

You do an experiment and they tell that the single answer for the experiment is this but someone else does the experiment with other devices and tells that the answer for it is his/her answer. In other words, there isn’t a single answer; there are different ones. (Erkan)	Bir tane şeyi yaparsınız deneyi onun tek yanıtı bu derler ama başka adam başka aletlerle farklı bir şey yapar o da der budur bunun yanıtı. Yani tek bir yanıt yoktur, farklıdır. (Erkan)
There are so many lessons in all science such as physics and biology that scientists can’t know all of them. I think that there are some things that they don’t know. (Merve)	Hocam yani tüm fendeki o kadar fizik biyoloji o kadar ders var yani bilim insanları hepsini bilemezler. Bilmedikleri birkaç şeyde vardır diye düşünüyorum. (Merve)
For example, because they are scientists, they do more research as days go by and I think they give different answers as they learn. (Merve)	Mesela gün geçtikçe onlar bilim adamı olduğu için daha da fazla araştırma yapıp bilim adamı oldukları için mesela işte öyle öğrendiklerinde daha da farklı cevap verirler bence. (Merve)
Scientists do not always agree on what is correct because sometimes the scientists say that bread is harmful and sometimes they say that it is not. It changes continually. (Yusuf)	Hocam bilim insanları doğru hakkında aynı fikirde değillerdir. Çünkü hocam bazen bilim insanları ekmek zararlı diyor, bazen zararlı değil diyor. Habire değişiyor. (Yusuf)
There is a single correct answer for all the questions in science. Because they found it at one time. Just like the discovery of gravity.” (Erdal)	Bilimde bütün soruların tek bir doğru yanıtı vardır hocam. Çünkü hocam zamanında bulmuşlar. Hocam yani yerçekiminin bulunması gibi. (Erdal)
There is a single correct answer. For example, 2 times 2 is four, this means 2 times 2 is again four or 2 times 4 is eight, 4 times 2 is again eight. It’s like this. The result is the same answer, a single answer but it may be reached through different means. (Aleyna)	Hocam tek bir doğru yanıt vardır. Mesela hocam 2 kere 2 dört, yani yine 2 kere 2 dört veya 2 kere 4 sekiz 4 kere 2 yine sekiz. Onun gibi. Aynı cevaba, tek bir cevaba çıkıyor ama farklı yoldan yapılabilir. (Aleyna)
Some scientists always agree with each other. For example, together they do research on a subject, they both achieve success on that subject; this means they agree. (Kurtuluş)	Bazı bilim insanları hep aynı fikirde oluyor mesela bir konuyu ikisi beraber çok iyi araştırıyor o konuda ikisi de iyi bir iş başarmış oluyor ayni fikirde olmuş oluyorlar. (Kurtuluş)
There isn’t a rule for scientists to know everything. I think normal people may also know the answers to some questions and things like that. (Betül)	Hocam bilim insanları her şeyi bilecek diye bir kaide yok. Bence normal insanlarda bilebilir bazı soruları falan onlar da bilebilirler. (Betül)

Scientists might not know everything about science. That's because the technology was not so good in the past; it developed gradually, it even got quite faster, etc. We even progressed to 4.5 G today. (Aleyna)	Bilim hakkında bilim insanları her şeyi bilmeyebilir hocam. Hocam çünkü çok eskiden yani o kadar iyi değil teknoloji, sonradan git gide teknoloji gelişti hatta bayağı da hızlandı falan. Hatta bugünde 4.5 G ye geçtik. (Aleyna)
I don't think that everything about science is known; perhaps we might discover many different animals. (Kurtuluş)	Bence bilim hakkında her şey bilinmemiştir, belki daha çok değişik hayvanlar bulabiliriz. (Kurtuluş)
Scientists cannot know everything. There are things left that they do not know. There may be things that they couldn't find and left to coming generations. There may be things they left to coming generations. (Erdal)	Hocam bilim insanları her şeyi bilmezler. Bilmedikleri şeyler kalmıştır. Hocam onlarında bulamayıp başka nesillere bıraktıkları şeyler olabilir hocam. Yeni nesillere bıraktıkları şeyler olabilir. (Erdal)

2. Quotations Taken from Development of Knowledge Category

For example, because the technology has developed, old knowledge may change now when it is reviewed again. (Bahadır)	Hocam mesela işte teknoloji ilerlediği için, eski bilgilerde şu an tekrar baktığımızda bilgiler değişebilir. (Bahadır)
Some scientific thoughts in our day may sometimes be different from the thoughts that scientists previously had. This may be due to technology. (Sude)	Günümüzdeki bazı bilimsel düşünceler, bilim insanların daha önce düşündüklerinden farklı olabiliyor hocam. Teknolojiden dolayı olabilir hocam. (Sude)
Scientific knowledge has to change because sometimes some information may not be correct. They review the information they previously had and if this information is wrong, they regain information with technology. That's it. (Bahadır)	Bilimsel bilgilerin değişmesi gerekir. Hocam çünkü bazen bazı bilgiler doğru olmayabilir önceden düşündükleri bilgiler o yüzden tekrarlayarak eğer zaten yanlışsa kendileri elde eder hocam teknolojiyle. Öyle hocam. (Bahadır)
Yes, some scientific thoughts in our day may be different from those that the scientists previously had. These differences are caused by the progress in science. (Bahadır)	Evet hocam günümüzdeki bazı bilimsel düşünceler, bilim insanların daha önce düşündüklerinden farklı olabiliyor hocam. Bu farklılaşma bilimin ilerlemesinden kaynaklanmaktadır. (Bahadır)

Scientific knowledge changes but it changes in this sense: For example, in the past, they used wired things as brooms, but this has changed; there are electronic vacuum cleaners now. This was thought and discovered by scientists. This changes our life. This changes our time, too. We can waste our time in sweeping, but this is faster with electronic vacuum cleaner. (Meltem)

Bilimsel bilgiler değişir ama şu anlamda, eskiden süpürgeler olarak nasıl diyeyim telli şeyleri kullanıyorlarmış artık değişmiş şimdi elektronik alet olarak süpürgeler var. Bunu da bilim insanları akıl edip bulmuşlar. Bu da hayatımızı değiştiriyor. Bir de vaktimiz de değiştirir o. Süpürerek vaktimizi boşa harcayabiliriz ama elektronik süpürgeler ile daha hızlı. (Meltem)

For example, there may be some things that are unknown about the universe or about the black holes because these cannot be answered by scientists, either. This is because they cannot observe them closely. However, knowledge may change with scientific progress. (Bahadır)

Mesela hocam, uzayla ilgili evrenle ilgili ya da kara delikler mesela onlarla ilgili bilinmeyen şeyler olabilir. Bilim insanları da yanıtlayamaz çünkü. Onları yakından inceleyemedikleri için. Ama bilimsel ilerlemeler ile bilgiler değişebilir. (Bahadır)

Now people get more education and know more and only a few people knew things in the past but now many things are known by everyone. (Buse)

Hocam insanlar daha çok eğitim görüyorlar daha çok biliyorlar ve hocam eskiden bir şeyi az kişi biliyordu, şimdi birçok şeyi herkes biliyor. (Buse)

Yes, they change. They used to believe that the World was not round but now we know that the World is round. This means that they change. (Buse)

Hocam evet değişir. Hocam mesela dünyanın yuvarlak olmadığına inanıyorlardı ama şu an dünyanın yuvarlak olduğunu biliyoruz. Değişir yani. (Buse)

For example, the scientific knowledge of 100 years ago and that of today are different. I mean, in my opinion, scientific knowledge may change because we make an experiment, the result is different in one experiment and same in three experiments. Then, the result of those three experiments is more correct. (Buse)

Mesela 100 yıl önceki bilimsel bilgiler ile şimdiler farklı. Yani bilimsel bilgiler değişebilir bence. Çünkü hocam deney yapıyoruz bir deneyde farklı çıkıyor üç deneyde aynı çıkıyor. O zaman 3 deneyin ki daha doğrudur. (Buse)

Scientists understand better with technological developments, but scientific knowledge does not change. They can understand better, I mean this is more reasonable. (Gamze)

Teknolojik ilerlemeler ile bilim insanları daha iyi anlarlar ama bence bilimsel bilgiler değişmez yani. Daha iyi anlayabilirler yani daha mantıklı. (Gamze)

I think there are too many questions that cannot be answered even by scientists because they too encounter a question they do not know the answer of. They do research to find the answer and they reach a conclusion by doing all that they can. Scientific knowledge changes. (Gamze)

Hocam bilim insanlarının da yanıtlayamayacağı sorular fazlasıyla vardır bence. Çünkü onlarda bilmedikleri bir soruyla karşılaşıyorlar. Onu bulmak için araştırma yaparak ellerinden gelen her şeyi yaparak sonuca ulaşıyorlar. Bilimsel bilgiler değişiyor. (Gamze)

Because of scientific knowledge. This is almost the same with the previous question. Scientific knowledge is still scientific knowledge. It was the same 50 years ago and will be the same 50 years later. If there is a proof of scientific thought, no one can change it. (Meltem)

Çünkü bilimsel düşünce. Daha demin ki soru ile hemen hemen aynı bence. Bilimsel düşünce hala bilimsel düşüncedir. 50 yıl önce de aynı olur, 50 yıl sonrada aynı olur. Bilimsel düşüncenin bir kanıtı varsa eğer, hiç kimse değiştiremez. (Meltem)

Because the World is changing. Technology has developed, and different things started to emerge. We can say that there are flying cars in the World, which is something different from the past. (Erkan)

Çünkü hocam dünya değişir. Teknoloji ilerledi daha farklı şeyler çıkmaya başladı. Diyelim ki şu an uçan arabalar var dünyada farklı olan. (Erkan)

For example, there weren't such fast cars 50 years ago, but they are being produced now. As you mentioned, there are ultrasound devices, sonars and everything. (Onur)

Hocam mesela 50 yıl önce öyle hızlı arabalar falan yoktu hocam ama şimdi yapılmaya başlandı. Sizin dediğiniz gibi ultrason cihazları işte sonarlar hepsi var hocam. (Onur)

Scientific knowledge does not change. For example, when we do an experiment, it is always the same. For example, that ball does not get bigger as years go by; it stays the same. It always stays the same when we do the same experiment. (Merve)

Bilimsel bilgi değişmez. Hocam mesela biz bir deneyi yaptığımızda o aynı kalıyor. Mesela seneler geçtikçe o top büyümez, aynı kalır. Aynı deneyi yaptığımızda aynı kalır. (Merve)

Scientific knowledge does not change. Just like the question you have previously asked; if it is like that, everything has a single answer. However, if there is a single answer, scientific knowledge does not change. (Onur)

Bilimsel bilgiler değişmez hocam. Hocam şimdi daha önceki sorduğunuz soru gibi aynı, hocam onun gibiyse her şeyin tek bir yanıtı vardır. Ama tek bir yanıtı varsa bilimsel bilgiler değişmez. (Onur)

Some of the scientific thoughts nowadays are different from those thoughts the scientists had in the past because technology has progressed. (Batuhan)	Günümüzdeki bazı bilimsel düşünceler, bilim insanlarının daha önce düşündüklerinden farklıdır. Çünkü teknoloji ilerledi. (Batuhan)
If something is done and it has an answer, the answer persists. When we do the same thing again, we get the same result. (Yusuf)	Hocam bir şey yapıldıysa onun cevabı varsa o cevapta kalır hocam. Aynı şeyi bir daha yaptığımızda aynı şey çıkar. (Yusuf)
For example, even the telephones were not present in the past, now they have developed so much. Not only the telephone but everything has developed. I just gave it as an example. I mean the technology has progressed very much. (Aleyna)	Mesela hocam, eskiden yani telefon bile yoktu şimdi o kadar telefonlar falan gelişti ki. Sadece telefon değil hocam her şey gelişti. Ben sadece onu örnek verdim. Yani teknoloji çok ilerledi. (Aleyna)
Scientific knowledge does not change. Let me give an example from Edison again. Edison found the lamp but found it with a few filaments. There are still lamps in our day and they are different lamps, but they use the same filaments. (Aleyna)	Bilimsel bilgiler değişmez, değişmez. Hocam mesela yine Edison'dan örnek vereyim Edison lambayı buldu ama birkaç telle buldu günümüzde de hala lambalar var ama farklı lambalar yine aynı telle devam ediyor. (Aleyna)
It doesn't change. The World is round, they can't say that the World is a square because everyone knows that the World is round, they've been aware of this since a long time ago because astronauts have been sent to the space. (Erdal)	Değişmez hocam. Hocam çünkü dünya yuvarlak dünya kare diyemezler. Çünkü hocam dünyanın yuvarlak olduğunu herkes biliyor hocam, yani çok önceden hatta hocam uzaylara astronotlarda gönderildiği için bunun farkındalar. (Erdal)
I don't think the thoughts of scientists change. If he/she did a very good research and if he/she understood the subject very clearly, I don't think it will ever change. (Kurtuluş)	Bilim insanlarının düşünceleri bence değişemez yani. Eğer onu çok iyi araştırdıysa o konuyu net anladıysa bence asla değişemez. (Kurtuluş)
Some scientific thoughts in our day are different from those considered by the scientists in the past because they didn't live such a long time ago. (Erdal)	Günümüzdeki bazı bilimsel düşünceler, bilim insanlarının daha önce düşündüklerinden farklıdır hocam. Çünkü hocam o kadar yıl önce yaşamıyorlardı. (Erdal)

The opinions of the scientists and scientific knowledge change with technological developments. (Erdal)	Bilim insanlarının düşünceleri ve bilimsel bilgiler hocam teknolojik gelişmelerle değişir. (Erdal)
The opinions of the scientists are changing because they think of newer things about the future. Like producing a lot of cars. They think about such things. (Yağız)	Bilim insanlarının düşünceleri değişmektedir hocam. Çünkü gelecek ile ilgili daha çok yeni şey düşünüyorlar hocam. Bir sürü araba yapmayı falan hocam. Onları düşünüyorlar hocam. (Yağız)
Scientific knowledge has to change because human brain is developing by time, it is trying to take some steps. For example, we can see it in the videos sometimes. The scientists have given up on telephones. iPhone only work with telephones. Other brands try to make robots or other things; they try to make them a part of our lives. (Erdal)	Bilimsel bilgilerin değişmesi gerekir hocam. Çünkü gün geçtikçe insanoğlu beyni daha da çok ilerliyor hocam, bazı şeylere adım atmaya çalışıyor hocam. Hocam misal yani şu an bazen videolarda da görüyoruz artık bilim adamları telefondan falan vazgeçti hocam Iphoneler sadece telefonla çalışıyor hocam. Diğer markalarda ya robot yapmaya çalışıyor ya şunu yapmaya çalışıyor hocam yavaş yavaş hayatımıza geçirmeye çalışıyorlar hocam. (Erdal)

3. Quotations Taken from Source of Knowledge Category

I believe in scientific books. Because they always have proofs. For example, once I read a book. It was called 'Crazy Discoverers' or 'Crazy Scientists". It had humor in general and it explained things with proofs. It told us about the scientist, about the proof in the experiment; if it didn't prove, no one would believe it because for example, no one believed that the world was round in the beginning but then they found the proofs. (Bahadır)	Bilimsel kitaplara inanırım. Hocam çünkü sürekli kanıtlı, mesela ben bir kitap okumuştum. 'Çılgın Kaşifler' ya da 'Çılgın Bilimciler' diye hocam, çoğu kez okudum esprili ve sürekli kanıtla anlatıyor hocam. O bilim insanını anlatıyor, deneydeki kanıtı anlatıyor kanıtlamasa kimse bir şeye inanmaz hocam. Çünkü dünyanın mesela yuvarlak olduğuna ile ilgili ilk önce kimse inanmamış ama sonra kanıtları var hocam. (Bahadır)
Everything the teacher says is correct because he/she wouldn't give us incorrect information. (Gamze)	Öğretmenin söylediği her şey doğrudur. Çünkü o bize yanlış bilgi vermeyecektir. (Gamze)
Everything the teacher says is correct. I cannot make an objection to my teacher. If he/she says it, it is correct. (Bahadır)	Öğretmenin söylediği her şey doğrudur hocam. Öğretmenime karşı çıkamam. Eğer söylüyorsa doğrudur. (Bahadır)

It’s not only the scientists that I believe. For example, let me give an example from the wars. Our grandfathers, our veterans have fought in those wars, but they weren’t necessarily scientists. However, they may know what is in a war, what its content is. Because the scientists have not lived there or have not seen them, they may sometimes give misinformation. (Meltem)

Sadece bilim insanlarına inanmam. Mesela savaşlardan örnek vereyim. Dedelerimiz gazilerimizde o savaşlara katılmıştır ama illa bir bilim adamı değillerdir ama savaşın içinde ne olduğunu içeriğini bilebilirler. Bilim insanları orada yaşamadıklarından dolayı görmediklerinden dolayı, bazen yalan yanlış haberlerde verebilir. (Meltem)

Scientists know everything exactly and I believe them because they work on things related to that subject, they do experiments. They don’t give an answer by saying, “in my opinion”, they give precise and clear answers because they have done research and found the hundred percent correct answer. (Gamze)

Bilim insanları her şeyi kesin olarak bilirler, bende inanırım. Çünkü o konuyla alakalı işlerle uğraşıyorlar, deneyler yapıyorlar. Bence diye bir cevap vermiyorlar, kesin net olarak cevap veriyorlar. Çünkü onu artık araştırmışlar yapmışlar, yüzde yüz onun cevabı o olduğundan dolayı. (Gamze)

Everyone does not have to believe what the scientists say. They can do things as they wish by themselves. They do experiments, they do research and I think they can reach the same results. (Gamze)

Tüm insanlar bilim insanlarının söylediklerine inanmak zorunda değillerdir. Onlarda kendi isteklerine göre bir şey yapabilirler. Deney yaparlar. Araştırırlar, bence aynı sonuca varabilirler. (Gamze)

It’s not only the scientists who know what is correct in science because we are also making experiments here now, we can know the results. I don’t think that scientists should know all the time. (Sude)

Bilimde neyin doğru olduğunu sadece bilim insanları bilmez hocam. Hocam çünkü biz de şimdi burada deneyler yapabiliyoruz biz de sonucunu bilebiliyoruz. İlla bilim adamlarının bilmesine gerek yok bence. (Sude)

Others may also know that something is right because by making simple experiments on that subject, others may also understand what is right in a subject. In other words, it is not only the scientists who know what is correct in science. (Bahadır)

Hocam başkaları da o şeyin doğru olduğunu bilebilir. Çünkü hocam bir konuda o konuyla ilgili kolay deneyler yaparak o konunun doğru olduğunu başkaları da anlayabilir hocam. Yani, bilimde neyin doğru olduğunu sadece bilim insanları bilmez hocam. (Bahadır)

It is not an obligation for everyone to believe what the scientists say because everyone has an idea or opinion of himself/herself. (Buse)

Tüm insanlar bilim insanlarının söylediklerine inanmak zorunda değillerdir. Çünkü hocam herkesin kendine göre bir fikri ve düşüncesi vardır. (Buse)

We can believe the scientific books, but we don't have to believe them. I mean we don't have to feel obliged. You and I might have different opinions, we might think of different things. (Meltem)

In the science classes, everything the teacher says is correct because they are science teachers; they have studied all the subjects at university and graduated. They know everything about science. (Merve)

I believe what is written in science books. The book is written correctly. (Yusuf)

All people should believe what the scientists say because they are scientists. (Merve)

I sometimes believe what is written in scientific books. Let's say that there is a snake with a length of 40 meters in scientific books; I never believe this because a 40 meters-snake has never been seen. (Erkan)

Not all people have to believe what the scientists say. They can produce logic and strategies themselves. They don't have to conform to what the scientists say. (Onur)

Because Newton was also a child. He was not a scientist at that time, but he tried to make inventions by himself. For example, the man on whose head an apple fell found gravity. (Erkan)

If that scientist is very famous and very successful in his/her work, we believe him/her. If he/she is very good in his/her work, he/she becomes famous. (Aleyna)

Bilimsel kitaplara inanabiliriz ama inanmak zorunda değiliz. Yani kendimizi zorunlu tutmamalıyız. Senin, benim farklı bir görüşümüzde olabilir, farkli şeyler düşünebiliriz. (Meltem)

Fen bilimleri dersinde, öğretmenin söylediği her şey doğrudur. Çünkü hocam onlar bir fen öğretmeni onlar üniversiteyi sonuna kadar okuyup bitirdiler konuları işte onlar fenle ilgili tüm şeyleri biliyorlardır. (Merve)

Bilimsel kitaplarda yazanlara inanırım. Hocam kitap doğru yazılmıştır. (Yusuf)

Tüm insanlar bilim insanlarının söylediklerine inanmak zorundadır. Çünkü onlar bilim adamı. (Merve)

Bilimsel kitaplarda yazanlara bazen inanırım. Diyelim ki bilimsel kitaplarda bir tane yılan varmış ona hiç inanmadım hocam. 40 metre mi neymiş. Hocam çünkü 40 metre yılan hayatta hiç görülmedi. (Erkan)

