MIDDLE SCHOOL STUDENTS' REASONING PATTERNS AND COMPREHENSIONS ABOUT PSEUDOSCIENTIFIC APPLICATIONS RELATED TO CRYSTALS

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

BY

DUYGU METİN

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF DOCTOR OF PHILOSOPHY
IN
THE DEPARTMENT OF ELEMENTARY EDUCATION

SEPTEMBER 2015

Approval of the Graduate School of Social Sciences

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To My Family

ACKNOWLEDGMENTS

First and foremost, I would like to express my deepest appreciation to ATATÜRK who is our national hero and our great leader. He devoted his life to the independence of this country. He always believed in supremacy of democracy, peace, and complete equity between men and women; thereby he made my today possible. I am grateful to him.

I wish to express my special thanks to Prof. Dr. Jale Çakıroğlu, my thesis supervisor, and to Prof. Dr. Gülşen Leblebicioğlu, my thesis co-supervisor, for their useful guidance, insightful comments, considerable encouragements, and continuous support throughout my research.

I would like to thank to my thesis examining committee members Prof. Dr. Ceren Öztekin, Assoc. Prof. Dr. Esen Uzuntiryaki Kondakçı, Assoc. Prof. Dr. Esin Şahin Pekmez, and Assist. Prof. Dr. Pelin Yalçınoğlu.

All these successful women enlighten my way by supporting me to pursue a research on a subject that I am sincerely curious about. Thanks all of them.

Last but not least, I would like to express my indebtedness to my parents for their endless love. All that I am or hope to be, I owe to my angel mother and my hero father. I love you.

ABSTRACT

MIDDLE SCHOOL STUDENTS' REASONING PATTERNS AND COMPREHENSIONS ABOUT PSEUDOSCIENTIFIC APPLICATIONS RELATED TO CRYSTALS

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September 2015, 247 pages

The purpose of this study was to discover and describe reasoning patterns that middle school students use while they reflect their understandings about pseudoscientific issues. Specifically, the aim was to reveal middle school students' comprehensions about aim, process, and justification of pseudoscientific applications related to crystals, and reliability, certainty, and scientific status of knowledge that derived from these pseudoscientific applications. This study was qualitative in nature. Basic interpretive qualitative approach was used as a research design. Seven girls and seven boys (8th graders, 14 years-old) who lived and went to school in rural areas, had basic skills in science, and were able to express themselves clearly participated in the study. Data were collected through individual interviews. The students were provided pseudoscientific claims and pseudoscientific scenarios. They were questioned on claims and scenarios and probed by further questions according to their responses. Thus interviews were semi-structured.

The results indicated that the eighth grade middle school students participated in this study were very gullible in terms of aim, process, and justification of pseudoscientific applications related to crystals, and reliability, certainty, and scientific status of pseudoscientific knowledge related to crystals. When the students reasoned about given pseudoscientific claims and research designs about crystals and crystal healing in terms of given aspects, they generally used weak reasoning patterns that were closer to that of pseudoscientists.

Keywords: Demarcation Problem, Pseudoscience, Understanding of Science, Crystal Healing, Middle School Students

ÖZ

ORTAOKUL ÖĞRENCİLERİNİN DOĞAL TAŞLARLA İLGİLİ SÖZDEBİLİMSEL UYGULAMALAR HAKKINDAKİ ALGILARI VE MANTIKSAL DÜŞÜNME DESENLERİ

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Bu araştırmanın amacı, ortaokul 8. sınıf öğrencilerinin sözdebilim hakkındaki algılarını ve sözdebilimsel uygulamalar hakkında tartışırken kullandıkları mantıksal akıl yürütme desenlerini ortaya çıkarmaktır. Daha ayrıntılı olarak, bu araştırma öğrencilerin sözdebilimsel uygulamaların amaçları, sözdebilimde kullanılan araştırma ve doğrulama süreçleri ve sözdebilimsel uygulamalardan elde edilen bilgilerin kesinliği, güvenirliği ve bilimsel statüsü hakkındaki algılarını ve mantıksal akıl yürütme desenlerini ortaya çıkarmayı amaçlamaktadır. Bu araştırma nitel bir araştırmadır. Araştırmada temel yorumlayıcı nitel araştırma deseni kullanılmıştır. Araştırmaya kırsal kesimde yaşayan ve orada okula giden, temel bilim eğitimi almış ve kendini açıkça ifade edebilen yedi kız ve yedi erkek 8. sınıf öğrencisi gönüllü olarak katılmıştır. Veri toplama aracı olarak yarı-yapılandırılmış görüşmeler kullanılmıştır. Görüşme sırasında öğrencilere sözdebilimsel iddialar ve sözdebilimsel senaryolar sunulmuştur ve öğrencilerin sözdebilim hakkındaki görüşleri bu iddialar ve senaryolar üzerinden sorgulanmıştır.

Araştırma sonuçları ortaokul 8. sınıf öğrencilerinin sözdebilimsel uygulamaların amaçları, sözdebilimde kullanılan araştırma ve doğrulama süreçleri ve sözdebilimsel

uygulamalardan elde edilen bilgilerin kesinliği, güvenirliği ve bilimsel statüsü hakkında kolay kandırılabilir (gullible) bir anlayışa sahip olduklarını göstermektedir. Öğrencilerin, doğal taşlar hakkında kendilerine sunulan sözdebilimsel iddialar ve sözdebilimsel senaryolar hakkında tartışırken genellikle sözdebilimciler tarafından kullanılan basit akıl yürütme desenleri kullandıkları görülmüştür.

Keywords: Bilim/Sözdebilim Ayrımı, Sözdebilim, Bilim Algısı, Doğal Taşlar, Ortaokul Öğrencileri

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CHAPTER 1

INTRODUCTION

More than ever before, the world in which we live is rooted on science and technology. The common use and familiarity of science and technology in everyday life bring with it misuse as well as benefit. In daily life, we encounter practitioners who are talking about the position of the planets that are assumed to influence people's characteristics and future life or the features of the gemstones that are assumed to heal the diseases in television programs, advertisements, Facebook, and Twitter or in any telecommunication network environment. Practices which are done under the name of science or seem to be scientific such as astrology or crystal healing can be defined as pseudoscience. Considering the television ratings oriented according to public's interest, the Turkish context gives many examples about these pseudoscientific applications. For instance, almost every TV channel in Turkey has its own morning drive time (6-10am) and midday drive time (10am-3pm) programs targeting generally women who are responsible for rising their children and interested in their families, and who have impact on their children's both psychical and cognitive development. The content of the programs are diverse. Generally cooking, handcraft, sportive activities, health issues, religious issues, astrology and healing with different substances constituted the content of the programs. Almost every program is having an astrologer who is knowledgeable about the horoscope, or practitioners who assert to heal diseases by using plants and herbs, gemstones or magnetic power. Based on the observation about the content of the TV program placed in morning and midday drive time, and TV ratings oriented by the public interest, it is possible to interpret that public interest in pseudoscience such as astrology, and healing and remedy based on nonmedical applications have been increased in recent years. In a parallel vein, the advertisements placed in social communication network have bombarded us with subscription to daily horoscope,

selling gemstones asserted to give good luck, tarot fortunetelling, miracle plant that asserted to burn your fat without any activity.

In addition to media bombardment, we are culturally taught pseudoscience through indigenous application such as wearing the evil eye which assumed to protect us from jealousy of others, knocking on wood in order to keep your luck from going bad, cupping on painful areas on body, drinking tea from the herbs that are rare, cultivating the soil according to the time of cemre that is believed that there is sudden increase in temperature in February and March, and so on.

Indigenous applications coming from the culture are generally based on the dogmatic acceptance. People in the culture apply indigenous knowledge unconsciously and do not need to criticize it, just believe it. Thus, they have tendency to believe what they are taught culturally and socially, especially by the practitioners who assert themselves as knowledgeable. For this reason, it is reasonable to define this tendency as an indicator of deficiency of reasoning in thinking.

Concerning the situation, some questions arise; why we are so vulnerable to this kind of beliefs? What are the reasons that orient us to believe that this kind of applications is effective? Why we are unable to detect logical errors in this kind of applications? One of the main reasons for believing pseudoscience stated by the researchers is the poor quality of science education (Carroll, 2005; Ede, 2000; Moore, 1992; Walker, Hoekstra & Vogl, 2002).

Students generally construct their understanding of science via their personal experiences of science education. What they almost know about science comes from what they are taught in science classes. Science is based on rational thinking, and the first and foremost responsibility of science education is to make students rational and critical thinkers. However, Ede (2000) criticized the science education as responsible for low level of rational thinking which can help students to critically evaluate explanations in order to separate knowledge from beliefs and dogmas. Ede's (2000) main argument was based on that science education primarily concern about teaching

scientific facts rather than emphasizing rational thinking skills. Technical laboratory works focus on confirming already known facts and right answers, not on scientific process skills, which causes students not being able to transfer their experimental skills outside the classroom. According to Ede's (2000) argument, students are located in a place of accepting what they are presented rather than critically evaluating what they are taught. Similar critics about science education came from Walker, Hoekstra and Vogl (2002). They argued that as a result of poor quality of science education, students were not able to transfer what they are taught in science classes to evaluate pseudoscientific claims. Their argument was based on that in science education, "students are taught what to think but not how to think" (Walker, Hoekstra & Vogl, 2002, p. 26). For this reason, one of the major reasons for why people are so vulnerable to pseudoscientific beliefs is poor quality of science education.

In the world perspective, there is a great consensus on the crucial importance of science education. The primary goal of science education is to educate students both about scientific knowledge of the physical world and about the way of knowing whereby scientific knowledge is generated by using data and evidence. Thus, one of the major issues in science education is to train scientifically literate individuals who are able to understand what science is, how science is done, how scientific knowledge is constructed, and how it is justified. Accordingly, it requires not only being able to comprehend the epistemology of science, but also being able to demarcate science from pseudoscience.

Although science literacy is a complex issue to be addressed and to be arrived at consensus, the well-documented review about science literacy was provided by Liu (2009). He emphasized the desirable expectation regarding science literacy around the world as "achieving science literacy by all children before high school graduation" (p. 301). Despite the complex structure of science literacy, most of the researchers believed that the ability of realizing flawed process and claims of pseudoscience should be considered as a part of science literacy. For instance, one of the more detailed definitions of science literate individual comes from Hurd (1998).

He approached to the issue as a set of characteristics that science literate individual should have and identified these characteristics of science literate person by providing very long list. In this list, some characteristics of science literate person come to the fore in respect of having scientific mentality, understanding nature of science (NOS) and ability to distinguish science from pseudoscience. According to Hurd (1998) science literate person:

- distinguishes theory from dogma, and data from myth and folklore
- senses the ways in which scientific research is done and how the findings are validated
- distinguishes science from pseudoscience such as astrology, quackery, the occult, and superstition
- knows how to analyze and process information to generate knowledge that extends beyond facts
- distinguishes evidence from propaganda, fact from fiction, sense from nonsense, and knowledge from opinion
- recognizes that science concepts, laws, and theories are not rigid but essentially have an organic quality and they grow and develop (p. 413-414).

Another detailed explanation about science literate individual regarding pseudoscience was provided by Hodson (2008). He emphasized the demarcation problem not only between science and pseudoscience but also between science and nonscience in his following quotation:

> To be fully scientifically literate, students need to be able to distinguish among good science, bad science, and nonscience, make critical judgments about what to believe, and use scientific information and knowledge to inform decision making at the personal, employment, and community level. In other words, they need to be critical consumers of science (Hodson, 2008, p. 3).

Likewise, Martin (1994) referred recognizing and evaluating pseudoscientific claims as a part of science literacy. His emphasis in the goal of science education was on being scientific rather than understanding science, and on to get students "to tend to think and act in a scientific manner in their daily life" (p. 357). In a similar vein, taking into account the necessity of realizing and critically evaluating pseudoscience in daily life in a scientific manner, he addressed the science education by stating that "learning to think critically about pseudoscientific and paranormal beliefs is part of being scientific" (Martin, 1994, p. 357).

Particularly, Ede (2000) proclaimed the deficiency of science education in achieving science literacy. By criticizing absence of significant drop in irrationality which is supposed to be as a result of significant increase in general science education, he reasoned out that "if students leave science class with no understanding of how scientific ideas were actually arrived at, or why science was done, it is not difficult to understand why many are susceptible to pseudoscience" (p. 50). In the same way, Good and Slezak (2011) stressed the demarcation problem in science literacy by asking that "can people be considered as scientifically literate if they are unable to recognize common forms of pseudoscience?" (p. 401).

Up to now, the researchers who dealt with science literacy referred the ability of recognizing pseudoscientific claims and beliefs as a precursor of being science literate. The assumption underlying their views is that science illiteracy can increase the beliefs in pseudoscience and irrationality. On the other hand, some other researchers approached the issue from different perspective. For instance, Beyerstein (1995) implied the importance of social environment in which the information are delivered and maintained that "the climate in which pseudosciences thrive contributes to a decline in science literacy and critical thinking" (p. 42). Correspondingly, he went on to say that decrease in science literacy constrains citizens from being responsible decision-makers on policies. Additionally, Moore (1992) made a clear relationship between pseudoscientific beliefs and lack of critical thinking ability and claimed that "the popularity of astrology and similar pseudoscientific shams attest to the unwillingness or inability of many people to think critically" (p. 4). As far as understood from Beyerstein (1995) and Moore (1992) that popularity of and stress on pseudoscience can increase the science illiteracy.

As implied previously, there would be a vicious cycle between science literacy and pseudoscience that means that science illiteracy paves the way for pseudoscientific beliefs and then more believing in pseudoscience and more stress on pseudoscience cause more science illiteracy. Regardless of which one is precursor for another, the researchers agreed that demarcation problem, pseudoscientific beliefs and claims,

and increasing in pseudoscientific beliefs should be concern of science educators and learning about realizing and evaluating pseudoscience should be a part of the science education (Ede, 2000; Good, 2012; Lundström & Jakopsson, 2009; Martin, 1994; Preece & Baxter, 2000; Walker, Hoekstra & Vogl, 2002).

It would be reasonable to reorganize science education curriculum with respect to demarcation issue between science and pseudoscience according to students' views about pseudoscience. As long as science educators know how students reason out pseudoscientific applications, it would be easy to focus on specific factors that orient students to believe pseudoscience. For this reason, the present study focused on pseudoscientific beliefs in the middle school students' eyes in order to provide evidence to guide future science education policy studies.

1.1 Purpose of the Study

The purpose of this study was to discover and describe reasoning patterns that middle school students use while they reflect their understandings about pseudoscientific issues. Specifically, the aim was to reveal middle school students' comprehensions about aim, process, and justification of pseudoscientific applications related to crystals and about reliability, certainty, and scientific status of knowledge that derived from these pseudoscientific applications profoundly. The primary focus in this study was to go beyond students' belief systems about pseudoscience and uncover features that orient their belief-driven decisions in pseudoscientific applications.

1.2 Research Questions

The research question addressed by the study was "How are the middle school students' reasoning patterns and comprehensions about aim, process, and justification of pseudoscientific applications related to crystals, and about reliability, certainty, and scientific status of knowledge that derived from these pseudoscientific applications?"

In the light of this general research question, the sub-questions which guided the present study were;

Research Question 1. What are the students' views about the aim of the pseudoscientific applications related to crystals?

Research Question 2. What are the students' interpretations about research process used by pseudoscientists in the development of knowledge in pseudoscientific applications related to crystals?

Research Question 3. How do the students understand justification procedure and process of testing ideas in pseudoscientific applications related to crystals?

Research Question 4. How do the students judge the reliability of knowledge in pseudoscientific context related to crystals?

Research Question 5. How do the students judge certainty of pseudoscientific knowledge related to crystals?

Research Question 6. How do the students judge scientific status of pseudoscientific knowledge related to crystals?

1.3 Significance of the Study

Without any exceptions, all the countries are pursuing the aim of developing responsible citizenship. Definitely, science literacy is a vital attribute of being a responsible citizen. Qualified science education, aiming at training science literate individuals who are able to understand what science is, how science is done, and what the inherent values of science are, ensures responsible citizenship in which the individual takes part in the decision-making and policy-making process about scientific issues, critically evaluates what is presented and served scientific or pseudoscientific, and uses rational thinking in order not to be deceived by applications that fall outside of the realm of science.

However, research studies have consistently revealed that students and even science teachers have naïve understanding of nature of science (Abd-El-Khalick &

Lederman, 2000; Lederman, 1992; Lederman, 2007) and naïve understanding of science itself (BouJaoude & Abd-El Khalick, 1995; Carey, Evans, Honda, Jay & Unger, 1989; Kang, Scharmann & Noh, 2005; Metin & Leblebicioglu, 2011; Sutherland & Dennick, 2002). Additionally, consistent evidence are available showing that pseudoscientific beliefs are widespread among general population, students, and even among science educators (Martin, 1994; Preece & Baxter, 2000).

Students' pseudoscientific beliefs are important but neglected aspect of science education. Existence of pseudoscientific beliefs can be seen as indicators of ignorance of the scientific approach to enquiry. It is impossible to expect students to demarcate science from pseudoscience without understanding process of science as inquiry. Process of science as inquiry refers to teach students how to think rather than what to think. Thus, the present study challenged the students with pseudoscientific assertions and problematic research design of the pseudoscience in order to understand how they think. Therefore, the primordial purpose of the present study was to provide the science educators and researchers with the clue about students' reasoning patterns in pseudoscientific context. Uncovering reasoning patterns of students in pseudoscientific context will benefit the science educators and researchers to reorganize the science education in order to educate students who are able to "judge claims based on lack of empirical evidence, testimonial or anecdotal evidence, unfalsiable theories or simple correlational data as weak claims" (Lawson, 1999, p. 207).

Although not directly aimed at, this study revealed the differences between what science educators and researchers were expecting from their students to think and what students really thought when they faced with pseudoscientific application. As a result of basic science education, as science educators and researchers we assume that students graduate as critical thinkers. However, students generally might prefer acceptance of the pseudoscience rather than critically reason or test whether there are underlying principles of the proposed pseudoscientific issues or find evidence about it. For instance, they are told that the positions of the stars and planets when they are born affect what will happen to them during their life. In such case, students

generally do not think about “why do I believe in this?” or “what is the evidence for this?” The present study provided the evidence about the factors that orient student to think like that.

In parallel to the goal of science education, students should be able to think critically and evaluate claims in a way that explicitly incorporates basic principles of science. However, the situation is opposite of what is expected. What is wrong with science education? As students improve their grade levels, they are supposed to learn more about science and scientific knowledge. Therefore, they are supposed to have less pseudoscientific beliefs. Nevertheless, science education is no guarantee of skepticism to weak claims of pseudoscience. Walker, Hoekstra, and Vogl (2002) expressed the inadequacy of teaching scientific fact that “individuals are not given the skills with which to critically evaluate the claims, thus they are placed in the position of accepting or rejecting claims based on what they are told to believe rather than being able to critically evaluate the evidence” (p.1). However, related literature provided evidence that neither knowledge of science facts nor understanding of science seem to be associated with the degree of pseudoscientific beliefs (Johnson, 2003). Additionally, Johnson (2003) stated that “if we wish our students to understand how science works, confronting them with a lot of factual knowledge does not seem to help” (p.14). In order to introduce insufficient situation of just knowing and applying scientific method, Erduran (1995) expressed that the description of scientific method which consists of gathering data, formulating hypothesis to explain the data and testing the hypothesis by experiment was not sufficient to distinguish science from pseudoscience. For this reason, the science educators and researchers need evidence in order to understand why the students have disposition to pseudoscience although they even know about science facts and understand how science works.

In the pseudoscience literature, there are many studies about students’ belief-driven decision in pseudoscience that generally stated widespread subscribing in pseudoscience among students (Martin, 1994). On the other hand, there is no well-documented evidence about reasoning patterns underlying these belief systems about

pseudoscience. In the light of the results of the present study, meaningful evidence about the students' deep understandings about general process of knowledge production in pseudoscience would contribute to the related literature. Thus, giving evidence about underlying comprehension of pseudoscientific belief system, science educators and researchers would take precautions to keep students away from subscribing pseudoscience.

Similarly, it is known from the related literature that students are unable to demarcate science and pseudoscience. However, there is no evidence about why students are unable to realize or determine the erroneous research design and flawed evidence on which the pseudoscientific knowledge is based. There should be something different that makes students to believe that the erroneous research design used by pseudoscientists and their approach to enquiry is true and scientific. In this case, as Carroll (2005) stated "in any case, it is not really the beliefs we should be interested in so much as the methods of arriving at and supporting those beliefs" (p.193). Furthermore, Lunström (2007) recommended that "more studies where not only what types of pseudoscience students believe but also people's reasoning and argumentation in this subject should be of interest" (p. 5). In the literature, there are well-documented attempts to survey learners' pseudoscientific beliefs stated in Martin (1994). Previous studies indicated that learners' pseudoscientific beliefs are widespread including water dowsing (Happs, 1991; Afonso & Gilbert, 2010), astrology (Happs, 1991; Preece & Baxter, 2000; Kallery, 2001), and crystal power-healing gemstone (Preece & Baxter, 2000). However, little is known about what are their reasoning about pseudoscience and how they articulate the aim, process, and justification of pseudoscientific applications, and reliability, certainty, and scientific status of knowledge that derived from pseudoscientific enterprise. The main reasoning patterns and underlying assumptions of learners in believing pseudoscientific enterprise is needed to be cleared out to go beyond their decisions about believing. Therefore, the present study focused on to uncover the thinking processes of students when they reasoned about given pseudoscientific assertions and research designs.

More specifically, the aim of the present study was to understand the middle school students' reasoning patterns and comprehensions about aim, process, and justification of pseudoscientific applications related to crystals, and about reliability, certainty, and scientific status of knowledge that derived from these pseudoscientific applications. The evidence is needed showing that whether the students are aware of that pseudoscience has commercial aim propagated by mass media or pseudoscience is based on postulates and questionable assumption while the science is based on data and evidence. As we know what the students' comprehensions about the approach of pseudoscience to inquiry are, it is much easier to educate students as skeptical about them.

On the other hand, both science and pseudoscience cannot be imagined without the influence of the society in which it is done. There is interplay between society and science. Not only society orients science, but also science constitutes its own values by which society articulates science. According to Allchin (1988), the relationship between science and social values can be explained in three ways; "first, there are values, particularly epistemic values, which guide scientific research itself. Second, the scientific enterprise is always embedded in some particular culture and values enter science through its individual practitioners, whether consciously or not. Finally, values emerge from science, both as a product and process, and may be redistributed more broadly in the culture or society" (p. 1083). As the pseudoscience pretends as science and it is seen as scientific in the public eye, the same process of science in terms of relationship with society is valid for pseudoscience. In parallel, pseudoscientific beliefs and understandings are spread out by culture of the society. People hear scientific, pseudoscientific, and even religious arguments about pseudoscientific issues throughout their life from their teachers, relatives, friends, and mass media. As a result of this social effect, some pseudoscientific beliefs become widespread in the society. According to Whittle (2004), the society creates and maintains such a belief through cultural knowledge, cultural artifacts, and cultural behaviors, thus, we are taught about our culture's beliefs and practices. Therefore, the present study provided extra evidence that revealed how the students interacted with stimulus about pseudoscience coming from their social and cultural

environment. In more clearly, present evidence revealed whether the students approached the pseudoscientific issues with cultural beliefs or they used their scientific thinking in order to criticize them.