Tüm insanlar bilim insanlarının söylediklerine inanmak zorunda değildir. Hocam kendileri de mantık üretebilirler, ondan sonra böyle strateji üretebilirler kendileri de. İlla bilim adamlarının dediklerine uymak zorunda değiller. (Onur)

Çünkü hocam Newton da çocuktu. O da o zamanlar bilim insanı değildi ama o da öyle kendi kendine buluşlar yapmaya çalıştı. Diyelim ki kafasına elma düşen adam yerçekimini buldu. (Erkan)

O bilim insanı gerçekten çok ünlüyse, işinde çok başarılıysa ona inanırız. İşinde iyiyse yani, çok iyiyse zaten ünlü oluyor. (Aleyna)

Everything the teacher says is correct because the teachers know everything. They know better than us. They teach us because they know. (Yağız)	Öğretmenin söylediği her şey doğrudur. Hocam çünkü hocalar her şeyi biliyor hocam. Bizden iyi biliyorlar. Çünkü onlarda bize öğretiyorlar bildikleri için. (Yağız)
I usually believe most of the things written in the scientific books. The people who wrote them have really done research on that subject. They have questioned if it really works and then turned it into a book. (Kurtuluş)	Bilimsel kitaplarda yazanlara çoğuna genellikle inanırım. O olayı gerçekten araştırmıştır yazan kişi. Bakmıştır gerçekten o işe yarıyor mu diye. Sonra onu bir kitap haline dönüştürmüştür. (Kurtuluş)
I believe what is written in scientific books because they were written by scientists. (Erdal)	Bilimsel kitaplarda yazanlara inanırım. Hocam çünkü bilim adamları yazmıştır. (Erdal)
No, some people carry out a very good research, too. It doesn't have to be a professor; an ordinary person, for example a teacher goes and does research on that subject. He/she finds information on that subject. He/she presents it to people. (Kurtuluş)	Yok hocam, genellikle bazı insanlarda çok iyi araştırıyor. İlla profesör değil sıradan bir adam gidiyor mesela eğer bir öğretmense gidiyor araştırıyor o konuyu. O konuyla ilgili bilgiler buluyor. Onu insanlara sunuyor. (Kurtuluş)
I don't think that all people can believe what the scientists say. For example, there is no such thing as the scientists will not do any mistakes. When scientists think about something, for example, Kurtuluş may think differently. We can reach different information by doing experiments. (Betül)	Tüm insanlar bilim insanlarının söylediklerine inanamazlar ben öyle düşünüyorum. Hocam mesela bilim insanlarının hata yapmayacak diye bir şey yok. Bilim insanları öyle düşündüğümde mesela Kurtuluş başka düşünebilir. Deneyler yaparak biz başka bir bilgiye ulaşabiliriz. (Betül)

4. Quotations Taken from Justification for Knowing Category

Scientists maintain the correctness of their ideas with multiple experiments. Then, they look at the result and test it again and again from time to time. (Bahadır)	Hocam bilim adamları bir fikirlerinin doğruluğunu birden fazla deneyle yapabilirler hocam. Sonra sonuca bakarlar tekrar test ederler ara ara falan hocam böyle. (Bahadır)
Good deductions in science depend on proofs obtained from many different experiments because there is nothing like getting the result in the first trial. (Sude)	Bilimdeki iyi çıkarımlar birçok farklı deneyin sonucundan elde edilen kanıtlara. Çünkü deneye deneye ilk seferde olacak diye bir şey yok hocam bence. (Sude)

It is more reasonable to do a lot of experiments and to find multiple answers because in this way they can make comparisons; if they do one experiment, what they get is not always its result because they might get a different result with a different experiment. (Gamze)	Çok fazla deney yaparak, birden çok fazla sonucun bulunması daha mantıklı. Çünkü onla onu karşılaştırırlar bir tane yapsalar o hemen onun sonucu olmaz çünkü farklı bir deneyde farklı bir sonuç alabilirler. (Gamze)
Good deductions in science depend on many different experiments. An experiment does necessarily give us a correct result; experiments may yield different results. Only if all of many experiments yield the same result. (Buse)	Bilimdeki iyi çıkarımlar birçok farklı deneye dayanır hocam. Bir deney illa bize doğru sonucu verecek diye bir şey yok hocam deneylerde farklı sonuç verebilir. Birçok deney ortak oluyorsa yani hepsinde aynı sonuç çıkıyorsa bence birçok deney yani. (Buse)
What we do in an experiment may differ depending on the material but if we try with other materials etc., we may find a common result. (Bahadır)	Hocam bir deneyde belki o deneyde yaptığımız şey maddeye göre farklılık gösterebilir ama başka maddelerle falan denersek ortak sonucu bulabiliriz. (Bahadır)
If you give some information but if you can't prove it and you don't do an experiment about it, that information is baseless, and no one believes it, but if you prove it and your claim comes out to be true, that information is correct. (Bahadır)	Eğer hocam bir bilgiyi öyle söyleseniz kanıtlayamazsanız onunla ilgili deney yapmazsanız o bilgi havada kalır kimse de inanmaz ama onu kanıtlarsanız iddianız doğru falan çıkarsa bilgi de doğru olur. (Bahadır)
For example, we question with experiments and actually these experiments show us the right way better. Then, it becomes really proven. Thus, we can learn more from the experiments. Thus, we can get more information from the experiments. In other words, doing experiments is an important part of scientific studies. (Buse)	Mesela hocam deneyle aslında biz sorguluyoruz ve bu deneyler aslında doğru yolu daha çok gösteriyor. Gerçekten kanıtlamış oluyoruz. Onun için deneylerden daha bilgi öğrenebiliriz. Yani deney yapma bilimsel çalışmaların önemli bir parçasıdır. (Buse)
Scientists carry out experiments to test thoughts or information. They do different experiments. Then, they may do research from different books. I mean by asking each other. This may be the process. (Gamze)	Bilim insanları düşünceleri veya bilgilerin test edilebilmek için, deneyler yaparlar. Farklı farklı deneyler yaparlar. Ondan sonra araştırabilirler, farklı farklı kitaplardan. Birbirlerine sorarak yani. Öyle olabilir. (Gamze)

Some of them can test the scientific knowledge by experiments. Some do it with experiments and some with observation etc. I think that way. (Sude)

Hocam bazıları deneyle bilimsel bilgileri test edebiliyor. Bazıları işte işlemlerle, bazıları da gözlemleyerek falan öyle düşünüyorum. (Sude)

One experiment and another are justifications of each other. First, we do that. We carry out a couple of more experiments to check if we did something wrong. Thus, we make its justification and then we understand. We find the right way. (Onur)

Bir deneyle öbür deney birbirini sağlamasıdır zaten hocam. Hocam önce onu yaparız. Yanlış yapmış mıyız diye birkaç deney daha yaparız. Yani sağlamasını yapmış oluruz, sonra da anlarız hocam. Doğru yolu buluruz. (Onur)

There may be two or three experiments to check the accuracy of the answer. (Yusuf)

Hocam iki üç deney olabilir cevabın doğru olmasını kontrol etmemiz için. (Yusuf)

There may be more than one way to test knowledge because by making different experiments, maybe different results may be found or maybe the same result may be found. (Erkan)

Bilgilerin test edilebilmesi için birden fazla yol olabilir. Çünkü farklı farklı deneyler yaparak belki farklı sonuçta çıkabilir belki aynı sonuçta çıkabilir. (Erkan)

Because the scientists know everything in the World, they can also check if the scientific knowledge is correct or not. (Merve)

Hocam bilim insanları dünyadaki her şeyi bildikleri için bilimsel bilgilerinde doğru olup olmadığını kontrol edebilirler. (Merve)

For example, the information that cannot be tested by a scientist may be checked by a science teacher. (Batuhan)

Mesela bir bilim adamının test edemediği bilgileri bir fenci test edebilir. (Batuhan)

For example, when the scientists carry out experiments on television, people may look at these experiments and test the scientific knowledge from these. (Betül)

Hocam mesela bilim insanları televizyona çıkıp deney yaptıklarında, insanlar deneylere bakıp onlardan bilimsel bilgiyi test edebilirler. (Betül)

Opinions and knowledge may be tested by many ways in scientific studies. For example, we look it up in a book or in a computer or we may go to a forest if we are searching for something about the animals. I think we can test information from there, too. (Kurtuluş)

Bilimsel çalışmalarda düşünceler veya bilgiler çok değişik yollarla test edilebilir. Mesela bir kitaptan bakarız, bilgisayardan bakarız ya da gideriz dışarıda bir ormana gideriz hayvanla ilgili bir şey arıyorsak. Oradan da bilgileri test edebiliriz bence. (Kurtuluş)

An ordinary person cannot justify scientific knowledge, but an educated man can. (Erdal)	Hocam herhangi biri bilimsel bilgileri doğrulayamaz ama hocam okumuş adam doğrulayabilir. (Erdal)
I think they do many different experiments for good deductions in science. For example, they might take a plant. They pour something on the plant, they watch if the plant will dye; they pour something else on another plant; they watch what will happen to that plant. (Kurtuluş)	Bilimdeki iyi çıkarımlar için bence birçok farklı deney yapıyorlardır. Mesela bir bitki almışlardır. Bitkiye bir şey dökerler, bakarlar ki bu bitki ölecek mi giderler başka bir bitkiye başka bir şey dökerler o bitkiye ne olup ne olmayacağına bakarlar. (Kurtuluş)
There would be no science without experiments because experiments show if the knowledge is correct or not. (Yağız)	Hocam deney olmadan bilim olmaz. Çünkü deney bilginin doğru olup olmadığını gösterir hocam. (Yağız)

5. Quotations Taken from Declarative Knowledge Category

I listen to the topics that I am interested better, I participate in the lessons more when those topics are being covered and I learn better. In other words, I do not guess the meaning, I can express it clearly because I learn it better. (Gamze)	İlgi duyduğum konuları daha iyi dinlerim, o konulara daha çok katılırım ve daha iyi öğrenirim. Yani cevabı tahmin etmem daha iyi öğrendiğim için net bir şekilde söyleyebilirim. (Gamze)
For example, sound. I am more interested in this topic when it's compared to chemistry or physics. I think I learn better. There may be some complications for example milk's turning into yogurt, getting a haircut, things like that. I know actually but when you want to answer instantly, you may be confused while thinking about the answer. But Light and Sound topic is interesting for me and I have learned it better. (Meltem)	Mesela ses. Bu konuya kimyasal fizikselden daha çok ilgi duyuyorum. Bence daha iyi öğrendiğimi düşünüyorum. Biraz karışıklık oluyor mesela sütün yoğurda dönüşmesi, saçın kesilmesi falan derken. Biliyorum aslında ama bir anda cevaplayınca aklın karışabiliyor acaba ne olabilir diye. Ama Işık ve Ses konusuna ilgim olduğundan dolayı daha iyi öğrendim. (Meltem)
As an example, I can say Light and Sound topics since I am interested in these topics, I know the significant information on these topics. (Buse)	Hocam mesela ışık konusu ya da ses konusu, ilgi duyduğum için daha iyi öğrendim. O konulardaki önemli bilgileri biliyorum. (Buse)

For instance, I love Light topic teacher. During Light topic, we studied reflection of the light and drawing lines and these were really easy. I love easy topics more thus I learn them better. (Bahadır)	Mesela Işık konusunu seviyorum hocam. Işık konusunda mesela biz ışığın yansıması normal çizme falan görmüştük bunlar çok kolaydı. Kolay konuları daha çok seviyorum ve sevdiğim içinde iyi öğreniyorum. (Bahadır)
I think I learn the topics that I have a previous knowledge better teacher. For instance, in the 5th-grade, we studied Light and Sound topic, now I know them and it is not necessary for me to study them again. I learn better when I recall that information that I learned. Moreover, I can study other lessons. (Buse)	Hocam önceden bildiğim konuları daha iyi öğrenirim. Mesela 5. sınıfta ışık ve ses konusunu işlemiştik, şimdi en azından onları bildiğim için bir daha çalışmaya gerek duymuyorum o eski öğrendiğim bilgileri hatırlayarak daha iyi öğreniyorum. Başka derslere de çalışabiliyorum. (Buse)
I have just talked about it. I have talked about Sound topic. We had some information about it, we studied it in 5th-grade. Actually, in 4th-grade, we talked about it a little but we didn’t study in details. We studied it in 5th-grade. That’s why I knew that the sound expands in waves in a linear way. And you asked us that what had we known about this topic. In other words, I learned the topic better by recalling my previous information. (Meltem)	Daha demin dedim, ses konusunu dedim, onda önceden birazcık bilgimiz vardı. 5. sınıfta işledik. Hatta 4. sınıfta da biraz girdik konuya ama pek işlemedik. 5. sınıfta işledik genelde. O yüzden sesin dalga dalga doğrusal yayıldığını biliyordum. Hatta siz sordunuz neler biliyorsunuz bu konu hakkında diye. Yani öncesinde bildiklerimi hatırlayarak konuyu daha iyi öğrendim. (Meltem)
For instance, I raise my hand in the lesson, you ask questions to us and we answer these questions. On the other hand, some other teachers do not let me participate in the lessons enough but you do, that’s why I learn better during your lessons because I participate in Science lessons actively. (Buse)	Mesela derste parmak kaldırıyorum siz bize sorular soruyorsunuz biz cevaplıyoruz bu soruları. Mesela bazı hocalar derste kaldırmıyor ama siz kaldırdığınız için fen derslerine aktif olarak katıldığımdan daha iyi öğreniyorum. (Buse)
I am always active during the lessons. I always raise my hand to participate in every topic or I do it without raising my hand. Because of it, I speak constantly and I believe I am active during the lessons, take responsibilities and learn better. (Meltem)	Hocam zaten ben sürekli aktifim. Her konuya böyle parmak kaldırıyorum ya da parmak kaldırmadan katılıyorum. O yüzden sürekli konuşuyorum o yüzden aktif olduğumu derslerde görev aldığımı ve böylece daha iyi öğrendiğimi düşünüyorum. (Meltem)

For example, density. I really loved it. It was a topic that I loved and I learned it better. I learned it better because I loved to listen to it. (Gamze)	Yoğunluk mesela. Onu çok seviyordum. Sevdiğim konuydu, daha iyi öğrendim. Daha severek dinlediğim için daha iyi öğrendim. (Gamze)
When I was a little boy, and my brother was at the age of me, I was curious about his Science lesson. I remember the Light topic from that time. I was curious about that topic then. Thus, I have learned the Light topic better teacher. (Bahadır)	Ben küçükken abim benim kadarken, onun fen dersini ben hep merak ediyordum hocam. Işık konusu oradan aklımda kalmıştı. O konuyu da merak etmiştim. O nedenle ışık konusunu daha iyi öğrendim hocam. (Bahadır)
Sexual reproduction and asexual reproduction subjects were my best courses because I was interested in them. I think we made a poster about it. It is still at home. (Erkan)	Eşeyli üreme, eşeysiz üreme konusu ilgi duyduğum için en iyi olduğum konuydu. Hocam hatta onla ilgili hem poster yapmıştık herhalde. Evde hala duruyordu. (Erkan)
I can say I have an interest in the subject of density. I was also interested in physical and chemical changes, and I can understand those topics better. (Merve)	Yoğunluk konusuna ilgim var diyebilirim mesela. Fiziksel ve kimyasal değişiklikler konusuna da ilgi duymuştum o konuları daha iyi anlayabiliyorum. (Merve)
I love to learn by reading rather than by writing. (Batuhan)	Ben yazarak öğrenmeyi değil okuyarak öğrenmeyi daha çok seviyorum. (Batuhan)
For example, I like the topic of flowers in the science course. I like to learn things like the inner parts of the flowers. I learn better about the things I love. I learned the subject of flowers. In science lessons, we learn them. (Onur)	Hocam mesela ben fen dersinde çiçekler konusunu severim. Çiçeklerin içini falan öğrenmeyi severim. Sevdiğim konuları daha iyi öğrenirim. Çiçekler konusunu öğrendim. Fen dersinde işte hocam onları öğreniyoruz. (Onur)
I am curious about rays and light and so I learn that subject better than the rest. (Batuhan)	Işınlar, ışık konularına meraklıyımdır o konuya yüzden daha iyi öğrenirim. (Batuhan)
When I get familiar with the subjects, I remember them better and I learn better. That’s why I learned better about the things that I used to study in the past. (Batuhan)	Çünkü konulara alıştığım zaman daha çok aklımda kalır ve daha iyi öğrenirim. Eskiden çalıştığım konuları daha iyi öğrenirim o yüzden. (Batuhan)

I did most of the experiments last year. For example, I was bringing ice from the house, I was bringing a lighter. I do better when I do the experiments actively, I learn better. (Erkan)	Hocam önceki yıl deneylerin çoğunu ben yapıyordum. Evden buz getiriyordum, çakmağı getiriyordum mesela. Hocam aktif bir şekilde deneyler yapınca daha iyi oluyor bana, daha iyi öğreniyorum. (Erkan)
I learned the subject of light and voice, I learned the chemical and physical changes. These subjects were topics of my interest. We did an experiment and learned how to swim a ping pong ball and a raisin with carbonated water and so forth. (Betül)	Hocam ışık ve sesi öğrendim, kimyasal ve fiziksel değişimi öğrendim. Bu konular ilgi duyduğum konulardı. Deney yapmıştık kuru üzümle sodayla falan pinpon topunu yüzdüğünü falan öğrendim. (Betül)
For instance, I was interested in force and movement. At first, I was interested in pictures and so on. Then I started to understand and learned better after doing experiments with our teacher. I also had an interest in electricity. (Erdal)	Hocam mesela kuvvet ve hareket konusuna ilgi duymuştum. Hocam ilk başta resimlerden falan ilgi duymuştum. Sonra hocam anlamaya başladım sonra da öğretmenimiz deney yapa yapa iyicene öğrendim. Hocam bir de elektrik konusuna ilgi duymuştum. (Erdal)
For example, I was interested in the subject of light. (Kurtuluş)	Mesela Işık konusu ilgi duyduğum konuydu. (Kurtuluş)
I knew the concepts of force and movement in the fourth grade. For instance, these topics were stuck in our minds after our teachers gave some examples when we were talking about force and motion. Our teacher said that you were applying a force when you push a desk, for example. For this reason, I learned better this year because I remembered. (Erdal)	Hocam 4. sınıfta kuvvet ve hareket konusunu biliyordum. Hocam mesela kuvvet ve hareket konusunda öğretmenimiz sıra falan derken onlarda aklımızda kalıyordu. Öğretmenimiz diyordu ki misal sırayı iterken kuvvet uyguluyorsunuz. Bu nedenle konuyu hatırladığımdan bu yıl daha iyi öğrendim. (Erdal)
For example, there was Newton and I learned about him in the past. Then I learned the similar concepts better in the class by remembering the information that I learned earlier. (Betül)	Hocam mesela Newton falan vardı onları önceden öğrenmiştim sonra önceki öğrendiğim bilgileri derste hatırladığımdan daha iyi öğrendim. (Betül)

6. Quotations Taken from Procedural Knowledge Category

One of the strategies that I have been using is doing tests. Before I take an exam, I do tests. I do it a lot. My mother also insists on this topic. (Bahadır)	Hocam kullandığım stratejilerden biri test çözmektir. Testler çözerim sınava girmeden önce. Aşırı fazla çözerim yani hocam. Annemde baskı yapıyor zaten hocam bu konuda. (Bahadır)
When I am trying to learn something, the strategy that I use is doing tests, teacher. (Buse)	Hocam mesela bir şey öğrenirken kullandığım strateji test çözmektir. (Buse)
For example, I use doing tests as a strategy of learning. (Gamze)	Öğrenme stratejisi olarak mesela test çözmeyi kullanırım. (Gamze)
I learn by doing tests, which means using doing tests strategy. (Sude)	Test çözerek, yani test çözme stratejisini kullanarak öğreniyorum. (Sude)
The other learning strategy that I have been using is studying by writing. (Buse)	Başka kullandığım öğrenme stratejisi, yazarak çalışıyorum. (Buse)
For instance, I always study for my exams by writing. It is easier to remember when you write. I think it is more efficient studying with this strategy. (Meltem)	Ben hep mesela sınavlara da hep yazarak çalışıyorum. Yazınca hep böyle aklımda kalıyor. Bunu stratejiyi kullanarak öğrenmek daha etkili oluyor. (Meltem)
For example, as a learning strategy, at first, I study by reading the course book for ten minutes. Then I read some other books. (Bahadır)	Hocam mesela öğrenme stratejisi olarak, ilk önce 10 dk. ders kitabından okuyarak çalışıyorum. Sonra başka kitapları falan okuyorum. (Bahadır)
One of the learning strategies that I use is reading the book. (Gamze)	Kullandığım öğrenme stratejilerinden biri kitabı okumaktır. (Gamze)
For instance, at first, I ask questions about the topic to others. I try to understand. I mean I try to understand the topic by asking questions. I use this strategy. (Bahadır)	Mesela ilk önce başkalarına sorarım konuyu. Anlamaya çalışırım. Yani soru sorarak konuyu öğrenmeye çalışırım. Bu stratejiyi denerim. (Bahadır)
I have just said. I put the notebook of the lesson in front of me. Then I close it and ask myself questions about the topic. I use this strategy in order to learn. (Meltem)	Dedim daha demin, dersin defterini karşıma alıyorum. Kapatıyorum mesela defterin kapağını kendime konuyla ilgili sorular soruyorum. Öğrenmek için bu stratejiyi kullanıyorum. (Meltem)

I ask questions by myself and prepare lots of answers. I try to learn by using this strategy. (Sude)	Kendi kafamdan sorular soruyorum bir sürü yanıt çıkartıyorum. Bu stratejiyi kullanarak öğrenmeye çalışıyorum. (Sude)
One of the strategies that I use when I learn something is doing researches on the internet. (Bahadır)	Bir şey öğrenirken kullandığım stratejilerden birisi internetten araştırma yapmaktır. (Bahadır)
I do researches from the books, I use this strategy most when I learn. (Gamze)	Araştırma yaparım kitaplardan, öğrenirken en çok bu stratejiyi kullanırım. (Gamze)
I can tell you that about learning strategy teacher. When I get home, I explain the topic on my own, I used to do it before and now I do the same. (Buse)	Mesela hocam öğrenme stratejisi olarak şunu söyleyebilirim. Eve gittiğimde kendime anlatırım dersi, eskiden de böyle yapıyordum şimdi de böyle yapıyorum. (Buse)
Teacher I explain the topic or the lesson myself. I think this is a strategy because it seems more logical and I understand easily. (Buse)	Hocam kendi kendime anlatırım konuyu veya dersi. Bu bence bir strateji çünkü daha mantıklı geliyor bana daha kolay anlıyorum. (Buse)
For example, during Math lessons, when I'm working on a question, I usually try to solve it by drawing pictures. I learn easily by using this strategy. (Gamze)	Matematik dersinde diyelim, bir problemi çözerken genelde resim çizerek çözmeye çalışırım. Bu stratejiyi kullanarak daha kolay öğrenirim. (Gamze)
For instance, when I explain a topic myself I draw a model of a cell. I explain it with the help pf that model. I try to use this strategy. (Buse)	Mesela konu anlatırken böyle kendim kendime işte hücre modeli çizerim. Bu model üzerinden anlatırım. Bu stratejiyi kullanmaya çalışırım. (Buse)
Generally, I write summaries. That is to say, I use summarizing as a strategy of learning. (Gamze)	Genelde özetler çıkarıyorum. Yani çoğunlukla özet çıkarmayı kullanırım öğrenme stratejisini olarak. (Gamze)
I watch videos related to Science topics on the internet. I can make a strategy by keeping those videos in my mind. (Sude)	Fen konularıyla alakalı internetten videolar izliyorum. Sonra o videoları aklımda tutarak bir strateji yapabiliyorum. (Sude)
Teacher, I try to memorize the topic. However, I try this learning strategy rarely. (Bahadır)	Hocam konuyu ezberlemeye çalışırım. Bu öğrenme stratejisini az kullanırım ama. (Bahadır)

I try to make connections between the topics. My mother and father taught me, teacher. They are also teachers, they told me to use this strategy because there is a connection between every topic. (Bahadır)	Konular arasında bağlantı kurmaya çalışırım. Annem ve babam öğretti hocam. Onlar da öğretmen, konuyu öğreneceğin zaman bu stratejiyi kullan çünkü her konunun birbirleri ile bağlantısı vardır dediler. (Bahadır)
For instance, teacher I try to do experiments on a topic at home. Learning by doing experiments is a good strategy. (Bahadır)	Mesela hocam bir konu hakkında evde deneyler yapmaya çalışırım. Deney yaparak öğrenme iyi bir stratejidir. (Bahadır)
When I come home, I rehearse the topics. I use this learning strategy constantly. (Sude)	Eve gelince konuları tekrar ederim. Bu öğrenme stratejisini sürekli kullanırım. (Sude)
I ask myself questions. Then I answer. This is the strategy that I use the most. (Merve)	Hocam kendime sorular falan soruyorum. Sonra cevaplıyorum. En çok bu stratejiyi kullanıyorum. (Merve)
Last year, we had a box of cards at home with questions written on the cards. My mother was picking cards from the box and she was asking me the question from those cards. I studied science in this way. (Erkan)	Hocam önceki yıl evde bir kutuya üzerine soru yazılmış kartlar koyuyorduk, annem onun içinden kartları seçiyordu o kartlardaki soruyu bana soruyordu. Fen dersine bu şekilde çalışıyordum. (Erkan)
This year, the strategy I use the most is to take tests. (Erkan)	Bu sene en çok kullandığım strateji test çözmek. (Erkan)
I write on a piece of paper, then I study what I wrote. I generally use this strategy. (Yusuf)	Hocam kâğıda yazıyorum sonra yazdıklarıma çalışıyorum. Genelde bu stratejiyi kullanırım. (Yusuf)
I try the strategy of rehearsal what I wrote in the science lesson. (Yusuf)	Fen dersinde yazdıklarımı tekrar etme stratejisi denerim. (Yusuf)
I rehearse, then it comes to my mind, I try this strategy (Merve)	Tekrar ediyorum hocam oradan aklıma geliyor, bu stratejiyi denerim. (Merve)
For example, while learning something, I try to transform the lesson into something like a game. I try to make it fun. This means to turn it into something not boring and to gamify it. I already use this strategy sometimes. (Onur)	Mesela hocam bir şey öğrenirken, bir dersi oyun gibi bir şeye çevirmeye çalışıyorum. Hocam eğlenceli hale çevirmeye çalışıyorum. Sıkıcı olmayan hale çevirip, oyunlaştırmak yani. Bu stratejiyi de zaten bazen kullanıyorum. (Onur)

As a learning strategy, I take tests. (Merve)	Öğrenme stratejisi olarak test çözerim hocam. (Merve)
I use the strategy of learning by reading. (Batuhan)	Okuyarak öğrenme stratejisini kullanırım. (Batuhan)
I try the learning strategy of listening to the teacher in class. (Merve)	Dersi dinleyerek öğrenme stratejisini denerim. (Merve)
I revive the questions in my mind. For example, my instructor says that a car is traveling at a speed of 100 km per hour, so I try to animate it in my mind. I'm trying to use this animation strategy. (Onur)	Aklımda soruları canlandırırım. Mesela hocam soruda, bir araba diyor bir saatte 100 km hızla gidiyor diyor onu aklımda canlandırırım öyle öğrenmeye çalışırım. Bu canlandırma stratejisini kullanmaya çalışıyorum. (Onur)
Rehearsing at home. (Aleyna)	Evde tekrar etmek. (Aleyna)
I rehearse what I write. For me, the strategy is usually to review. Mostly, I review. (Kurtuluş)	Yazdığım şeyleri tekrar ederim. Benim için strateji, genellikle tekrar etmektir. En çok tekrar ederim. (Kurtuluş)
I use the strategy of listening to the teacher very well. (Betül)	Hocam dersi çok iyi dinleme stratejisini kullanırım. (Betül)
How can I say, to understand better, I usually listen to my teacher well when the teachers are doing experiments. (Kurtuluş)	Daha iyi anlamak için nasıl desem genellikle hani böyle öğretmenler deney yaptığında öğretmenimi iyi dinlerim. (Kurtuluş)
I use the strategy of doing some tests. (Yağız)	Test çözme stratejisini kullanırım hocam. (Yağız)
If I understand the subject, I do some tests on that subject. (Kurtuluş)	Konuyu anladıysam biraz o konu hakkında test çözerim. (Kurtuluş)
I read the book from the beginning to the end. (Aleyna)	Kitabı baştan sona okurum. (Aleyna)
I read the book as a strategy, I read it when my teacher gives me homework, but also I read the topics once, twice or three times when I have a hard time to understand the subjects. (Erdal)	Hocam strateji olarak kitabı okurum, hocamız ödev verdiği zamanda okuyorum da anlamadığım bir konuyu da bir, iki, üç kere okuyorum. (Erdal)
I use the strategy of rewriting things which I have previously written in my notebook. (Aleyna)	Deftere yazdığım şeyleri yeniden yazmak stratejisini kullanırım. (Aleyna)

Imm, as a learning strategy, I rewrite important parts of what I have written in my notebook on another page. (Aleyna)	Eee hocam, öğrenme stratejisi olarak deftere yazdıklarımın önemli kısımlarını yeniden başka sayfalara yazmak. (Aleyna)
I usually try to do the experiment which I see in the book. (Erdal)	Hocam genellikle misal kitapta gördüğüm deneyi yapmaya çalışırım. (Erdal)

7. Quotations Taken from Conditional Knowledge Category

For instance, by repeating the things that we wrote in our notebooks or by checking from the book, I can understand whether I have learned or not. (Bahadır)	Mesela, defterde yazdığımız şeyleri tekrarlayarak, kitaptan bakarak öğrenip öğrenmediği kontrol ediyorum. Bazen de öğretmenlerime sorular sorarak öğrenip öğrenmediğimi anlayabiliyorum. (Bahadır)
For example, when I get home I lecture myself in order to learn whether I have learned or not. Also, I can understand that by doing tests. (Buse)	Mesela eve gittiğimde derslerimi kendi kendime anlatırım, öğrenmiş miyim öğrenememiş miyim kontrol etmek için. Hocam mesela test çözerek de anlayıp anlamadığımı kontrol edebiliyorum. (Buse)
I generally summarize and then I compare my summaries with my notes, in this way I can understand whether I have learned or not. I also do tests in order to evaluate how much I have learned. (Gamze)	Ben genelde böyle özet çıkarırım öyle sonra karşılaştırdıktan sonra öğrenmiş miyim öğrenmemiş miyim anlarım. Testler de çözüyorum ne kadar öğrendiğimi kontrol etmek için. (Gamze)
In order to check how much I have learned, first of all, I ask myself question about that topic. I evaluate my own knowledge, I mean I evaluate whether I have learned or not. Then I do a test on the topic. It shows me if I have learned or not. My mistakes are my lacks. (Meltem)	Ne kadar öğrendiğimi kontrol etmek için, ilk önce kendime konuyla alakalı sorular sorarım. Kendi bilgimi ölçerim. İşte yani öğrenip öğrenmediğimi ölçerim. Sonra konu hakkında bir test çözerim. O zaten öğrenip öğrenmediğimi gösterir. Yanlış olanlar zaten eksik bildiklerimdir. (Meltem)
I have a board at home. I do calculations on the board. I do tests and check whether I have learned or not. I can understand by practicing at home. (Sude)	Hocam ben evde tahtam var ben tahtayla işlem yapıyorum. Test falan çözüyorum öyle kontrol ediyorum anlayıp anlamadığımı. Evde tekrar yaparak anlayabiliyorum. (Sude)

Sometimes I do not want to study, then I tell myself to study. I study then it ends. For instance, after I reach the half of a topic, even if I get bored I persuade myself to study by saying I have come this far I can finish it quickly and I study. (Buse)	Hocam bazen canım ders çalışmak istemez, o zaman çalışacaksın diyorum kendime. Çalışıyorum bitiyor sonra. Mesela bir konunun yarısına geldikten sonra sıkılsam bile en azından buraya kadar gelmişim hemen biter diyorum çalışıyorum. (Buse)
I motivate myself by saying in the future this information is going to be necessary. (Gamze)	İleri ki zamanlarda bana lazım olacak bu bilgiler diyerek kendimi motive ederim. (Gamze)
By solving tests and rehearsing the subject, I check how well I learned it. (Merve)	Test çözerek, tekrar ederek konuyu ne kadar iyi öğrendiğimi kontrol ederim. (Merve)
For example, by rehearsing the lesson that we had on that day, listening to the teacher at school and taking the tests related to the subject, I check what I learned. (Onur)	Mesela hocam bugün işlediğimiz dersi evde tekrar ederek, okulda dersi dinleyerek, dersle ilgili testler çözerek öğrendiğimi kontrol ederim. (Onur)
By rehearsing the subject, which we have studied here, in the study hour and by summarizing it in the other class, I check whether I have learned or not. (Yusuf)	Hocam burada işlediğimiz konuyu tekrar ederek, etütte, bir de diğer derste özetini geçerek öğrenip öğrenmediğimi kontrol ederim. (Yusuf)
If I cannot find the answers to the questions, I continue. I motivate myself. I tell myself that I will find it. I try to remember the answer and I motivate myself by saying that I will find the answer. (Onur)	Soruların cevaplarını falan bulamazsam hocam devam ederim. Kendimi motive ederim. Bulacağım derim. Aklıma getirmeye çalışırım cevabı bulacağım diyerek kendimi motive ederim. (Onur)
I tell myself, 'You studied before and learned'. I motivate myself in this way. (Batuhan)	Kendi kendime eskiden çalıştın öğrendim derim ve motive olurum. (Batuhan)
For example, I read the books to check whether I understand the subject or not. For instance, about the subject of light, I read my notes that I wrote in my notebook in order to understand the topic of light. I do some tests and check the results to see if I understood it well or not. (Kurtuluş)	Mesela o konuyu anlayıp anlamadığımı kitapları okuyarak kontrol ederim. Mesela Işık konusunda, Işık konusunu iyi anladım mı diye deftere yazdığım yazıları okuyorum. Bazı testler çözüyorum ona göre iyi anlayıp anlamadığıma bakıyorum. (Kurtuluş)

By repeating what you have told us, I check whether I learned or not. I also check what I have learned from your lectures by solving tests about the topics. (Yağız)	Hocam sizin anlattıklarınızı tekrarlayarak öğrenip öğrenmediğimi kontrol ederim. Hocam bir de sizin anlattıklarınız ile ilgili test çözerek öğrenip öğrendiğimi kontrol ederim. (Yağız)
For instance, I say, 'Erdal, you can do it.' Sometimes, I say this to myself when I do not know something. For example, to do things that I do not understand completely, I tell myself, 'If you force yourself, you can do it. Try to work hard, get it into your brain.' (Erdal)	Hocam mesela diyorum ki, Erdal sen bunu yaparsın. Hocam kendi kendime bunu diyorum bazen bilemediğim şeyler için hocam. Misal tam anlamadığım şeyler için kendime diyorum ki zorlarsan yaparsın ya iyicene çalış beynine sok. (Erdal)
I open my notebook, sometimes I read the places that I do not understand to check how much I have learned, and then I try to remember the experiments that we have done at school. (Erdal)	Hocam defterimi açıyorum bazen anlamadığım yerleri okuyorum ne kadar öğrendiğimi kontrol etmek için, sonra işte okulda yaptığımız deneyleri aklıma getirmeye çalışıyorum. (Erdal)
For instance, when I learn something, I say, 'I can achieve this,' to myself. (Betül)	Hocam mesela ben bir şeyi öğrenirken kendi kendime ben bu işi başarabilirim derim. (Betül)

8. Quotations Taken from Planning Category

For instance, when I try to solve a problem, I think of different ways. Firstly, I ask for others, later on, I try to solve it with the help of the formula by reading the course book. I make connections between the problem that I solved before and the problem that I am currently trying to solve. Then I choose the easier one. (Bahadır)	Mesela hocam bir problemi çözerken türlü türlü yollar düşünürüm. Mesela ilk önce başkalarına sorarım, sonra ders kitabını okuyarak formülden çözmeye çalışırım. Daha önce çözdüğüm problem ile bu problem arasinda bağlantı kurarım. Sonra hangisi kolayıma geliyorsa onu seçerim. (Bahadır)
For example, I am going to solve questions about density topic. Dividing, multiplication, I choose the easiest way, the way that I know I am not going to waste time. Of course, there are several ways but I follow the way that I know. (Buse)	Mesela fen dersinde yoğunluk sorularını çözeceğim diyelim. Hocam bölmeli çarpmalı daha kısa yoldan zaman harcamayacağım bildiğim yoldan yaparım. Birkaç yol var aslında ama bildiğim yoldan yaparım. (Buse)

When I try to solve a problem, I choose the easiest and the most rational way. That's why instead of dealing with long calculations, we can do it in a short way. (Gamze)	Bir problemi çözerken, en kolay ve en mantıklı yol hangisiyse onu seçerim. Böylece uzun bir işlem olacağına kısadan yapabiliriz. (Gamze)
Especially in Math, there are alternative ways. But I choose the way that I can understand better, the way that I feel close. (Meltem)	Özellikle matematikte 1. yol, 2. yol falan oluyor. Ama ben kendime mesela hep daha yakın olan yolu, daha anlayabileceğim yolu seçiyorum. (Meltem)
Before I begin a task, I think of the sources that I am going to need and where I am going to learn that information. Besides, I think of where I am going to do my researches. (Gamze)	Bir göreve başlamadan önce ihtiyacım olan kaynaklar neler, o bilgileri nereden öğreneceğim diye düşünürüm. Ayrıca, nereden araştırmalar yapacağımı da düşünürüm. (Gamze)
Before I learn something, I think that I need to go online, I need that source. (Sude)	Bir şeyi öğrenmeden önce internete girmem gerekir bu kaynağa ihtiyacım var diye düşünürüm. (Sude)
Let's suppose we are going to do an activity or an experiment. First, I think. I think what equipment I am going to need. (Meltem)	Bir etkinlik ya da deney yapacağız diyelim. İlk önce düşünürüm. Hangi araç gereçlere ihtiyacım olduğunu düşünürüm. (Meltem)
Even you, teacher, give us a project, first of all, I think of the materials which I am going to use during my work and prepare them. Then I do it. (Buse)	Hocam mesela bir proje ödevini bile siz verdiğinizde, ben önce ödevde su malzemelere ihtiyacım var deyip onları hazırlarım. Sonra yaparım. (Buse)
I make a plan for the difficult topics. I think of my purposes. I mean I define my goals when I make a plan. But when the topic is easy or when I know it, I do not make lots of plans. (Buse)	Hocam zor olan konularda önce bir plan hazırlarım. Şu şu amaçlara ulaşacağım diye hocam. Yani plan hazırlarken öncelikle amaçlarımı belirlerim. Ama hocam mesela konu kolay olduğunda veya bildiğim bir konu olduğunda o kadar çok plan kurmam. (Buse)
I choose different ways to solve a problem. For instance, I choose the shortest way. However, this sometimes changes; if the longer is better, I choose it. (Erkan)	Bir problemi çözmek için farkli yollar seçerim. Mesela hangi yol daha kısaysa onu seçiyorum. Ama bazen değişiyor uzun daha iyiyse onu. (Erkan)

For example, when transforming the kilometers to meters per second, there is a way taught by the teacher, but I do it by another way using logic. I mean that I try out different ways in solving a problem. (Merve)	Hocam mesela kilometreyi metre bölü saniyeye dönüştürürken mesela hocanın anlattığı bir başka oluyor bende mesela mantık yürüterek başka yoldan yapıyorum. Yani farklı yollar denerim bir problemi çözerken. (Merve)
For example, before I start doing my homework, I think that I need internet and sources. (Batuhan)	Mesela bir ödeve başlamadan önce internet ve kaynağa ihtiyacım var diye düşünürüm. (Batuhan)
Source books. Before I start learning something, I need some books related to science and a notebook. (Merve)	Kaynak kitaplar hocam. Mesela fenle ilgili kitaplara ve deftere ihtiyacım olur bir şeyi öğrenmeye başlamadan önce. (Merve)
For example, let's say that we are about to learn the particles etc. in the flowers. Then, I will need sources for research, books on that subject and informative sources for the experiments I will conduct. (Onur)	Hocam örnek olarak, mesela çiçeklerin içindeki tanecikleri falan öğreneceğiz. Onun için araştırma yapacağım kaynağa, hakkında kitaplara ve yapacağım deneyler için bilgi veren kaynaklara ihtiyacım vardır. (Onur)
I make a plan first and while making this plan, primarily, I list my goals. First, I do this and then I finish my task and work. (Batuhan)	İlk önce plan yaparım. Plan yaparken de öncelikle amaçlarımı sıralarım. Öncelikli olarak, bunu yaparım sonra görevimi ve işimi bitiririm. (Batuhan)
First, I think about which materials I will use in what I will do. Cardboard, scissors, adhesives, etc. I already do it this way all the time. (Erkan)	Hocam yapacağım şeyi önce hangi malzemelerle yapacağımı düşünüyorum. Karton lazımsa hemen onlar, makas, yapıştırıcı. Hep zaten böyle yaparım. (Erkan)
For example, I think like this when I solve a problem: I ask myself if it is better to review the subject or if it would be better to do a test or if it would be better to listen to the teacher. (Kurtuluş)	Mesela şu şekilde, şimdi şöyle düşünürüm bir problemi çözerken. Bir tekrar edeyim o mu daha iyi olur. Yoksa test çözsem mi daha iyi olur. Yoksa hocayı dinlesem mi daha iyi olur diye böyle düşünürüm. (Kurtuluş)
When I solve a problem, I prefer the way which is the most correct way. (Erdal)	Hocam bir problemi çözerken en doğru yol hangisi ise onu tercih ederim. (Erdal)