Besides emphasizing the cultural influence on pseudoscientific beliefs, Whittle (2004) also pointed out that "such beliefs begin almost from infancy" (p.1). Therefore, he recommended that it is needed to do more research investigating developmental stages of such beliefs, thus it is needed to conduct research with young children in order to understand how they reason while they encounter such an enterprise. Additionally, Tsai et al. (2012) recommended investigating the process by which young citizens engage in pseudoscientific practices in order to understand why younger students consider the pseudoscience. The related literature generally gives us the information about the high school or university students' beliefs about pseudoscience (DeRobertis & Delaney, 1993, 2000; Preece & Baxter, 2000; Walker, Hoekstra & Vogl, 2002), not about middle school or younger. Based on Whittle's (2004) recommendation stated above, it is necessary to clear out the situation about younger students' understanding and beliefs about pseudoscience. For that reason, the present study aimed at discovering and describing reasoning patterns that middle school students use while they reflect their understandings about pseudoscientific issues.

Findings of the present study would contribute the educational policy, science teachers, science educators and researchers. As an essential purpose, educational policy directs the educational system in order to educate students as science literate persons. For this reason, science educators and researchers should make efforts to enhance students' science understanding regarding their reasoning patterns in believing pseudoscience.

1.4 Definitions of Terms

In this part, some important definitions related to present study were provided.

Demarcation Problem: an attempt to define "what distinguishes science from nonscience and pseudoscience" (Pigliucci & Boudry, 2013, p. 1). It represents philosophical problem dealing with what should be considered scientific and what should be considered nonscientific or pseudoscientific.

Pseudoscience: "a systematic body of propositions, practices, and attitudes that gives the appearance of being a science but is not" (Martin, 1972, p. 40).Practices which are done under the name of science or seem to be scientific such as astrology or crystal healing can be defined as pseudoscience.

Crystal Healing: pseudoscientific health practice pretending as a scientific area.

Pseudoscientific Beliefs: ignorance of the fundamental principles of scientific investigation, misunderstanding of the theory and its evidential support in science, and lack of critical evaluation of an idea (Martin, 1994). It refers beliefs in truthfulness of claims regarding astrology, crystal healing, water dowsing, and homeopathy without scrutiny.

Science Literacy: "developing an ability, to creatively utilize appropriate evidence-based scientific knowledge and skills, particularly with relevance for everyday life and a career, in solving personally challenging yet meaningful scientific problems as well as making, responsible socio-scientific decisions" (Holbrook & Rannikmae, 2009, p. 286).

Reasoning Pattern: the way of thinking which is used to make a judgement, decision, or draw a conclusion.

CHAPTER 2

LITERATURE REVIEW

This chapter included the review of the literature relevant with demarcation problem in a philosophical manner, definitions of science, pseudoscience, and nonscience, reasons for believing in pseudoscience, and research on believing in pseudoscience.

Despite the great emphasis on demarcation problem in science education, it is not easy to demarcate science since there are no clear-cut demarcation criteria for distinguishing scientific area from another one even among science philosophers (Turgut, 2011; Afonso & Gilbert, 2010). When it comes to demarcation problem, primarily the differentiation between science and pseudoscience comes to mind. Hansson (2013) objected to the use of "demarcation of science" and "demarcation of science from pseudoscience" in the same meaning and referred this using as a oversimplifying of demarcation issue. However, the demarcation problem is more complex than it is assumed. It involves many different concepts such as science, pseudoscience, nonscience, and even unscience.

All of these concepts have their own features and characteristics. Despite of this, the demarcation problem is knotted to the definition of science before anything else. The complex nature of science makes it harder to differentiate science from other areas. The researchers and philosophers reached the consensus that necessity of clear definition of science is vital and crucial factor in demarcation issue (Baran, Kiani & Samuel, 2014; Bunge, 2011; Ede, 2000; Hansson, 2013; Hansson, 2015).

2.1 What is Science?

The literature provided us different definitions of science. Basically, science can be defined as a way of knowing. Sagan (1995) defined science as open-mindedness to new claims and referred science as candle in the dark. According to Beyerstein

(1995), science is “systematized knowledge derived from observation, study, and experimentation” (p. 2). Additionally, Beyerstein (1995) talked about the scope of science in his definition and maintained that only phenomena which are open to empirical testing can be investigated scientifically. By his definition, he narrowed down the area of interest of science. By expressing reliability of science, Hansson (2013) described science as a “practice that provides us the most reliable statements that can be made, at the time being, on subject matter covered by the community of knowledge disciplines” (p. 70). Additionally, Lilienfeld, Ammirati and David (2012) dealt with science as a “toolbox of techniques designed to minimize human error” (p. 15).

However, none of these definitions are enough to distinguish science from other areas. Since more detailed attempt should be done, some researchers and philosophers provided some criteria of science that are directly pointed out the specific structure of science. For instance, Hansson (2013) demonstrated three quality criteria of science. These are reliability, fruitfulness, and practical usefulness. According to him, one of the basic quality criteria of science is reliability and it corresponds to epistemologically warranted statements of science. The second criterion is fruitfulness and he demonstrated progressive structure of science. In the third criterion, he implied not only reliable process of knowledge production in science but also practical effectiveness of this knowledge in daily life.

On the other hand, in his great criticism about genuine and bogus knowledge Bunge (2011) stressed on the scientific investigation process that manifests the essential difference of science from other areas. According to Bunge (2011), scientifically investigated facts should be material, lawful, and open to scrutiny. Additionally, he assumed that scientific investigation “builds on a body of previous scientific findings, and it is done with main aims of describing and explaining the facts in question with the help of the scientific method” (p. 413). Other criteria of science provided by Bunge (2011) are; logical validation, changeability, compatibility with previous knowledge, partial intersection with other sciences, and control by the scientific community. Likewise Bunge (2011), Beyerstein (1995) emphasized the

intersection between science's branches. According to him, nonisolated structure of science that means that various branches of science support each other mutually and they are related to each other's progress is a major strength of science.

Similarly, Lakatos (1978) claimed that "the typical descriptive unit of great scientific achievements is not an isolated hypothesis but rather a research programme. Science is not simply trial and error, a series of conjectures and refutations (p. 4). According to his observation, common to all scientific theories is the ability of "discovery of hitherto unknown novel facts" (p. 5) which are never dreamt of or are competitive with previous rival hypotheses.

As understood, researchers emphasized the dynamic and progressive structure of science as its outstanding feature. Baran, Kiani and Samuel (2014) summarized this dynamic progressive investigation process as follow; "question, answer, debate, verify, and ask further questions" (p. 23). Afterwards, Baran, Kiani and Samuel (2014) drew a borderline of realm of science. By expressing testable and falsifiable structure of science, they defended that any opinion or explanation that "cannot be tested or refuted fall outside of the realm of scientific investigation" (p. 24).

Similarly, Moore (1992) pointed out the borderline of realm of science. Moore (1992) defined science as "a search for truth, but is not the only way of knowing." (p. 5). According to Moore (1992) science does not make any judgment which involves values and beliefs. Due to the untestable structure of values and beliefs, these judgements fall outside of the realm of science. Once again, the testable structure of science as its strength was emphasized.

Like being testable, other more emphasized feature of science is falsifiable. One of the major attempts to distinguish science from other areas came from Popper. Popper (1963) proposed falsification criterion and stated that criterion of the scientific status of a theory depends on its falsifiability, refutability, and testability. Many philosophers and researchers pursued Popper's criterion of falsification (Baran, Kiani & Samuel, 2014; Beyerstein, 1995; Carroll, 2014; Hansson, 2015). With a basic

definition, a hypothesis is falsifiable "if it can potentially be ruled out by data to show that hypothesis does not explain the observations" (Baran, Kiani & Samuel, 2014, p. 24). Beyerstein (1995) defended falsificationism by stating that "a growing accumulation of instances supporting a theoretical explanation can only strengthen our subjective probability that the theory is correct, but a single disconfirming instance is sufficient to topple the entire enterprise" (p. 30). Falsificationism and more were summarized by Carroll (2014) in Skepdic's Dictionary as characteristics of scientific theories. According to him, scientific theories are characterized as;

- being empirically tested in some meaningful way
- being impersonal and therefore testable by anyone
- being dynamic and fecund
- being approached with skepticism rather than gullibility
- being fallible and put forth tentative rather than being put forth as infallible and inerrant (Carroll, 2014, p. 1).

Despite being one of the essential criteria for demarcation, there are some objections to falsificationism. According to Kuhn (1974), in contrary to Popper's criterion, "science takes place between the unusual moments of scientific revolutions" (p. 801), thus Kuhn's demarcation criterion is based on existence of paradigm which is shaped by scientific revolutions and science is a kind of puzzle solving activity. Although it is the most famous demarcation criterion, Mahner (2013) criticized the Popper's falsifiability condition as not having ability of detecting all possible problems of areas which are not labeled as science. Specifically, he pointed out the problem that "many pseudosciences do contain falsifiable statements and therefore would count as sciences" by giving example of astrology (p. 30). Most of the statements related to astrology are statistically testable and refutable, that means that falsifiable, however it is not scientific. Additionally, Erduran (1995) refuted falsification criterion by claiming that "A scientific theory is not validated or invalidated by empirical data. Science involves a process of conjecture, refutation, and a new conjecture to overcome the refutation" (p. 3). By her refutation, she emphasized the progressive nature of science. Other objection comes from Lakatos. According to him, Popper's falsifiability condition disregards "the tenacity of scientific theories" (Lakatos, 1978,

p. 4). As stated previously, Lakatos (1978) suggested progressive and fecund structure of science as a distinguishing criterion.

As understood from aforementioned discussion, the definition of science is not a topic on which all the researchers agreed. Additionally the key features that make what science is are not compendious. However, after examining complex structure of science, the next step is to reveal what pseudoscience really is.

2.2 What is Pseudoscience?

As it was in science, there is no clear-cut checklist that summarizes key characteristics of pseudoscience in order to get a grasp on what pseudoscience is. Nevertheless, there are pretty much attempts to differentiate the bogus side of it. For instance, in their paper on skepticism and gullibility, Preece and Baxter (2000) defined pseudoscience as "a set of ideas or theories which are claimed to be scientific but which are contrary to standard science and which have failed empirical tests or which cannot in principle be tested." (p. 1148). Similarly, Martin (1972) referred pseudoscience as "a systematic body of propositions, practices, and attitudes that gives the appearance of being a science but is not" (p. 40). Later he described pseudoscience as "false science pretending to be a true science" (Martin, 1994, p. 357). Another definition attempt was made by Beyerstein (1995) in a more detailed manner. He described pseudoscience as "fields that try to appropriate the prestige of genuine sciences, and copy their outward trappings and protocols, but fall far short of acceptance standards of practice and verification in the legitimate fields they seek to emulate" (p. 3). Additionally, pretention of being science has been emphasized by many researchers who define pseudoscience as, beliefs or practices whose followers insisted on these are scientific (Mugaloglu, 2014), activities possess the superficial appearance (Lilienfeld& Landfield, 2008), set of ideas being put forward as scientific (Carroll, 2014), ideas or procedures displayed as being science (Bunge, 2011), beliefs superficially resembled science (Green, 1996) or claims appear scientific despite of its absence of plausibility (Shermer, 1997). To sum up briefly, it can be concluded that one of the key characteristics of the pseudoscience is its tendency of

parading as science and its pretention of being science. Laydman (2013) emphasized the connotation related to pretense of being science as an essential factor in order to use the contemporary term of pseudoscience. Furthermore, it is obvious that another characteristic that make an attempt pseudoscientific is its proponents who insist on the idea that it is scientific or display their attempts as science (Carroll, 2005; Eve & Dunn, 1990; Hansson, 2015). In order to clarify this, it is necessary to look at Hansson's two criteria that should be satisfied in order to be called pseudoscience; "it is not scientific", yet "its major proponents try to create the impression that it is scientific" (1996, p.169). In addition to this, Lilienfeld, Lohr and Morier (2001) emphasized the nonrealistic persistence of adherents by stating that "What renders these claims largely or entirely pseudoscientific is not that they are necessarily incorrect, but rather that their proponents have typically insisted that they are correct, despite compelling evidence to the contrary" (p. 183).

Although science and pseudoscience seem to have some similarities, they are absolutely different from each other in their assumptions, processes, and methods. Eve and Dunn (1990) made a clear definition of pseudoscience by stressing methodological errors in pseudoscience. That is to say, beliefs which "lack empirical support or were arrived at either through faulty reasoning or poor scientific methodology" (Eve & Dunn, 1990, p. 10) can be definitely labeled as pseudoscientific.

Similarly, Smith (2010) differentiated pseudoscience that it uses methodology in which sources, logic, and observations are used in a wrong way, thus it "fails to systematically consider alternative explanations" (p. 38). Another attempt made by Lawson (2007) in order to emphasize methodological error in pseudoscience. According to him, pseudoscience is "false or sham science that is not characterized by carefully controlled studies that result in publicly verifiable knowledge" (p. 4). Moreover, other methodological insufficiencies of pseudoscience were emphasized by Ladyman (2013) in his definition in which he referred pseudoscience as "cult figures and networks whose relational structure involves a lot of chat, but lacks the integration with rich mathematics, material interventions, and technology that

characterizes science" (p. 56-57). Besides, Bunge (2011) formalized pseudoscience around five concepts that reflect the philosophy of pseudoscience; irrationalism, subjectivism, spiritualism, anti-systemism, and commercialism. According to him, pseudoscience is methodological error that depends on aforementioned philosophical stakeholders.

On the other hand, there are also attempts in order to generalize the typical characteristics of pseudoscience in a list. Distinctively, these attempts made sense of pseudoscience by comparing it with the characteristics of science and scientific investigation. For instance, Hansson (2013) reduced pseudoscience into three criteria which are opposite to science; 1) it pertains to an issue within the domains of science in the broad sense (the criterion of scientific domain) 2) it suffers from such a severe lack of reliability that it cannot be trusted at all (the criterion of unreliability) 3) it is part of a doctrine whose major proponents try to create the impression that it represents the most reliable knowledge on its subject matter (the criterion of deviant doctrine) (p. 70-71).

As mentioned earlier, one of the essential characteristics of science stated by the researchers is being progressive and being open to new claims. Having emphasized the importance of the progressive structure of science, Thagard (1980) stressed three elements in order to distinguish science from pseudoscience. These are theory, community, and historical context of pseudoscience. Based on these elements, Thagard (1980) proposed two criteria that are kind of criticism of pseudoscience that violates the progressive characteristic of science. These criteria were (p. 228);

- it has been less progressive than alternative theories over a long period of time and faces many unsolved problems
- the community of practitioners makes little attempt to develop the theory towards solutions of the problems, shows no concern for attempts to evaluate the theory, and is selective in considering confirmations and disconfirmations.

Like Thagard, Martin (1994) stressed the community of adherents who advocate pseudoscientific theories and additionally defined this community of advocates as

isolated and not having tolerance to rival theories. As a result, he focused on characteristics of pseudoscientists rather than pseudoscience. These were as follows;

- its propositions are untested, untestable, or already refuted,
- its practice will include attempts by the practitioners to prevent their theories from being exposed to critical test and evaluations,
- its practice will also include attempts of the practitioners to isolate themselves from the mainstream of scientific inquiry.
- the attitude of pseudoscientist will be dogmatic and paranoid; he or she will be intolerant of all other theories (Martin, 1994, p. 361).

According to Martin (1994), these were depth properties of pseudoscience as well as surface properties of it. He distinguished these two types of properties by stating that the surface properties were easy to distinguish and these were the essential criteria which gave pseudoscience an appearance of science. On the other hand, depth properties were not easy to realize but these properties actually reflected the so-called scientific structure of the pseudoscience. Additionally, he expressed that in respect to surface properties, science and pseudoscience were very similar and there was no such difference between them whereas the depth properties were the essential which create the difference between science and pseudoscience.

In the same way with Martin, Beyerstein (1995) highlighted the isolated structure of pseudoscience. According to him, pseudoscience is "typically isolated from mainstream research organizations and from workers in relevant academic field" (Beyerstein, 1995, p. 27). In addition to this, Beyerstein (1995) attempted to define other properties of pseudoscience, for instance misuse of data, uncumulative and unself-correcting structure, special pleading, and non-falsifiability.

Furthermore, there are some attempts to criticize the pseudoscience in respect to its methodological structure. For instance, Carroll (2005) highlighted the scientific method of testing and evaluating claims and criticized the pseudoscience as misunderstanding, misusing, misapplying, or ignoring scientific method of testing and evaluating claims. Additionally, Carroll (2005) provided just three basic criteria

that were easy to comprehend in order to label an endeavor as pseudoscience when their adherents advocated that their claims or theories were scientific;

- the methods used to defend the beliefs are misapplied or misunderstood scientific methods,
- the belief itself is not capable of being scientifically tested,
- the belief is capable of being scientifically tested and has been falsified, but its adherents refuse to give up the belief(p. 193).

It is obvious from Carroll's criteria mentioned above that the difference between science and pseudoscience is based on methodological concern rather than anything else. Pseudoscience is not a primer or primitive version of science. They use different methodologies and different testing procedure. Because of this, pseudoscience and science differ in kind rather than in their degree. For those who have asserted that alternative treatment, for instance cupping therapy works on them; it is not easy to scrutinize this treatment in a methodological manner. However, what makes pseudoscience is not based on if it works or not, rather is based on methodology in which its proponents test their claims. Lilienfeld, Ammirati, and David (2012) clarified this situation by stating that "It is worth noting that pseudoscientific practices are not necessarily entirely invalid or ineffective, but the assertions associated with these practices greatly outstrip the available scientific evidence." (p. 10). Same particular viewpoint was expressed by Lilienfeld, Lohr and Morier (2001).

Martin (1994) based his argument on the difference between standard of proof and evidence used in pseudoscience and science. He argued that "science critically tests its theories and hypotheses and modifies them in the light of evidence, but pseudoscience does not" (p. 362). Radner and Radner (1982) expressed that pseudoscientists were generally interested in volumes and quantity of evidence and they tended to use selective data which confirm their ideas, and pseudoscientists might also have tendency to use personal experience and anecdotes as evidence, and might have tendency to use eyewitness evidence.

As it is obvious, there are differences between science and pseudoscience in their method of investigation and also in their approach to evidence. This is what makes

the difference between science and pseudoscience in their kind rather than in their degree. However, it is also worth noting that "some fields begin as pseudoscience but gradually gain respectability by improving their standards and procedures" (Beyerstein, 1995, p. 27). Thus, when it comes to claim, it would be scientific or pseudoscientific. What makes this claim pseudoscientific is the way the proponents deal with this claim. According to Coker (2001) the aim of pseudoscience is to "rationalize strongly held beliefs, rather than to investigate or test alternative possibilities" (p. 1). As understood, pseudoscientists have tendency to assert a claim and to believe this claim is true, as they have experienced it as they claimed without making scrutiny investigation about it. Their understanding of methodology is different from that of scientists. Carroll (2015) confirmed this tendency by stating that "pseudoscientists claim to base their ideas on empirical evidence, and they may even use some scientific methods, though often their understanding of a controlled experiment is inadequate" (p. 1). Generally, having experience with something or being heard about some testimonials about it is enough for pseudoscientists to test their claim. Additionally, Smith (2010) clarified the situation by expressing the importance of methodology used in testing a claim. According to Smith (2010), as reported by the pseudoscientists, their research result may reveal positive effect or may prove the effectiveness of a treatment until their methodologies are scrutinized. "When methodologies are improved, the effect disappears" (Smith, 2010, p. 282).

Up to now, some characteristics of pseudoscience came to the forefront. These were pretention of being science, community of proponents, unprogressive and isolated structure, and methodological errors. Additionally, a detailed list of characteristics both of pseudoscience and pseudoscientists provided by Carroll (2005);

- the tendency to propose theories as scientific, but which cannot be empirically tested in any meaningful way,
- the dogmatic refusal to give up an idea in the face of overwhelming evidence that the idea is false and the use of ad hoc hypotheses to try to save the theory,
- selective use of data: the tendency to count only confirming evidence and to ignore disconfirming evidence,
- the use of personal anecdotes as evidence,

- the use of myths or ancient mysteries to support theories which are then used to explain the myths or mysteries,
- gullibility, especially about paranormal, supernatural, or extraterrestrial claims (p. 199).

2.3 What is nonscience?

Science is a way of knowing, however, it is not the only way of knowing (Moore, 1992; Smith & Scharmann, 1999). We can appreciate the world in a scientific way, pseudoscientific way, or even nonscientific way. This is the choice. However, we need to know working areas of these ways of knowing which would direct our choices when we make sense of the world. Thus, another differentiation should be done between science, pseudoscience and nonscience (Hansson, 2013). According to Turgut (2011), there is confusion between pseudoscience and nonscience, which derived from misuse of these terms. Sometimes these terms might be used interchangeably, yet they are not equivalent terms. While pseudoscience seems to be scientific although it is not, nonscience is neither similar to science nor included in scientific research area. As a result of this, nonscientific areas such as religion, mysticism, and metaphysic are not included in working area of science. Furthermore, they cannot be explained by science and they cannot be investigated by scientific method.

As introduced by Baran, Kiani and Samuel (2014), and Moore (1992), untestable or unrefutable explanations such as supernatural, mystical, or religious fall outside of the realm of science. Particularly, science does not include judgement that reflects value (Moore, 1992; Smith & Scharmann, 1999), for instance, if there is God or if it is beautiful. This type of beliefs or explanations or judgements can be classified as nonscientific. According to Smith and Scharmann (1999), the difference between science and nonscience is based on three criteria; these are authority, objectivity, and falsifiability. When we look at from this perspective, nonscience and pseudoscience look very similar. Due to this similarity, a major differentiation must be made between nonscience and pseudoscience.

As emphasized previously, one of the major characteristics of pseudoscience is the pretention of being science. However, nonscience does not have such a pretention. Other characteristic of pseudoscience which stated by Hansson (2013) is that pseudoscience "pertains to an issue within the domains of science" (p. 70). On the other hand, nonscience, for instance religion (Baran, Kiani & Samuel, 2014), is not an area which is interested in scientific domain or something that can be investigated scientifically. Additionally, as Mahner (2013) clarified, many pseudosciences consist of testable and refutable statements and therefore would be count as falsifiable. On the other hand, according to Orr (2006) nonscience is unfalsifiable. Furthermore, Orr (2006) differentiated the nonscience and unscience. According to him, nonscience is unfalsifiable whereas unscientific is falsifiable. Particularly, according to Orr (2006), something such as faith or religious fact that "is not based on proof" yet "does not contradict what is known, either" can be classified as nonscientific, but not unscientific (p. 443).

Hansson (2015) viewed metaphysics, religion, and various types of nonscientific systematized knowledge as nonscientific. On the other hand, unscience includes a kind of contradiction or conflict with science (Hansson, 2015). To make it clear, Hansson (2013) sorted these concepts in respect to their scopes. According to him, pseudoscience is the narrower one whereas nonscientific is wider one.

Understanding these distinctions among science, pseudoscience, nonscience, and even unscience is a basic consideration and prior adequacy for understanding and developing scientific ideas, claims or theories. For this reason, teachers or science educators should take the characteristics of pseudoscience and nonscience as serious as that of science in science education. For instance, in the context in which students encounter and discuss about both scientific and pseudoscientific areas, they are not only provided opportunity to articulate their understanding, but they see clearly the nuance of the viewpoint of these different systems. Similarly, Erduran (1995) argued that "science itself would be more meaningful for learners of science if it was articulated with respect to and differentiated from pseudoscience" (p. 4).

Although we have many criteria in order to differentiate science from pseudoscience, when it comes to apply these criteria to the daily practices, we also have some difficulties in distinguishing science and pseudoscience. To know the criteria and to know how to apply criteria are two different skills. Hansson (2013) attempted to explain demarcation issue by using analogy. He resembled demarcation between science and pseudoscience to riding a bicycle. According to him, most of us are able to ride a bicycle; however, few of us can explain how we ride a bicycle. Additionally, in order to imply the difficulty in demarcation Mahner (2013) criticized that although we have many criteria "when it comes to formulating criteria for the characterization of science and pseudoscience" no such demarcation is possible (p. 31). Therefore, we need to examine inner processes that make pseudoscientific practices attractive to us and that make us blind in distinguishing science and pseudoscience.