For example, when we began to study light, I thought, “Do I need a laser or something like that. Or do I need something like a lamp? (Kurtuluş)	Mesela Işık konusuna başlarken şöyle düşünmüştüm. Acaba bir lazer şey mi lazım. Ya da bir lamba gibi bir şey mi lazım mı diye düşünmüştüm. (Kurtuluş)
For instance, I think I need some tools and some short or long information about the topic. (Erdal)	Hocam mesela bazı araç ve gereçlere ve onlar hakkında bazı kısa veya uzun bilgilere ihtiyacım var diye düşünürüm. (Erdal)

9. Quotations Taken from Monitoring Category

During Science lessons, I take a break and review whether I have learned or not. (Bahadır)	Fen öğrenimi sırasında ara verip öğrenip öğrenmediğimi genellikle gözden geçiririm. (Bahadır)
For example, when I study at home, I read and read and read and I feel like I didn’t understand at all then I reach to the half of my study I try to lecture myself from the beginning. I review it by explaining the part that I have studied to myself. (Buse)	Mesela hocam evde ders çalışırken ben, okuyorum okuyorum okuyorum hocam anlamamışım gibi geliyor bana sonra çalışmamın yarısına geldiğimde, en baştan bir söyleyeyim öğrenmiş miyim diyorum. Çalıştığım yerlere kadar olan kısmı kendi kendime anlatarak gözden geçiriyorum. (Buse)
When I learn something, I take a break and I ask myself questions about which points I have learned or I haven’t learned. (Meltem)	Bir şey öğrenirken, ara verip duruyorum anladığım ve anlamadığım yerler nereleri diye kendi kendime sorular soruyorum. (Meltem)
For example, while I’m learning these subjects, I sometimes stop and ask myself questions and I understand whether I’ve learned the subject or not. (Merve)	Hocam mesela ben konuları öğrenirken arada duruyorum ve kendime sorular falan soruyorum konuyu öğrenip öğrenmediğimi anlıyorum. (Merve)
Just like the questions you ask in class, I also ask myself questions. For example, while I’m learning something in class, I stop and ask myself questions about what I learned. (Onur)	Hocam sizin dersteki sorularınız gibi, bende kendime sorular soruyorum. Mesela derste bir şey öğrenirken ne öğrendim diye durup, sorular soruyorum kendime. (Onur)

For example, while learning something in science, I make a pause and I make a review to see if I have understood it or not. I make this review also when I'm learning something in the study hour. (Yusuf)	Mesela hocam fende bir şey öğrenirken ara verip konuyu öğrenip öğrenmediğimi gözden geçiriyorum. Bu gözden geçirmeyi etütte de bir şey öğrenirken yapıyorum. (Yusuf)
When I learn something, I ask myself if it is better do it in this way or not and to work from this side or not. (Aleyna)	Bir şey öğrenirken, kendi içimden derim ki acaba böyle mi yapsam bunu yoksa bu taraftan çalışsam diye kendi içimden sorular sorarak böyle düşürüm. (Aleyna)
First of all, I ask myself if I have understood the subject or not. If I have, I study a little bit by myself. To understand it better, if I could not understand it, I try to learn it by working a little harder. (Kurtuluş)	O konuyu anladım mı anlamadım mı diye bir kendime sorarım öncelikle, eğer anladıysam kendim az bir şey böyle kendim çalışırım. Çok daha iyi anlamak için eğer konuyu anlayamazsam biraz daha fazla çalışarak onu öğrenmeye çalışırım. (Kurtuluş)
When I learn something new, I ask myself some questions such as: should I do it this way or not? Should I do it this way or can I learn it better if I do it in the other way. (Erdal)	Hocam yeni bir şey öğrenirken derim ki, bunu böyle yaparsam mı olur yoksa öyle yaparsam mı daha iyi öğrenirim diye kendime sorular sorarım. (Erdal)
I pause during the learning process and review the things that were written by my teacher for about 10 minutes to check what I learned and what I did not. (Kurtuluş)	Öğrenme sırasında ara verip hocamın yazdığı yazıları bir 10 dk. gözden geçiririm neler öğrenmişim neler öğrenmemişim anlamak için. (Kurtuluş)

10. Quotations Taken from Evaluation Category

After the topics are finished, I do tests. So, I can evaluate whether I have understood or not. (Gamze)	Konular bittikten sonra testler çözüyorum. Böylece konuyu anlayıp anlamadığımı anlayabiliyorum. (Gamze)
I have a board at home. I do calculations about the topics that we have learned in our lessons on the board. Then I do tests. In that way, ı can evaluate whether I have understood or not. (Sude)	Hocam benim evde tahtam var. Ben tahtaya derste işlenen konularla ilgili işlemler yapıyorum. Sonra test falan çözüyorum. Böylece konuyu anlayıp anlamadığımı değerlendiriyorum. (Sude)

For instance, after the topic which we study in our Science lesson is finished, I lecture myself about that topic at home. Thus, I can evaluate whether I have learned or not. (Buse)	Mesela fende işlenen konu bittikten sonra, eve gittiğimde konuyu kendi kendime anlatırım, böylece öğrenmiş miyim öğrenememiş miyim değerlendiririm. (Buse)
For example, I have just talked about it. After I complete my study, I evaluate whether I have understood or not. I usually do this teacher. (Bahadır)	Mesela biraz önce söyledim. Çalışmamı tamamladıktan sonra, anlayıp anlamadığımı değerlendiririm. Genellikle yaparım hocam bunu. (Bahadır)
During Science lessons, I prepare summaries after every topic. (Gamze)	Fen dersinde biten her konudan sonra özet çıkarıyorum. (Gamze)
After I complete my study, I summarize what I have learned. I am careful about to prepare my summary shortly and neatly. I do this in order to remember more. If it is short, it is easier to remember. (Buse)	Çalışmanı tamamladıktan sonra öğrendiklerini özetliyorum. Hocam özetimin kısa ve öz olmasına dikkat ediyorum. Aklımda daha çok kalsın diye. Kısa olunca daha kolay aklımda kalıyor. (Buse)
For instance, I study my lessons, after I complete my study, I prepare a summary of what I have learned. When I summarize, I write down the important points. (Meltem)	Mesela ders çalışıyorum, çalışmam bittikten sonra öğrendiklerini özetliyorum. Özetlerken onemli olan noktaları yazıyorum. (Meltem)
For example, after I finish my study, I evaluate myself about how I could have learned better. (Sude)	Mesela konuya çalışıp bitirdikten sonra, acaba daha iyi nasıl öğrenebilirdim diye kendimi değerlendiririm. (Sude)
After I complete my study, I think about how I could have learned better. (Buse)	Çalışmamı tamamladıktan sonra hocam, mesela daha iyi nasıl öğrenebilirdim diye düşünürüm. (Buse)
I make a summary after I learn the subjects. In summarizing, I try to write the things which I think are important and things that I have underlined previously. (Merve)	Konuları öğrendikten sonra özetlerim. Özetlerken önemli olduğunu düşündüğüm daha önce altını çizdiğim yerleri yazmaya çalışıyorum. (Merve)
After I finish studying, I make a summary of what I have learned. (Batuhan)	Çalışmamı bitirdikten sonra öğrendiklerimi özetlerim hocam. (Batuhan)

I usually think about how I could have learned a subject better after we finish studying that topic. (Erkan)	Hocam ben genelde bir konu bittikten sonra nasıl daha iyi öğrenebilirdim bu konuyu diye düşünüyorum. (Erkan)
I read such books, for example, to know if I have understood the topic or not. (Kurtuluş)	Mesela o konuyu anladım mı anlamadım mı diye böyle kitapları okurum. (Kurtuluş)
I usually pay attention to find out if I understood the subject or not. (Kurtuluş)	Genellikle o konuyu anlayıp anlamadığıma dikkat ediyorum. (Kurtuluş)
I summarize what I learned after I complete my study. For example, when summarizing, I do not write everything about a topic but write down what I have in mind. (Betül)	Çalışmanı tamamladıktan sonra öğrendiklerimi özetlerim hocam. Hocam mesela bir konunun hepsini yazmak değil aklımda kalanları yazarım özetlerken. (Betül)
After completing my study, I sometimes summarize and sometimes I don't summarize at all. As I summarize, I pay attention to the most important words, for instance, my teacher says that a millipede has forty feet. I pay attention to the things my teacher emphasizes. (Erdal)	Çalışmanı tamamladıktan sonra bazen özetlerim bazen de hiç özetlemem. Hocam özetlerken en çok önemli sözlere dikkat ediyorum, misal hocam öğretmenim şöyle der ki bir kırk ayaklı böceğin kırk tane ayağı vardır. Öğretmenimin ağırlık verdiği şeylere dikkat ederim. (Erdal)

11. Quotations Taken from Debugging Category

Teacher, for instance, one of my friends can easily understand not only Science lesson but the other lessons. Sometimes our teachers explain the topic in a difficult way but they explain to me the easy way and quickly. That's why when I don't understand I ask help from my friends. (Bahadır)	Hocam mesela bazı arkadaşlarım bir tek fen dersi değil her derste kolay anlayabiliyor. Öğretmen bazen zor yoldan anlatıyor ama onlar hemen hıphızlı ve kolayını anlatıyorlar bana. O nedenle anlamadığım zaman arkadaşlarımdan yardım isterim. (Bahadır)
When I do not understand I ask help from my teachers and sometimes from my sister. (Buse)	Anlamadığım zaman konuyu öğretmenlerimden ve bazen de ablamdan yardım isterim. (Buse)
I usually ask help from my teachers when I do not understand. (Sude)	Anlamadığım yerlerde genellikle öğretmenlerimden yardım istiyorum. (Sude)

Usually, we ask the points that we haven't understood each other with Buse, Sude, Buse, Gamze we already hang around like that. I ask them the points I haven't understood and they ask me. We get help from each other. (Meltem)	Biz genelde Buse ile anlamadıklarımızı birbirimize soruyoruz. Sude, Buse, Gamze öyle takılıyoruz zaten. Onlara soruyorum anlamadıklarımı onlarda bana soruyor. Yani birbirimizden yardım alıyoruz. (Meltem)
Teacher, if I understand the beginning, I do not go back. If I haven't understood the beginning and if I have a problem in the middle, I try to understand by reading those parts. If I can't understand at all, I go back again and take from the beginning. I think that obviously there is a problem in the beginning, I haven't understood those parts. (Buse)	Hocam başı anladıysam başa dönmem. Eğer başı anlamadıysam fakat ortalarda bir yerlerde bir takılmam olduysa oraları okuyarak anlamaya çalışırım. Bu sefer yine hiç anlamazsam en son başa dönerim yeniden. Demek ki başta bir sorun var tam oraları anlamamışım diyerekten. (Buse)
I wouldn't call it taking from the beginning, I read the parts that I couldn't understand again and again. What I am trying to say is If I haven't understood a topic or information, I read that part. If I understand I continue from where I have left. (Gamze)	Başa dönmek demeyelim de o anlamadığım yeri tekrar tekrar okurum. Yani eğer konuyu veya bir bilgiyi anlamadıysam anlamadığım yeri okurum, anladıysam kaldığım yerden devam ederim. (Gamze)
If I don't understand a point, I do not go back. I read the part that I haven't understood and I try to understand. (Sude)	Bir bilgiyi anlamazsam başa dönmem. Anlamadığım yeri tekrar okurum ve anlamaya çalışırım. (Sude)
For example, because Bahadır is good in subjects, I ask Bahadır to help me when I do not understand a subject. (Batuhan)	Mesela Bahadır konularda iyi olduğu için bir konuyu anlamadığım zaman Bahadır'a sorarım. Bahadır bana yardım eder misin derim. (Batuhan)
When I don't understand while I'm learning something, I read the place that I don't understand once more from the beginning. If I don't understand again, I ask someone. (Erkan)	Bir şey öğrenirken anlamadığımda, anlamadığım yeri baştan bir daha okurum eğer yine anlayamazsam birilerine sorarım. (Erkan)
I also ask the teacher the questions that I cannot understand, the questions that I get stuck upon and cannot understand. (Merve)	Cevaplayamadığım çok takıldığım ve anlamadığım soruları da hocaya soruyorum. (Merve)

For example, I couldn't understand the physical and chemical changes in science, I ask my desk mate Betül. I ask Miray. They try to help me. I may also ask you. (Onur)	Örneğin fende fiziksel ve kimyasal değişiklikleri anlayamadım hocam yanımda oturan Betül'e sorarım, Miray'a sorarım hocam. Onlarda yardımcı olmaya çalışır zaten hocam. Size de sorarım. (Onur)
When I don't understand a subject, I ask my friends Sude and Buse because they are hardworking. (Merve)	Konuyu anlamadığım zaman, çalışkan oldukları için Sude ve Buse arkadaşıma soruyorum. (Merve)
I sometimes ask my desk mate for help when I don't understand something. (Yusuf)	Yanımdaki arkadaşımdan anlamadığım yer olunca bazen yardım isterim. (Yusuf)
I ask my mother and my older sister when there is a question that I don't understand. (Merve)	Anlamadığım soru olursa anneme soruyorum ablama soruyorum. (Merve)
I ask my teacher about the things that I don't know or understand. I don't ask the things I know. (Yusuf)	Bilemediğim ve anlamadığım yerleri öğretmene sorarım. Bildiğim yerleri sormam. (Yusuf)
If I do not understand, I go back to my teacher and ask if he/she could explain the subject to me. (Aleyna)	Anlayamazsam, tekrar hocaya giderim hocaya, hocam bu konuyu bana tekrardan anlatır mısınız diye söylerim. (Aleyna)
Sometimes, I ask my teachers the things that I do not understand. (Betül)	Hocam anlamadığım konuları bazen hocalarıma sorarım. (Betül)
If I do not understand, first, I ask for help from the girls because they are more hardworking. Then I want help from boys. (Erdal)	Hocam anlayamazsam bir konuyu önce kız arkadaşlarımdan yardım istiyorum çünkü onlar daha çalışkan oldukları için hocam. Sonra erkeklerden yardım istiyorum hocam. (Erdal)
For instance, if I do not understand a subject at all, I go to Batuhan and tell him that I do not understand the subject, so I ask him for a favor to explain me the lessons. Batuhan is a close friend of mine. (Kurtuluş)	Ya mesela bir konuyu hiç anlayamadığımda giderim mesela Batuhan'dan ben bu konuyu hiç anlamayamadım bana tekrardan anlatabilir misin derim. Batuhan yakın arkadaşım. (Kurtuluş)
I sometimes ask my friends about the subjects that I do not understand. (Yağız)	Arkadaşlarıma bazen soruyorum hocam anlamadığım konuları. (Yağız)

If I cannot understand, I ask my teacher or friends. (Erdal)	Hocam anlayamazsam ya hocama sorarım ya da arkadaşlarıma. (Erdal)

12. Quotations Taken from Information Management Category

I draw my attention to the specific information which our teacher mentioned in our lesson. Actually, my thoughts generally stick there. (Bahadır)	Öğretmenin derste söylediği özel bilgilere yoğunlaşırım ve odaklanırım hocam. Hatta kafam orada kalır. (Bahadır)
For instance, I underline the important parts when I study teacher, later on when our teacher teaches us those parts I can understand if they are really important or not. In other words, I always focus on the important parts. (Sude)	Hocam mesela ben ders çalışırken önemli yerlerin altını çiziyorum, ondan sonra hoca bize anlattığında o yerlerin gerçekten önemli olup olmadığını anlıyorum. Yani ben hep önemli yerlere odaklanırım. (Sude)
I divide my studies into small steps when I study. Because when I try to learn all of them I get confused. I learn step by step. (Bahadır)	Ders çalışırken çalışmalarımı küçük parçalara ayırırım. Çünkü hepsini bir anda öğrenmeye çalıştığımda kafam allak bullak oluyor hocam. Ayrı ayrı öğreniyorum. (Bahadır)
When I study lesson, I try to learn by dividing the parts that I am supposed to learn into small steps depending on how difficult the topic is. (Buse)	Hocam ders çalışırken konunun zorluğuna bağlı olarak öğrenmen gereken bilgileri küçük adımlara bölerek öğrenmeye çalışıyorum. (Buse)
During Math lesson, when I try to solve a problem I usually draw pictures. It is easier for me to learn that way. But I do not do this during Science lessons. (Gamze)	Matematik dersinde mesela problem çözerken genelde resim çizerim. Öğrenmem daha kolay oluyor. Ama fende bunu fazla yapmıyorum. (Gamze)
I draw a picture in order to make my learning easier. Especially I draw pictures and figures during Math lessons in order to understand. I draw things including fractions. I draw numerical axis. (Meltem)	Öğrenmemi kolaylaştırmak için resim çizerim. Özellikle matematik dersinde anlayabilmem için şekil ve resim çizerim. Böyle kesirli mesirli bir şeyler çizerim. Sayı doğrusu çizerim. (Meltem)
I focus on general definitions known by everyone. At least they are easy to remember. (Buse)	Herkesin bildiği genel tanımlara odaklanıyorum. En azından daha çok akılda kalıyor bu tanımlar. (Buse)

For instance, general definitions are easier to remember. I think general definitions of chemical transformation are more important than specific definitions. Also, general definition, which is known by everyone, is easier to remember. They ask them in the tests or exams. We study specific definitions of course but general definitions are more important. (Meltem)	Mesela genel tanımlar aklımda daha çok kalır. Mesela kimyasal değişimin özel tanımları değil de genel tanımları daha önemlidir. Hem herkes tarafından bilinen genel tanımın akılda kalıcı özelliği daha fazladır. Testlerde çıkar, sınavlarda çıkar. Özel tanımlara da çalışırız ama daha çok genel tanımlar önemlidir. (Meltem)
When I study, I usually focus on specific meanings and definitions. Because in my opinion, Specific definitions are important. (Gamze)	Ders çalışırken, daha çok özel anlamlara ve tanımlara odaklanırım. Çünkü özel tanım önemli olduğundan dolayı. (Gamze)
For example, when I learn something new, I focus on that information. I concentrate on there. (Bahadır)	Mesela yeni bir bilgi öğrenirken, o yeni bilgi üzerine odaklanırım. Orada yoğunlaşırım. (Bahadır)
I divide all the subjects one by one. Under the divided subjects, I write the key words of that subject. I mean I do it like this when I study. (Onur)	Hocam konuların hepsini tek tek bölüyorum. Böldüğüm konuların altına işte hocam o konunun anahtar kelimelerini yazıyorum. Yani ders çalışırken böyle yapıyorum hocam. (Onur)
When I'm studying, I mostly focus on general descriptions because if we look at the whole, we can understand it all at once. (Erkan)	Ders çalışırken daha çok genel tanımlara odaklanırım. Çünkü bütüne bakarsak hepsini bir anda anlayabiliriz. (Erkan)
When I'm learning something or studying, I first focus on special descriptions because special descriptions are more important. (Batuhan)	Hocam bir şey öğrenirken ya da ders çalışırken ilk önce özel tanımlara odaklanırım. Özel tanımlar daha önemli olduğu için. (Batuhan)
I draw pictures to facilitate learning because pictures explain better. (Erkan)	Öğrenmeni kolaylaştırmak için resim çizerim. Çünkü resim daha iyi anlatır. (Erkan)
I focus on general definitions while studying. When I say general definitions, I mean what everyone knows. The general definition is easier because everyone knows it. (Erdal)	Ders çalışırken genel tanımlara odaklanırım hocam. Hocam genel tanım derken herkesin bildiği şeyler. Hocam genel tanım en azından herkesin bildiği olduğu için daha kolay olur hocam. (Erdal)

APPENDIX F

CURRICULUM VITAE

Personal Information	
Name	: Yurdagül
Surname	: Boğar
Date of Place	: Eskişehir/Turkey
Academic Title	: Research Assistant
Mail Address	: Middle East Technical University, Faculty of Education, Department of Mathematics and Science Education, Universiteler Cad. Dumlupınar Bulvarı, No: 1, 06800, Çankaya, Ankara/ TURKEY
E-mail	: yurdagul-bogar@hotmail.com

Educational History		
2011- 2018	**Ph.D.**	**Middle East Technical University** Faculty of Education Department of Mathematics and Science Education/ Science Education Ankara, Turkey
2007- 2010	**M.S.**	**Gazi University** Faculty of Education Department of Elementary Education/Science Education Ankara, Turkey
2003- 2007	**B.Sc.**	**Osmangazi University** College of Education Department of Elementary Education/Science Education Eskişehir, Turkey

Professional Employment History

Year	**Title**	**Affiliation**
2011- 2018	Research Assistant	Middle East Technical University Faculty of Education Department Math & Science Education Ankara, Turkey

August 2014- June 2015	Visiting Scholar	Department of Theory and Practice in Teacher Education The University of Tennessee Knoxville, TN, USA
March 2014 – August 2014	Research Assistant	Learning and Student Development Office Middle East Technical University Engineering Building(MM) Ankara, Turkey
September 2013- January 2014	Exchange Student	School of Health and Education Middlesex University London, England
2009 – 2010	Research Assistant	Hakkari University Faculty of Education Hakkari, Turkey
2008 – 2009	Science Teacher	Büyükkayı İlköğretim Okulu Han, Eskişehir, Turkey
2007 – 2008	Science Teacher	Mehmet Yetkin İlköğretim Okulu Mamak, Ankara, Turkey

Research Interests

Argumentation in Science Education

Metacognition in Science Education

Epistemological Perspectives in Science Education

Reasoning Skills

Nature of Science

STEM Education

Neuroscience

Foreign Languages

Advanced English

Basic Spanish

Publications

Articles Published in the Journals that Are Not Indexed in SCI (Science Citation Index), SSCI (Social Science Citation Index), AHCI (Arts and Humanities Citation Index)

1. **Boğar, Y.** (2017). Türkiye'de ve Amerika Birleşik Devletleri'nde Öğretmenlere Yönelik Mesleki Gelişim Programlarının İncelenmesi. *The Journal of International Education Science, 4*(10), 223-234.

2. Karıbayeva, A. & **Boğar, Y.** (2014). To what extent does parents' involvement in middle school influence children's educational progress? *Procedia- Social and Behavioral Sciences, 152*, 529-533.

3. **Bogar, Y.,** Kalender, S., & Sarikaya, M. (2012). The Effects of Constructive Learning Method on Students' Academic Achievement, Retention of Knowledge, Gender and Attitudes Towards Science Course in "Structure and Characteristics of Matter" Unit. *Procedia- Social and Behavioral Sciences, 46*, 1766-1770.

Conference Papers Presented in the International Conferences and Published in the Abstract Books or Proceedings

1. **Boğar, Y.** (2018, May). *6. Sınıf Öğrencilerinin Bilimsel Epistemolojik İnançlarının Gelişimi Üzerine Bilimsel Argümantasyonun Etkisinin İncelenmesi.* Paper presented at 8th International Congress of Research in Education (ICRE), Manisa Celal Bayar University, Manisa, Turkey.

2. **Boğar, Y.** (2018, April). *STEM Education in Turkey: A Content Analysis.* Paper presented at X. International Congress of Educational Research, Nevşehir Hacı Bektaş Veli University, Nevşehir, Turkey.

3. **Boğar, Y.** (2018, April). *Improvement of Middle School Students' Scientific Epistemological Beliefs and Metacognitive Awareness through Scientific Argumentation.* Paper presented at X. International Congress of Educational Research, Nevşehir Hacı Bektaş Veli University, Nevşehir, Turkey.

4. **Boğar, Y.** (2018, April). *Development of 6th Grade Students' Scientific Epistemological Beliefs through Scientific Argumentation-Based Teaching.* Paper presented at 27th International Conference on Educational Sciences (ICES), Antalya, Turkey.

5. **Bogar, Y.** (2017, May). *Ortaokul 7. Sınıf Öğrencilerinin Fen ve Teknoloji Dersinde Yazılı Bilimsel Açıklama Yapabilme Kalitesinin Değerlendirilmesi.* Paper presented at IV. International Eurasian Educational Research (EJER) Congress, Pamukkale University, Denizli, Turkey.

6. **Bogar, Y.** (2017, April). *Ortaokul Sınıflarında Mühendislik Becerilerinin Geliştirilmesi için STEM Tabanlı Öğrenme Ortamının Tasarımı.* Paper presented at 7th International Congress of Research in Education (ICRE), Çanakkale 18 Mart University, Çanakkale, Turkey.

7. **Bogar, Y.** (2017, April). *Lisans Öğrencilerinin Bilimsel Teori ve Kanun Kavramlarına İlişkin Algılarının Belirlenmesi.* Paper presented at 7th International Congress of Research in Education (ICRE), Çanakkale 18 Mart University, Çanakkale, Turkey.

8. **Bogar, Y.** (2017, April). *Quality of A Group Middle School Students' Written Scientific Explanation.* Paper presented at 26th International Conference on Educational Sciences (ICES), Antalya, Turkey.

9. **Boğar, Y.** (2017, May). *Epistemology in Science Education Research: A Journal Content Analysis from 2005 to 2016.* Paper presented at International Conference of Strategic Research in Social Science and Education (ICoSReSSE), Prague, Czech Republic.

10. **Bogar, Y., &** Cakiroglu, J. (2016, April). *Elementary, Middle and High School Students' Scientific Reasoning Skills: A Content Analysis from 1980 to 2015.* Paper presented at the annual meeting of the National Association for Research in Science Teaching (NARST), Baltimore, MD.

11. **Bogar, Y.** (2016, April). *Elementary School Students' Reasoning Skills: A Meta-Analysis*. Paper presented at the annual meeting of the National Association for Research in Science Teaching (NARST), Baltimore, MD.

12. **Boğar, Y.** (2015, December). *Türkiye'de SSCI'da Taranan Eğitim Dergilerinin Fen Eğitimi Alanında Araştırma Eğilimleri: İçerik Analizi.* Paper presented at 2nd Cyprus International Congress of Education Research, Kyrenia, North Cyprus.

13. **Boğar, Y., &** Çakıroğlu, J. (2015, October). *The Importance of Teaching and Learning Nature of Science through Metacognitive Strategies: A Synthesizing Study*. Paper presented at International Conference on Best Practices and Innovation in Education (INOVED), İzmir, Turkey.

14. **Boğar, Y.** (2015, October). *The Comparison of Higher Education in Turkey and the United States: A Comparative Study.* Paper presented at I. International Higher Education Studies Conference (IHEC), Boğaziçi University, İstanbul, Turkey.

15. **Boğar, Y.** (2015, June). *Türkiye'de ve ABD' de Öğretmenlere Yönelik Mesleki Gelişim Programlarının Geçmişten Günümüze Karşılaştırılmalı Olarak İncelenmesi.* Paper presented at II. International Eurasian Educational Research (EJER) Congress, Hacettepe University, Ankara, Turkey.

16. Karıbayeva, A. & **Boğar, Y.** (2014, June). *To what extent does parents' involvement in middle school influence children's educational progress?* Paper presented at Educational Researches and Publications Association (ERPA) Congress, İstanbul University, İstanbul, Turkey.

17. **Boğar, Y**. & Arık, S. (2012, May). *Fen ve Teknoloji Öğretmen Adaylarının Teknolojik Pedagojik Alan Bilgisi Özgüven Seviyelerinin Belirlenmesi.* Paper presented at IV. International Congress of Educational Research, Yıldız Teknik University, İstanbul, Turkey.

18. **Bogar, Y**., Kalender, S. & Sarikaya, M. (2012, February). *The Effects of Constructive Learning Method on Students' Academic Achievement, Retention of Knowledge, Gender and Attitudes Towards Science Course in "Structure and Characteristics of Matter" Unit.* Paper presented at IV. World Conference on Educational Sciences (WCES), Barselona, Spain.

Conference Papers Presented in the National Conferences and Published in the Proceedings

1. **Boğar, Y., &** Çakıroğlu, J. (2016, September). *6. Sınıf Öğrencilerinin Bilimsel Epistemolojik İnançlarını ve Bilişüstü Farkındalıklarını Belirlemeye Yönelik Bir Çalışma.* Paper presented at XI. National Science and Mathematics Education Conference (UFBMEK), Karadeniz Technical University, Trabzon, Turkey.

2. **Boğar, Y.** & Çakıroğlu, J. (2014, September). *Türkiye'de Fen Eğitiminde Eleştirel Düşünme Üzerine Yapılan Çalışmalarla İlgili Derleme.* Paper presented at XI. National Science and Mathematics Education Conference (UFBMEK), Çukurova University, Adana, Turkey.

3. Arık, S. & **Boğar, Y.** (2014, September). *Fen ve Teknoloji Öğretmen Adaylarının Çevre Eğitimine İlişkin Nitel Bir Çalışma.* Paper presented at XI. National Science and Mathematics Education Conference (UFBMEK), Çukurova University, Adana, Turkey.

4. Yenilmez Türkoğlu, A. & **Boğar, Y**. (2012, June). *Eğitim Fakülterindeki Araştırma Görevlilerinin Bilimsel Modeller Hakkındaki Anlayışlarının İncelenmesi.* Paper presented at X. National Science and Mathematics Education Conference (UFBMEK), Niğde University, Niğde, Turkey.

5. Bircan, S., Taş, M., **Boğar, Y.,** & Tanrıverdi, K. (2012, June). *Argümantasyon Tabanlı Bilim Öğrenme (ATBÖ) Raporlarının 7. Sınıf Elektrik Konusundaki Kazanımlarla İlişkisinin İncelenmesi.* Paper presented at X. National Science and Mathematics Education Conference (UFBMEK), Niğde University, Niğde, Turkey.

6. Canpolat, S., **Boğar, Y.,** & Sarıkaya, M. (2012, June). *Fen ve Teknoloji Dersinde Kavram Haritası Kullanmanın Öğrencilerin Başarıları ve Tutumlarına Etkisinin Araştırılması.* Paper presented at X. National Science

and Mathematics Education Conference (UFBMEK), Niğde University, Niğde, Turkey.

7. **Boğar, Y**., Kalender, S. & Sarıkaya, M. (2010, September). *İlköğretim 7. Sınıf Öğrencilerinin Fen Akademik Başarılarına 5E Modeli ve Cinsiyet Etkilerinin Araştırılması.* Paper presented at IV. National Science and Mathematics Education Conference (UFBMEK), Dokuz Eylül University, İzmir, Turkey.

8. Turhan, E. A., Kılıç, E., **Boğar, Y**. & Sarıkaya, M. (2008, August). *Sekizinci Sınıf Öğrencilerinin Mıknatıs ve Özellikleri Konusunu Kavramalarına ve Fene Karşı Tutumlarına Çoklu Zeka Kuramına Dayalı Öğrenme Modeli ve Cinsiyetin Etkileri*. Paper presented at VIII. National Science and Mathematics Education Conference (UFBMEK), Abant İzzet Baysal University, Bolu, Turkey.

Projects

1. ODTÜ- BAP-05-06-2012-001, Değer Norm İnanç Teorisi Çerçevesinde İlköğretim Öğretmen Adaylarının Enerji Tasarrufu Davranışlarının Açıklanması.

2. Mentor in the project entitled "The Scientific Research Game Project", funded by European Union. (February 2014- June 2014).

3. Project Coordinator in the project entitled "Sorgulamaya Dayalı Bilim Öğrenme İçerisindeki Tartışmacı Söylem Aracılığıyla Öğrencilerin Eleştirel Düşünme Seviyelerinin Değerlendirilmesi", funded by The Scientific and Technological Research Council of Turkey (TÜBİTAK) (August 2014- June 2015).

Memberships in Scientific Associations

1. NARST: A Worldwide Organization for Improving Science Teaching and Learning Through Research
2. AERA: American Educational Research Association
3. ESERA: European Science Education Research Association
4. Science Education and Research Association (Fen Eğitimi ve Araştırmaları Derneği)

Awards

1. Honor Award from Türk Eğitim Vakfı (TEV) 2004
2. Honor Award from Türk Eğitim Vakfı (TEV) 2005

3. High Honor Award from Türk Eğitim Vakfı (TEV) 2006
4. High Honor Award from Türk Eğitim Vakfı (TEV) 2007

Scholarships

1. NARST International Committee Conference Scholarship 2016

National Scholarship

1. Türk Eğitim Vakfı (TEV) Scholarship (4 years) 2003- 2007
2. ERASMUS+ Programme Turkish National Agency Scholarship (6 months) 2013
3. TÜBİTAK, PhD Research Scholarship in USA (1 year) 2014-2015
4. Middle East Technical University, Conference Scholarship 2016
5. TÜBİTAK (2224) Conference Scholarship 2016

Certificates

1. First Aid Certificate 2017

Seminars, Workshops, Forums, and Training Camps Attended

1. Seminar on Nature of Science (Bilimin Doğası) by Prof. Dr. Fouad Abd El Khalick, Pamukkale University, Denizli, Turkey, 1 June. 2012

2. Science Education and Research Association Workshops-II: LISREL and NVivo, Niğde University, Niğde, Turkey, June 26. 2012

3. Seminar on Socio-Scientific Issues, Prof. Dr. Dana Zeidler, Dr. Ahmet Kılınç, Dr. Özgül Yılmaz-Tüzün, Learning and Student Development (LSD): Middle East Technical University, Ankara, Turkey, August 1. 2012

4. Forum on Eğitim Siyaseti Nedir? by Prof. Dr. Ziya Selçuk, TED Ankara College, Ankara, Turkey, 27-28 April. 2013

5. Seminar on New Trends in Education by Prof. Dr. Deanne Kuhn & Doc. Dr. Ahmet Kılınç, Abant İzzet Baysal University, Bolu, Turkey, 6 August. 2013

6. Seminar on Writing High Quality Papers in Social Sciences by Prof. Dr. Deanne Kuhn & Doc. Dr. Ahmet Kılınç, Abant İzzet Baysal University, Bolu, Turkey, 6 August. 2013

7. Seminar on Students' Engagement in Epistemic Practices in the Science Classroom: Producing Expressed Models by Prof. Dr. Maria Pilar Jimenez Alexiandre, Bogazici University, Istanbul, Turkey, August 26. 2013

8. Seminar on PISA 2012 Sonuçları ve Eğitim Politikaları by Doc. Dr. Gültekin Çakmakçı, Hacettepe University, Ankara, Turkey, 21 February. 2014

9. Seminar on 21. Yy Çocuklarına Anne-Baba Olmak by Prof. Dr. Ziya Selçuk, Özel Maya Schools, Ankara, Turkey, 8 March. 2014

10. TÜBİTAK Horizon 2020 Marie Sklodowska Curie Actions Info-Day, TÜBİTAK Feza Gursey Conference Room, Ankara, Turkey, 27 March. 2014

11. Seminar on Köy Enstitüsünden Günümüze, Middle East Technical University, Ankara, Turkey, 17 April. 2014

12. Workshop on Öğrenen Lider Öğretmen, Middle East Technical University, Ankara, Turkey, 26-27 April. 2014

13. Seminar on Üstün Yetenekli Çocuklar by Prof. Dr. Ayşegül Ataman, ODTÜ Geliştirme Vakfı Ankara Schools, Ankara, Turkey, 21 May. 2014

14. Seminar on Reinventing the Laboratory Experience (Laboratuvar Deneyiminin Yeniden Yapılandırılması) by Prof. Dr. William F. McComas, Özel Maya Schools, Ankara, Turkey, 26 May. 2014

15. Seminar on Confronding Some Big and Little Myths about Education by Prof. Dr. David C. Berliner, The University of Tennessee, Knoxville, TN, USA, 28 October. 2014

16. Seminar on Mixed Methods Research Design and Analysis with Validity: A primer by Prof. Dr. Burke Johnson, Hacettepe University, Ankara, Turkey, 8-10 June. 2015

17. Seminar on A Social Constructivist View of Learning Trajectories, by Dr. Michelle Stephan, Middle East Technical University, Ankara, Turkey, 1 July. 2015

18. STEM & Makers Fest 2015/ EXPO Türkiye 2015, STEM 1. Öğretmenler Konferansı (Araştırmaya Dayalı Bilim Öğretiminde Değerlendirme Stratejileri), Hacettepe University, Ankara, Turkey, 7-8 September. 2015

19. PhD Research Camp held within the scope of the International Conference on Best Practices and Innovations in Education (INOVED), Dokuz Eylül University, İzmir, Turkey, 29-30 October. 2015

20. TÜBİTAK Seminar on Akademik Düzeyde Bilimsel Araştırma Projesi Hazırlama Eğitimi by Prof. Dr. Asim Kadıoğlu, Prof. Dr. Birdoğan Baki, Prof. Dr. Nurettin Yaylı, Prof. Dr. Bülent Güven, Prof. Dr. Yener Eyüboğlu, Karadeniz Technical University, Trabzon, Turkey, 23-25 September. 2016

21. 5. Ulusal Açık Erişim Conference, The Scientific and Technological Research Council of Turkey (TÜBİTAK), Ankara, 27 October. 2016

22. Eğitimde FATİH Projesi Eğitim Teknolojileri Zirvesi (ETZ) by Ministry of Education, The Green Park Hotel Ankara, Ankara, Turkey, 17-18 November. 2016

23. TÜBİTAK Seminar on Alan Uzmanlarıyla Nitel Temelli Araştırmalara Yolculuk by Prof. Dr. Salih Çepni, Uludağ University, Bursa, Turkey, 19-25 November. 2016

24. Seminar on First Aid, Middle East Technical University, Ankara, Turkey, 05-06 December. 2016

Board and Committee Memberships in National and International Associations and Actions

1. Project Reviewer, METU College 16. Science Festival
2. Project Reviewer, METU College 17. Science Festival
3. Project Reviewer, METU College 2. EUREKA Scientific Project 2012
4. Project Reviewer, METU College 4. EUREKA Scientific Project 2014
5. Proposal Reviewer, 89th NARST Annual International Conference 2015
6. Proposal Reviewer, 90th NARST Annual International Conference 2016

APPENDIX G

TURKISH SUMMARY/TÜRKÇE ÖZET

Giriş ve Alan Yazını

Epistemoloji kavramı; felsefenin bilgi sorununu temel alarak, bilgiyle ilgi problemleri araştıran, bilginin doğasını, yapısını, kaynağını, kökenini, değerini, ölçütlerini, geçerliliğini ve sınırlarını inceleyen felsefe alanı olarak tanımlanmaktadır (Aydın ve Ertürk-Geçici, 2017; Çüçen, 2005). Epistemoloji doğal olarak bilgiyi merkeze alan birçok soru sormuş, bu sorular merkezinde bireyler cevapları bulmaya çalışarak, kendi içsel inançlarını epistemoloji sayesinde yönlendirmişlerdir. Bu yönlendirme sonucunda epistemolojik inançlar ortaya çıkmıştır. Epistemolojik inançlar; bireylerin bilginin ne olduğu, bilme ve öğrenmenin nasıl gerçekleştiği, kesinliğinin derecesi, sınırları, organizasyonu ve kriterleri üzerindeki görüşleri ile ilgili öznel inançları olarak tanımlanmaktadır (Deryakulu, 2014; Hofer, 2001; Kaleci, 2012; Koç-Erdamar ve Bangir-Alpan, 2011; Tickle, vd., 2005).

Bilimsel epistemolojik inançlar bireyin bilgiyi edinme ve yapılandırmasını etkilemekte ve yaşam boyu öğrenme için vazgeçilmez bir rol üstlenmektedir (Eroğlu ve Güven, 2003, Hofer, 2001). Dahası, bilimsel epistemolojik inanışların bireylerin bilimsel bilgiye yönelik bakış açıları, derse katılım düzeyleri, akademik başarıları ve motivasyonları üzerinde etkili olduğu, bu inanışların büyük oranda ilkokul çağlarından itibaren şekillenmeye başladığı ve gelişmiş epistemolojik inanışlara sahip öğrencilerin daha karmaşık, derin ve çok yönlü düşünceler oluşturabildiği bilinmektedir (örneğin; Buehl, ve Alexander, 2001; Cano ve Cardella-Elawar, 2004; Çavuş, 2013; Deryakulu ve Büyüköztürk, 2005; Sadıç, Çam, ve Topçu, 2012; Schraw, 2001). Bunlara ek olarak, öğrencilerin bilimsel epistemolojik inançlarının öğrenme, akil yürütme, karar verme, problem çözme ve yaratıcılık gibi üst düzey düşünme becerileri üzerinde etkili olduğunu ortaya koyan çeşitli araştırmalar da mevcuttur (örneğin; Aksan, 2009; Cano, 2005; Deryakulu, 2004; Kaymak, 2010;

Phan, 2008; Phillips, 2001). Tüm bu belirlemeler bilimsel epistemolojik inançların eğitimdeki önemine ve çalışılmasına olan ihtiyaca dikkat çekmektedir.

Öğrencilerin konuyu kavramsal olarak anlamaları sonucunda sergiledikleri performansı ifade eden akademik başarı (Marshall ve Dorward, 2000) araştırmacılar tarafından araştırmaya değer önemli bir konu olarak karşımıza çıkmaktadır. Çünkü hangi yaş grubunda olursa olsun epistemolojik inançlar ve akademik başarı üzerine yapılan birçok çalışmada; epistemolojik inançların öğrencilerin akademik başarıları ile ilişkili olduğu bulunmuştur (örneğin; Koç-Erdamar ve Bangir-Alpan; Önen, 2011; Schommer ve Walker, 1997; Schommer-Aikins, Duell, ve Hutter, 2005; Schommer-Aikins, Duell, ve Barker, 2003; Schommer-Aikins ve Hutter, 2002; Topçu ve Yılmaz-Tüzün, 2009). Yapılan bu çalışmalarda akademik başarısı yüksek düzeyde olan öğrencilerin gelişmiş bilimsel epistemolojik inançlara sahip oldukları görülmektedir (örneğin; Cano, 2005; Conley vd., 2004; Driscoll, 2012; Evcim, vd., 2011; Hofer, 2000; Muis vd., 2006; Ricco, vd., 2010; Ryan, 1984; Sadıç ve Çam, 2015; Schommer, 1993; Tsai, Ho, Liang, ve Lin, 2011; Uysal, 2010) Ayrıca akademik yönden başarılı olan ve gelişmiş bilimsel epistemolojik inançlara sahip olan öğrenciler, düşük başarılı ve naif epistemolojik inançlara sahip öğrencilere göre daha nitelik ve fazla sayıda öğrenme stratejisi kullanmaktadırlar. Literatür ele alındığında, epistemolojik inançları ve öğrencilerin başarılarını birlikte ele alan çalışmalar bulunmaktadır (örneğin; Akgün ve Gülmez 2015; Aşut, 2013; Conley vd., 2004; Demirel ve Çam, 2016; Ricco, vd., 2010; Yankayış, Güven, ve Türkoğuz, 2014; Yeşilyurt, 2013). Fakat literatürde farklı başarı düzeyine sahip öğrencilerin bilimsel epistemolojik inançlarını nitel olarak belirlemeye çalışan ve ortaokul düzeyinde yapılan çalışmalara rastlanılmamıştır. Bu araştırma bu yönüyle de alanyazın için önem arz etmektedir. Dahası, öğrencilerin aktif öğrenenler olmaları ve yaşamlarının farklı evrelerinde başarılı olmaları için öğrencilerin bilimsel epistemolojik inançlarının tespit edilmesi önem taşımaktadır.