2.4 Why Do People Believe in Pseudoscience?

The reasons or causes that make us believe in pseudoscience vary. It is such a complex issue that it stems not only from psychology, but also from sociology, and even from educational perspective. Therefore, lots of theories such as basic social motives, cognitive-experiential self-theory, social learning theory, causal attribution theory, and media priming theory and so on should be addressed in order to get a substantial grasp of why we believe in pseudoscience. Before going further, it is worth noting that all of us are vulnerable to pseudoscientific beliefs. Keinan (1994) clarified that when it comes to a phenomenon which we lack information about it, feel threat or uncertainty, or unable to explain it; this ambiguity structure of the phenomenon increases the disposition to such beliefs among all of us. Additionally, Shermer (1997) acknowledged that believers in different kind of pseudoscience are normal people yet their "normal thinking has gone wrong in some way" (p. 45). If so, what is going wrong in thinking?

In order to answer the question, the detailed but not enough synthesis came from Epstein. According to cognitive-experiential self-theory of personality, as human

being, we use two independent but interactive ways in processing information; preconscious experiential thinking and conscious rational thinking (Epstein, 2003). As it is understood from the names of the thinking systems, one of them is based on experience and other is based on logic. In the same way, Lindeman (1998) labeled them heart and reason. Epstein (2003) attempted to compare these two ways of thinking in a table. According to comparison, experiential thinking system is "holistic", "emotional", "outcome oriented", and based on "past experience" whereas rational thinking system is "analytic", "logical", and "process oriented" (Epstein, 2003, p. 160). Furthermore, due to the fact that self-evidently validation is enough to orient the behavior, the information is processed rapidly and is resist to change in experiential thinking, on the one hand. On the other hand, when it comes to process information in rational thinking system, justification process is supported by logic and evidence is necessary so that this process is slow and the information is subject to change rapidly as a result of new evidence or more logical situation.

Lindeman (1998) claimed that pseudoscientific beliefs are originated from experiential thinking system that mentioned above. His claim was based on his definition of pseudoscience so that he defined pseudoscience as "a joint function of the basic social motives and the default way of processing everyday information" (Lindeman, 1998, p. 257). Other claim of him was that as a human being, we are under the impression of social motives such as having sense of control, belonging, maintaining self-esteem, making sense of world and so on, and then pseudoscience makes better to meet these motives than science does. To put it in a different way, pseudoscience provides simplistic way to comprehend phenomena that are difficult to do. Shermer (1997) referred this process as simplicity of pseudoscience and expanded it on by stating that "Scientific explanations are often complicated and require training and effort to work through" and believing in some kind of pseudoscience "provide a simpler path through life's complex maze" (p. 277). Additionally, Good (2012) referred this simplistic way of pseudoscience as easy-to-believe characteristic of pseudoscience. In his book of Scientific and Religious Habits of Mind: Irreconcilable Tensions in the Curriculum, Good (2005) put forwarded two different habits of mind; scientific habit of mind such as skepticism,

respecting evidence, being open minded, and questioning authority; and religious habit of mind such as valuing personal testimonies and anecdotes, gullibility, accepting authority. When he compared these two, he referred easy-to-believe characteristic of pseudoscience as natural and, not-easy-to-believe mode of science as unnatural and demanding of uncommon sense. Additionally, he acknowledged that "coming to understand and believe many "unnatural" ideas in science is not an easy task for most people" (Good, 2012, p. 101).

In addition to simplistic structure of pseudoscience, pseudoscience provides another simple way to stop occupying our brains with unexplained issue by referring them inexplicable. Thereby, the problem is solved. To make it clear, when people are unable to explain something or unable to get satisfy information from experts, they tend to think that it must be inexplicable and meanwhile they tend to think that it must be true or mysterious, as Shermer explain in his book of "Why people believe weird things" in 1997.

Other reason that makes us believe in pseudoscience is ability of reasoning. Our reasoning ability is responsible for our decision-making processes and ability of considering alternative possibilities. In their chapter dealing with difficulties in everyday reasoning, Perkins, Allen, and Hafner (1983) differentiated two types of reasoners. The first one is naïve reasoner who has makes-sense-epistemology in which the truth test is based on "whether propositions make superficial sense" and the second one is sophisticated reasoner who has critical epistemology that includes construction of pro and con arguments that is based on integration of one's knowledge base (p. 177). Similar to experiential thinking as mentioned earlier, makes-sense epistemology goes parallel with pseudoscientific thinking system. Particularly, naïve reasoners who have makes-sense epistemology handle the test of truth by examining their proposition whether it "makes intuitive sense, sounds right, rings true" (Perkins, Allen, & Hafner, 1983, p. 186). If the proposition makes sense, the problem is solved and they do not examine the proposition scrutinizingly again. Perkins, Allen, and Hafner (1983) viewed this reasoning process as superficial mental model rather than logical fallacies. However, most of other researchers

maintained that pseudoscientific thinking system is a result of logical fallacies or reasoning errors or cognitive errors (Beyerstein, 1995; Shermer, 1997; Singer & Benassi, 1981; Smith, 2010). For instance, one of the most stated reasoning error is confirmation bias. Confirmation bias is "seeking or interpreting of evidence in ways that are partial to existing beliefs, expectations, or a hypothesis in hand" (Nickerson, 1998, p.175). It is a kind of way of seeking evidence yet in a one-way or biased way. Similarly, Tavris and Aronson (2007) defined confirmation bias as tendency by which the people just look for to find confirmation evidence which contradicts with available belief or proposition, and then deny or ignore the evidence that is contract to their belief. In more clearly, Shermer (1997) stated that this bias drives "to seek and find what they are looking for, and to confirm what they already believe" (p. 210). For instance, in most of the pseudoscientific applications, the proponents of them just mention about the positive results they observed which are consistent with what they already believe. It is scarce but if they do a research, they have tendency to find a result in a way they believe even at the beginning of the research.

There are also some boosters of confirmation bias. One of them is testimonials and other is anecdotal evidence (Matute, Yarritu & Vadillo, 2011; Smith, 2010). Testimony is a kind of having experience or witness something on your own. In specific case of pseudoscience, it is a tendency to share and try to make people convinced by providing positive instances of something. Baran, Kiani, and Samuel (2014) viewed testimonials as a main reason of why people appreciate pseudoscientific claims as reasonable. Additionally, they criticized the one-way or biased structure of testimonials that only people who get benefit provide their testimonials, however, people who do not get benefit have tendency not to share their testimonials. Anecdotes, as well as testimonials, are strategies which are used to prove ideas as if they are evidence. Similarly, people who believe in pseudoscience provide their anecdotes as evidence to make other people believe in their idea. However, as Shermer (1997) stated "anecdotes do not make a science" (p. 48). It is obvious that neither testimonials nor anecdotes substitute for evidence. On the other hand, for most of the people who believe in pseudoscience, there is no such clear

difference between evidence and testimonial or anecdotes. Thus, these two could be more reliable and convincing than scientific evidence for most of the people.

Furthermore, if we have heard of something before, it would seem higher in quality (Goldstein & Gigerenzer, 1999; Todd & Gigerenzer, 2000). This heuristic is called recognition heuristic and is a kind of reasoning error called ignorance-based-reasoning (Todd & Gigerenzer, 2000). It has direct relationship with social or communal reinforcements of pseudoscientific beliefs. Unfortunately, we are so vulnerable to social culture in which we live and to ideas of people who we live together. Consequently, social reinforcement and importance of group thinking were emphasized as main reasons of pseudoscientific beliefs (Carroll, 2005; Eve & Dunn, 1990; Janis, 1972; Nisbet, 2006; Preece & Baxter, 2000). Specifically, Carroll (2005) made an analogy of pseudoscience with viruses and clarified that as a result of communal reinforcement, the pseudoscientific belief are delivered and maintained their existence. Additionally, Janis (1972) emphasized how group thinking influence and impair our reasoning skills when we encounter pseudoscientific application. If group is agree with a decision, individual in the group tend to obey the decision of the group and does not need to criticize or evaluate the decision. Accordingly, as Carroll (2005) underlined that "It is always easier to believe something, no matter how wild or weird, if others believe it, too" (p. 212).

Other reasoning errors and fallacies that are seen responsible for prevalence of pseudoscientific beliefs were well documented in Smith's book of Pseudoscience and Extraordinary Claims of the Paranormal: A Critical Thinker's Toolkit in 2010. Smith (2010) emphasized both formal logical fallacy and informal logical fallacy, as well as pragmatic fallacy. In formal way of logic, we use generally two types of logical arguments; deductive reasoning and inductive reasoning. Particularly, Smith (2010) focused on the fallacies in deductive reasoning and differentiated valid and false reasoning structure. The rule in deductive reasoning is that as long as you accept the premise, then the conclusion comes as follow. If your premise is true, there is no need to criticize the conclusion. This is the type of valid deductive reasoning. What if your premise is wrong, you reach the questionable conclusion. In this case, you have

valid but false deductive reasoning. Suppose that you made an argument that the Geminis (a kind of astrological sign) are so confident, and my brother is Gemini, therefore he must be confident. In this argument, the deduction is valid but the first premise is wrong so that the deduction is false. This fallacy is called unfounded assertion. The second fallacy is based on invalid argument in which the logic is operated from tail to head. Suppose that you made an argument that if the bracelet that made of coral gives you luck as it is supposed to be, you will be lucky through the day. You are so lucky today therefore, the bracelet that made of coral gives you luck. In this case, you just affirm the consequent. According to Smith (2010) "affirming the consequent proves nothing" (p. 73) and, pseudoscientific and paranormal beliefs are generally based on this logical error.

In addition to this, Smith (2010) clarified the pragmatic fallacy and fallacy related to correlation and causality. The former one is actually based on Fishburn's utility theory. Utility theory is a comprehensive theory that is interested in people's decisions, choices, judgments, preferences, and values (Fishburn, 1968). As a social perceiver, we make an attribution for each option we face in social life. In individual level, everyone assesses their attributions in respect to these options according to their subjective value or utility (Busemeyer, Townsend, & Stout, 2002). Utility is a kind of way that guides our decisions. Therefore, the utility must be in accordance with our decisions. Additionally, someone attributes a utility in way that contributes to the individual's purpose of changing decision context (Busemeyer, Townsend, & Stout, 2002). In the same way, Kunda (1990) clarified that people use this way in order to reach the desired conclusion. Accordingly, attribution of utility is an outcome expectation oriented process. That is to say, "people will come to believe what they want to believe only to the extent that reason permits'' (Kunda, 1990, p. 483).

Correspondingly, pragmatic fallacy is based on the same way as mentioned previously. Pragmatic fallacy is act of approving something is true because of its perceived benefit that supposed to be provided by it. Likewise, pragmatic fallacy is commitment to a belief that assertion must be true, just because it seems to work

(Smith, 2010). It derives from our perception of something as satisfying, convincing, beneficial, making you feel better, and working on you as you suppose. When we observe these satisfying outcomes, we tend to think of that it must be true in accordance with pragmatic fallacy. In this case, observer is just interested in fulfilling his/her outcome expectation without criticizing truthfulness of the assertion. Briefly, as Carroll (2014) indicated that individual considers practical benefit or utility in believing that something is true without considering whatever its truth-value is. For instance, you made an argument that; when I wear evil-eye jewelry, I feel better and protected, therefore, it must be more of a true belief than a superstition and it also must be true that the evil-eye jewelry protects us from others' jealousies. It is a typical kind of pragmatic fallacy. In this case, you have tendency to believe in working efficacy of evil-eye just because wearing it makes you feel better and make you believe that it works on you.

Pragmatic fallacy is also very similar with post-hoc fallacy that is one of the responsible fallacies of prevalence of pseudoscientific beliefs. Post-hoc implies if-then relationship. Shermer (1997) referred post-hoc fallacy as after-the-fact-reasoning. Smith (2010) dealt with post-hoc fallacy as correlation-causation relationship. Lilienfeld, Ammirati, and David (2012) related post-hoc fallacy to naïve realism. Whatever its label is, the post-hoc fallacy is derived from Latin phrase of "post hoc, ergo propter hoc" which means that "after this, therefore because of this". It is a tendency to see two facts occurring in a sequence related in a causal way. For instance, Coker (2001) gave an excellent example in order to differentiate the two different perspectives of science and pseudoscience. His example is that; "Joe Blow puts jello on his head and his headache goes away" (p. 1). According to scientific perspective, it does not mean anything due to the absence of evidence. However, from pseudoscientific perspective or post-hoc fallacy perspective, it means that jello cures headache, even it could be used as an anecdotal evidence to prove jello's efficacy. In fact, it does not mean that two facts following each other in a sequence are connected in a causal way. As Shermer (1997) stated, "correlation does not mean causation" (p. 53). Similarly, Smith (2010) clarified that occurring at the same time does not mean that one fact caused the other fact. There are four possible reasons that

might explain the co-occurrence of two facts. However, people who have post-hoc fallacy tend to selectively chose just one of these reasons that seems both simplistic and satisfying.

Lindeman (1998) exemplified the four-part chart of possible rival explanation by giving example of a woman who observed twelve relativities who recovered from the flu just after they took particular treatment. In his example, Lindeman (1998) argued that for this woman it is not possible to believe inefficacy of the treatment. As note before, in order to see the full picture of the causal relationship between the treatment and the disease, all other possible parts of the chart must be considered. That is to say, she must consider those who did not recover despite they took the treatment, those who recovered although they did not take the treatment, and those who both did not recover and did not take the treatment, as well as those who took the treatment and recovered.

As understood from the example, people preferred to see what they expect to see among the four equally possible facts. Furthermore, for most of the people seeing something on their own would be more convincing than others would. It could be called "seeing is believing tendency" of our brain. In nature of science literature, it is called "seeing is knowing" (Khishfe, 2008; Khishfe & Lederman, 2006) and indicating misconception about how science is done. In fact, it refers the process in which only concrete or visual evidence is convincing. In this process, if people see something with their own eyes, they tend to believe that it is true, it exists and it is more convincing. Similarly, Lilienfeld, Ammirati, and David (2012) explained this logical positivist perspective with the epistemological term of naïve realism. In respect to naïve realism, its erroneous assumption is that "the world is exactly as we see it" (Lilienfeld, Ammirati, & David, 2012, p. 13). For instance, people would make an argument that "I believe the efficiency of drinking green tea in losing weight, because I saw that it worked on my sister" or "of course it is true, I saw it with my own eye" or "I cannot believe it unless I see it on my own". All of these are based on seeing is believing tendency. When we combine naïve realism and post-hoc fallacy in the same example, one can asserted that for instance, "I saw that my friend

placed the amethyst on her back and her back pain was relieved, that is why I believe in crystal healing". In this argument, due to his/her naïve realistic epistemology, it would seem true or convincing as s/he observed it directly. Even so, this argument reflects the post-hoc reasoning fallacy. Indeed, these two facts would be correlated but it does not prove that these are connected in a causal way.

Bandura's (1989) social cognitive theory which stems from social learning theory demonstrated us that individual's thoughts, beliefs, and feelings have influence on how s/he behaves. Yet, how these thoughts, beliefs, and feelings are constructed and justified. One of the answers comes from the social cognitive theory itself; interaction with social context via observing, imitating, modeling, and collaborating. Other answer comes from the transformation learning theory. In transformation learning theory, reasoning involves assessing of reasons that reinforce beliefs resulting in decisions to behave (Mezirow, 2003). As a result of this assessment process, "beliefs are justified when they are based on good reasons" (Mezirow, 2003, p. 58). These good reasons could be benefit, satisfaction, feeling of happiness, and feeling of better health as stated previously.

As regard to construction and reinforcement of beliefs, there are also some essential factors that are called shortcomings, commonplaces, and heuristics. Shortcoming is a version of judgmental error. Shortcomings are characterized as "defective information processing system of people who believe in pseudosciences" (Lindeman, 1998, p. 263). Additionally, heuristics and commonplaces are some beliefs, rules, or norms that are approved by society. Pratkanis (1995) provided the detailed compilation of various common heuristics and commonplaces. One of them is consensus or bandwagon heuristic. The assumption in this heuristic is "if everyone agrees, it must be true" (Pratkanis, 1995, p. 23). The second one is natural commonplace which is based on the assumption that "what is natural is good and what is made by human is bad" (Pratkanis, 1995, p. 24). Nature depiction of alternative medicine that is based on natural commonplace is emphasized by some researchers (Atkinson, 1979; Hines, 1988; Pratkanis, 1995). Another commonplace is science commonplace. It indicates the language used by pseudoscientists in order to

imitate the science. Ladyman (2013) indicated this imitation by stating that "for many people, scientific terms are indistinguishable from those of pseudoscience" (p. 55). For instance, when someone mentioned you about quantum crystal healing, it would seem you scientific due to the term of quantum, and probably you would find the claims about this quantum crystal healing reasonable due to the misleading use of the scientific term. However, Shermer (1997) explained that in the absence of evidence and experimental testing, howsoever, you use scientific terms as much as you can it just proves nothing. This pseudoscientific attempt of imitating science by using its terms is based on desire to use respectability of science. Additionally, mass media contributes to this attempt by guiding society sometimes in a wrong way. For instance, following quotation was taken from newspaper article (Adams, 2014)which misleads the reader toward pseudoscience;

> **Is this proof humans have TELEPATHIC powers? Two men, 4,600 miles apart, send messages to each other using just their minds**
>
> With a blindfold covering his eyes, and earplugs cancelling out almost all sound, Dr Michel Berg sat in a state-of-the-art laboratory at the University of Strasbourg in north-eastern France, and began to think. Nearly 5,000 miles away, at a research facility in the Indian city of Kerala, a young Spanish man called Dr Alejandro Riera pulled on a tightly fitting hat, placed a laptop computer on a white table, and also began to think.Over the course of the next hour, on March 28 this year, the 51-year-old Dr Berg and his faraway counterpart would attempt something that had only previously occurred in the exotic realms of science fiction.
>
> The two men aimed to send a simple message between each other, across the continents, without using any of the five senses that human beings and indeed animals have for millennia used to communicate. They instead hoped to achieve what scientists call 'mind-to-mind direct technological communication' and the rest of us would recognize by a single, tantalizing word: telepathy.
>
> This, in layman's terms, means they carried out the first scientifically documented telepathic conversation in human history. The exchange was nothing if not brief. The duo shared just two words: the Spanish greeting 'hola', and the Italian 'ciao'. Yet what it might have lacked in colour and complexity, it surely made up for in potential historic importance. 'We have shown that it is possible to send a mental message between two people, without using sight, touch, sound, taste or smell,' Dr Berg told yesterday.

This headline actually includes misinterpretation or misleading of the results of a scientific study “Conscious Brain-to-Brain Communication in Humans Using Non-Invasive Technologies” written by Grau and his colleagues (2014). At the first glance, it could be concluded that scientists proved the brain-to-brain telepathy. Specifically, the terms of “scientists” and “telepathy” take place together. Additionally, it includes pseudoscientific terms such as telepathy, telepathic conversation, and mental message however, these terms are not used in any part of the original research paper. Although the details of the original experiment such as using technology to interact electromagnetically or wearing a wireless internet-linked electroencephalograph are included in the main body of the article, it is quite possible people who just read the headline of the articles would infer that the telepathy is true and it is also scientific.

As obvious from the above example, mass media would lead us to believe pseudoscience, intentionally or unintentionally. But, a considerable amount of researchers expressed the importance of intentional mass media exposure of pseudoscience in the prevalence of pseudoscience (Baran, Kiani, & Samuel 2014; Ede, 2000; Carroll, 2005; Castelao-Lawless, 2002; Coker, 2001; Lilienfeld, Lohr, Morier, 2001; Nisbet, 2006; Preece & Baxter, 2000; Shermer, 1997; Singer & Benassi, 1981; Smith, 2010; Tsai et al, 2012). Some pseudoscientific endeavors such as water dowsing (Happs, 1991; Afonso & Gilbert, 2010), astrology (Happs, 1991; Preece & Baxter, 2000; Kallery, 2001), and crystal power (Preece & Baxter, 2000) have been propagated in the mass media as if they were science. Books, television programs, and advertisements commonly stress these pseudoscientific applications. Generally, mass media exposure of pseudoscience is associated with commercial interest or stake of pseudoscientists. Pseudoscientific applications are generally propagated in popular media by well-organized groups with the aim of substantial commercial interests (Castelao-Lawless, 2002; Preece & Baxter, 2000). Nisbet (2006) stated that frequency and availability of media depiction of these pseudoscientific applications increases, the total level of belief in these applications also increases.

According to Castelao-Lawless (2002), impact of mass media mislead the people about image of science that all ideas can be seen scientific as long as it conducted in the eye of the beholders and it is accepted by some group of people as such. Since this image of science imposes people scientific relativism and influences their epistemology, it is accepted as one of the most important limitation in achieving desirable understanding of science. In a similar vein, Turgut (2011) asserted popularization and assimilation of pseudoscience via the media as possible reasons for erroneous popular perceptions of science.

In addition to mass media exposure, science education is also in the list of whoever is responsible for prevalence of pseudoscience (Carroll, 2005; Ede, 2000, Eve & Dunn, 1990). It is common to these researchers is that the real reason is the poor quality of science education. Specifically, Carroll (2005) criticized the poor design of the biology lessons, the first science for most students, which seem to aim at snuffing out interest in all science education. On the other hand, Ede (2000) listed some problems about science education; 1) science classes are primarily aimed at teaching students technical skills, 2) science is taught with little or no social context, 3) science education emphasized elite behavior over concepts of common good (p. 50) and strikingly claimed that the combination of these three problems negatively contributes to what was intended in science education, indirectly orients students to pseudoscience.

Despite its importance, pseudoscience which might cause inadvisable understanding of science does not take place in science education. Pseudoscientific beliefs are important but neglected aspect of science education. Martin (1994) defined existence of pseudoscientific beliefs as indicators of ignorance of the fundamental principles of scientific investigation, misunderstanding of the theory and its evidential support in science, and lack of critical evaluation of an idea.

As a result of science education, students are supposed to understand the process of science in which scientific knowledge are constructed by collecting data and looking for evidence. Students also are supposed to understand the justification process that

scientists use when they call knowledge as scientific to ensure the reliability of it. When it is called scientific knowledge, what it is implied and what the criteria are to accept something as scientific are the other questions that needed to be articulated by students in the light of the science education. When they comprehend aforementioned processes about science, they are supposed to distinguish pseudoscience that is based on flawed evidence and unproven theories. In science education, we set our goals as to make our students capable in understanding science, but we generally disregard and ignore to make them capable in being scientific.

Thus, the present study focused on the degree of students' capability of being scientific when they encounter pseudoscientific applications and on how they criticize the research processes used in these applications.

2.5 Research on Belief in Pseudoscience

Although the root of the research held in pseudoscience is based on psychology, it has been studied over the thirty-five years in an educational manner. The most comprehensive and longitudinal research attempt belongs to National Science Foundation (NSF) of the United States of America. NSF has surveyed public understanding about Science and Technology (S&T) by measuring the capacity of the public to distinguish science from pseudoscience since 1979. The survey mainly focused on astrology as well as lucky numbers, unidentified flying objects (UFOs), extrasensory perception (ESP), and magnetic therapy as a pseudoscientific area. Several reports have been published by NSF in this period. According to one of the recent report published in 2012, more than half (%54) of the youngest informants whose age ranging from 18 to 24 were more likely to say astrology was very or sort of scientific (NSB, 2012). Additionally, the belief in paranormal phenomena including psychic, extrasensory perception, extraterrestrial, and communication with dead person increased in a ten years period from 1990 to 2001 (NSB, 2002).