Bireyin kişisel özelliklerinin farkında olması, kendi öğrenmesiyle ilgili sorumlulukları alması, kendi kendine öğrenmesi için kendi biliş ve öğrenme özellikleri hakkında fikir sahibi olması için gerekli en önemli kavramlardan biri de üstbiliştir (Atay, 2014; Göçer, 2014; Baltacı ve Akpınar, 2011). Gelişim psikoloğu John Flavell'in 1970'lerde, üstbilişi bireyin kendi bilişsel yapısı hakkında bilgi sahibi olması ve bu bilişsel yapıyı düzenlemesi olarak tanımlaması ile terim alanyazına girmiş ve günümüze kadar farklı arastırmacılar tarafından farklı şekilde tanımlanmıştır (Akın, 2006; Borkowski, 1992; Chekwa, McFadden, Divine, ve Dorins, 2015; Demircioğlu, 2008; Hofer, 2004; Schraw, 1994; Share & Dover, 1987). Örneğin, Georghiades (2004) üstbilişi bireyin kendi zihinsel süreçleri hakkındaki bilgisi ve bu süreçleri yönetmesi olarak tanımlarken, Gama (2004) düşünce hakkında düşünme olarak ya da bireyin bilişi hakkındaki bilgisi olarak tanımlamaktadır. İlgili literatür incelendiğinde, üstbiliş gibi üstbilişsel farkındalığın da pek çok tanımının yapıldığı görülmektedir (örneğin; Balcı, 2007; Baykara, 2017; Boyce, VanTassel-Baksa, Burruss, Sher, ve Johnson, 1997; Flavell, 2000; Gallagher, 1997; Livingston, 1997; Olgun, 2011; O'Neil & Abedi, 1996). Wilson (1999) üstbilişsel farkındalığı, bireyin öğrenme sürecindeki farkındalığını, kişisel öğrenme stratejilerini, içerik bilgisi hakkındaki bilgilerini ve neyin yapılıp yapılmadığını bilmesini olarak tanımlamaktadır. Papaleontiou-Louca'ye (2003) göre üstbilişsel farkındalık; bilmeyi, algılamayı, anlamayı ve hatırlamayı kapsayan bir süreç olarak tanımlanmaktadır.

Üstbilişsel farkındalık eğitimde önemi gittikçe artan bir konudur (Carin ve Bass, 2001; Hartman, 2002; Llewellyn, 2005; Schraw vd., 2006). Bunun nedeni; üstbilişsel farkındalığın, bilgi edinme, başarılı bir öğrenme, kavramsal anlama, akılda tutma, öğrendiğini uygulama, bilinçli karar verme, ve problem çözme becerilerinin (Aydemir, 2014; Boyce vd., 1997; Çakıroğlu, 2007; Malkoç, 2011; Paul, 1992; Sapancı, 2012; Sbhatu, 2006; Senemoğlu, 2011; Solmaz, 2014) önemli bir parçası olarak kabul edilmesinin yanısıra eğitsel açıdan başka yararları da bulunmaktadır. En önemli eğitsel yararlarından birisi, öğrencilerin kendi öğrenmelerini kontrol eden ve öğrenmeyi öğrenen bağımsız bireyler olarak yetişmelerine katkıda bulunmasıdır (Çavuş, 2015; Papaleontiou-Louca, 2003). Dahası, öğrenenin düşünme biçiminin farkında olmasına, nasıl çalışacağına karar verirken yalnızca materyali öğrenmeye odaklanmayıp, aynı zamanda bilişsel güç ve zayıf yönlerini fark etmesine olanak sağlamaktadır (Çeliköz, Erişen, & Şahin, 2012). Bunlara ek olarak, üstbilişsel farkındalık; düşünme, öğrenme süreci ve ürünler üzerinde kontrol veya öz-düzenleme imkânı tanımaktadır (Hartman, 1998).

Üstbilişsel farkındalığın ayrıca akademik başarı üzerinde de bir etkiye sahip olduğu yaygın şekilde kabul gören bir görüştür (örneğin; Alcı et al., 2010; De Backer, Van Keer, & Valcke, 2012; Mega et al., 2014; Pilten, 2008; Ruban & Reis, 2006; Schleifer & Dull, 2009). Yapılan araştırmalarda üstbilişsel farkındalığı yüksek düzeyde olan öğrencilerin başarılı olmalarının nedenleri; kendi öğrenmelerinin farkında olmalarına, bu öğrenmeleri yönlendirebilmelerine (Senemoğlu, 2011), öğrenme surecine katılabilmelerine, öğrenme surecini planlayabilme ve değerlendirebilmelerine bağlanmıştır (Çakıroğlu, 2007). Ayrıca bazı araştırmacılar yüksek ve düşük başarılı öğrencilerin üstbilişsel farkındalıkları arasında önemli farklılıklar olduğunu ortaya koymuşlardır (örneğin; Alexander, Carr, ve Schwanenflugel, 1995; Hannah ve Shore, 1995; Schunk ve Zimmerman, 1994; Sperling vd., 2004). Düşük başarı düzeyine sahip öğrencilere göre, yüksek başarı düzeyine sahip öğrenciler yeni öğrendikleri bilgileri yeni durumlara ve olaylara daha iyi transfer edebilmekte, daha farklı ve yeni öğrenme stratejileri kullanabilmektedirler (Gurb, 2000; Hwang ve Vrongistinos, 2002; Romainville, 1994). Bunlara ek olarak, yüksek başarılı öğrenciler, düşük başarılı öğrencilere göre daha nitelikli öğrenmelere sahiptirler (Woolfolk, 1993).

Üstbilişsel farkındalığı ele alan çalışmalarda, öğrencilerin akademik başarıları ile üstbilişsel farkındalık düzeyleri arasındaki ilişki önemli bir araştırma konusu olarak karşımıza çıkmaktadır. Çünkü, bazı araştırmacılara göre; akademik başarı ile üstbilişsel farkındalık birbiri ile bağlantılıdır (örneğin; Bağçeci, Döş, ve Sarıca, 2011; Deseote ve Roeyers, 2002; Garner ve Alexander, 1989; Kruger ve Dunning, 1999; Sawhney ve Bansal, 2015; Turan ve Demirel, 2010; Young ve Fry, 2008). Bu araştırmacılar öğrencilerin akademik başarısı yükseldikçe üstbilişsel farkındalıklarının ve üstbilişsel becerilerinin daha gelişmiş olacağını ileri sürmüşlerdir (örneğin; Bağçeci, Döş, ve Sarıca, 2011; Cooper, 2008; Deseote ve Roeyers, 2002; Case, Harris, ve Graham, 1992; Kuiper, 2002; Sawhney ve Bansal, 2015; Sperling vd., 2004; Young ve Fry, 2008). Dahası, başarı düzeyleri yüksek olan öğrenciler kendi öğrenmelerini planlar, izler, değerlendirir, öğrenme stratejileri ile ilgili düşünür ve öğrenme sürecinin tüm kısımlarında sorumluluklarını alırlar, neyi bilip bilmediklerinin farkındadırlar ve tüm bunlar üstbilişsel farkındalıklarının yüksek düzeyde olmasına olanak sağlar (Everson ve Tobias, 1998; Schraw ve

Dennison, 1994). Ayrıca, başarı düzeyi yüksek olan öğrenciler başarı düzeyi düşük olan öğrencilere göre; daha iyi performans göstermekte, daha stratejik düşünmekte ve bunların sonucu olarak da üstbilişsel farkındalık düzeyleri daha yüksek olmaktadır (Carrell, Gajdusek, ve Wise, 1998; Coutinho, 2007; Garner ve Alexander, 1989; Desoete, Roeyers, ve Buysse, 2001). Literatür ele alındığında ise, üstbilişsel farkındalık ile öğrencilerin başarılarının birlikte ele alındığı çalışmalar bulunmaktadır (Bağçeci, Döş, ve Sarıca, 2011; Coutinho, 2007; Ruban ve Reis, 2006). Fakat literatürde farklı başarı düzeylerine sahip öğrencilerin üstbilişsel farkındalık düzeylerini nitel olarak belirlemeye çalışan ve ortaokul düzeyinde yapılan bir çalışmaya rastlanılamamıştır. Bu bağlamda, bu araştırma alanyazın için büyük bir önem arz etmektedir.

Yukarıda değinildiği üzere, çeşitli araştırma bulguları hem üstbilişsel farkındalığın hem de bilimsel epistemolojik inançların öğrenme, karar verme, problem çözme ve akademik başarı gibi değişkenler üzerinde etkili olduğunu göstermektedir. Bu nedenle; bu çalışmadan elde edilecek sonuçların; epistemolojik inançlar ve üstbilişsel farkındalık konularında çalışma yapan diğer araştırmacılarına yol göstereceği ve yeni çalışmalar için fikir üretmelerine yardımcı olacağı düşünülmektedir. Ayrıca bu çalışma öğretmenler açısından da bilimsel epistemolojik inanç ve üstbilişsel farkındalık düzeyleri düşük olan öğrencilere yönelik alınacak tedbirlerin belirlenmesi bakımından önemli katkılar sağlayacaktır.

Bu araştırma iki amaca hizmet etmektedir. Araştırmanın ilk amacı, farklı başarı seviyesinde olan ortaokul 6. sınıf öğrencilerinin bilimsel epistemolojik inançlarını belirlemektir. Diğer bir ifadeyle; öğrencilerin bilimsel bilgi edinme yolları, bilimsel bilginin değişen doğasına yönelik görüşleri ve bilimsel bilgiye ilişkin bakış açılarının ele alınması amaçlanmıştır. Araştırmanın ikinci amacı ise, farklı başarı seviyesinde olan ortaokul 6. sınıf öğrencilerinin üstbilişsel farkındalıklarını saptamaktır. Bu amaçlar doğrultusunda aşağıdaki sorulara cevap aranmıştır:

<u>Araştırma Sorusu 1:</u> 6. sınıf öğrencilerinin başarı düzeylerine ilişkin bilimsel epistemolojik inançları nedir?

Araştırma Sorusu 2: 6. Sınıf öğrencilerinin başarı düzeylerine ilişkin üstbilişsel farkındalıkları nedir?

Yöntem

Bu çalışma; eğitim alanında yaygın olarak kullanılan, yapılandırmacılığı temel alan, fenomonoloji ve sembolik etkileşimden beslenen nitel araştırma yöntemlerinden biri olan "temel nitel araştırma yöntemi" ile yürütülmüştür. Temel nitel araştırma deseni bu araştırmada, 6. sınıf öğrencilerinin bilimsel epistemolojik inançlarını ve üstbilişsel farkındalıklarını saptamak amacıyla kullanılmıştır. Merriam (2015) temel nitel araştırmayı bireylerin yaşamdaki deneyimlerini nasıl yorumladıklarını, ne gibi duygulara sahip olduklarını, dünyayı nasıl algıladıklarını ve biçimlendirdiklerini araştıran araştırmacılar tarafından kullanılan bir araştırma yöntemi olarak tanımlamıştır. Bu tanımdan yola çıkarak, temel nitel araştırmayı yöneten bir araştırmacının amacı, katılımcıların bir problem, fenomen veya konsept üzerine algılarını ortaya çıkararak, onları bütüncül ve kapsamlı bir biçimde yorumlamaktır (Creswell, 2009; Mack, Woodsong, Macqueen, Guest, ve Namey, 2005; Merriam, 2015; Merriam ve Tisdell, 2016).

Çalışmanın katılımcıları, 2015-2016 eğitim-öğretim yılında, Ankara il merkezinde yer alan bir devlet okulunda öğrenim gören 6. sınıfta öğrenim gören 15 öğrenciden oluşmaktadır. Katılımcı öğrencilerden 7'si kız, 8'i ise erkektir. Çalışmanın katılımcılarının belirlenmesinde, seçkisiz olmayan örneklem yöntemlerinden biri olan amaçsal örneklem yönteminden faydalanılmıştır. Bu örnekleme yöntemi ile araştırmacı, belirli bir amaç doğrultusunda veya odaklanılan konuyla ilgili ihtiyacı olan çalışma grubunu seçme imkânına sahiptir (Cohen, Monion, ve Morrison, 2007; Neuman, 2014; Patton, 2014; Punch, 2005). Amaçlı örnekleme yöntemi kendi içinde belirli alt türlere ayrılmaktadır (Merriam, 2015; Patton, 2014; Yıldırım & Şimşek, 2016). Bunlardan biri de bu çalışmada katılımcıların seçilmesinde kullanılan "ölçüt örnekleme" yöntemidir. Bu çalışmada katılımcıların seçilmesinde bazı ölçütler göz önünde bulundurulmuştur. Bu ölçütlerden ilki katılımcıların sınıf düzeyidir. Bu çalışmada ortaokul 6. sınıf öğrencileri ile çalışmanın yararlı olacağı düşünülerek araştırma kapsamına alınmıştır. Ölçütlerden ikincisi, seçilecek olan 6. sınıf öğrencilerin aynı okulda ve aynı sınıfta öğrenim gören öğrenciler olmasıdır. Ölçütlerden üçüncüsü ve sonuncusu ise, öğrencilerin başarı düzeyleridir. Araştırma için seçilen sınıfta öğrenim gören toplam 32 öğrenci yer almaktadır. Bu öğrencilerden 8'inin bir önceki dönem fen bilimleri dersi karne notu 5, 11 öğrencinin fen bilimleri dersi karne notu 3 ve 6 öğrencinin fen bilimleri dersi karne notu 1'dir. Ayrıca, araştırmacı fen bilimleri dersi karne notları bu şekilde olan 15 (5 başarı düzeyi yüksek, 5 başarı düzeyi orta ve 5 başarı düzeyi düşük) öğrenciyi seçerken, öğrencilerin fen bilimleri öğretmeniyle de detaylı konuşarak bilgi almıştır. Çünkü o sınıftaki öğrencileri en iyi tanıyan kişi o dersin öğretmenidir. Örneğin fen bilimleri dersi karne notu 5 olan 8 öğrenciden, 5'i seçilirken bu öğrencilerin derse katılım düzeyleri, görüşme sorulara yanıt verip vermeyecekleri gibi faktörler göz önüne alınmıştır. Daha sonra bir önceki dönem fen bilimleri karne notu 5 olan 8 öğrenciden 5'i, fen bilimleri karne notu 3 olan 11 öğrenciden 5'i ve fen bilimleri karne notu 1 olan 6 öğrenciden 5'i seçilmiştir. Fen bilimleri karne notu 2 olan 3 öğrenci ve fen bilimleri karne notu 4 olan 4 öğrenci çalışmaya dahil edilmemiştir. Çalışmada; öğretmenin öğrenciler ile ilgili görüşleri ve öğrencilerin 2015-2016 yılı güz dönemi fen bilimleri dersi karne notları dikkate alınarak başarı düzeyi yüksek olan 5 öğrenci, başarı düzeyi orta olan 5 öğrenci ve düşük başarı düzeyine sahip 5 öğrenci araştırmacı tarafından seçilmiştir. Katılımcıların seçilmesinde belirlenen bu üç ölçüt birlikte ele alınmıştır.

Çalışmanın veri toplama araçlarını; yarı yapılandırılmış görüşmeler oluşturmaktadır. Yarı yapılandırılmış görüşmenin tercih edilmesinde, çalışmanın amacı ve yarı yapılandırılmış görüşmelerin araştırmacıya sağladığı esneklikler önemli rol oynamıştır. Yarı yapılandırılmış görüşmede; araştırmacı öğrencinin anlamadığı ya da yanlış anladığı soruları tekrarlayabilir, soruları değişik biçimde sorabilir, soruların belli bir öncelik sırasına göre sorulma zorunluluğu olmadığından öğrencinin verdiği cevaplara göre sorulacak soruların yerlerini değiştirebilir ve daha derinlemesine cevaplar almak için ek sorular sorabilir. Böylelikle araştırmacı öğrencinin düşüncelerini ve bu düşüncelerin altında yatan nedenleri net ve ayrıntılı olarak ortaya çıkarılabilir (Altunışık vd., 2010; Aytar, 2011; Barbour ve Schostak, 2005; Hill, Thompson, ve Williams, 1997; Merriam, 2015; Tinsley, 1997; White ve Gunstone, 1992; Yıldırım & Şimşek, 2016; Zengin, 2015).

Çalışmada verilerin toplanmasında, araştırmacı tarafından geliştirilen iki farklı yarı yapılandırılmış görüşme protokolü kullanılmıştır. Her iki görüşme protokolü araştırmacı tarafından 2015-2016 eğitim- öğretim yılının güz döneminde tasarlanmış ve bir sonraki dönem amaçlı olarak seçilen 6. sınıf gönüllü 15 öğrenciye Şubat-Mart 2016 tarihleri arasında uygulanmıştır. Görüşme protokollerinde araştırmanın amacı doğrultusunda öğrencilere sorulacak sorular yer almaktadır.

Bilimsel epistemolojik inançlar görüşme protokolünün hazırlanmasında, öncelikli olarak yurtiçi ve yurtdışı literatürden yararlanılarak kuramsal çerçeve oluşturulmuştur. Bu bağlamda görüşme soruların oluşturulmasında, orjinali Conley ve arkadaşları (2004) tarafından geliştirilen ve Türkçeye Kurt (2009) tarafından çevrilen bilimsel epistemolojik inançlar ile ilgili anket sorularından yararlanılmıştır. Bu anket öğrencilerin bilimsel epistemolojik inançlarını bilginin kesinliği, bilginin gelişimi, bilginin kaynağı ve bilginin doğrulanması olmak üzere dört boyutta belirlemeye çalışmaktadır. Orjinali Conley ve meslektaşları (2004) tarafından geliştirilen bu anket 26 maddeden oluşmaktadır. Araştırmacı tarafından soruların araştırmanın amacına yönelik olmasına dikkat edilerek bilginin kesinlik boyutunu ölçen 4 soru, gelişim boyutunu ölçen 4 soru, kaynak boyutunu ölçen 4 soru ve de doğrulama boyutunu ölçen 4 soru olmak üzere açık uçlu toplam 16 soru hazırlanmıştır. Çalışmada kullanılan görüşme soruları Ek C' de verilmiştir.

Üstbilişsel farkındalık görüşme protokolünün hazırlanmasında, öncelikli olarak yurtiçi ve yurtdışı literatürden yararlanılarak kuramsal çerçeve oluşturulmuştur. Bu bağlamda görüşme soruların oluşturulmasında, orjinali Schraw and Dennison (1994) tarafından geliştirilen ve Türkçeye Akın ve arkadaşları (2007) tarafından çevrilen üstbilişsel farkındalık ile ilgili anket sorularından yararlanılmıştır. Bu anket bilişin bilgisi ve bilişin düzenlenmesi olmak üzere iki boyuttan oluşmakta ve her boyutun kendi içinde alt boyutları bulunmaktadır. Bilişin bilgisi boyutu altında; açıklayıcı bilgi, işlemsel bilgi ve durumsal bilgi olmak üzere üç alt boyut, bilişin düzenlenmesi boyutu altında ise; planlama, izleme, değerlendirme, hata ayıklama ve bilgi yönetimi olmak üzere beş alt boyut bulunmaktadır (Schraw & Dennison, 1994). Araştırmacı tarafından soruların araştırmanın amacına yönelik olmasına dikkat edilerek bilişin bilgisi ölçen 6 soru (2 soru açıklayıcı bilgi için, 2 soru işlemsel bilgi için, ve 2 soru durumsal bilgi için) ve bilişin düzenlenmesini ölçen 10 soru (2 soru planlama için, 2 soru izleme için, 2 soru değerlendirme için, 2 soru hata ayıklama için ve 2 soru bilgi yönetimi için) olmak üzere açık uçlu toplam 16 soru hazırlanmıştır. Çalışmada kullanılan görüşme soruları Ek D'de verilmiştir.

Bu araştırma kapsamında yapılan yarı yapılandırılmış görüşmeler öğrencilerinin ders dışı saatlerinde yapılmıştır. Katılımcılar ile gerçeklesen yarı yapılandırılmış görüşmeler uygulama yapılan okulun fen ve teknoloji laboratuvarında gerçekleştirilmiştir. Bütün bireysel görüşmeler katılımcıların uygun olduğunu beyan ettikleri zamanlarda yapılmıştır. Görüşmelere başlamadan önce her bir öğrenciye, etik ve şeffaflık kuralına uygunluk açısından, çalışmanın amacı ve içeriği hakkında açıklayıcı bilgiler verilmiştir. Dahası, öğrencilerin kendi bakış açılarını ve düşüncelerini cevaplarında yansıtabilmeleri için, öğrencilerin görüşmelerdeki sorulara verdikleri cevapların gizli kalacağı, hiçbir şekilde düşüncelerinden dolayı yargılanmayacakları, verdikleri cevapların bu çalışmanın dışında başka bir amaçla kullanılmayacağı ve kimliklerinin deşifre olmayacağı (takma isimler kullanılacağına) sözlü olarak belirtilerek garanti edilmiştir. Ayrıca, öğrencilere görüşme soruların doğru ya da yanlış cevaplarının olmadığı, en küçük ya da önemsiz olarak nitelendirdikleri düşüncelerinin bile çok önemli olduğu, zaman sınırlamalarının olmadığı, anlamadıkları sorunun istedikleri takdirde tekrardan okunabileceği ve sorular eğer yeterince açık değilse açıklama yapılabileceği ifade edilerek öğrencilere soruları istedikleri gibi cevaplayabilecekleri söylenmiştir. Bireysel görüşmeler 15 öğrenci ile yapılarak ses kaydı ile kayıt altına alınmıştır. Araştırmacı öğrenciler ile yapacağı bireysel görüşmeleri gerçekleştirmeden önce fen bilimleri dersinin öğretmeni ile bir araya gelmiş, öğrenciler ve fen bilimleri dersinin işlenişi hakkında bilgi almıştır. Edinilen bilgilere göre, öğretmen derslerinde argümantasyon, inquiry, probleme dayalı öğretim, deney, benzetim, soru-cevap gibi çesitli yöntem ve teknikleri kullanarak fen bilimlerini dersini işlemektedir. Hatta öğretmen öğrencilere ders kapsamında ödev verirken de, öğrencilerin materyal hazırlamalarına ve bu materyali veya ödevi sınıf içinde arkadaşlarına sunmalarına olanak sağlayacak şekilde ödev verdiğini ifade etmiştir.

Ortaokul 6. sınıf öğrencilerinin bilimsel epistemolojik inançlarının ve üstbilişsel farkındalıklarının belirlenmesini amaçlayan bu çalışmanın verileri, nitel analiz yöntemlerinden biri olan tematik analiz yöntemi kullanılarak analiz edilmiştir.

Literaturde farklı arastırmacılar tarafından farklı tanımlanan tematik analiz hem tümdengelim hem de tümevarım şeklinde uygulanabilmektedir (Ersoy, 2016; Frith & Gleeson, 2004). Tümdengelimci tematik analizlerde veriler kodlanmadan önce bir kod şeması oluşturulmakta ve bu şemaya göre veriler kodlanmaktadır. Bu doğrultuda, yapılan analizler genelden özele doğru ilerleme göstermektedir (Çetin, 2016). Dahası, bu analiz sürecinde veriler, araştırma sorularının ortaya koyduğu temalara göre oluşturulabildiği gibi görüşme sürecinde kullanılan sorular ya da boyutlar dikkate alınarak da sunulabilmektedir (Yıldırım & Şimşek, 2016). Tümevarımcı tematik analiz ise, tanımlanan tema ve kategoriler verilerin kendisiyle güçlü bir şekilde ilişkilidir (Patton, 1990). Bu nedenle tümevarımcı tematik analizde önceden var olan bir kod şemasına veya araştırmacının analitik önyargılarına bağlı kalınmadan veriler kodlanmaktadır (Thomas, 2003).

Bu çalışmada, öncelikle verilerin açık bir bakış açısıyla incelenebilmesi ve öğrencilerin görüşme sorularına verdikleri cevapların tam olarak anlaşılabilmesi için araştırmacının sahip olduğu ön yargı, bakış açısı, varsayım ve bilgiler mümkün olduğunca göz ardı edilerek doğrudan katılımcıların görüşlerine odaklanılmaya çalışmıştır. Bu sağlandıktan sonra, yarı-yapılandırılmış görüşmeler aracılığıyla öğrencilerle gerçekleştirilen ve kayıt altına alınan görüşmeler hiçbir değişikliğe uğratılmadan yazılı olarak bilgisayar ortamına aktarılarak transkriptler oluşturulmuş ve bu transkriptler analiz için hazır hale getirilmiştir. Verilerinin yazılı dökümü yapıldıktan sonra, veriler araştırmacı tarafından tekrar tekrar okunarak iyice özümsenmiştir. Daha sonra, dökümü yapılan verilerdeki kelimeler, cümleler ve paragraflar kodlama için belirlenip işaretlenerek kodlama aşamasına geçilmiştir. Kodlar birbirleriyle ilişkili olma durumlarına göre farklı tema ya da alt temalar altında toplanmıştır. Bu süreç tematik kodlama aşamasıdır. Bu aşamada epistemolojik inançlar ve üstbilişsel farkındalık konularında nitel çalışmaları bulunan uzmanlardan yardım alınarak bağımsız kodlayıcılar arasındaki tutarlılık sağlanmaya çalışılmıştır. Bu işlem sırasında yansız atama ile belirlenmiş ve tüm görüşmelerin %20-25'ine (Gay, 1987) karşılık gelen görüşmeler başka araştırmacılar tarafından kodlanmıştır. Kodlayıcılar hakkında bilgi vermek gerekirse, kodlayıcılardan birisi matematik eğitimi alanında doktora yapmış, tezinde metacognitive awareness konusu üzerine çalışmış, ayrıca bu konuda nitel çalışmaları olan ve şu an İstanbul'da bir vakıf üniversitesinde görev yapmakta olan Dr. Öğretim Üyesidir. Bir diğer kodlayıcı kişi ise beden eğitimi alanında doktora eğitimini tamamlamış, tezinde scientific epistemological beliefs konusunu nitel araştırma yöntemi kullanarak çalışmış ve şu an Trabzon da bir devlet üniversitesinde görev yapmakta olan Dr. Araştırma Görevlisidir. Daha sonra, araştırmanın güvenilirlik hesaplaması için Miles ve Huberman'ın (1994) önerdiği güvenirlik formülü kullanılmıştır. Bilimsel epistemolojik inançlar için iki kodlayıcı arasındaki anlaşma yüzdesi %91, üstbiliş farkındalık ile ilgili iki kodlayıcı arasındaki anlaşma yüzdesi %87 olarak hesaplanmıştır. Hesaplanan bu değerler Miles ve Huberman'in önerdiği %80 değerinden fazla bulunmuştur.

Öğrencilerin Bilimsel Epistemolojik İnançlarına İlişkin Bulgular

Öğrencilerin bilimsel epistemolojik inançlarına ilişkin bulgular; bilginin doğası ve bilmenin doğası olmak üzere iki tema, bilginin kesinliği, bilginin gelişimi, bilginin kaynağı ve bilginin doğrulanması olmak üzere dört kategori ortaya çıktığını göstermiştir. Bu kategoriler ayrı ayrı ele alındığında; bilginin kesinliği kategorisinde *dogmatik* ve *şüpheci* kodu; bilginin gelişimi kategorisinde *bilimdeki bilgi veya fikirler değişebilir* ve *bilimdeki bilgi veya fikirler değişemez* kodu; bilginin kaynağı kategorisinde *otorite, bilimsel yöntem, deneyim* and *akıl yürütme* kodları ve bilginin doğrulanması kategorisinde ise *deney, gözlem, kanıtlama, araştırma yapma* ve *otorite* kodları ortaya çıkmıştır. Öğrencilerin bilimsel epistemolojik inançlarına ilişkin bulgular; yüksek başarı düzeyine sahip öğrencilerin bilimsel epistemolojik inançları, orta başarı düzeyine sahip öğrencilerin bilimsel epistemolojik inançları ve düşük başarı düzeyine sahip öğrencilerin bilimsel epistemolojik inançları olmak üzere üç alt baslıkta sunulmuştur.

Yüksek Başarı Düzeyine Sahip Öğrencilerin Bilimsel Epistemolojik İnançları

Yüksek başarılı 6. sınıf öğrencileri bilginin kesinliği kategorisindeki *"şüpheci"* kodu f (13) ile ilgili daha fazla görüş bildirirken, "*dogmatik"* kodu f (5) ile ilgili görüşlere daha az yer vermişlerdir. Yani yüksek başarılı öğrencilerin çoğunlukla ifadeleri, bilimsel bilgi açısından değişmez doğrulardan söz edilemeyeceği yönündedir. Bu nedenle, yüksek başarılı öğrencilerin certainty of knowledge kategorisinde genel olarak gelişmiş/olgunlaşmış bilimsel epistemolojik inançlara sahip olduğu bulgusuna ulaşılmıştır.

Yüksek başarılı öğrencilerin bilginin gelişimi kategorisindeki *bilimdeki bilgi veya fikirler değişebilir* kodunun frekansı f (14) iken, *bilimdeki bilgi veya fikirler değişmez* kodunun frekansı f (5)'tir. Bu bulgu, yüksek başarılı öğrencilerin çoğunlukla bilimsel bilginin değişebileceği yönünde ifadeler kullanmış oldukları göstermektedir. Bu noktada, yüksek başarılı öğrencilerin development of knowledge kategorisinde genel olarak gelişmiş/olgunlaşmış bilimsel epistemolojik inançlara sahip olduğu vurgulanabilir.

Yüksek başarılı öğrencilerin bilginin kaynağı kategorisindeki *bilimsel yöntem* f (4) ve *akıl yürütme* f (2) kodlarının frekansları toplamı f (6) iken, *otorite* kodunun frekansı f (8)'dir. Bu bulguya göre, yüksek başarılı öğrenciler bilginin kaynağını bilim insani, öğretmen, kitap, aile büyükleri gibi otorite tarafından üretildiğine ve oluşturulduğuna inanmaktadırlar. Diğer bir ifadeyle, yüksek başarılı öğrencilerin source of knowledge kategorisinde genel olarak gelişmemiş/olgunlaşmamış bilimsel epistemolojik inançlara sahiptirler.

Yüksek başarılı öğrencilerin bilginin doğrulanması kategorisindeki *deney* f (12), *araştırma yapma* f (3), *kanıtlama* f (2) ve *gözlem* f (1) kodlarının frekansları toplamı f (18) olduğundan ve *otorite* kodu hiçbir şekilde ifade edilmediğinden dolayı, yüksek başarılı öğrencilerin bilginin doğrulanması kategorisinde genel olarak gelişmiş/olgunlaşmış bilimsel epistemolojik inançlara sahip olduğu söylenebilir.

Orta Başarı Düzeyine Sahip Öğrencilerin Bilimsel Epistemolojik İnançları

Orta başarılı 6. sınıf öğrencileri bilginin kesinliği kategorisindeki *"şüpheci"* kodu f (10) ile ilgili daha fazla görüş bildirirken, "*dogmatik"* kodu f (5) ile ilgili görüşlere daha az yer vermişlerdir. Diğer bir ifadeyle; orta başarılı öğrencilerin çoğunluğu, bilimsel bilgi açısından kesin doğrulardan bahsetmenin söz konusu olmadığını savunmaktadır. Dolayısıyla, orta başarılı öğrencilerin certainty of knowledge kategorisinde genel olarak gelişmiş/olgunlaşmış bilimsel epistemolojik inançlara sahip olduğu saptanmıştır.

Orta başarılı 6. sınıf öğrencilerinin bilginin gelişimi kategorisindeki *bilimdeki bilgi veya fikirler değişebilir* kodunun frekansı f (4) iken, *bilimdeki bilgi veya fikirler değişemez* kodunun frekansı f (6) olduğundan dolayı; orta başarılı öğrencilerin çoğunlukla bilimsel bilginin değişmeyeceğine inandıkları ve o yönde ifadeler kullandıkları sonucuna ulaşılabilir. Diğer bir ifadeyle, orta başarılı öğrencilerin development of knowledge kategorisinde genel olarak gelişmemiş/olgunlaşmamış bilimsel epistemolojik inançlara sahip olduğu söylenebilir.

Orta başarılı öğrencilerin bilginin kaynağı kategorisindeki *akıl yürütme* f (2) ve *deneyim* f (1) kodlarının frekansları toplamı f (3) iken, *otorite* kodunun frekansı f (6)'dır. Bu bulguya göre, orta başarılı öğrenciler bilginin kaynağının bilim insanı, öğretmen, kitap ve aile büyükleri gibi otoriteler olduğuna inanmaktadırlar. Bu nedenle, orta başarılı öğrencilerin source of knowledge kategorisinde genel olarak gelişmemiş/olgunlaşmamış bilimsel epistemolojik inançlara sahip olduğunu vurgulayabiliriz.

Orta başarılı 6. sınıf öğrencileri bilginin doğrulanması kategorisindeki *"deney"* kodu f (5) ile ilgili daha fazla görüş bildirirken, "*otorite"* kodu f (2) ile ilgili görüşlere daha az yer vermişlerdir. Yani orta başarılı öğrencilerin çoğunlukla ifadeleri, bilimsel bilgilerin deneyle doğrulanabileceği yönündedir. Bu nedenle, orta başarılı öğrencilerin bilginin doğrulanması kategorisinde genel olarak gelişmiş/olgunlaşmış bilimsel epistemolojik inançlara sahip olduğu bulgusuna ulaşılmıştır.

Düşük Başarı Düzeyine Sahip Öğrencilerin Bilimsel Epistemolojik İnançları

Düşük başarılı 6. sınıf öğrencilerinin certainty of knowledge kategorisindeki *"şüpheci"* kodu f (5) iken, "*dogmatik"* kodu f (4)'tur. Bu nedenle, düşük başarılı öğrencilerin certainty of knowledge kategorisinde genel olarak gelişmiş bilimsel epistemolojik inançlara sahip olduğu ifade edilebilir.

Düşük başarılı öğrencilerin development of knowledge kategorisindeki *bilimdeki bilgi veya fikirler değişebilir* kodunun frekansı f (6) iken, *bilimdeki bilgi veya fikirler değişmez* kodunun frekansı f (3)'tir. Bu bulgu, düşük başarılı öğrencilerin çoğunlukla bilimsel bilginin değişebileceği yönünde ifadeler kullanmış olduklarını göstermektedir. Bu nedenle, düşük başarılı öğrencilerin development of knowledge kategorisinde genel olarak gelişmiş/olgunlaşmış bilimsel epistemolojik inançlara sahip olduğu ifade edilebilir.

Düşük başarılı öğrencilerin source of knowledge kategorisindeki *bilimsel yöntem* kodunun frekansı f (2) iken, *otorite* kodunun frekansı f (6)'dır. Bu bulgu, düşük başarılı öğrencilerin bilginin kaynağını olarak bilim insanı, öğretmen ve kitap gibi otoriteleri gördüğünü destekler niteliktedir. Dolayısıyla, düşük başarılı öğrencilerin source of knowledge kategorisinde genel olarak gelişmemiş/olgunlaşmamış bilimsel epistemolojik inançlara sahip olduğunu söyleyebiliriz.

Düşük başarılı 6. sınıf öğrencileri bilginin doğrulanması kategorisindeki *"otorite"* kodu f (4) ile ilgili daha fazla görüş bildirirken, "*deney"* kodu f (3) ile ilgili görüşlere daha az yer vermişlerdir. Yani orta başarılı öğrencilerin çoğunlukla ifadeleri, bilimsel bilgilerin otorite aracılığıyla doğrulanabileceği yönündedir. Bu nedenle, düşük başarılı öğrencilerin justification for knowing kategorisinde genel olarak gelişmemiş/olgunlaşmamış bilimsel epistemolojik inançlara sahip olduğu bulgusuna ulaşılmıştır.

Öğrencilerin Üstbilişsel Farkındalıklarına İlişkin Bulgular

Öğrencilerin üstbilişsel farkındalıklarına ilişkin bulgular; bilişin bilgisi ve bilişin düzenlenmesi olmak üzere iki tema, açıklayıcı bilgi, işlemsel bilgi, durumsal bilgi, planlama, izleme, değerlendirme, hata ayıklama ve bilgi yönetimi olmak üzere sekiz kategori ortaya çıktığını göstermiştir. Bu kategoriler ayrı ayrı ele alınıp incelendiğinde; açıklayıcı bilgi kategorisinde *ilgi duyma, merak, bilgiyi hatırlama* ve *aktif olma* kodları; işlemsel bilgi kategorisinde *sorular sorma, araştırma yapma, test çözme, okuma, ezberleme, bağlantı kurma, deney yapma, kendi kendine anlatma, resim çizme, yazma, özet çıkarma, video izleme, tekrar etme, oyunlaştırma* ve *canlandırma* kodları; durumsal bilgi kategorisinde farklı *öğrenme stratejileri kullanma* ve *motive olma* kodları; planlama kategorisinde *amaçlarını belirleme, uygun kaynak seçimi, uygun strateji/yöntem seçimi* ve *gerekli materyalleri/malzemeleri belirleme* kodları; izleme kategorisinde *kendi kendine sorular sorma* ve *gözden geçirme* kodları; değerlendirme kategorisinde *anlayıp anlamadığını değerlendirme, daha iyi nasıl öğrenebileceğini değerlendirme* ve *özetleme* kodları; hata ayıklama kategorisinde *yardım alma* ve *durup anlamadığı yeri tekrar* kodları ve bilgi yönetimi kategorisinde ise; *önemli bilgilere odaklanma, çalışmayı küçük adımlara ayırma, yeni bilginin anlamına odaklanma, genel anlamlara odaklanma, özel anlamlara odaklanma* ve *öğrenmeye yardımcı olması için şekil çizme* kodları ortaya çıkmıştır. Öğrencilerin üstbilişsel farkındalıklarına ilişkin bulgular; yüksek başarı düzeyine sahip öğrencilerin üstbilişsel farkındalıkları, orta başarı düzeyine sahip öğrencilerin üstbilişsel farkındalıkları ve düşük başarı düzeyine sahip öğrencilerin üstbilişsel farkındalıkları olmak üzere üç alt başlıkta sunulmuştur.

Yüksek Başarı Düzeyine Sahip Öğrencilerin Üstbilişsel Farkındalıkları

Yüksek başarılı 6. sınıf öğrencileri bilişin bilgisi teması altında açıklayıcı bilgi kategorisinde bulunan kodların frekansları toplamı f (11), işlemsel bilgi kategorisinde bulunan kodların frekansları toplamı f (34) ve durumsal bilgi kategorisinde bulunan kodların frekansları toplamı f (24) olduğundan; yüksek başarılı öğrencilerin en fazla işlemsel bilgi kategorisinde, en az da açıklayıcı bilgi kategorisinde görüşlerine bildirdikleri sonucuna ulaşılabilir.

Yüksek başarılı 6. sınıf öğrencileri bilisin düzenlenmesi teması altında planlama kategorisinde bulunan kodların frekansları toplamı f (11), izleme kategorisinde bulunan kodların frekansları toplamı f (4), değerlendirme kategorisinde bulunan kodların frekansları toplamı f (13), hata ayıklama kategorisi altında bulunan kodların frekansları toplamı f (9) ve bilgi yönetimi kategorisinde bulunan kodun frekansı f (13) olduğundan; yüksek başarılı öğrencilerin en fazla değerlendirme ve bilgi yönetimi kategorilerinde, en az da izleme kategorisinde görüşlerini ifade ettiklerini söylenebilir.

Yukarıdaki bulgular ışığında, yüksek başarılı öğrencilerin bilişin bilgisi teması altında daha fazla sayıda görüş bildirdiği öne sürülebilir.

Orta Başarı Düzeyine Sahip Öğrencilerin Üstbilişsel Farkındalıkları

Orta başarılı 6. sınıf öğrencileri bilişin bilgisi teması altında açıklayıcı bilgi kategorisinde bulunan kodların frekansları toplamı f (7), işlemsel bilgi kategorisinde bulunan kodların frekansları toplamı f (15) ve durumsal bilgi kategorisinde bulunan kodların frekansları toplamı f (12) olduğundan; orta başarılı öğrencilerin en fazla işlemsel bilgi kategorisinde, en az da açıklayıcı bilgi kategorisinde görüşlerine bildirdiklerini söyleyebiliriz.

Orta başarılı 6. sınıf öğrencileri bilişin düzenlenmesi teması altında planlama kategorisinde bulunan kodların frekansları toplamı f (8), izleme kategorisinde bulunan kodların frekansları toplamı f (3), değerlendirme kategorisinde bulunan kodların frekansları toplamı f (3), hata ayıklama kategorisi altında bulunan kodların frekansları toplamı f (10) ve bilgi yönetimi kategorisinde bulunan kodun frekansı f (4) olduğundan; orta başarılı öğrencilerin en fazla hata ayıklama kategorisinde, en az da izleme ve değerlendirme kategorilerinde düşüncelerini bildirdikleri ifade edilebilir.