Another comprehensive research based on demarcation astronomy from astrology conducted by DeRobertis and Delaney (1993, 2000). They conducted two identical

large scale surveys in 1993 and 2000 with 1500 university students to determine their attitudes toward astrology and to establish whether they are able to distinguish astronomy from astrology. The surveys' results were very identical and indicated that more than 45% and 53% of art students and more than 37% and 53% of science students (in 1993 and 2000, respectively) subscribed to the principles of astrology. Likewise, more than 60% and 55% of art students and more than 50% and 44% of science students were unable to distinguish astronomy from astrology. They interpreted these results as a serious problem with science literacy.

Interested in secondary school students' skepticism and gullibility, Preece and Baxter (2000) surveyed a total of 2159 secondary school students' pseudoscientific beliefs. They used very comprehensive context including astrology, ghosts, palmistry, crystals, pendulum, mirrors, and Friday 13th as indicator of pseudoscience in their survey. They focused on students' skepticism and gullibility by examining their responses to aforementioned pseudoscientific issues by stating almost certainly true, quite likely to be true, quite likely to be untrue, and almost certainly untrue. They also focused on the relationship between pseudoscientific beliefs and grade level (from grade 7 to 11), gender, and the source of these beliefs. Additionally, they interviewed with four students (two with high survey score and two with low survey score) from each grade level. Researchers found that skepticism increased steadily as the grade level increased (average score of skepticism is 19.06 in 7th grade and 20.42 in 11th grade with the maximum score is 28). Concerning to this result, researchers warned science educators that many school students were very gullible. They also extended their research scope by asking students about the source of the beliefs being studied. According to interview result, superstitious beliefs frequently resulted from the influences of family, television, and personal experience.

Using specifical astrology context, Kallery (2001) investigated 103 early-years teachers' opinions and attitudes toward astrology and tested their awareness of the distinction between astronomy and astrology. Result of the study revealed that majority of the teachers (59%) view both astronomy and astrology as scientific, and they cannot distinguish science and pseudoscience. Interestingly, almost half of the

teachers (44%) were not aware of what astronomers can or cannot do, and quarter of them (27%) believed that astronomers can predict people's character and future as astrologists do. When considering the possible effects on young children's attitudes toward science, the result of this study was substantially alarming. The researcher also recommended an in-service education program that addresses and challenges the teachers' views to improve their science literacy and their critical thinking in this field.

In a similar vein, Nickell (1992) investigated high school students' nature of pseudoscientific beliefs and attitudes toward science. In this quantitative study, the researcher also investigated if there was a relationship between students' pseudoscientific beliefs and their scientific attitudes. A total of 280 high school students enrolled in science classes participated in the study. The researcher used three-part survey including demographic section (from 1 to 5), pseudoscientific beliefs (from 6 to 30), and attitudes toward science (from 31 to 100). The researcher used The Belief in the Paranormal Scale to assess students' pseudoscientific beliefs. This scale included 25 items related to horoscope, extrasensory perception, psychic phenomena, reincarnation, UFO, ghost, and black magic. The Test of Science-Related Attitudes was used to assess students' attitudes toward science and technology. This scale included seven subscales including Social Implication of Science, Attitudes toward Scientific Inquiry, Adoption of Scientific Attitudes, the Normality of Scientists, the Enjoyment of Science Lessons, the Leisure Interest in Science, and the Career Interest in Science. In order to determine current level of pseudoscientific belief, the researcher calculated the frequency and percentage of each response then compared these frequencies to the result obtained in a National Gallup Survey conducted in 1988. According to the result, high school students had lower score of beliefs in astrology and extrasensory perception although they had higher score of beliefs in witchcraft, ghost, Losh Ness monster than the national sample had. When it came to the relationship between pseudoscientific belief and attitude toward science, the researcher found a significant positive relationship between the score obtained from the Belief in Paranormal Scale and score on some subscales of Scientific Attitude such as Social Implication of Science, Adoption of

Scientific Attitudes, the Leisure Interest in Science, and the Career Interest in Science. This result is very interesting and very surprising. More clearly the result indicated that students with better attitudes toward science were more likely to believe in pseudoscientific phenomena. The researcher explained this result by being open minded and receptive to new ideas. According to the researcher, the higher score on attitude scale, the more receptive the student was to new ideas, thus this openness of students made them higher score in belief in pseudoscience.

In the following years, the scope of the research held in pseudoscientific belief was extended in a way that based on an assumption stating that students who have more scientific knowledge are less likely to believe in pseudoscience. In order to clarify this assumption, Walker, Hoekstra and Vogl (2002) surveyed a total of 207 American undergraduates from three different universities. They structured their research on the argument stating if science leads to skepticism about pseudoscience, science knowledge and paranormal beliefs should be inversely related. They used two stages survey including not only scientific knowledge but also pseudoscientific context. The first unit of the survey included 10 questions about science knowledge related to biology, chemistry, geology, and astronomy. The second unit of the survey included 14 paranormal and pseudoscientific claims which students need to rate how much they believe in. They correlated students' science test score with their pseudoscientific belief score. They found no relation between level of science knowledge and skepticism regarding pseudoscientific beliefs. They also stated that "it is possible for a student to accumulate fairly sizable science knowledge without learning how to properly distinguish between reputable science and pseudoscience" (p.1). This result is the evidence for the notion that having a strong scientific knowledge base is not enough to make students not to believe in pseudoscience. Researchers also pointed out that "students are taught what to think but not how to think." (p. 3)

Similar with the aforementioned study, Johnson (2003) addressed the relationship among science factual knowledge, conceptual understanding of science, and belief in pseudoscience by comparing science majors and non-science majors. He planned to

test assumption that science majors express lower degrees of pseudoscientific belief than non-science majors (presumably because their knowledge of science makes them more skeptical of such claims). He used 30-question survey consisting of three types of questions. The first group of questions intended to assess the students' general knowledge of science about the periodic table, the nature of photons, genetic disorders, organic, and inorganic compounds. The second group of questions was related to students' understanding of important scientific concepts such as the difference between theories and laws, scientific method myth, and tentativeness of scientific knowledge. The third group of questions was used to examine the students' degree of belief in paranormal phenomena, such as telepathy, astrology, the existence of the Loch Ness monster, magnetic healing, and broken mirror. The result of the study showed that there was a weak positive correlation between knowledge of science fact and understanding of science concepts while there was a weak negative correlation between pseudoscientific beliefs and science facts. Additionally, there was no apparent relationship between pseudoscience belief and understanding of scientific concepts and methods. Consistent with the result of the research conducted by Walker et al. (2002), neither knowledge of science facts nor understanding of scientific concepts seemed to be associated with the degree of belief in pseudoscience.

Losh and Nzekwe (2011) investigated upper class preservice teachers' views about evolution theory, intelligent design, fantastic beasts, magic, and extraterrestrials. High number of preservice teachers (n=663) from different majors such as elementary education, social studies, science education, math education, and English education participated in the study. Since the main purpose of the study was to compare preservice teachers' basic scientific knowledge and pseudoscientific belief with the educated adults in the US, researchers used a survey including demographics and 88 knowledge and belief items, which is consistent with the NSF survey. It was found that preservice teachers rejected evolution, accepting Biblical creation and intelligent design accounts. The researchers also found striking uncertainty in several topics. Responses excluding "agree" and "disagree" were ''the evidence is inconclusive", thus the sizable minority of the preservice teachers

‘‘awaited more evidence’’ about fantastic beasts, magic, or extraterrestrials. Although the Oxford items indicating science knowledge were related to beliefs about evolution-creation, it was generally unassociated with other variables being studied as indicator of pseudoscientific beliefs. This provided consistent result with the research studies based on assumption stating that students who had more scientific knowledge were less likely to believe in pseudoscience. Similar to Walker et al. (2002), the researchers recommended necessity of training focused on critical evaluation of scientific evidence in teacher education.

As stated previously astrology is one of the most debated issues in research studies held in pseudoscience. There were well documented evidence indicated that one could believe in astrology although those had fairly sizeable science knowledge. An interesting result about students’ beliefs in astrology and in general pseudoscience was reported by Sugarmann, Impey, Buxner and Antonellis (2011). They surveyed attitudes toward science, perceptions of pseudoscience, and general scientific knowledge of nearly 10000 undergraduates from different majors with a similar assumption stated that students who know or who understand more science are less likely to subscribe to the principles of astrology, or be susceptible to other forms of pseudoscience. Thus, their survey included several questions which were designed to measure attitudes toward science, perceptions of pseudoscience, and general scientific knowledge. They used two indicators for astrology. First of all, they asked students to choose “astrology is not at all scientific”, “astrology is ‘very’ or ‘sort’ of scientific”. They were also asked to choose suitable option (disagree, strongly disagree, agree, strongly agree or have no opinion) for the statement indicating, “the positions of the planets influence everyday life”. The research results revealed that students who said that astrology is not at all scientific had an average science literacy score of 12.5 (out of 15) and those who said that astrology is very or sort of scientific had an average score of 11.5 (out of 15). Similarly, students who stated that they strongly disagree or disagree about the statement “the positions of the planets influence everyday life” had an average science literacy score of 11.6, while students who “agree,” “strongly agree,” or have “no opinion” had an average science literacy score of 11.00. Thus, they found that beliefs in astrology were not strongly linked to

science literacy and the researchers interpreted that belief in astrology was also relatively impervious to a college education. Therefore, they suggested that the frequent use of astrology as an indicator of science literacy or as a symptom of general science illiteracy appeared to be invalid, because of the psychological basis for astrological belief.

In another study, Yates and Chandler (2000) gave the situation a new perspective. They investigated the patterns between pseudoscientific beliefs and anti-scientific attitudes in preservice primary teachers. A group of researchers including authors of the study, three philosophers, and colleagues from the faculty rated eight statements as unbelievable in panel, then the researchers referred them as new age beliefs. The context of new age beliefs comprised from issues about pyramid shape, people mediation in crime rate, reincarnation, astrology, crystal healing, UFOs, psychic power, and Nostradamus predictions. The researchers investigated the predictors of new age thinking. They used 30-item beliefs questionnaire fell into four categories; new age beliefs, anti-scientific sentiment, pro-scientific sentiment, and filler items. Additionally, media exposure questionnaire and the need for cognition scale were used in this study. A total of 232 undergraduate students, 202 were teacher education majors, whilst the others were from other faculties who happened to be undertaking education topics participated in the study. Interestingly, only four students rejected all the new age beliefs being dealt with in this study and when they faced with new age items generally, they had no particular opinion. Additionally, the researchers found that undergraduate students' new age beliefs score and their anti-scientific attitudes were unrelated. Their knowledge of television content was also found to be unrelated with students' new age beliefs score. The researchers were unable to demonstrate a significant relationship between New Age beliefs and the psychological need for cognition.

Similar research study was conducted by Barnes, Abd-El-Fattah, Chandler, and Yates in 2008. They investigated new age beliefs (pseudoscientific and paranormal beliefs and superstitions) of 362 teacher education students at an Australian university. They used six-item New Age Belief questionnaire consistent with the

previous study, six-item Anti-scientific Attitudes Scale, and 20-item Argumentation Approach and Avoidance scale. It was found that 10% of them consistently rejected all six New Age statements on the survey, and 1% consistently accepted all six statements. In all, 62% indicated agreement with at least one New Age belief. Additionally, it was found that New Age beliefs did not relate to university grade, grade point average, anti-scientific attitudes, or dispositions to approach or avoid personal argumentation.

Another interesting study was conducted by Mirtz (2007). In his dissertation, in order to understand university students' skill in demarcation science from pseudoscience, Mirtz (2007) used health-related issues both as a scientific and pseudoscientific area. By using health-related issues, he investigated students' beliefs, attitudes, knowledge in science and pseudoscience, and their preference for deductive reasoning or inductive reasoning. A total of 514 university students participated in the study. In the first part of the survey, in addition to demographic data part, the researcher utilized 19-item scale to assess students' belief and view about science and pseudoscience. The pseudoscientific issues included in scale were related to health such as crystal healing, homeopathy, magnetic healing, acupuncture, psychic surgery, and iridology. In the second part of the survey 23-item Deductive Preference Scale was used. The third part of the survey, The Consumer Health IQ Test was used to assess students' health-related literacy. Finally, the researcher found that the students participated in the study had positive attitudes toward scientific concepts, and negative attitudes toward pseudoscientific concepts. Additionally, the results also indicated that there was a significant negative correlation between health-related literacy and beliefs in pseudoscience, but deductive preference was not found to be associated with belief in science or pseudoscience. It is believed by the researcher that a person who had a belief in pseudoscience would likely have a preference for deductive reasoning. Thus, one of the aims of this study was to assess thinking preference among students who believed in pseudoscience. The researcher interpreted the result that the students participated in the study may have deductive preference that was more akin to problem-solving instead of as the basis for pseudoscientific thought.

Up to now, the literature was unable to explain the basis of pseudoscientific beliefs. The research studies consistently showed that students' pseudoscientific beliefs were widespread, and these beliefs were found to be unrelated with the scientific knowledge base and scientific attitudes, which were assumed to presumably be predictors of pseudoscientific beliefs. On the other hand, there was a great agreement among researchers that mass media had a great influence on society, especially on younger population. Whittle (2003) in his dissertation investigated the effectiveness of watching prime-time television programs on learning in science and pseudoscience. By dealing with ER, a serial drama in hospital emergency room and the X-File, a drama about two Federal Bureau agents pursuing extraterrestrial life and paranormal activities, he provided program-specific on-line chatting opportunity to the potential respondents. In this Internet-based environment, 117 respondents who were more than 18-year old were involved in the study. The study took nine months. In this period the participants responded to the survey. The result of the study was highly interesting and shed light on the mass media effect. The researcher analyzed the data according to respondents' viewing time of a program a week, their educational degree, and their personal experiences such as science-related career, health problem, or paranormal activity and parasocial interaction. The results indicated that the viewers of ER and the X-File learned science and pseudoscience from these television programs. The essential factor influencing what the television viewers learned from the program was their personal experiences. ER viewers with science career experience had higher science scores. The viewers' beliefs in pseudoscience were also influenced by watching pseudoscientific fictional television program. Likewise, believing in the paranormal activities or having paranormal experiences was related to learning X-Files pseudoscience content. Additionally, parasocial interaction was a significant characteristic in X-File pseudoscience learning. Although heavy viewers of ER learned more program's science content, people who watched many X-File did not learn more X-File's pseudoscientific content. According to this result, it could be concluded that people learn from television programs. Nevertheless viewing pseudoscience-oriented television program may not be direct source of belief in pseudoscience. People who have

personal experiences about pseudoscience were more vulnerable to pseudoscientific beliefs.

Driver, Leach, Millar, and Scott (1996) indicated the essential role of the understanding of the scientific approach to enquiry whereby students can identify scientific study and can identify differences between science and pseudoscience. Clearly, they implied that students who did not understand process of science as inquiry were not able to differentiate scientific and pseudoscientific study. As understood, understanding of nature of science and the nature of scientific inquiry is the basic understanding to demarcate science from pseudoscience. For this reason, recently research studies have focused on studying understanding nature of science in pseudoscientific context.

One of the first attempts to integrate nature of science into the research studies dealing with pseudoscience was conducted by Oothoudt (2008). In his master thesis, the researcher developed and validated an instrument assessing understanding of nature of science in the context of pseudoscience. Unfortunately, this was just an attempt to develop an instrument. For this reason, the researcher did not provide data about the relationship between students' understanding of science as a process of inquiry and their beliefs in pseudoscience. The Nature of Science Scale developed by the researcher consisted of three subcategories. These are "belief in pseudoscience" assessing general opinion and belief in pseudoscience; "science as a process of inquiry" measuring understanding of experimental design and scientific methods; and lastly "application of science in a non-scientific realm" assessing if the participants could demarcate science from pseudoscience.

The Nature of Science Scale developed by Oothoudt (2008) was adapted into Turkish by Kirman Cetinkaya, Lacin Simsek, and Çaliskan (2013). In adaptation process, the researchers reduced the items from 32 to 23, and they categorized the items into four factors instead of three: pseudoscience, scientific method, demarcation science from pseudoscience, and beliefs in pseudoscience. Like Oothoudt (2008), they did provide data about the adaptation and factor analysis

processes, but not about the relationship between students' understanding of science as a process of inquiry and their beliefs in pseudoscience. However, in another study, same research team collected data from 138 preservice science teachers by using the 23-item Turkish version of the scale. They investigated the preservice teachers' understanding of scientific method in pseudoscientific context with respect to some variables such as gender, attending morning or evening courses, and their grade levels (junior or senior). According to the result of the independent sample t-test, the researchers did not found statistically significant difference in respect to gender, attending morning or evening courses, and their grade in their score of each subscale; pseudoscience, scientific method, demarcation science from pseudoscience, and beliefs in pseudoscience except in their grade level in scientific method subscale (Kirman Cetinkaya & Lacin Simsek, 2012).

By focusing on specific pseudoscientific application, Afonso and Gilbert (2010) investigated the university students' NOS understanding. They used water-dowsing issue as a pseudoscientific context. Assumption the researchers focused on this study was that the adherence to the precepts of pseudoscience may restrict the use of argument based on NOS and constrain its understanding. For this reason, the aim of the study was to investigate students' views and use of NOS in pseudoscientific context. University science and non-science students were interviewed about their beliefs in and explanations for "water dowsing", a pseudoscientific approach to search groundwater. The demarcation criteria between science and pseudoscience, and students' research designs into "water dowsing" were also enquired into. The students were questioned about their judgment in working status, scientific status of water dowsing, its efficacy, and their scientific research design into water dowsing. The participants of the study were 45 Portuguese university students. The researchers collected the data by using semi-structured interview and analyzed the data qualitatively. As a result of analysis, they constructed three main themes: "the nature and extension of students' beliefs in water dowsing", "scientific status of water dowsing and demarcation criteria between science and pseudo-science" and "design of scientific enquiry". Specifically, second and third themes provided information about students' views and use of NOS in pseudoscientific context. The results

showed that many students believed in the working efficacy of water dowsing and stated pseudoscientific explanations for it. Students who believed in efficacy of water dowsing gave reasons based on personal experiences or resemblance reasoning by stating an example about elephant searching humidity by using its trunk. On the other hand, students who did not believed in efficacy of water dowsing gave reasons based on aspects of NOS. The research designs provided by students were also categorized as “interviews in the rural communities”, “naïve empiricism”, “experimental design”, “testing models”, and “impossible to enquire”. The views of the students categorized into “interviews in the rural communities” were based on the argument that science does not require evidence. Likewise, the students categorized into “naïve empiricism” implied the idea that science is based on single datum and collects only confirmatory data. The students also provided experimental design but with insufficient control of variables. Additionally, the students categorized into “testing models” suggested searching for the most appropriate theory among the available theories related to the features of water and soil. Furthermore, they were also unaware of the demarcation criteria between science and pseudoscience. Finally, the researchers criticized the distortion of the meaning of evidence in students’ research designs and pointed out the little emphasis given to the concept of evidence in science education.

In order to evaluate the perceptions and competencies of preservice teachers about the demarcation science from pseudoscience, Turgut (2009) designed a study including open-ended questions, a sample case and interviews performed by randomly selected 11 first-year preservice teachers out of 57. The researcher asked the preservice teachers that which kind of factors they took into consideration as a criterion while they evaluated a text for being scientific. The preservice teachers were provided some options such as source of publication of text, author of text, and content of text. The assertions derived from the analysis of data were very interesting and alarming. More than half of the preservice teachers indicated factors mentioned above as criteria to judge the scientific status of a text, 76% in source of publication of text, 65% in author of text, and 68% in content of text. Although the situation did not seem to be alarming, the arguments asserted by preservice teachers were not

necessary to demarcate science from pseudoscience. A small minority of the teachers who took the source of publication of text into consideration reasoned being in accordance theoretically with the ideas accepted by the scientific community. Preservice teachers who took the author of text into consideration stated being respected by everyone, being authority, having a positive belief based on the previous studies and having an academic title as criteria in order to identify status of a text. Additionally, being experimental and confirmative or provable were stated by the preservice teachers who took the content of text into consideration. According to results of the study, the researcher drew a spectrum of preservice teachers' demarcation criteria; on the one end of spectrum was perceiving science as being provable, and on the other end of spectrum was perceiving science as a discipline researching everything. The researcher also interpreted the result as indicator of lack of skill of preservice teachers to examine science-pseudoscience difference critically.

Recently, the focus of the research studies dealing with pseudoscience has shifted to the more pedagogical perspective including teaching nature of science and demarcation science from pseudoscience. Science education researchers need to evidence about preservice and inservice teachers' understanding and teaching competence in demarcation science from pseudoscience, since the teachers have essential role in training new generation who are able to criticize pseudoscientific issues from a scientific viewpoint. One of the studies conducted by Turgut, Akcay, and Irez (2010) focused on demarcation of science from pseudoscience as context in nature of science teaching. In this nature of science teaching attempt, astrology was examined as a case according to demarcation criteria proposed by the philosophers in this field. The study conducted with 38 elementary preservice science teachers in context of the Science-Technology-Society course during 12 weeks. Data were collected using a questionnaire including open-ended questions and analyzed qualitatively. The researchers designed the implementation in four parts. In the first week of the course, they identified participants' misconceptions about basic aspects of science. Following six weeks, participants were taught and discussed about basic philosophical demarcation movements and philosophers. In next four weeks, participants were engaged in astrology as a case and they examined and criticized the

astrology according to its presumptions, methods and knowledge claims. The participants were also assigned to prepare a report in order to reflect their personal statements and understandings. Finally, they made a discussion as two opposing groups; one of them defending astrology was science, and other defending astrology was pseudoscience. As a result of implementation, the participants improved their understandings about most of the NOS aspects although they had naïve understandings about it at the beginning. According to the results, the development of participants was remarkable especially on description of science, necessity of empirical evidence, the role of experiment in science, the status, role and the relationship between scientific laws and theories, tentative NOS, and empirical NOS. Finally, the researchers concluded that the context of demarcation of science from pseudoscience was an effective way of teaching nature of science. Additionally, they noted that engaging participants with basic philosophical problems about issue of demarcation and allowing them to discuss and reflect ideas could be part of explicit/reflective teaching of nature of science.

Similar research study performed by Turgut (2011) investigated whether a teaching context based on the issue of demarcation would provide a suitable opportunity for exposing and further developing the NOS understandings of individuals enrolled in a teacher education course named Science-Technology and Society course. Astrology was used as a pseudoscientific context in this study. Based on the assumption stating that popularization of pseudoscience by the media and the assimilation of pseudoscience into previously established scientific fields might be one of the reasons of naïve understanding of science among population, the researcher designed 12-week implementation focusing on science literacy, nature of science, and issue of demarcation. A total of 46 preservice science teachers who enrolled in a Science-Technology and Society course participated in the study. After theoretical preparation including teaching and discussing about nature of science and philosophical basis of the demarcation, the participants were asked to list their demarcation criteria. Then a brief history of astrology, its assertions, and activities conducted in astrology, and some videos about popular astrologers were presented to the participants without stating whether astrology is scientific or pseudoscientific.

The participants were asked to examine astrology and activities of astrologers according to their criteria and background about astrology. Finally, whole class discussed the potential pedagogical benefits of using demarcation of science from pseudoscience, and wrote their reflections. The results indicated that the criteria mentioned by participants for evaluation of claims were being justifiable by experiments and observations, being falsifiable by experiments and observations, having congruency with scientific knowledge, and being subjected to a consensus in scientific community. On the other hand, majority of the participants hesitated to state astrology as pseudoscientific although none of them labeled it as scientific. Interestingly, after implementation, the number of participants who were uncertain about the status of astrology increased from 22 to 28. Additionally, 61 % of the participants stated that demarcation of science from pseudoscience should take place in science classrooms whereas 39 % of them were at opposite position. Finally, the researcher emphasized the importance of making participants face with trying to answer basic philosophical questions about science in teaching nature of science.

Recently, Cetinkaya (2012) performed a research to determine secondary school students' perceptions toward being scientific and to develop these perceptions through activities involving the context of the issue of demarcation. Different contexts such as iridology, spoon bending, levitation, reflexology and healing stones were used in this study. The results showed that the students tended to believe in naïve inductive claims and most of them considered their personal sense to accept something to be scientific. Interestingly, the results revealed that most of the students did not change their naïve inductive reasoning after the implementation of activities aiming to develop students' perceptions toward being scientific.

Considering research studies especially held recently, it is obvious that the focus of research has been changing over the years. As understood, there is a shift in focus of the research studies held both in pseudoscience and in nature of science from the limited emphasis of aspects of nature of science to more pedagogical emphasis of more specific features of science in an extended way. According to necessity of evidence in the literature, the present study focuses on pseudoscience and

demarcation issue in terms of the students, which provide evidence in order to guide next steps for pedagogical aspects of demarcation issue rather than philosophical part of it. More clearly, it focuses on questions including what students know about research process in pseudoscience and if they have enough knowledge to demarcate pseudoscience from science or not, and what can be done to improve their skills in demarcation.

CHAPTER 3

METHOD

The present chapter was devoted to information about research methodology of the present study. The research design, participants of the study, data collection instrument and procedure and data analysis technique were explained in detail in this chapter.

This study was qualitative in nature. The present study aimed at discovering and revealing reasoning patterns that middle school students used while they reflected their understandings about pseudoscientific issues. More clearly, the purpose of the study was to reveal middle school students' comprehensions about aim, process, and justification of pseudoscientific applications related to crystals and about reliability, certainty, and scientific status of knowledge that derived from these pseudoscientific applications profoundly. For these purposes, a qualitative approach was used in the present study.

3.1 Rationale for Using Qualitative Approach

The reason for choosing qualitative approach in the study was that some characteristics of the researcher overlapped with qualitative research paradigm. Fraenkel and Wallen (2006) stated that selecting a research approach was shaped by paradigms or worldviews of researchers. They defined paradigm or worldview as "basic set of beliefs or assumptions that guide the way researchers approach their investigations" (p. 427). According to Creswell (2009), worldviews were shaped by discipline area, belief systems, and past research experiences of researcher, and he also put forward four different worldviews which researchers have in conducting their research; Postpositivism, Constructivism, Advocacy/Participatory, and Pragmatism.

The qualitative approach is based on philosophy of postpositivism which basically states that each individual constructs his/her own understanding and it emphasizes the constructed truth. Thus, this study was directed by postpositivist worldview of the researcher.

Similarly, according to Merriam (1998), the key philosophical assumption upon which qualitative research was based, was the view that reality was constructed by individuals interacting with their social worlds. Thus, qualitative researchers are interested in understanding the meaning that people have constructed. Since, I explored students' pseudoscientific beliefs without pre-judgment, qualitative research was more reasonable.

According to Creswell (2009) qualitative research was a mean for exploring and understanding the meaning that individuals or groups ascribed to a social or human issue or problem. The process involved emerging questions and procedures, data typically collected in the participant's setting, data analysis inductively building from particulars to general themes, and the researcher making interpretations of the meaning of the data. I thought that data analysis should also be inductive and interpretive in order to construct a comprehensive and meaningful theory that explained reasons underlying students' pseudoscientific beliefs.

Additionally, Maxwell (1998) identified some particular research purposes that made qualitative research strong and powerful;

- understanding the meanings of the participants which related to the events, situations, and actions they are involved in,
- understanding the particular context within which participants act, and the influence that this context has on their actions,
- identifying unanticipated phenomena and influences,
- understanding the process by which events and actions take place,
- developing causal explanations (p. 75).

Pseudoscience, the subject being studied in present study, is complicated in nature. It has social, cultural, and economical aspects. We are bombarded by many information

about pseudoscientific applications. In this situation, everyone constitutes their own meaning about pseudoscience. In accordance with above rationales, the present study aimed at exploring the meanings that students assigned to pseudoscience. What they knew about pseudoscience, how they understood pseudoscience, what was the scientific status of pseudoscientific applications in their views, which aspects of pseudoscience made them consider pseudoscience as scientific, how they designed inquiry to test pseudoscientific claims, all of were investigated in qualitatively in order to uncover the meaning that students had constructed about pseudoscience.

Qualitative research is an "umbrella concept covering several forms of inquiry that help us (researchers) understand and explain the meaning of the social phenomena" (Merriam, 1998, p. 5). Different researchers refer to the several forms of inquiry which are grouped into qualitative research differently. Taking into account the different version of qualitative research design, basic interpretive design provided the best approach for studying students' pseudoscientific beliefs and the reasoning behind their beliefs.

3.2 Basic Interpretive Qualitative Approach

Qualitative research is one of the research approach studying explanation, exploration, and interpretation. Thus, the focus is social phenomena and the processes. According to Denzin and Lincoln (2005), the qualitative research basically dealt with discovering how social experience was created and how the meaning was constructed. Thus, the basic concern was the participant's viewpoint about the phenomenon being studied. Merriam (1998), referred to this approach as the emic or insider's perspective. On the other hand, the other actor in research was the researcher as the "primary instrument for data collection and analysis" (Merriam, 1998, p. 7). In research process, "the researcher's personal experiences and insights are an important part of the inquiry and critical to understanding the phenomenon" (Patton, 2002, p. 40). As a result, qualitative research is an interpretive process whereby researcher uncovers or discovers the meaning which is socially constructed by the individual in real world setting and interprets this meaning.

The fundamental characteristics of qualitative research stated above are incorporated by basic interpretative qualitative research. Therefore, firstly Merriam (1998) referred it as basic or generic qualitative study. Later, she enlarged her approach as "basic interpretive qualitative study" (Merriam & Associates, 2002, Merriam, 2009). According to Merriam and Associates (2002), the fundamental purpose of basic interpretive qualitative approach was "to understand how people make sense of their lives and their experiences" (p. 38). Merriam (2009) also clarified the purpose of this approach by stating that qualitative researchers conducting basic interpretive qualitative approach was interested in "(1) how people interpret their experiences, (2) how they construct their worlds, and (3) what meaning they attribute to their experiences" (p. 23).

Basic interpretive qualitative approach rests upon the constructed meaning. Exploring and explaining of constructed meaning is located in the center of basic interpretive qualitative approach. "Meanings are constructed by human beings as they engage with the world they are interpreting" (Crotty, 1998, p. 43). Therefore, the truth or the meaning cannot be described independently from individual's perspective. Thus, the basic interpretive qualitative approach gives researcher the opportunity to understand and interpret the meaning individuals attribute to the studied phenomenon and how they interpret the cultural meaning of the studied phenomenon.

3.3 Rationale for Selecting Basic Interpretive Qualitative Design

Researchers who conduct basic interpretive qualitative study "simply seek to discover and understand a phenomenon, a process, or the perspectives and worldviews of the people involved", and data are collected through interviews, observation, or document analysis (Merriam, 1998, p. 11). In the analysis process, researchers try to delineate and identify common patterns in the perspectives, worldviews, processes, or actions of the participants. Researchers also try to

construct themes and categories which can reflect the relationship between these common patterns.

In present study, middle school students' reasoning patterns that they used while they reflected their understandings about pseudoscientific issues were investigated. Researcher tried to go beyond students' belief systems about pseudoscience and uncovered features that oriented their belief-driven decisions in pseudoscientific applications. The phenomenon being studied, the understanding about pseudoscience, is complex in nature and it was supposed to be effected by different factors. Related literature just made us informed about learners' belief-driven decision in pseudoscientific applications. Science educators and researchers need to know further about what were students' arguments in pseudoscientific issues, in order to understand the factors that oriented the students' beliefs. Thus, I had no particular hypothesis to be tested or theory on which the study based at the beginning of the research. The process was resembled to the nature of qualitative study stated by Fraenkel, Wallen, and Hyun (2012) that "Qualitative researchers do not, usually, formulate a hypothesis beforehand and then seek to test it out. Rather, they tend to play it as it goes." (p. 427). In accordance with the nature of studied phenomenon, researcher conducted basic interpretive qualitative design.

Basic interpretive qualitative design provided data on how the middle school students' attributions to pseudoscientific applications were and how they constructed the meaning about pseudoscience. As human-being, we construct meaning. Similarly, middle school students construct meaning and arguments about pseudoscientific applications throughout their life while they engage with their teachers, relatives, friends, and mass media. As a result of this social engagement, they make sense about pseudoscientific applications. In this process, the data came from the stories that middle school students composed in their mind when they thought about pseudoscience. During the interview, they reflected these constructed meaning about pseudoscience.

Using basic interpretive qualitative design provided opportunity to enlighten the middle school students' interpretations about aim, process, and justification of pseudoscientific applications related to crystals, and about reliability, certainty, and scientific status of knowledge that derived from these pseudoscientific applications. This opportunity allowed researcher to go beneath the surface to uncover the features that oriented middle school students' belief-driven decisions in pseudoscientific applications. In this way, researcher got evidence to explain how middle school students interpreted pseudoscientific applications and why they believed in pseudoscientific application and which aspects of pseudoscience made them consider pseudoscience as scientific. Thus, the present research study provided evidence about constructed meaning about pseudoscientific applications in middle school students' minds instead of their decisions on believing or not in pseudoscience.

3.4 Participants of the Study

The participants of this study, who were interviewed about their understanding about pseudoscience, were middle school students.

According to the argument stating pseudoscientific beliefs began almost from infancy and the necessity of data related to understanding of pseudoscience in younger ages, the middle school students were decided to be selected for present study. Other reasons for selecting this group were reasoning and self-expression ability. According to Piaget, there are some cognitive development stages such as sensorimotor, preoperational, concrete operational and formal operational. The age range included in present study contained concrete (7 to 12 years) and formal (12 years and up) operational stages. In late grade 5 and beyond, students start to acquire formal operations. Through their educational process from 5th grade to 12th grade, students are assumed to both hypothetic-deductive reasoning and abstract thinking. Thus, the students who were between 5th and 8th grade are appropriate participants for this study. On the other hand, other criterion was self-expression ability of the students. During the research, the qualitative data were obtained through in-depth interviews. One of the main elements which determined the getting rich data was the

self-expression ability of the students. I also tried to assure reaching diverse participants from different schools in different school districts.

In qualitative study, researcher generally uses purposive sampling technique, because "researcher wants to ensure that he or she obtains a sample that is uniquely suited to the intent of the study" (Fraenkel & Wallen, 2006, p. 434). In this type of sampling procedure, researcher uses his/her own judgment which based on researcher's prior knowledge and information about participants. According to Patton (2002), the main purpose in purposive sampling was the "selection of information-rich cases", and the logic and power underpinning the purposive sampling was "in-depth understanding" of cases being selected (p.46). Pseudoscientific beliefs and understandings are spread out by culture of the society. Considering the role of the family and other social environment on disposition to pseudoscience (Preece & Baxter, 2000), the most important criterion supposed to have more influence on students' understanding was the district where students lived in. It was believed that applications such as cultivating according to cemre, water dowsing, and healing with plants were much more common in village or rural areas. Sampson and Beyerstein (1996) indicated that because of traditional folk-healing being held in rural areas and modest education, people who live in rural areas are more likely prone to pseudoscience, especially in health-related issues. For this reason, it was found to be much more appropriate to interview with students who lived and went to school in rural areas rather than city center.

Compulsory education in Turkey consists of three parts including 12 grades. 1-4 grades are called as primary school education, 5-8 grades are called as middle school education and last four grades are called as high school education. At the end of the 8th grade, students are supposed to have basic skills and knowledge on science, mathematics, social studies, and literature. According to recent science curriculum published by Ministry of Education in Turkey (2013), the main goal of elementary science education is to develop science literacy. Those who are about to graduate from middle school are supposed to be science literate and also assumed to finish

basic science education in Turkey. Thus, it was assumed that 8th graders had more basic skills in order to argue about pseudoscience than lower graders had.

By means of this narrowing in sample, similar cases were selected from homogeneous population according to homogeneous purposive sampling stated by Patton (2002, p.235). Using homogeneous purposive sampling leads to research the homogeneous group composed with similar-featured cases. Thus, the main attempt here was that studying with a group of composed with similar background to understand them in deeply rather than studying with group composed cases from different backgrounds. More clearly, the attempt was focusing on in-depth understanding rather than wider but shallow understanding.

According to aforementioned criteria, the purposive sample was narrowed as 8th graders who lived and went to school in rural areas, had basic skills in science, and were able to express themselves clearly. Considering these criteria, 7 girls and 7 boys who were all 8th graders, participated in the study. All of them were born in 2000. Eleven of them had more than one sibling. Nine of them were living with their grandparents and five of them were living very close to their grandparents. Thus, grandparents play a very important role in students' lives.

Before the interviews, having ethical considerations, the participants were informed about the aim, content and process of the study. Additionally, data collection procedure was introduced to the participants. In order to ensure the mutual trust between participants and the researcher, ethical committee approval was shown to them. They were asked to read the informed consent form just for the information, the signature was not requested. Moreover, parental permission document presented to them and they were also requested to ask their parent to sign. All the rights of the participants stated in ethical committee approval were considered and preserved throughout the study.

3.5 Data Collection

In accordance with qualitative approach, qualitative data which represented students' understandings, thoughts, views, and values about pseudoscience were obtained throughout this study. It was important to note that the researcher was the primary instrument for data collection and analysis in qualitative research (Merriam, 1998). For this reason, researcher's inherent understanding, thoughts, views, and values about the target issue was an important factor in quality of the data.

This study was exploratory in nature and qualitative data were obtained from middle school students. It involved exploring middle school students' understandings, thoughts, views, and values about pseudoscience thoroughly. It aimed at revealing reasoning patterns about pseudoscience by using their elaborated understanding, thoughts, views, and values. Taking complex nature of the research subject, the comprehensive qualitative data were collected through in-depth interviews. Beginning with the prior knowledge about the target issue being studied in this study, the literature related to studies aiming at explaining or elaborating the distinction between science and pseudoscience was reviewed. Although there were no clear-cut demarcation criteria for distinguishing science from pseudoscience, I made an attempt to make this distinction clear for middle school students. Based not only on the literature (Baran, Kiani, Solomon, 2014; Carroll, 2005; Hansson, 2013; Mahner, 2013; Martin, 1994; Pratkanis, 1995; Shermer, 1997; Smith, 2010), but also on personal understanding and perspective of the researcher about the target issue, the table pointed out the difference between science and pseudoscience in terms of their working area, aim, process, certainty, justification, source, and communication was constituted. This table included primary differences which were required to be understood by middle school students. Considering the target group, the language of the table was simplified although it involved epistemological perspective inherently. The data were collected in accordance with the principles stated in this table.

Table 1. Differences between science and pseudoscience

	Science	Pseudoscience
Working area	• scientifically testable phenomena	• astrology • healing • dowsing
Aim	• to make sense of the world and universe we live in	• to make money • commercial trickery
Process	• is based on data and evidence • constructs hypothesis and theories • tests its hypotheses and theories • considers all type of data which is supporting or not • considers the quality of data rather than the amount of data • takes alternative hypotheses into account	• is based on postulates and questionable assumptions • is based on flawed evidence and unproven theories • primarily draws conclusion and then tries to find supporting data and evidence • ignores conflicting data and evidence • considers the amount of data rather than the quality of data • fails to critically evaluate alternative hypotheses • neglects the essential principles of scientific investigation
Tentativeness	• is subject to change • revises its hypotheses and theories in the light of the data and evidence • progressive	• is not subject to change • is based on dogma • everything is known • nothing left uncovered
Justification	• needs justification • uses data and evidence to justify the knowledge • includes scientific knowledge • critical reasoning	• does not need to test its ideas • does not need justification • includes personal ideas • uses scientific terminology to give appearance of being science • invalid reasoning

Table 1. Differences between science and pseudoscience (continued)

	Science	Pseudoscience
Communication	• scientific journals • peer-review process	• propaganda • hearsay • rhetoric
Source	• experiment • testing • data	• preconceived ideas • anecdotes • eyewitness testimony • commercial advertisement

The in-depth interviews were used to collect comprehensive data. Questions regarding aspects of pseudoscience (stated in Table 1) were included in interview protocols. The aim was to reveal middle school students' comprehensions about aim, process, and justification of pseudoscientific applications related to crystals, and about reliability, certainty, and scientific status of knowledge that derived from these pseudoscientific applications in compliance with the research questions. The pseudoscientific context used in interview was crystal healing.

3.6 The Rationale for Selecting Pseudoscientific Context

Crystal healing is a pseudoscientific health practice. This practice is referred as pseudoscience by many researchers in different terminologies such as crystal healing (Beyerstein, 1995; Smith, 2010), crystal power (Moore, 1992), crystal therapy (Baran, Kiani, Samuel, 2014), and crystal energy (Smith, 2010). The reasons why I used crystal healing as a pseudoscientific context were diverse. First reason was based on the evidence coming from related literature. Although most types of pseudoscientific contexts were investigated by surveys in a wider perspective (DeRobertis & Delaney, 1993, 2000; Losh & Nzekwe, 2011; Nickell, 1992; NSB, 2002, 2012; Preece & Baxter, 2000; Walker, Hoekstra & Vogl, 2002), the astrology was frequently used in an in-depth perspective in order to explain learners' dispositions. On the other hand, Sugarmann, Impey, Buxner and Antonellis (2011) claimed that astrology was an invalid indicator of science literacy due to the psychological basis of astrological belief. They attempted to explain psychological

causes that might affect the disposition to astrology. For instance, Barnum effect, personality and the positive self-conception, or illusory sense of control might be more explanatory in explaining disposition to astrology than scientific illiteracy. When it comes to astrology, believers might consider psychological basis although they are scientific literate. However, I wanted to use a context that promoted students to use reasoning skills without impact of psychology.

In accordance with the research questions, I wanted to reveal middle school students' comprehensions about aim, process, and justification of pseudoscientific applications related to crystals, and about reliability, certainty, and scientific status of knowledge that derived from these pseudoscientific applications. Therefore I needed to use a much more concrete context which could stimulate students thinking about knowledge construction process in pseudoscience.

Crystal healing is a kind of alternative medicine practice. According to Lindeman (1998), alternative health care practices appealed to our experiential thinking so that we had tendency to believe it. Likewise, experiential thinking system, alternative health care practices are emotionally-laden, outcome oriented, experience-directed, and self-evidently valid. Thus, pseudoscientific beliefs stem from experiential thinking. For this reason, I chose one of the alternative health care practices, crystal healing. As Tsai et al. (2012) recommended, the health-related pseudoscientific practice and practitioners should be the interest of research. Additionally, evidence showed that there could be gender difference in different pseudoscientific phenomena (Preece & Baxter, 2000; Shermer, 2003; Wiseman & Watt, 2004). However, "health is a field where there is no gender difference in pseudoscientific beliefs" (Lundström, 2007, p. 5). Thus, using a health issue as a pseudoscientific context was convenient both for girls and boys.

Furthermore, crystals are materials which are claimed to be used for a variety of beneficial purposes by placing them on problematic areas. Due to the concrete structure of crystals, it was assumed that students could produce much more ideas

about probable processes used by practitioners in order to show the effectiveness of crystals.

On the other hand, it was investigated in present study that how students enquired scientifically into crystal healing. In a similar vein, students needed more concrete context by which they designed a research in order to see the effectiveness of the crystals. Likewise taking a pill to be cured in daily life, they were supposed to assert a design in which they placed crystals on problematic areas. The point here was that whether the designs asserted by the students were based on controlled experiments and scientific processes or not. Of course another alternative medicine would be used such as phytotheraphy, healing with plants and herbs. However, in crystal healing, there was no risk of oral consumption of any material. Taking precautionary principles, I decided to choose less harmful context.

The other reason for selecting crystal healing is about the degree of familiarity of the context. On the contrary to astrology and phytotheraphy, the crystal healing was relatively less-debated concept although it was known for its so-called effectiveness. It was assumed that the less-debated nature of crystal healing in media could direct students to build neutral or objective arguments that included less media effect. In that way, students were supposed to be less exposed to negative or positive arguments about crystal healing being stated in media.

Before going further, final differentiation should be done between pseudoscience and paranormal. It is pretty clear that pseudoscience is different from nonscience and unscience. However, it is generally used interchangeably with paranormal. Even, paranormal is referred as subdivision of pseudoscience (Hines, 1988). However, Martin (1994) rejected to this view, and used the terms of pseudoscience and paranormal separately. His rejection was based on the assumption related to the pseudoscience's pretention of being science. He gave an example in order to grasp the difference between these two; "Cures allegedly brought about by religious faith are, in turn, considered to be paranormal phenomena but the related religious practices and beliefs are not pseudoscientific since they usually have no scientific

pretensions" (Martin, 1994, p. 364). As argued previously, one of the key characteristics of the pseudoscience was its tendency of parading as science and its pretention of being science. However, Thalbourne (1982) referred paranormal as hypothesized processes which were outside the realm of human capability or practices which were physically impossible. In science, everything is within the boundaries of human mind. In this way, when we look from perspective of pseudoscience, which is pretending being science, subjects that involved in pseudoscience should be within the boundaries of human mind. According to Hansson (2013), pseudoscience should fulfill the criterion of scientific domain, which explained that pseudoscience pertained to an issue within the domains of science. Thus, ESP (Extra Sensory Perception), PK (Psychokinesis), precognition, astral projection, and psychic healing are classified as paranormal (Irwin, 1993). Additionally, Tobacyk (1983) developed his Paranormal Belief Scale from the subscales such as religious belief, psi belief, witchcraft, superstition, extraordinary life forms, and precognition. Thus, I narrowed the working area of pseudoscience. For this reason, I attempted to use the context which was actually called pseudoscience, not paranormal. Crystal healing is pseudoscientific application which is testable, refutable, and falsifiable. At the same time, it is considered within scientific domain of geology and earth science. Additionally, it is pretending as a scientific area and most importantly, although there is no scientific evidence showing its effectiveness, the proponents of crystal healing consistently insist on its effectiveness on health. That is why, I chose crystal healing as a context which fulfilled the criteria of being pseudoscientific in the present study.

3.7 The Interview Protocol

After deciding on the pseudoscientific context as crystal healing, researcher developed interview protocol by taking the aspects of pseudoscience stated in Table 1 into consideration. The questions to be used in interview protocol were presented in Appendix A. The interview protocol was organized into four parts. These were introduction, pseudoscientific claim, hypothetical situation, and ill-designed pseudoscientific research process.

Introduction:

Introduction part was aimed at revealing the students' understandings and previous knowledge about the subject that they bring with them throughout their life. Another aim of this part was to make students familiar to the subject being interviewed and to the interview process. Especially, the students' views about the aim of the pseudoscientific applications were investigated. Introduction part included questions probing students' previous knowledge of pseudoscientific application. Students were asked about what and how they knew about crystals, what the sources were, what they knew about the crystal healing, if they encountered these types of applications ever before, how they encountered, what the aim of these applications would be, why people applied for these applications. According to degree of level of knowledge they had, additional questions in order to understand their interpretations about the issues being discussed were asked. Those who inherently knew more about the issue and wanted to share ideas were not blocked and were allowed to indicate their disposition to this type of applications.

Pseudoscientific Claim:

The second part included pseudoscientific claims related to crystal healing. This part was organized for several purposes. First of all it aimed at revealing the students' disposition to crystal healing and to uncover whether they believed in the effectiveness of this type of pseudoscientific claims. Secondly, it aimed at revealing students' predictions about probable research processes or principles on which claims related to so-called attributions about crystal healing were based. The students were asked to detail the probable research processes which would be used by claimers in order to construct these claims. The other aim of second part was to discuss about scientific status of the research processes which were believed to be used by claimers in order to construct attributional claims about crystal healing, which were provided to students at the beginning of the second part. By this way, I aimed at revealing students' criteria or concern to be scientific. Additionally, the students were questioned about the reliability of these claims and the reliability of

probable research processes which would be used by claimers in order to construct these claims, and probable justification processes that would be used to ensure reliability.

In this part of the interview the list of so-called effects attributed to crystal healing was provided to the students. These claims were combination of information retrieved from different web site related to crystal healing such as crystalwellbeing.co.uk, healing-crystals-for-you.com, butunmedyumlar.com, degerlitaslar.com, derdedevataslar.blogspot.com.tr, milliyet.com.tr/sifali-taslarin-gucuyle-iyilesin--pembenar-detay-alternatiftip-1084846, meanings.crystalsandjewelry.com. The students were informed that these were the claims stating the effect of the crystals on health of individuals which could be found in any visual or written communication environment. Then, students were asked about their opinion on whether crystals could provide beneficial effects as they were claimed to do. Then students were asked to put forward a reason to justify their opinions. Additionally, their opinions about how people who claimed aforementioned attributions would construct this type of knowledge, how their research process would be, how they would use process to justify their knowledge were questioned. In the context of asserted research processes which were believed to be used by claimers, scientific status of probable asserted research processes was also questioned.

Hypothetical Situation:

The third part consisted of two scenarios based on two different hypothetical situations. The scenarios in this part were developed by the researcher.

The first scenario: Carnelian-Hypertension

The first scenario was related to blood pressure disorder and carnelian gemstone. The aim of the first scenario was to question the students' views about research process and justification process in pseudoscientific context. The first scenario was based on

the pseudoscientific assumption stating that “carnelian encourages positive thinking, is beneficial for insomnia (sleeping disorder) and regulates the blood pressure”. The students were asked to suppose that they had a relative who had high blood pressure disorder and this relative wanted to test whether s/he could use the carnelian which was recommended to her/him in order to remedy her/him high blood pressure disorder. After that, students were asked to put forward a research design in order to test this claim.

The high blood pressure disorder was chosen particularly in this study. The high blood pressure disorder, hypertension, is one of the most common and familiar medical problem encountered in Turkey. On the other hand, it was possible to measure blood pressure level by blood pressure monitor so that it was supposed to be easy and achievable for students to design a research in order to test the so-called effectiveness of carnelian on high blood pressure level. The aim of first scenario was to provide opportunity to think about and design a basic research design in order to test an idea. Based on the research designs asserted by the students, I aimed at revealing their understandings on research process, the meaning of research for them, and the sources they use when they test an idea. The main purpose was that whether the students used scientific process skills such as defining and controlling variables, measuring and collecting data, interpreting the collected data. More clearly, I wanted to see whether the students concerned scientific processes and conducted research design which was based on fair test. In a similar vein, the main purpose here was to understand students’ dispositions to research process and to find out whether they were closer to understandings of pseudoscientists and they designed to conduct research design which was based on their pseudoscientific beliefs or scientific principles.

The second scenario: Red Coral-Concentration

The second scenario was related to the level of concentration and the red coral. The aim of second hypothetical situation was to explore the students’ thinking styles in decision making process. I aimed to see whether students derived knowledge stating

red coral increases concentration from only personal experience. By this way, I questioned the students' justification processes. It was also questioned whether it was enough to experience something in order to construct knowledge for students or they were searching for more evidence and information, or they needed to justify their experience. Basically, I looked for the evidence about knowledge construction process of students which either it was resemble to that of pseudoscientists or of those who considered data and evidence instead of personal experience or anecdotal data. Additionally, students were given the opportunity to elaborate on their opinion about the certainty of the knowledge that they derived from only their short experience without needing any additional evidence or information.

The second scenario was based on the pseudoscientific assumption stating that "red coral heals psoriasis (skin disease), regulates respiration, increases concentration, and strengthens the cardiovascular system". The students were asked to suppose that you had experienced the increase of your level of concentration due to the use of red coral for a couple of days. After that students were asked to what kind of knowledge they would derive from this experience. On the contrary to first scenario, the second scenario was based on the context which was much more difficult to measure. Additionally, the scenario was directly structured on the personal experience.

Ill-designed Pseudoscientific Research Process

The fourth part consisted of two ill-designed pseudoscientific research processes located into third and fourth scenarios. On the contrary to hypothetical situations, the students were not required to design a research rather they were expected to criticize the research designs stated in the scenarios.

The third scenario: Growing a plant

The third scenario was related to a girl trying to grow a plant and effect of crystal quartz on the growth of the plant. The third scenario was intended to find out the direct inferences of the students when they were encountered such a scenario and

such an ill-designed research process as presented in the scenario. I looked for the evidence about whether the situation presented in the scenario had an effect on students' ideas as pseudoscientists expect to do and directed them to think positive about the effectiveness of crystal healing. Other intention of this scenario was to explore the students' interpretations about the process that implemented in the scenario so that they were asked about the scientific status of this process. They were required to indicate whether they referred this process as scientific experiment or not. Then they were also asked to put forward reasons to justify their decisions. In that way I would examine the impact of such a kind of scientific-looking process on students' ideas directly and students' understandings about scientific process and scientific experiment indirectly. The point here was to see which sides of research processes stated in Table 1 the students were prone to and if they preferred scientific one or tended to think like that pseudoscientists do and implement. I searched for evidence about whether the students were skeptical or gullible when they were provided this kind of scenario generally used by pseudoscientists in order to convince someone to their ideas. Additionally, the reliability of knowledge implied in this scenario was investigated.

In this process, the students were given "growing a plant" scenario which was developed by the researcher. This scenario exemplified the remarkable unfair testing procedure used by pseudoscientists. The example stated in this scenario was related to effectiveness of crystals on plants rather than on human beings. Pseudoscientists generally use this kind of examples to make counter-evidence in order to disprove the idea that proponents of crystal power report some specific sensations or feel better as they believe it. Thus, the pseudoscientists try to prove that even plants instead of human being are affected by the power of crystals although they have no ability to believe. The scenario was also presented as a process in which every phase is followed step by step so that it gave illusionary appearance of being scientific.

After provided the third scenario, the students were also asked to suppose that they implemented the same process presented in the third scenario, but they did not observe any changes in their plant. Then they were asked how they justify their

observation. The aim here was to find out the students' tendency when they were encountered contradictory situation and their tendency of justification in order to show who was right. In justification process, generally students tended to show visual evidence such as video record, photograph, and prints including writing materials instead of collecting reliable data or reasoning about the process of collecting data. On the other hand, other tendency of the students was believing in what was told by the authority. If it was written in a source, the students tended to accept it as true and reliable. For this reason, I needed evidence that reflect the students' tendency of justification and reliability when they were provided ill-designed pseudoscientific research process.

The fourth scenario: Balancing blood pressure

The fourth scenario was related to a researcher who conducted unfair testing procedure. The aim of this scenario was to reveal the students' views about flawed research process and their judgements about scientific status of this flawed research process.

Similar to third scenario, this one included unfair testing procedure in which researcher ignored controlling variables. In order to give an appearance of being scientific, it provided some clues about the participants and setting. Additionally, it included some scientific processes such as claiming and testing something, and measuring. However, it did not include any clue about the conclusion of the research. By means of this scenario, the students were questioned on their interpretations about the process being used in the scenario. Whether they had tendency to refer it to scientific process as intended by pseudoscientists was the basic issue in using this type of scenario. Additionally, whether they realized the flawed research process used in the scenario was the other point being examined in the fourth scenario. On the other hand, pseudoscientists have tendency to suppose something to be happened as it is claimed by authority. Although there were mentioned any collected data and the conclusion of the process in the scenario, it was possible that the students had tendency to interpret the conclusion as positively and certain if they were close to

thinking style of the pseudoscientists. Table 2 indicates the interview questions used for each research question.

Table 2. Relationship between research questions and interview questions

	Research Questions	**Interview Questions**
RQ1	What are the students' views about the aim of the pseudoscientific applications related to crystals?	Introduction Questions 1-9
RQ2	What are the students' interpretations about research process used by pseudoscientists in the development of knowledge in pseudoscientific applications related to crystals?	Pseudoscientific Claims Questions1-2 The First Scenario: Carnelian-Hypertension Questions 1 The Fourth Scenario: Balancing Blood Pressure Question 1-2
RQ3	How do the students understand justification procedure and process of testing ideas in pseudoscientific applications related to crystals?	Pseudoscientific Claims Questions 3, 7 The First Scenario: Carnelian-Hypertension Questions 2, 3 The Second Scenario: Red Coral-Concentration Questions 1, 2, 3 The Third Scenario: Growing a Plant Questions 1, 2, 7
RQ4	How do the students judge the reliability of knowledge in pseudoscientific context related to crystals?	Pseudoscientific Claims Questions 8 The Third Scenario: Growing a Plant Questions 1, 2, 5, 6
RQ5	How do the students judge certainty of pseudoscientific knowledge related to crystals?	Pseudoscientific Claims Questions 4 The Second Scenario: Red Coral-Concentration Questions 4
RQ6	How do the students judge scientific status of pseudoscientific knowledge related to crystals?	Pseudoscientific Claims Questions 5, 6, 7 The Third Scenario: Growing a Plant Questions 3, 4 The Fourth Scenario: Balancing Blood Pressure Question 3

All of the questions asked in the interview protocol had intentions to provide researcher evidence about students' status about being skeptical or gullible when they were provided such phenomena including pseudoscientific claims, research process or pseudoscientific thinking style. By this way, I got evidence in order to build reasoning patterns of the students which was close to scientific one or gullible

one. To state differently, it was investigated that whether the students' had reasoning pattern that was intended by the pseudoscientists in order to make people unable to detect logical errors by using scientific-looking process. Moreover, the intention was to examine students' responses in accordance with the principles stated in Table 1 and to see which side of reasoning styles the students used more when they were encountered pseudoscientific applications. All the questions used in interview protocol were piloted before main implementation. The details about the pilot study were presented below in the pilot study section.

All the participants were met three times. Except first attempt, all the interviews were conducted at a time and place of the students' convenience. All the interviews were audio taped with a digital recorder so that I was provided the opportunity to store the interviews as computer files. All the files were named by referring students' name and the date of the interview and saved in particular folder. The first attempt was based on requesting for their voluntary participation. After accepting voluntary participation, participants were met in second time. The second interview was aiming at building mutual trust between interviewer and interviewee. In this part, I introduced myself and tried to recognize the participant. The effective communication environment for the data collection interview was facilitated by the respectful listening to the responses of the interviewee and the egalitarian relationship between interviewer and interviewee. The second interview did not focus on the data collection directly. It was aiming at getting information about social and school life of the students and learning about their demographics. Participation Information Form was used to collect information about participant's school, district of the school and home, parent's educational level and jobs, and facilities at home. Participants' daily habits at school and at home were interviewed as well. Necessary ethical information about the right of withdrawal was presented in this interview in order to make interviewee feel safe. I provided my contact information as well to strength the mutual trust. The information about the aim of the research and the interview process were also presented in this section. Data collecting procedure was introduced as well.

It was the third interview in which the researcher collected data in order to answer the research questions. The interview protocol including semi-structured interview questions was implemented in this section. Throughout the interview process, the students were provided to comfortable interview environment to focus on interview and to elaborate their understandings about the subject being studied. Additionally, they were encouraged to reflect themselves freely. The duration of the interview was ranged from 50 to 80 minutes. At the end of the third interview each student was presented with a chocolate referring my appreciation for her/his participation.

3.8 Pilot Study

The process including sampling, data collection, and data analysis that is intended to be used in this study was piloted before the main study. The pilot study was the small-scale version of the main study. Thus, it included same processes as main study does. According to sampling criteria stated above, seven 8th graders were chosen for interview. Two of them expressed that they didn't want to continue and withdrawn at the middle of the interview. Five 8th graders attending different schools from rural area of the city voluntarily participated in the pilot study. All of them were interested in school science and were confident in expressing themselves. Two of them were boys and three of them were girls.

The pilot study was conducted into two stages. The aim of the first interview was to introduce interviewer and interviewee. Introducing part was aiming at building a mutual trust between interviewer and interviewee, and to construct an effective communication environment for the second interview. In this part, participants were asked their daily school lives, daily habits, and interests. Researcher also introduced herself.

In the second interview, the questionnaire used to collect data about students' views about pseudoscience was piloted. Each interview took about 50 minutes. The aim of the second interview was to see whether participants understand the questions and to reveal unclear points in the questions. Additionally, by means of the pilot study

researcher got opportunity to find out whether the questions were suitable to answer the research questions.

The pilot study provided considerable insight to the researcher. According to pilot study, I concluded that the questions were suitable in order to answer the research questions and to reveal students reasoning patterns about pseudoscientific applications.

3.9 Data Analysis

The qualitative data was obtained from in-depth interview aiming at revealing middle school students' understanding about pseudoscience. In accordance with qualitative data, the data collected in present study were analyzed by using the constant comparative method (Glaser & Straus, 1967). The method is originated from grounded theory (Glaser & Straus, 1967) and generally used to analyze data in order to construct a theory. However, Merriam and Associates (2002) clarified that "many qualitative researcher have adapted the constant comparative method, originally used for developing grounded theory, whether or not they are seeking to build substantive theory" (p. 14). Although I was not aiming at building a theory directly, I had intent to propose propositions that had potential to explain students' dispositions to pseudoscientific applications.

Since qualitative data analysis was complex and demanding process, some preliminary preparation was needed. Because all the data were collected via digital recorder as audio, first of all audio-recordings were translated into verbatim texts. Before coding process, all the texts were read for many times. It allowed researcher to be familiar with the data and to perceive some patterns. Then, each text belonging to the students were transferred into software program called NVivo. The program enables the researcher to organize and coding the data without any lose.

In constant comparative method, the data analysis proceeds in stages. The method consists of three essential stages that are open coding, axial coding, and selective

coding (Glaser & Straus, 1967; Johnson & Christensen, 2012; Straus & Corbin, 1990). The **open coding** stage is the phase in which raw thoughts of the participants is converted into codes. It involves naming and categorizing discrete elements in the data set (Johnson & Christensen, 2012). I began by coding the first interview. Sometimes the sentence was considered as unit of coding, sometimes the whole paragraph was coded. Having coded particular situations, thoughts, meanings, ideas or understandings, I constantly compared these particular units with another particular unit both in same data set and in another one. My main aim was to perceive the recurring patterns. By this way, I developed themes that reflected the central ideas being told by the students. For instance, the students reflected how they saw the crystal healing; being interesting, arousing curiosity, being persuasive, being easy and simple, being popular. I interpreted these characteristics stated by the students as factors that would have potential to direct students to use crystal healing. For this reason, I categorized all these characteristics into motivational factors so that I moved on to an upper stage. In a similar process, I categorized other characteristics as personal factors, social impact, and health problems. All these factors were categorized into another theme related to why people would have tendency to be treated by crystal healing. By this way, I moved on to another upper level and organized my data or small piece of coding into more general themes by moving upward to theoretical categories. As process continued, I reached the central ideas stated by the students. That is why; the directions of the arrows presented in models pointed out the central ideas. By using inductive interpretive approach, I tried to explain central ideas stated by the students. Briefly, the codes were classified into themes inductively until all the codes were organized for the next stage. In this analysis process, bottom-up or emergent approach (Bogdan & Biklen, 1998; Winne & Perry, 2000) was used to constitute themes and categories from the data. Thus, I did not use previously determined coding scheme, rather, the codes, and themes were derived from raw data.

Additionally, the memos or informal analytic notes (Charmaz, 2006) were written during coding process. Memo writing provided several advantages to researcher. For instance, Charmaz (2006) stated that “writing successive memos throughout the

research process keeps you involved in the analysis and helps you to increase the level of abstraction of your ideas" (p. 72). Additionally, I analyzed my ideas about the codes during memo writing. The memo writing was a great way for me to record my simultaneous ideas, thoughts, relationships, and connections about and among codes without any loses. I was also provided opportunity to develop conceptual definitions about the themes and categories that identify the main ideas in them. Memo writing process continued to the end of this interpretive coding process.

The second stage is **axial coding**. The axial coding stage is the phase of categorizing the themes into categories and organizing the categories. In axial coding, "these categories relate to and surround the core phenomenon" (Creswell, 2006, p. 64). In this stage, I looked for possible relationships among the categories and organized these relationships as a meaningful unity which reflected one of the core ideas that had potential to answer one of the research questions. According to Johnson and Christensen (2012), the main goal of the axial coding is "to show how the phenomenon operates" (p. 403). At the beginning of the axial coding, all the codes, themes, and memos were revisited for many times. By reading them for many times, I saved time for myself to be familiar with codes, themes, and memos. In axial coding stage, with the help of the memos, I determined the relationships among categories and made conceptual connections between them by comparing them to each other. Then the themes and categories were organized according to research questions. Related categories that provide evidence to answer the particular research question were grouped around the research question. This inductive coding process started by the beginning of the open coding continued to the end of the axial coding.

The last and the most demanding part of the coding process is **selective coding** stage. This phase is related to the theoretical part of the coding. It is the final touch to constitute a theoretical storyline that summarizes the interrelationship of the categories. Although the research questions were almost answered by the end of the axial coding, I needed to do more in order to explain the students' reasoning patterns that they used when they were encountered pseudoscientific applications. For this reason, most of the related literature, especially articles that would put forward

theoretical explanations in believing in pseudoscience, and social learning theories were revisited during this period. The evidences coming from present study were compared with the available related literature. I tried to find theoretical evidence to my emerging explanations. In selective coding stage, the main consideration was to determining and focusing on central idea (Johnson and Christensen, 2012) and to connect this central idea with the emerging categories (Creswell, 2006; Straus and Corbin, 1990) in order to constitute propositions, theory, or storyline that have potential to explain the main issue. In the light of the available theoretical background and the evidences coming from open and axial coding, I constructed a storyline as an attempt to explain the students' reasoning patterns about the subject being studied. Then, this storyline was also modeled in a way of logical chain of evidence. Table 3 illustrates exemplary coding structure for Research Question 1.

Table 3. Exemplary coding structure for research question 1

Core Concept	Major Themes	Sub-categories	Exemplary Quotation
The students' views about the aim of the pseudoscientific applications related to using crystals	Medical purpose	Using for remedial	Generally, people use them in order to cure something. They use crystals and so forth for backache.
		Using in SPA center	I saw SPA brochure including black round-shape crystals located on the back of body.
		Using in health center	The first thing I remember is that this summer a health center about crystals was opened here. There was a machine there and there was a mobile crystal under that machine being good for backache.
	Helping others	By giving advice	They share their knowledge about these crystals. They just give advice to people who are similar to them
		By curing others' health problem	There are some knowledgeable people who are expert in crystals. They know which crystal is used for which purpose. Thus, they can heal diseases.
		By promoting crystals	People promote crystals. The more they promote, the more people use them, the more people are treated by these crystals.

Table 3. Exemplary coding structure for research question 1 (continued)

Core Concept	Major Themes	Sub-categories	Exemplary Quotation
The students' views about the aim of the pseudoscientific applications related to using crystals	Superstitious purpose	Using for boosting energy	I believe that the crystals give positive energy and can make me relax like herbs.
		Using for getting stress away	There are colorful crystals. There are particular crystals for each particular emotion. For example, stress gemstone. It can get rid of stress when we are stressed.
		Using as birthstone	Birthstones have come to my mind. Different birthstones representing a month. I like them.
		Using for luck	It is told that colorful gemstones bring good luck. Each gemstone represents different purposes.
	Getting profit from people	Using for making money	I do not know whether they cure diseases or not but these people have commercial aims. They set web sites for this reason. They mention that these crystals are good for these diseases and cure these ones.
		Using for tricking people	They sell these crystals. And people buy them. But their blood pressure doesn't decrease. So the sellers say that you may have done something wrong. In other words, they actually fool people.

In coding process, some of the students were referred as gullible and some of them were referred as skeptical. The students who have tendency to pseudoscientific applications without questioning, who use personal ideas, intuitive sense, anecdotal or testimonial evidence when deciding on whether a treatment is effective or not, and who have tendency toward testing an idea by relying on personal trial and error processes instead of applying basic science process skills were coded as gullible. For instance, the student provided below was coded as gullible;

> S: Let me give an example from my grandmother again. She has told me. She has different diseases such as high blood pressure and diabetes. She has also told me that she has backache. She has told me to bring the crystal to her, which she has bought before. I have brought the crystal and she has put it on her back. Then, she has told

> that her ache has passed away. I would obviously share a topic like that and observations about it on the internet if I were a manager of a web site.
> I: What do you think about whether it is scientific or not?
> S: It is scientific. There is unproved knowledge on your hand and you try it in order to prove it. These trials would be evidence for it. By trying them out on human being, they would test if it is effective or not. Therefore, these trials are scientific.

As understood from his quotation, he relied on personal trial and error process being held by his grandmother when deciding on the crystal healing was effective or not. Additionally, he indicated that it was enough to prove an idea scientifically by providing personal observation which was based on personal trial and error process. However, he was supposed to consider whether there is a scientific basis for this treatment and was supposed to ask for data and evidence derived from scientific investigation when he referred something as scientific.

On the other hand, the students who use reasoning, who question and debate an idea in an informed basis, who think logically and identify relationships between observations, and who recognize inferential thinking instead of naïve realism were coded as skeptical. For instance, the student provided below was coded as skeptical;

> S: I think a man has been ill. He has taken the crystal. And he has felt better. Namely, he has felt better afterwards. Then, he has begun to think that the crystal has been good for his diseases.
> I: He has begun using the crystal and considering that the crystal is good for his illness?
> S: Yes, but perhaps he would feel better in time. This is not logical for me for this reason. Namely, the illness would be better but he begins using the crystal by chance at the same time. Moreover, he begins thinking that he has gotten better because of the crystal. In fact, getting better is not related to the crystal.

As understood from his quotation, he criticized the reasoning pattern which was based on “after this, therefore because of this” logical error. He was able to identify two unrelated observations and he did not have tendency to combine these two unrelated observations in order to make sense or explain his observations.

As stated above, I used qualitative data analysis software program during the study. This program provided the opportunity to organize all the codes and categories in coding schemes that like trees. The other opportunity provided by the program was that I constituted models that were assembles of the tree-like coding schemes. The coding schemes organized according to research questions were reported in a form of narrative discussion (Creswell, 2002). The narrative discussions were supported by the visual models and the quotations from the raw data.

3.10 Trustworthiness

The validity and the reliability are two important concepts that require a great deal of attentions in all type research methods. Morse, Barrett, Mayan, Olson, and Spiers (2002) clarified the concern of verification in research by stating "Without rigor, research is worthless, becomes fiction, and loses its utility" (p. 2). Johnson and Christensen (2012) defined valid qualitative study as "plausible, credible, trustworthy, and therefore defensible" (p. 264). Merriam (1998) defined reliability as "the extent to which research findings can be replicated" by emphasizing problematic status of reliability in social sciences due to the unstable nature of human behavior (p. 205).

However, different terminology is used to refer validity and reliability in qualitative study. Although all the validity and reliability concerns are based on the same bases, the literature review showed that there is no conceptual consensus among the researchers. For instance, Creswell (2007) and Johnson and Christensen (2012) approached validation and reliability separately and they used the trustworthiness as an equivalent concept of validity. Merriam (1998) mentioned internal validity, reliability, and external validity in order to ensuring the quality of qualitative study. Maxwell (2009) focused on threats to validity and attempts used to rule out those particular threats. On the other hand, some other researchers used trustworthiness as a comprehensive concept to refer the validity and reliability of the study and dealt with credibility, transferability, dependability, and confirmability separately (Glesne,

2011; Lincoln & Guba, 1985; Lodico, Spaulding, & Voegtle, 2006; Marshall & Rossman, 2006; Miles, Huberman & Saldana, 2014; Patton, 2002, Shenton, 2004).

In this study, the validity and reliability of the study was referred to as trustworthiness. The concept of trustworthiness is used to evaluate the quality of a qualitative study and implies how valid and reliable your study is. Lincoln and Guba (1985) referred the facets of trustworthiness as credibility, transferability, dependability, and confirmability. Marshall and Rossman (2006) clarified the meaning of trustworthiness by asking some questions that are correspond to one of the facets of trustworthiness; "How credible are the particular findings of the study?", "How transferable and applicable are these findings to another setting or group of people?", "How can we be reasonably sure that the findings would be replicated if the study were conducted with the same participants in the same context?", and "How can we be sure that the findings reflect the participants and the inquiry itself rather than a fabrication from the researcher's biases or prejudices?" (p. 201). In order to constitute trustworthiness of the present study, I conducted particular strategies to eliminate the potential threats to trustworthiness, so that, to enhance the research study's credibility, transferability, dependability, and confirmability. Although there are plenty of strategies that ensure trustworthiness, it is not efficient to use all the strategies at a time in terms of economic using of time and effort. Therefore, Maxwell (2009) suggested focusing on "specific validity threats and what strategies are best able to deal with these" (p. 243). Taking into account this suggestion, I focused on particular strategies in terms of each facet of trustworthiness.

Ensuring credibility is one of the most important factors in establishing trustworthiness (Lincoln & Guba, 1985). The term of credibility refers to internal validity of the study. According to Merriam (1998) "internal validity deals with the question of how research findings match reality" (201). According to Marshall and Rossman (2006) the goal in credibility is to demonstrate that "the inquiry was conducted in such a manner as to ensure that the subject was appropriately identified and described" (p. 201). Credibility actually depends on the accuracy of the

researcher in presenting "what the participants think, feel, and do and the processes that influence their thoughts, feelings, and actions" (Lodico, Spaulding, & Voegtle, 2006, p. 273).

To achieve credibility or believability, the researcher must provide accurate and whole picture of the research setting, participants, the relationship between researcher and the participants. Since there was no familiarity between me and the participants beginning of the study, three appointments were arranged with all participants in order to achieve mutual trust between me and my participants, and to construct an effective communication environment. As suggested by Shenton (2004) they were also asked their voluntary participation and were informed about the right of withdrawal at any time and without giving any reason. It was an attempt to make sure that they express themselves clearly and speak their thoughts sincerely and outspokenly. Another goal of this attempt was to get familiar with teenagers' way of expression in verbal communication in order to prevent any misinterpretation of their thoughts that might be caused by age difference between me and my participants. Additionally, it was also indicated and emphasized regularly that there were no right answers to the questions and the only thing that I was interested in was their own thoughts and viewpoints.

One of the most suggested strategies to ensure credibility of the research is using triangulation. There are lots of forms of triangulation such as theory triangulation, method triangulation, data triangulation, investigator triangulation (Johnson & Christensen, 2012), informant triangulation, and site triangulation (Shenton, 2004). In this study, the informant or respondent triangulation was used. In the selection of the participant, it was taken into account that all the participants came from different school and different district, so that they have different backgrounds. In such an attempt, I tried to construct rich picture of viewpoints, experiences, and thoughts coming from the range of different participants. Additionally, the member checking, participant feedback or respondent validation strategy recommended by many researchers (Glesne, 2011; Johnson & Christensen, 2012; Lincoln & Guba, 1985; Lodico, Spaulding, & Voegtle, 2006; Maxwell, 1998; Miles, Huberman & Saldana,

2014; Patton, 2002, Shenton, 2004) were also used. Some of the participants were asked to read the transcripts of the dialogues in which they participated and they were requested to compare the transcripts with what they actually intended to express. Additionally, I shared my preliminary interpretations about the context of transcripts with the participants. After their feedback, some corrections and additions were done.

Shenton (2004) suggested to state background, qualifications and experience of the researcher, and examination of previous research findings as strategies for increasing credibility. I have been following the literature on the pseudoscience and the nature of science for six years. I took part in a research project about pseudoscientific beliefs and attended lots of conferences and presented my research studies about students' pseudoscientific beliefs. Additionally, I am familiar with and experienced in qualitative research method. In my master thesis, I conducted a research study based on qualitative methodology. I also published researched studies conducted with qualitative methodology. Besides, I also have certificate showing qualification in using NVivo software which is used to analyze qualitative data. In order to show whole picture of the existing body of knowledge about pseudoscience, in the literature part I included cornerstone research studies and their findings and indicated what was needed more. The existing body of knowledge and existing theories about pseudoscience lead the way of me in analyzing the collected data. Taking into mind of the existing theories, I coded data and named my categories. By comparing existing theories with the emerging explanations, I refined my explanations and tried to provide new perspective to the literature.

Another facet of trustworthiness is transferability. Transferability corresponds to external validity and generalizability. For this reason, it is one of the most problematic facets in qualitative research (Marshall & Rossman, 2006) and an inappropriate goal for interpretive research (Erickson, 1986). In nature of qualitative research, there is no intent to generalize the findings to the other situation or to a population. Even Maxwell (2009) stated the lack of generalizability as the criterion showing the value of a qualitative study due to the sampling structure used in

qualitative study. Nevertheless, “the lesson learned in one setting might be useful to others” (Lodico, Spaulding, & Voegtle, 2006, p. 275). The transferability was defined by the Lodico, Spaulding, and Voegtle (2006) as “the degree of the similarity between the research site and other sites as judged by the reader” (p. 275). Therefore, one of the most suitable strategies to ensure transferability is to provide rich and thick descriptions about the context in which the study took place in order to enable the reader to judge the available similarities. Merriam (1998) referred this process reader or user generalizability that is why “the researcher has an obligation to provide enough detailed description of the study’s context to enable readers to compare the fit with their situations” (p. 211).

In the present study, I clearly presented the method of the study. The research design, participants of the study, data collection instrument and procedure and data analysis technique were explained in detail with their rationales. Additionally, the semi-structured interview protocol used for data collection was also introduced. The aim of the questions and the context used in each questions were explained. The rationales for using these questions and context in protocol were also clarified. In order to provide what is needed by readers and to ensure transferability, all the process utilized in present study was presented as it was.

In addition to validity, the reliability is equally important in qualitative study. In qualitative terminology, it refers dependability. According to Miles, Huberman and Saldana, (2014) the dependability is “whether the process of the study is consistent, reasonably stable over time and across researchers and methods” (p. 272). The underlying issue here is to make sure that the findings derived from the study are consistent with the data. Likewise reliability in quantitative study, the aim is not to replicate the results, rather is to make the results consistent with the collected data. One of the most recommended strategies for increasing dependability is audit trail (Creswell, 2007; Johnson & Christensen, 2012; Merriam, 1998, 2009). According to Merriam (2009) audit trail is the details about “how data were collected, how categories were derived, and how decisions were made throughout the inquiry” (p. 223). In a similar way, it indicates taking records about what happened in study and

taking records about rationales of what you intent to do in study. In present study, necessary records were kept both in electronic and hard copy forms. All the interviews were audio taped with a digital recorder so that I was provided the opportunity to store the interviews as computer files. All the files were named by referring students' name and the date of the interview and saved in particular folder. The audio-recordings were translated into verbatim texts electronically. Then all the data were coded in NVivo software. Additionally, I kept a journal in which I wrote the process, emerging ideas, emerging codes and categories, and recent theories and the relationship with the available data. Similar with transferability, the rich and thick description is other strategies for showing dependability. In order to have consistency among the participants, semi-structured interview protocol was used, so that all the participants were treated in the same way. Additionally, probe or following questions corresponding to possible responses of the participants were written outset of the study. The process including sampling, data collection, and data analysis that was intended to be used in this study was piloted before the main study. The pilot study was the small-scale version of the main study. Similar results were derived from main study as it was in pilot study.

In qualitative study, the dependability is to decrease the researcher bias to minimum. In the coding process, researcher coded the data and other researcher who were expert in science education and experienced in qualitative research checked the coded data and they resolved the discrepancies by discussing and reaching a consensus. This peer-review process provided more powerful analysis and increases the reliability of the study. Additionally, I determined the intracoder reliability by randomly selecting two datasets. I coded these datasets twice with an interval of twelve days. The intracoder agreement was found to be .91 which demonstrates high agreement (Johnson & Christensen, 2012; Miles, Huberman & Saldana, 2014).

The last concept included in trustworthiness is confirmability. It refers the objectivity of the researcher. According to Lincoln and Guba (1985) the confirmability is "the extent to which the findings of a study are shaped by the respondents and not researcher bias, motivation, or interest" (p. 145). To address confirmability, I

developed an audit trail, as discussed previously. Additionally, in order to minimize the researcher bias, peer review process in which the researcher discusses his/her interpretations and conclusions with other researchers and takes their advices (Glesne, 2011; Johnson & Christensen, 2012) was used. In addition to this, in order to show that the interpretations and conclusions of the researcher are derived from the real data, the quotations which were the direct citations from the interviews were added. By this way, I tried to minimize bias, and always kept in touch with data.

CHAPTER 4

RESULT

In this chapter, the researcher summarized the research findings under six main sections devoted to each research question and related subsections. The researcher decided to present the findings in a way that was easy to understand for readers, that was called narrative discussion. Narrative discussion is one of the primary ways reporting findings in qualitative research. Creswell (2012) defined narrative discussion as "written passage in a qualitative study in which authors summarize, in detail, the findings from their data analysis" (p. 254). The forms of narrative discussion used in the present study were "a discussion of themes" and "a discussion of figures (models)". Additionally, Creswell (2012) suggested some hints to strength narrative discussion. These were as follows;

- include dialogue that provides support for themes
- use metaphors and analogies
- report quotations from interview data
- report multiple perspectives and contrary evidence
- write in vivid detail
- specify tensions and contradictions in individual experiences (Creswell, 2012, p. 255-257).

In addition to taking Creswell (2012) suggestions into account, the researcher also used visual models in order to support narration. According to Miles and Huberman (1994) most of the qualitative researchers preferred displaying the findings visually.

The purpose of this study was to discover and describe reasoning patterns that emerge while middle school students reflect their understandings about pseudoscientific issues. The aim was to reveal middle school students' comprehensions about aim, process, and justification of pseudoscientific applications related to crystals, and about reliability, certainty, and scientific status of knowledge that derived from these pseudoscientific applications profoundly. The primary focus in this study was to go beyond students' belief systems about pseudoscience and

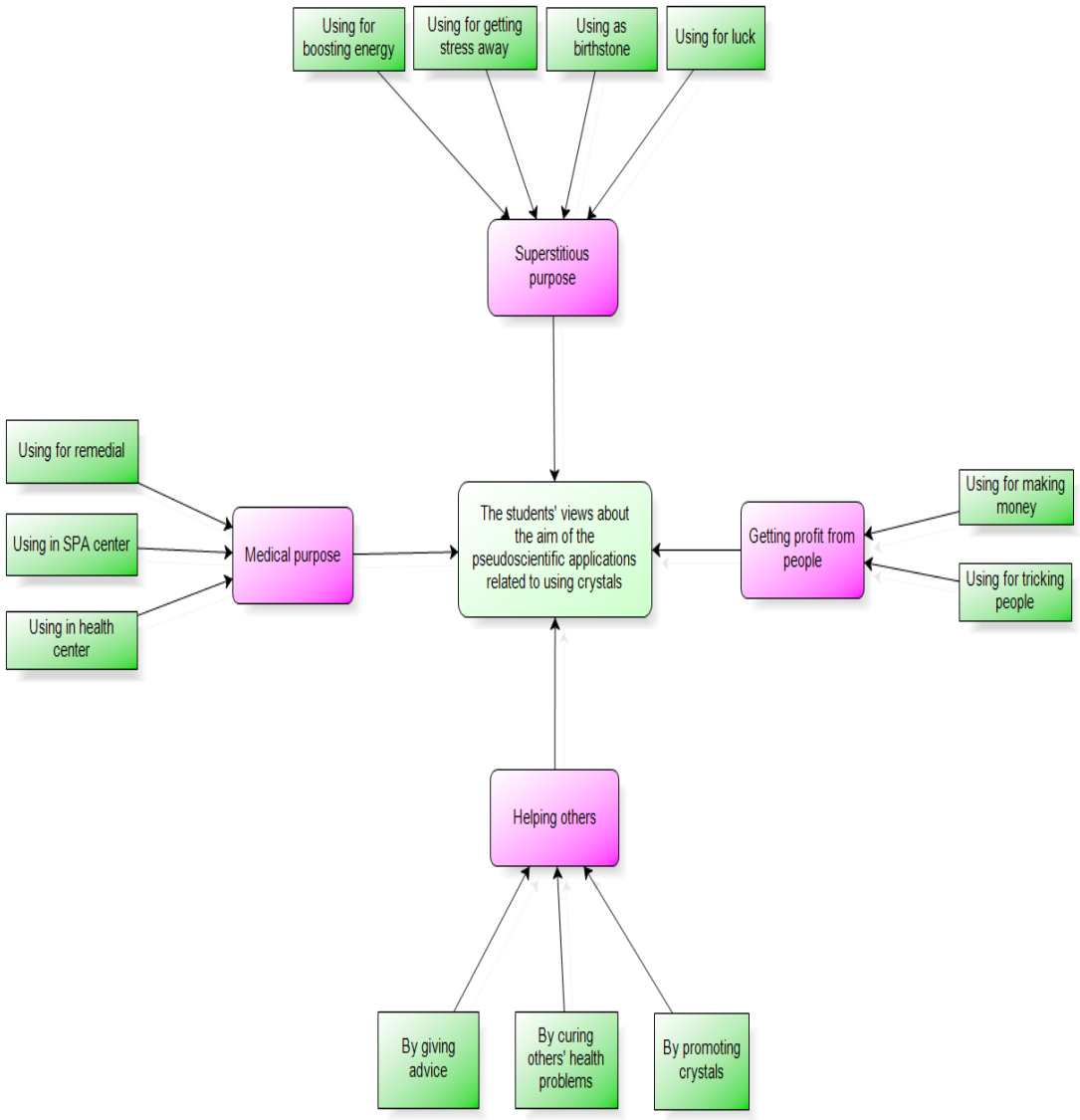
uncover features that orient their belief-driven decisions in pseudoscientific applications.

The research question addressed by the study was "How are the middle school students' reasoning patterns and comprehensions about aim, process, and justification of pseudoscientific applications related to crystals, and about reliability, certainty, and scientific status of knowledge that derived from these pseudoscientific applications?" The pseudoscientific context used in interview was crystal healing. In order to answer the research questions, the findings of the each subquestion were presented below.

Before going further, it was necessary to clear up that the coding schemes and visual models in each subquestion were depended on the students' reasoning abilities. Their reasoning abilities guided their arguments about aim, process, and justification of pseudoscientific applications related to crystals, and about reliability, certainty, and scientific status of knowledge that derived from these pseudoscientific applications. Due to their restricted reasoning abilities, sometimes they asserted same arguments for aim, process, and justification of pseudoscientific applications related to crystals, and reliability, certainty, and scientific status of knowledge related to crystal healing. For instance, they generally used the same arguments when they explained their judgments both in reliability and in certainty. For this reason, their similar arguments in each subquestion were coded into different categories and thus some categories seem very similar.

RQ1. What are the students' views about the aim of the pseudoscientific applications about crystals?

To answer RQ1, the researcher was interested in middle school students' ideas about what they know about crystals, why people use them, and why people implement crystal healing. Their ideas were categorized around four themes presented in Model 1; for medical purpose, for helping people, for superstitious purpose, and for making profit.



Model 1. The students' views about the aim of the pseudoscientific applications related to using crystals

When the students' views about aim of the pseudoscientific applications about crystals were analyzed, the results revealed that most of the students (n=11) thought that crystals were used for medical purpose. They stated that due to the therapeutic structure of crystals, particular crystals were used to cure particular diseases. To illustrate the students' familiarity with crystals and their views about using crystals for medical purpose, one related quotation was the following;

> S: My mother uses natural crystals or similar materials a lot. Moreover, people say that crystals being bought from Hajj are also curative, my mother absolutely hides them. Generally, people use

> them in order to cure something. They use crystals and so forth for backache. I have heard them; in other words, I have seen them.
> I: Where have you seen them?
> S: My mother has a CD, she believes in these kinds of things such as cupping. There is probably a ring relieving stress. A ring made of onyx. She has used it.
> I: Has your mother told that whether that ring has been good for her or not?
> S: She has not told whether that ring has been good for her or not but she usually uses it. She thinks that perhaps that ring will be good for her sometime. However, she has said that crystals are good for backaches. In other words, she has heard that crystals are good for backaches.
> I: Do you have any other observations about this topic?
> S: No, but I have heard something about coral crystal. My grandmother uses it. She has cutaneous disease. She uses wristbands made of coral crystals to cure her disease. (13Z)

As stated in her quotation, she was aware of medical attempts used by her relatives. Particularly, she stated that she had observed her mother and grandmother when they were using crystals for particular medical purposes. She was also aware that her mother believes crystals' effectiveness.

Additionally, some of the students (n=3) talked about the existence of SPA centers and cure or treatment centers in which the crystals are used for medical purpose. Two of them also saw and experienced such a treatment center that aimed at curing herniated disc disease and rheumatism by using crystals. Three of them talked about their experiences on SPA brochure including black round-shape crystals located on the back of body. Related example was evident in the following quotation of the student about his experience on crystal healing;

> S: SPA, volcanic crystals, massages made with these volcanic crystals, in order to straighten and cure the spine, there is something like green emerald crystal for backache or hand fracture have come to my mind. People's recovering some parts of their bodies has come to my mind. One of my friend's mother has usually told something about them. He also has a ring and a wristband made of emerald. He has used them. I have also seen them on the internet a few times. I have seen these kinds of pages by mistake while surfing on the internet. I have read them.
> I: Then, can you tell me your observations about them?

> S: He has been using that wristband; her arm has been getting better and better. She has also been scrubbing her arm. He could not use her arm as long as he has not used that wristband. (3C)

In his quotation, he mentioned many attempts that most of the people apply pseudoscientifically. Furthermore, he was aware of existence of jewelry such as ring and bracelet made of crystals due to his eyewitness of his friend's medical attempt. Additional quotation regarding experience on treatment center was as follows;

> S: The first thing I remember first is that this summer a health center about crystals was opened here. There was a machine there and there was a mobile crystal under that machine being good for backache. In fact, I did not have backache but I accompanied one of my friends. They put hot crystal on people's backs there. I remember that. I immediately remember that.
> I: What are the purposes of these kinds of shops according to you?
> S: Promotion. I think people may see some effects. For this reason, they opened this shop for welfare. And for selling that products afterwards. They advertise the product now so that people may like and buy it later.
> I: What are the purposes of people's tending towards these kinds of treatments?
> S: I do not know but they seem more convincing. When you see a doctor, he writes a prescription or he operates but here crystals treat people. Being treated by crystals is easier for people. Because they are given information about crystals at these shops. Then, they are given examples, for example shop owners say that this person has come here and used this crystal, lied down on this bed and recovered. Some people in that shop also say that one of their close relative has also used that and recovered afterwards. Moreover, once you hear that, these kinds of things sound more believable to you. (4C)

As she stated in her quotation, it was obvious that she had been to treatment center before. Interestingly, she stated that she found the information about remedial side of the crystals told in the treatment center was convincing. Especially, she explained how pseudoscientists interested in crystal healing convinced people to purchase and use crystals by applying a tactic based on so-called first-hand experience or hearsay reporting of so-called effectiveness of crystals.

Nine students thought that people who were interested in crystals and crystal healing were using these materials with the goal of helping other people who are suffering from particular diseases. Six of them stated that the aim of the pseudoscientists was

to promote the crystals and their usage on health in order to help people. However, these six students were not aware of implied commercial aim that lies behind promotion of crystals. Related example was as follow;

> S: In order to promote crystals. Because, as I have just said, there are brochures in these kinds of shops.
> I: What is written on these brochures?
> S: Properties of crystals. That is to say, this crystal is good for these diseases and it relieves you in that way.
> I: In other words, they promote these crystals to people in that way. Do they have other aims?
> S: They promote them. The more they promote, the more people use them, the more people are treated by these crystals. (12Y)

In the given quotation above, she experienced one of the street fair in which the crystals were sold. However, as understood from her quotation, she focused on informing papers about crystals provided there instead of commerce. She gullibly thought that salesman of crystals just aimed at making other people informed about crystals so that more people could be able to use them. Other gullible quotation in which a boy mentioned about treatment center was as follows;

> S: A center has been opened. There have been machines in that center. There have been crystals like magnets in these machines. There have been some patients there. They have been treated there free of charge.
> I: What has been done in that center?
> S: They have given a speech about herniated disc, bones or crystals to people. They have been giving promotion until the next session. Then, they have continued giving promotion to people in the next session. It has been very crowded. They have told us what they are used for. They have told us the crystals being presented there.
> I: What are the purposes of these people in opening such kind of a center?
> S: They promote crystals to people, tell that crystals are harmless, and can recover people. (5D)

As it was clear in his quotation, he was not aware of the commercial interest of the people who funded such a treatment center. Being free at the first stage probably gave him such an impression that the center must not pursue a commercial goal; it just would work for public interest.

For other four students, it was unnecessary to look for malicious intentions. They indicated that people who were interested in crystals and asserted positive claims

about crystals just wanted to give advices about their experiences to other people. For instance, given quotation below was related to this;

> S: I think they want to help people.
> I: How do you think that they want to help people?
> S: They share their knowledge about these crystals. In other words, they want other people to know and use them. They say that people who do not believe in doctors can also use these crystals.
> I: Why do you think that they want people to use these crystals?
> S: There is not a certain reason but they just give advice to people who are similar to them. (6F)

As understood, he did not need to find a reason. According to him, people just wanted to share their experiences with each other. He stated that the initial aim of the people was to give an advice to people who had the same problem. Additionally, four of the students indicated that the initial goal of the people who were interested in crystals in a special manner was to help people who suffer from particular diseases by curing their diseases using crystals.

In addition to using crystals for medical and help purpose, some of the students (n=6) stated that the crystals could be used for superstitious purpose. For instance, four of them stated that they heard or encountered examples in which crystals were used to increase an individual's energy and to affect their mood positively. Another purpose of using crystals stated by the students was to relieve or demolish the stress. Four students mentioned that generally, their mothers or elder sisters used crystals to get rid of stress and they thought that their relatives believed in that these crystals make them relax and decrease their level of stress. Other forms of using crystals were using them as a birthstone that each month is represented by a particular crystal and as a luck stone that is believed in bringing good luck for holders. Three students stated that they were using these crystals as birthstone or luck stone. The following quotation exemplified one of the student's experience with her mother who was using the crystals for superstitious purpose;

> S: My mother buys these crystals wherever we go. She says they relax her. I find these kinds of things a bit nonsense. However, I like their images at home. I sometimes ask my mother why she buys these kinds of things and she says she likes them. She believes in them.
> I: What does she believe in?

> S: As for mother, they relax her and receive negative energy. Some of them may be good for diseases. Some of them are harmful. I do not know their names. Well, there are exhibitions; we have tried to learn the uses of these crystals at the exhibitions. There is also a book about them. There is information in square shape. My sign is bull. My mother has also bought it to me. She has searched information on the internet afterwards.
> I: What other things have you heard about crystals?
> S: I cannot remember its name well. We have gone somewhere and there have been natural crystals on the tables there. People have said that these crystals receive negative energy. They become black in color in time as they take negative energy.
> I: There are people around you who are interested in natural crystals. What do you think about these people?
> S: We have not stayed there for a long time but I have gone there and had a look as I'm interested. It has had white edges and purple top. It has been getting black in time. Information about these natural crystals may be true. (12Y)

This quotation informed us that the crystal healing became so common that you might come across crystals and related pseudoscientific information even in a street fair. Another interesting part of her quotation was related to the amethyst. Amethyst is a violet variety of quartz generally supposed to purify negative energy and give positive energy. It is also believed that when it purifies negative energy, inside of the quartz gets darker. However, it is known that the color of amethyst ranges from light to dark purple and generally the mineral is banded with light purple and whitish lines although the inside of the mineral is dark purple or violet. Although she stated that she referred using crystals for antianxiety agent as absurd, she was also seemed as being affected by the story about amethyst.

On the other hand, a few of them (n=5) approached the issue more skeptically. Five students were aware of that the aim of using crystals was based on getting profit from people who were prone to pseudoscientific beliefs. Four of them indicated that the people who were interested in crystals in a special manner aimed at making money by selling these crystals. One exemplifying quotation was as follow;

> S: I think their aim is commercial.
> I: How do you think that their aim is commercial?
> S: I do not know whether they cure diseases or not but these people have commercial aims. They set web sites for this reason. They give

> information about these crystals. They mention that these crystals are good for these diseases and cure these ones.
> I: You say that these people may have commercial aims. So why do people buy a thing the effect of which they do not know.
> S: They believe in them, they want to try first. They try them as they think that they may cure their diseases. They try as they cherish the hope.
> I: Can they have other aims?
> S: I do not think so. They just want to earn money by playing on people's heartstrings. (3C)

In his quotation, he advocated that the initial aim was to earn money by promoting crystals on their websites. He stated that most of the people did not know the real effectiveness of crystals but they just hoped to be cured as soon as possible. After that, he claimed that promoters of the crystals also abused patients' hope of recovery in order to make money. Additionally, just two students were partially able to realize the trickery of the promoters of crystals. Representative quotation was the following;

> I: You have just said that you have seen the sales of these crystals on the internet. What are the aims of these people?
> S: I think they sell them in that way as they have reaped the benefit of them. I do not think they tell a lie. I think they sell these crystals as they know how they cure diseases. They sell these crystals as they think they have specific aims.
> I: What are their aims?
> S: I think this is not a topic to do scientific research or experiment. Blood pressure falls down in any conditions. The sellers of these natural crystals have also begun selling them by thinking like that.
> I: How do they think according to you?
> S: They sell these crystals. And people buy them. But their blood pressure doesn't decrease. So the sellers say that you may have done something wrong. In other words, they actually fool people. When the blood pressure of people does not decrease, they say you may have done something wrong. (11T)

In this interesting quotation, the student seemed to be confused. At the beginning, he stated that salesman of crystals knew that which crystals were used for particular intents. Additionally, he claimed that it was impossible that they lie people so that crystals must have influence on health. After that he changed his view in a way that the crystals did not work on health, thus salesman deceived the people and blamed them for using crystals in a wrong way. Thus, he could be referred as partial skeptic.

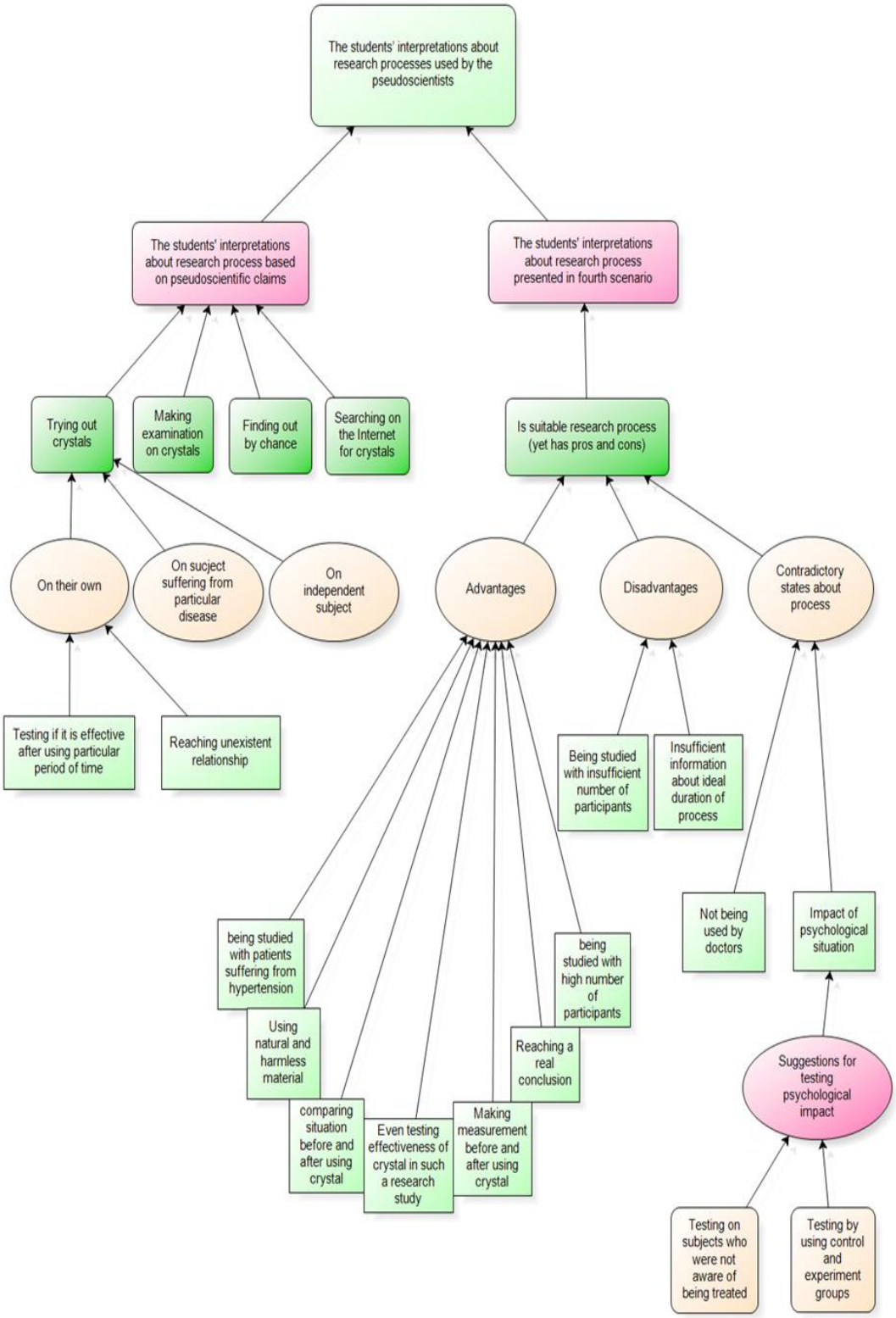
In brief, the results related to the students' views about goal of pseudoscientific applications related to crystals and crystal healing revealed that the students generally thought that crystals were particularly used to cure diseases. Therefore, they indicated that main aim of using crystals was based on medical purpose. Other gullible aim of using crystals stated by the students was to help other people who were suffering from particular diseases by promoting crystals, making advice about using crystals, or healing them with crystals. Interestingly, the students stated that some of them or their relatives were using crystals for superstitious purposes such as for boosting their energy, for getting luck, and for removing stress from their body. On the other hand, few of them were aware of trickery aim of pseudoscientists who were interested in crystal healing. These students stated that the initial aim of using crystals was to get profit from people by selling crystals to patients who were looking for hope, and by deceiving people by promoting ineffective crystals. Based on these results, it could be concluded that most of the students were not aware of the inherent aim of the pseudoscience which was based on commerce and trick. Most of the students were very gullible about goal of pseudoscientific applications related to crystals and crystal healing. Based on their gullibility about aim of using crystals and crystal healing, it could be also concluded that most of the students were prone to pseudoscientific applications related to crystal healing.

RQ2. What are the students' interpretations about research process used by pseudoscientists in the development of knowledge in pseudoscientific applications related to crystals?

To answer RQ2, the researcher was interested in middle school students' interpretations about research processes used by the pseudoscientists when they construct knowledge based on pseudoscientific applications related to crystal healing. Therefore, the students were provided some claims (Pseudoscientific claims) about crystal healing asserted by practitioners and they were asked that how people who asserted these claims would construct this type of knowledge and how their research process would be. Additionally, the students were provided an ill-designed pseudoscientific research process (fourth scenario: balancing blood pressure) that

was related to a researcher who conducted unfair testing procedure, and then they were asked to interpret this research process.

In this part, the students' interpretations about research processes would be used by the pseudoscientists when they construct knowledge based on pseudoscientific applications were presented in Model 2. The themes emerged from analysis were categorized into two parts that were "interpretations about research processes based on pseudoscientific claims", and "interpretations about research process used in pseudoscientific scenario".



Model 2. The students' interpretations about research process used by the pseudoscientists

When the students were asked where claims about crystals come from and how practitioners would construct these claims, the students provided four sources of knowledge. These were searching crystals on the Internet, making examination on crystals, finding out by chance, and trying out the crystals. Specifically, one student thought that all the information about crystals and even instructions about how they could be used to cure diseases were available on the Internet. According to him, there was no need to make anything else but searching on related websites. He referred the knowledge about the crystals as if they were always existed and thus he did not need to think about the construction process of these knowledge. Additionally, three students indicated that people would have found out effectiveness of crystals by chance when they were interested in something different. Following quotation exemplified one girl's own story about finding out effectiveness of the crystals by chance;

> S: Well, there is something like that. People do experiments on mice or other animals and while searching something they explore another thing accidentally. Things have already been invented like that. Things have been invented due to the needs of the inventors; well, they have these things in their houses but they do not know what they are used for. They have used them as ornamentals or accessories. However, in time, they have found that these objects have begun to be useful for him or he has begun to feel better with them. Well, why did Graham Bell invent the telephone? In order to make the communication easier. People may do this in order to show how treatments are getting easier by this way. The person discovering this has already experienced it in a good way; so he makes it available. (9M)

As she stated in her quotation, she considered process of exploring the effectiveness of crystals by chance equal to the scientific experiments conducted on experimental animals to test effectiveness of prescription drugs. According to her, a researcher who had a relief due to the crystal coincidentally, investigated the contributions of crystals to treatments.

On the other hand, other students basically indicated superficial research processes which were not based on scientific principles. For instance, when they were asked about how practitioners would construct knowledge about effectiveness of crystals, three of them mentioned about making examinations on crystals. They tended to

believe that making examinations on crystals such as examining their surface, structures, and atoms would reveal what they needed to know about effectiveness of crystals on health. For instance, this was evident in the following quotation;

> I: After what kind of a research process have these people gained this knowledge according to you?
> S: By examining crystals.
> I: What kind of an examination have they done according to you?
> S: They have examined what a crystal is like, what there is inside a crystal, how its atoms are, whether it spreads energy or not. Many things can be discovered in this way. In addition, whether it is efficient or not can be understood in this way. Then, they have tested it on people's skin in order to see the effects. They have tried it by giving them a ring or necklace shape. They have analyzed crystals in this examination process. Thus, they believe in them. (3C)

As understood from his quotation, he assumed that necessary information about crystals could be understood by examining the crystals in detail, after that the crystals were tested on the people to prove findings about its effectiveness. Additionally, he assumed that the crystals would emit energy and this energy would be determinant of crystals' effectiveness on health.

Additionally, almost all of the students (n=11) indicated that people would have found out effectiveness of crystals by trying them out. According to them, this testing was based on a kind of trial and error process in which people used a kind of crystal for particular intent and if they believe in its effectiveness, they continued to use it and if they did not believe in its effectiveness, they tried another crystal for the same intent. When the students were asked to elaborate their trial and error processes, they focused on the subjects on which crystals were tried out rather than focusing on research details. For instance, three of them stated that in order to see effectiveness of crystals, the practitioners would have tried them out on another people who were independent from themselves. They were not able to give any additional detail about the subject or the process. They just stated that if it is really effective, the people can see it by trying out on another people. On the other hand, five students gave details about the subject being implemented in trial and error process. They thought that if the people wanted to see the crystals' effectiveness, the subject must suffer from particular disease in accordance with their intent. Thus, they designed a trial and

error process in which effectiveness of crystals was tried out on the patients who were suffering from particular disease. The exemplifying quotation was as follows;

> I: After what kind of a research process have these people gained this knowledge according to you?
> S: I think it has been tested on humans and then grouped. It must have happened like that.
> I: So can you please tell me what kind of a research process it is?
> S: I think these crystals have been found first; then, these crystals have been examined thoroughly.
> I: What do people search? What kind of research is it?
> S: The effects of these crystals on people have been examined.
> I: How are these effects examined?
> S: I would use it on your body. Then, I would ask you whether it is good for your health or not. I would ask this question to about ten people, of course, I would not ask this question to just one person. If nine of these ten people said that it was good for their health, then, I would consider this crystal as healthy. Then, I would put it on the market and cure people. For example, coral crystal is mentioned here. I would call my friend having psoriasis and I would try it on him, and I would tell him to use this crystal for a week, come back here. I would warn him to use it regularly. If he used it regularly and his psoriasis were cured, then, I would consider that this crystal were good for psoriasis. We have to do many tests in order to learn the properties of these crystals. For example, we must try them on people having diseases, or with health problems. (10S)

Although he contrived to make a test on patients suffering from a particular disease, it was seen from his quotation that his experiment was unable to go beyond the naïve realism. That is to say, he assumed or believed that the result was precise as he saw it. Besides naïve realism, he was not able to recognize the fair testing process to collect data in order to construct knowledge. At the same time, he was aware of the importance of the number of testing and participants, however he was not aware of the quality of research. His reasoning pattern was based on “try and see it”.

The last group of the students (n=3) suggested a trial and error process in which the people might test the effectiveness of the crystals on their own body. They additionally explained their process by giving detail about the period of the process. Consequently, after particular period of time with crystal, they believed that this period was enough to reveal its effectiveness, if it was really effective. Representative quotation was given in the following;

> I: After what kind of a research process have people claiming that these crystals have these properties reached that information according to you?
> S: They have tried that for a while but I do not know exactly. If they have tried and these crystals have been good for diseases, these crystals are curative.
> I: What kind of test have they done about that according to you?
> S: Perhaps I would put that crystal on one part of my body, and would wait for a while. If it worked, I would continue doing that.
> I: How long would you wait for instance?
> S: I would wait for 5-10 minutes, if it really worked, it would cure my disease anyway. I would experience it within this period. If it did not work, I would quit using it.
> I: How would you understand that whether it worked or not?
> S: If my blood pressure increased and that crystal made my blood pressure decrease, I would understand that it worked.
> I: So do we have to try that at the time blood pressure increases?
> S: Of course, we have to try that at the time blood pressure increases; otherwise, I cannot understand if it is effective or not. (14Z)

In her research design, she preferred testing the crystals' effectiveness when she was suffering from high blood pressure in order to see if her high blood pressure decreased or not. She also believed that it was possible to test the crystals' effectiveness in such a short period of time and in one shot trail.

On the other hand, one skeptical student approached the issue from a different perspective. He stated that sometimes people hoped for help from the nature including crystals so that they decided to try out the natural materials on their own, and then consequently, they concluded nonexistent relationship between their relief and crystals, although there was no effect of the crystals. Exemplifying quotation was presented below;

> I: People claim that these crystals show these kinds of effects. After what kind of research do people claim that?
> S: I think a man has been ill. He has taken the crystal. And he has felt better. Namely, he has felt better afterwards. Then, he has begun to think that the crystal has been good for his diseases.
> I: He has begun using the crystal and considering that the crystal is good for his illness?
> S: Yes, but perhaps he would feel better in time. This is not logical for me for this reason. Namely, the illness would be better but he begins using the crystal by chance at the same time. Moreover, he begins thinking that he has gotten better thanks to the crystal. In fact, getting better is not related to the crystal. (8K)

In his quotation, he particularly pointed out the one of the common logical error which is called as after-the-fact-reasoning. Literally, it is based on the statement that "post hoc, ergo propter hoc" which means that "after this, therefore because of this". As he stated in his quotation, he was aware of this error in individuals' thinking when they had after-the-fact-reasoning.

As it was seen, when they were asked about how practitioners would construct knowledge about effectiveness of crystals, their responses were very identical and very limited. They were far from critically evaluating how and why people decided that the crystals would be effective. The students directly focused on research designs based on testing the effectiveness of the crystals by trying them out on their own, on patients, or on other people. Their testing designs were based on a kind of trial and error process in which practitioners use a kind of crystal for intent and if they feel satisfaction, they continue to use, or if they do not believe in its effectiveness, they try another crystal for the same intent. It also provided evidence about how the students evaluate and process information. It was obvious that they tended to have experiential system for processing information rather than rational system for processing information. Most of the time, they believed in that "try and see it". Therefore, they generally preferred fast, intuitive, and emotionally-driven mode of information processing rather than doing research in which they would implement science process skills.

On the other hand, the students were asked about their interpretations about ill-designed pseudoscientific research process. Ill-designed pseudoscientific research process includes unfair testing procedure in which researcher ignored controlling variables (The fourth scenario: Balancing blood pressure). It also included some details about the participants and setting in order to give an appearance of being scientific. Additionally, it included some scientific terminologies such as claiming and testing, and measuring. By means of this scenario, the students were questioned on their interpretations about the process being used in the scenario. When they were asked their opinion about the process utilized in scenario was suitable to test the idea being claimed, all of them stated that it was very suitable and if they were the

researcher they would design the same research process. Most of the students (n=13) focused on possible strengths of the research process being utilized in the scenario. Just four of them mentioned that the process implemented in scenario would have some weaknesses, but not in an expected way.

The students especially focused on the details provided in the scenario to which the pseudoscientists intended to draw attention. For instance, being studied with patients suffering from high blood pressure was referred to one of the advantages of this research process. The related quotation was as follows;

> S: If he puts the crystal onto the right part of his body, well, here in that example the man puts the crystal onto his heart, if the heart is the right part of the body and he has done everything correctly, it has worked.
> I: Is this research suitable for that kind of research in order to test the claim of the researcher?
> S: When we do not have any idea, we can try it first and after we try it, it will be convenient for further steps.
> I: Which aspects of it are convenient for instance?
> S: In fact, his using that crystal for patients having high blood pressure is very good. Otherwise, he cannot understand whether the crystal is good for high blood pressure. For this reason, I think that it is good for him to find patients having high blood pressure. Nevertheless, I cannot comment more as I do not know where to put it.
> I: I suppose you think the part of the body is important.
> S: Yes, if there is a special part of the body, we must put the crystal there; otherwise, it will not work. It should be done in the right way; otherwise, it will not work. (5D)

According to him, being studied with patients suffering from high blood pressure was an advantage of this research study. This advantage would give positive impression to the student. Additionally, it was particularly understood that he was under the impact of one of the pseudoscientists' strategies used to convince individuals. That is to say, he believed that the crystals must be located on particular point, and then if you locate it in different point it does not work properly. The assumption underlying his belief was that the crystals are very effective and then the crystals would not work properly only owing to the fact that you apply it or locate it in a wrong way.

Additionally, using crystal as natural and harmless material instead of giving an injection or utilizing oral-intake drug was referred as another advantage of the process presented in the scenario. This was evident in following quotation;

> S: I think this is a right method. It is very good.
> I: Why do you think like that?
> S: They keep this crystal in their hands, it is not harmful. He wants them to put it near their hearts. In other words, it is safe. It is convenient for this reason. It does not give any harm to people. They use something natural. At least he does not want people to eat or drink something. He does not give any pills. (6F)

Additionally, two students stated that the process included comparison between the situation before and after using crystal, although it was not provided any information about the pre-measurement of the blood pressure. Although the researcher who was presented in the scenario did not measure the blood pressure of the patients before the treatment, the students assumed that it was happened and they referred it as strength of the research process. Related quotation was given below;

> S: He wants to test whether the crystal is curative on high blood pressure and he can do that in that way.
> I: Why do you think like that?
> S: He measures the blood pressure and looks at the difference.
> I: Which difference?
> S: The difference between before and after measurements of blood pressure; actually, I think if there is decrease in blood pressure, this means that he can reach his aim. (4C)

As stated above, the student assumed that the researcher who was presented in the scenario measured the blood pressure of the patients before and after the treatment, and then compared his measurements in order to determine the difference.

According to four students, testing of effectiveness of crystals in such a research study rather than searching in written sources or on the Internet was one of the strength of that research study. They thought that at least the researcher in the scenario was trying out crystal in a real research process. One of the related quotations was presented;

> S: This is actually a kind of research as I have just mentioned. This research does not lack anything because he tests it. He does something with experience. He does not say them with a high hand. He does not tell them to us by reading them from somewhere.

> I: What other things can be done about this topic?
> S: Perhaps I would get information beforehand. Then, I would experience it. Actually, experiencing itself is not enough.
> I: I wonder whether you confuse experiment and experience or not. There is experiment and experience you know.
> S: No, they are different from each other.
> I: Which one do you want to express here?
> S: Experience. You try whether something is real or not. In experiment, you try to find. Actually, they are different from each other. (14Z)

Take the case of her; it was obvious that she had confusion about experience (deneyim) and experiment (deney). Specifically, she referred experience as a tesing process of available information in order to see if it was real or if it really happened. On the other hand, she referred experiment as exploration process in which an unknown was found out. Additionally, according to her, by means of experience the researcher justified her/his thoughts of crystals by testing them on individuals.

Interestingly, five students mentioned possibility of acquiring a result as strength of the research. Although there was no information about the result of the research in the scenario, due to their outcome expectations, they tended to interpret the result of the research positively. This was evident in the following quotation.

> S: If positive outcome has been achieved, the accuracy of the research has been proved. In other words, if there is a good result, this means that there is also right research and a right method. If the result is good, this means this is scientific research. Possible result is positive in any case. (7G)

Likewise stated previously in previous quotation, she referred this research study as testing process of available information in order to see if it was true. Additionally, due to her positive outcome expectation she thought that the result was probably positive.

On the other hand, the students also stated research-related details such as the number of participants and making measurement as strength. Five students indicated the importance of making measurement that was the curial part of data collection. They stated it was an advantage that the researcher in the scenario measured the blood pressure of the patients after the treatment; however, they were not aware of

that the researcher must measure the blood pressure level of the patients before the treatment as well. Additionally, six students found 15 as representative number of participant for such a research. According to them, studying with 15 participants was enough to conduct this type of research study. Representative quotation was the following;

> S: I think it is very good research. Because he tests it on many people not just one person. If it is tested on only one person, it will not be reliable but if it affects many people, I think it is effective. It is tested on many people. It does not happen by chance. It is factual research.
> I: What kind of research would you do?
> S: I would possibly do the same as he tests on many people. (13Z)

As she stated in her quotation, she referred this research study as a real research and she stated that she would prefer doing the same way of investigation, if she were a researcher. According to her, testing the effectiveness of crystals on many individuals made the research result purified from doubt and impact of coincidence.

On the other hand, one student indicated that the number of the participants was small and it must be increased. Thus, she referred small number of participants as a weakness of the research study presented in the scenario. The student's quotation was as follows;

> S: I think 15 people are not enough in order to assert this claim. If he works with more people, it will be more reliable. If blood pressure of people decreases, this means that this research is successful. In other words, he claims that onyx