Yukarıda belirtilen bulgular doğrultusunda, orta başarılı öğrencilerin bilişin bilgisi teması altında daha fazla sayıda görüş bildirdiği görülmektedir.

Düşük Başarı Düzeyine Sahip Öğrencilerin Üstbilişsel Farkındalıkları

Düşük başarılı 6. sınıf öğrencileri bilişin bilgisi teması altında açıklayıcı bilgi kategorisinde bulunan kodların frekansları toplamı f (7), işlemsel bilgi kategorisinde bulunan kodların frekansları toplamı f (13) ve durumsal bilgi kategorisinde bulunan kodların frekansları toplamı f (9) olduğundan; düşük başarılı öğrencilerin en fazla işlemsel bilgi kategorisi üzerine görüşlerini bildirdikleri ifade edilebilir.

Düşük başarılı 6. sınıf öğrencileri bilişin düzenlenmesi teması altında planlama kategorisinde bulunan kodların frekansları toplamı f (4), izleme kategorisinde bulunan kodların frekansları toplamı f (5), değerlendirme kategorisinde bulunan kodların frekansları toplamı f (6), hata ayıklama kategorisi altında bulunan kodların frekansları toplamı f (11) ve bilgi yönetimi kategorisinde bulunan kodun frekansı f (1) olduğundan; düşük başarılı öğrencilerin en fazla hata ayıklama kategorisi üzerine görüşlerini bildirirken, en az bilgi yönetimi kategorisi üzerine düşüncelerini bildirdikleri söylenebilir.

Yukarıda ortaya konulan bulgular doğrultusunda, düşük başarılı öğrencilerin bilişin bilgisi teması altında, bilişin düzenlenmesi teması göre daha fazla sayıda görüş bildirdiği saptanmıştır.

Sonuçlar, Tartışma ve Öneriler

Ortaokul öğrencilerinin bilimsel epistemolojik inançlarına ilişkin nitel bulgulardan elde edilen sonuçlardan birisi; yüksek başarılı ortaokul öğrencileri bilginin kesinliği, bilginin gelişimi ve bilginin doğrulanması kategorilerinde genel olarak gelişmiş bilimsel epistemolojik inançlara sahiplerken, bilginin kaynağı kategorisinde gelişmemiş (naif) bilimsel epistemolojik inançlara sahip olduklarıdır. Diğer bir ifadeyle, yüksek başarılı ortaokul öğrencilerinin bilimsel epistemolojik inançları 4 kategoriden 3'unde gelişmiş düzeyde iken, 1'inde gelişmemiş düzeydedir. Araştırmanın bu sonucu, literatürde öğrencilerin bilimsel epistemolojik inançlarının farkı boyutlar için farklı gelişmişlik düzeyinde olabileceğini destekler niteliktedir (Schommer, 1990; Schommer, 1994; Songer ve Linn, 1991; Yenice & Ozden, 2013).

Yüksek başarılı öğrencilerin bilginin kesinliği, bilginin gelişimi ve bilginin doğrulanması kategorilerinde genel olarak gelişmiş bilimsel epistemolojik inançlara sahip oldukları sonucundan yola çıkarak öğrencilerin genel geçer tek bir doğrunun var olduğuna inanmadıkları, bilim insanlarının fikirlerinin değişebileceğine inandıkları bu anlamda çağdaş bilimsel bilgi anlayışına sahip oldukları ve bilimsel bilginin gerekçelendirilmesi gerektiğine inandıkları söylenebilir. Ayrıca yüksek başarılı öğrencilerin bilginin doğrulanması kategorisinde sophisticated bilimsel epistemolojik inançlara sahip olmalarının nedeni, öğrencilerin bilimde deney yapmanın önemini ve doğru cevaba ulaşmak için sadece tek bir deney değil, birden fazla deneyin yapılması gerektiği anlamış olmaları şeklinde yorumlanabilir.

Çalışmanın bir diğer sonucu; orta başarılı ortaokul öğrencileri bilginin kesinliği ve bilginin doğrulanması kategorilerinde genel olarak gelişmiş bilimsel epistemolojik inançlara sahipken, bilginin gelişimi ve bilginin kaynağı kategorilerinde ise gelişmemiş bilimsel epistemolojik inançlara sahip olduklarıdır. Buradan, orta başarılı ortaokul öğrencilerinin bilimsel bilginin kesin ve tek bir cevabının olmadığı ve ulaşılan bilimsel bilgilerin bir gerekçesinin olması gerektiğini düşündükleri yorumu yapılabilir. Ayrıca, orta başarılı öğrencilerin bilginin kaynağı kategorisinde gelişmemiş bilimsel epistemolojik inançlara sahip olduğu sonucuna dayanarak, öğrencilerin bilimsel bilginin kaynağı olarak kitap, öğretmen gibi otoriteleri tercih etmedikleri ve bilgiyi kendi zihinlerinde yapılandırarak, bilginin kaynağı olarak akıl yürütmeyi (reasoning) gördükleri söylenebilir.

Düşük başarılı ortaokul öğrencileri bilginin kesinliği ve bilginin gelişimi kategorilerinde genel olarak gelişmiş bilimsel epistemolojik inançlara sahipken, bilginin kaynağı ve bilginin doğrulanması kategorilerinde ise gelişmemiş bilimsel epistemolojik inançlara sahip oldukları sonucuna ulaşılmıştır. Araştırmanın bu sonucu, Schommer (1990, 1994) ve Hofer ve Pintrich (1997, 2002)'in sonuçları ile uyuşmaktadır. Bu araştırmalarda, bilimsel epistemolojik inançların dikey bir gelişme göstermediği, bazı boyutlarda gelişmiş bilimsel epistemolojik inanışlar gösteren öğrencilerin bazı boyutlarda gelişmemiş bilimsel epistemolojik inanışlar gösterdikleri vurgulanmaktadır.

Düşük başarılı ortaokul öğrencileri bilginin kesinliği ve bilginin gelişimi kategorilerinde genel olarak gelişmiş bilimsel epistemolojik inançlara sahipken, bilginin kaynağı ve bilginin doğrulanması kategorilerinde ise gelişmemiş bilimsel epistemolojik inançlara sahip olmaları çeşitli sebeplerden kaynaklanmış olabilir. Deryakulu (2004) bireylerin bilimsel epistemolojik inançlarını farklı boyutlar için farklı gelişmiş düzeyinde olabileceğini bu epistemolojik inançların oluşumunu etkileyen faktörleri; zihinsel gelişim, eğitim düzeyi, yaş, öğrenim görülen alan, aile ve kültür başlıkları altında toplamıştır. Öğrencilerin bilimsel epistemolojik inançlarındaki farklılıkların sebepleri bu çalışmanın konusunu oluşturmadığından araştırılmamıştır fakat öğrencilerin yaşlarının, eğitim durumlarının aynı olduğu göz önüne alındığında, bilimsel epistemolojik inançların alt boyutlarında meydana gelen farklılıkların aile ve kültürden kaynaklanmış olabileceği yorumu yapılabilir.

Bu çalışmanın ilgi çekici sonuçlarından biri ise; bilginin kesinliği kategorisinde yüksek, orta ve düşük başarılı öğrencilerin geneli gelişmiş bilimsel epistemolojik inançlara sahiplerken; bilginin kaynağı kategorisinde yüksek, orta ve düşük başarılı öğrencilerin geneli gelişmemiş bilimsel epistemolojik inançlara sahiptirler. Diğer bir ifadeyle, yüksek, orta ve düşük başarılı öğrenciler genel olarak bilimsel bilginin kesin ve tek bir cevabının olmadığına inanırken, bilginin kaynağı olarak otoriteyi (kitap, öğretmen vb.) kabul etmektedirler.

Yüksek, orta ve düşük başarılı öğrencilerin bilginin kaynağı kategorisinde gelişmemiş epistemolojik inançlara sahip olmalarının birçok nedeni olabilir. Bu nedenlerden birisi, öğrencilerin eğitim süreçleri boyunca yapılandırmacı yaklaşımın tam ve doğru uygulanmamış olması olabilir. Yani öğrencilere bilgiye kendilerinin ulaşması ve bilgiyi yapılandırması gerektiğinin tam olarak benimsetilmemiş olması olabilir.

Çalışmanın bir diğer dikkate değer sonucu ise, yüksek başarılı ortaokul öğrencileri bilimsel epistemolojik inançların üç (bilginin kesinliği, bilginin gelişimi ve bilginin doğrulanması) kategorisinde gelişmiş bilimsel epistemolojik inançlara sahipken, orta başarılı ortaokul öğrencileri iki (bilginin kesinliği ve bilginin doğrulanması) ve düşük başarılı ortaokul öğrencileri iki (bilginin kesinliği ve bilginin gelişimi) kategorilerinde sophisticated bilimsel epistemolojik inançlara sahiptirler. Yani yüksek başarılı öğrenciler, orta başarılı ve düşük başarılı öğrencilere göre bilimsel epistemolojik inançların daha fazla boyutunda gelişmiş inançlara sahiptirler yorumu yapılabilir.

Ortaokul öğrencilerinin üstbilişsel farkındalıklarına ilişkin nitel bulgulardan elde edilen sonuçlara göre; yüksek başarılı ortaokul öğrencileri bilişin bilgisi teması altında en çok açıklayıcı bilgi kategorisinde görüş bildirirken, bilişin düzenlenmesi teması altında ise; en fazla değerlendirme ve bilgi yönetimi kategorilerinde, en az da izleme kategorisinde görüşlerini bildirdikleri sonucuna ulaşılmıştır. Bu çalışmada yüksek başarılı öğrencilerin bilişin düzenlenmesi teması altında en fazla görüşlerini ifade ettiği kategorilerden birisinin değerlendirme kategorisi olduğu sonucu beklenen bir sonuç olup, bu sonuç doğrultusunda yüksek başarılı öğrencilerin ne öğrenip öğrenmediğini, konuyu kavrayıp kavramadığını ve kendi performanslarını değerlendirdiği yorumu yapılabilir. Dahası, alanyazında üstbilişsel farkındalığın planlama boyutunda daha gelişmiş olması öğrencilerin öğrenmesini ve öğrenme görevlerinin planladığı ve önemli ve gerekli olmayan bilgileri ayırt edebildiği seklinde yorumlanırken, üstbilişsel farkındalığın değerlendirme boyutunda daha gelişmiş olması öğrencilerin kendi öğrenimlerini değerlendirebildiği olarak yorumlanmaktadır (örneğin; Aydemir, 2014; Altındağ & Senemoğlu, 2013; Drmrod, 1990). Bunlara ek olarak, yüksek başarılı ortaokul öğrencilerinin bilişin bilgisi teması altında en çok işlemsel bilgi kategorisinde görüş bildirmelerinin nedeni de öğrencilerin kendi öğrenmeleri hakkında ve öğrenme sürecinde kullanacakları stratejiler hakkında yeterliliğe sahip olmaları seklinde yorumlanabilir.

Araştırmadan elde edilen diğer sonuçlara göre, orta başarılı ortaokul öğrencileri bilişin bilgisi teması altında en çok işlemsel bilgi kategorisinde en az da açıklayıcı bilgi kategorisinde görüşlerini bildirirken, bilişin düzenlenmesi teması altında ise; en fazla hata ayıklama kategorisinde, en az da izleme ve değerlendirme kategorilerinde düşüncelerini bildirdikleri sonucuna ulaşılmıştır. Orta başarılı ortaokul öğrencilerin bilişin bilgisi teması altında en çok işlemsel bilgi kategorisinde görüşlerini bildirmeleri öğrencilerin yeni bir şey öğrenirken ve ders çalışırken kullandıkları stratejilerin farkında oldukları seklinde yorumlanırken, orta başarılı ortaokul öğrencilerinin bilişin düzenlenmesi teması altında en az evaluation ve monitoring kategorilerinde görüşlerini bildirmeleri ise öğrencilerin kendi öğrenimlerini değerlendiremedikleri ve kendi öğrenimlerini veya performanslarını izleyemedikleri seklinde yorumlanabilir.

Çalışmanın bir başka sonucu ise, düşük başarılı ortaokul öğrencileri bilişin bilgisi teması altında en çok işlemsel bilgi kategorisinde en az da açıklayıcı bilgi kategorisinde görüşlerini bildirirken, bilişin düzenlenmesi teması altında ise; en fazla hata ayıklama kategorisinde, en az da bilgi yönetimi kategorisinde düşüncelerini bildirdikleri sonucuna ulaşılmıştır. Düşük başarılı ortaokul öğrencilerinin bilişin bilgisi teması altında en az açıklayıcı bilgi kategorisinde görüş bildirmelerinin nedeni olarakta, öğrencilerin kişisel yeteneklerinin, kendi güçlü ve zayıf yönlerinin farkında olmamaları söylenebilir.

Bu çalışmanın ilgi çekici sonuçlarından biri ise; öğrencilerin bilimsel üstbilişsel farkındalıklarının bilişin bilgisi ve bilişin düzenlenmesi olmak üzere iki temada toplandığı ve yüksek, orta ve düşük başarılı ortaokul öğrencilerinin görüşlerini en fazla bilişin bilgisi teması altında bulunan işlemsel bilgi kategorisinde ortaya koyduklarıdır.

Bilişin düzenlenmesi teması altında bulunan kategorilerdeki sonuçlar öğrencilerin başarı düzeylerine göre değerlendirildiğinde ise hem orta hem de düşük başarılı öğrencilerin en fazla hata ayıklama kategorisinde görüşlerini ifade ederken, yüksek başarılı öğrencilerin en fazla ve eşit sayıda değerlendirme ve bilgi yönetimi kategorilerinde görüşlerini ifade ettikleri saptanmıştır. Orta başarılı ve düşük başarılı öğrencilerin bilişin düzenlenmesi teması altında en fazla hata ayıklama kategorisinde görüşlerini ifade etmeleri bu öğrencilerin öğrenme sırasında hatalarının farkında oldukları ve bu hataları düzeltmek için öğretmen, arkadaş, aile gibi kişilerden yârdim alarak anlamadıkları yerleri anlamaya çalıştıkları şeklinde yorumlanırken, yüksek başarılı öğrencilerin bilişin düzenlenmesi teması altında en fazla değerlendirme ve bilgi yönetimi kategorilerinde görüşlerini ifade etmeleri ise, öğrencilerin öğrenip öğrenmediklerini değerlendirebilmesi yani öz değerlendirme yapabildiği ve öğrendiği eski ve yeni bilgi arasında ilişki kurarak bilgiyi yönetebildiği seklinde yorumlanmaktadır.

Araştırmadan elde edilen sonuçlar, 6. sınıf ortaokul öğrencilerinin bilimsel epistemolojik inançlarının ve üstbilişsel farkındalıklarının farklı boyutlar için farklı gelişmişlik düzeylerinde olabileceğini göstermektedir. Bu nedenle, eğitim-öğretim sürecinde tüm öğrencilerin bilimsel epistemolojik inançlarının ve üstbilişsel farkındalıklarının aynı gelişmişlik düzeyine sahip olduğu varsayımıyla hareket edilmemeli; bilimsel epistemolojik inançlar ve üstbilişsel farkındalık kavramları önemli bireysel farklılıklar olarak dikkate alınmalıdır. Böyle bir girişim, ortaokul öğrencileriyle daha etkili ve sağlıklı bir iletişim kurulabilmesinde ve eğitim-öğretim süreçlerinin daha etkili ve verimli bir biçimde yerine getirilebilmesinde oldukça önemlidir.

Fen Bilimleri Öğretim Program geliştiren araştırmacıların, öğrenci kazanımlarını hazırlarken hem bilimsel epistemolojik inançlara hem de üstbilişsel farkındalığa daha fazla yer vermeleri önerilmektedir. Ayrıca, öğrencilerin yüksek bilimsel epistemolojik inanca ve üstbilişsel farkındalık düzeyine sahip olmaları için, ders içeriklerinde de bu yapılar yer almalıdır. Bu düzenlemeler öğrencilerin gelişim özelliklerine göre aşamalı bir yapı izlemelidir.

Bu çalışmada, araştırmacı tarafından, öğrencilere yeterli zaman verildiğinde öğrencilerin sorulan görüşme sorularına cevap verdikleri gözlemlenmiştir. Buradan hareketle, araştırmacılar sorulan sorulara her öğrencinin düşünmesi için zaman vermelidirler. Burada önemli olan, bazı öğrencilerin hızlı cevap vermesinden ziyade, bütün öğrencilerin soru hakkında düşünmesi ve görüşünü bildirmesidir. Dahası, görüşme soruları aracılığıyla veri toplayan araştırmacı, öğrencilerin bilimsel epistemolojik inanç ve üstbilişsel farkındalık düzeylerini ortaya çıkarmak için öğrencilerin bireysel görüşlerini açıklamaları yönünde teşvik etmeli ve olumsuz üstbilişsel farkındalığa ve bilimsel epistemolojik inançlara sahip olan öğrencilerin görüşlerine saygı göstererek, değer verdiğini hissettirmelidir.

İleride bilimsel epistemolojik inançlar ile üstbilişsel farkındalığı birlikte ele alarak yapılacak olan araştırmalarda; öğrencilerin bilimsel epistemolojik inançlarının ve üstbilişsel farkındalıklarının detaylı bir şekilde irdelenmesi sadece görüşmelerle sınırlı kalmayıp gözlem, video kaydı gibi veri toplama araçları eklenerek çalışmalar yapılabilir.

Gerçekleştirilen araştırmada, ortaokul öğrencilerin hem bilimsel epistemolojik inançları hem de üstbilişsel farkındalıkları nitel araştırma yöntemleri kullanılarak belirlenmeye çalışılmıştır. İleride ki araştırmalarda hem nitel hem de nicel araştırma yöntemleri kullanılarak ortaokul öğrencilerinin bilimsel epistemolojik inançları ve üstbilişsel farkındalıkları saptanabilir.

Bu araştırmada sadece ortaokul 6. sınıf öğrencileri ile çalışılarak, bu öğrencilerin bilimsel epistemolojik inançları ve üstbilişsel farkındalıkları nitel araştırma yöntemi kullanılarak belirlenmiştir. Bu çalışmanın bağlamı aynı kalmak kaydıyla, ortaokul 7. ve 8. sınıf düzeyindeki öğrencilerden de nitel veriler toplanarak farklı sınıf seviyesindeki öğrencilerin bilimsel epistemolojik inançları ve üstbilişsel farkındalıkları nitel olarak karşılaştırılabilir. Dahası farklı eğitim kademesinde (ilkokul, lise ve üniversitede) öğrenim gören öğrencilerin bilimsel epistemolojik inançlarının ve üstbilişsel farkındalıklarının belirlenmeye çalışıldığı nitel çalışmalar tasarlanabilir. Bu sayede, öğrenim düzeyleri farklı olan öğrencilerin bilimsel epistemolojik inançları ve üstbilişsel farkındalıkları kıyaslanarak benzerlikler ve farklılıklar ortaya konulabilir. Böylece, eğitimin hangi düzeyinin öğrencilerin epistemolojik inançlarını ve üstbilişsel farkındalıklarını hangi boyutlar açısından ve nasıl etkilediği konusunda daha kapsamlı bir görünüm elde edilebileceği gibi, epistemolojik inançların ve üstbilişsel farkındalığın gelişimi için kritik bir evrenin olup olmadığı da kapsamlı olarak sorgulanabilir.

Bu araştırmada bilimsel epistemolojik inançları ve üstbilişsel farkındalıkları belirlenen ortaokul öğrencileri ile daha sonraki yıllarda da uzun soluklu çalışmalar yapılarak bilimsel epistemolojik inanç ve üstbilişsel farkındalık düzeylerinde değişimler meydana gelip gelmediği saptanabilir. Dahası, elde edilen bulgular ve sonuçlarla karşılaştırmalar yapılabilir.

APPENDIX H

TEZ FOTOKOPİSİ İZİN FORMU

ENSTİTÜ

- [ ] Fen Bilimleri Enstitüsü
- [x] Sosyal Bilimler Enstitüsü
- [ ] Uygulamalı Matematik Enstitüsü
- [ ] Enformatik Enstitüsü
- [ ] Deniz Bilimleri Enstitüsü

YAZARIN

Soyadı : Boğar
Adı : Yurdagül
Bölümü: Matematik ve Fen Bilimleri Eğitimi Bölümü

TEZİN ADI (İngilizce) : Exploring 6th Grade Students' Scientific Epistemological Beliefs and Metacognitive Awareness Regarding Achievement Level

TEZİN TÜRÜ : Yüksek Lisans [ ] Doktora [x]

1. Tezimin tamamından kaynak gösterilmek şartıyla fotokopi alınabilir. [ ]
2. Tezimin içindekiler sayfası, özet, indeks sayfalarından ve/veya bir bölümünden kaynak gösterilmek şartıyla fotokopi alınabilir. [ ]
3. Tezimden bir bir (1) yıl süreyle fotokopi alınamaz. [x]

TEZİN KÜTÜPHANEYE TESLİM TARİHİ: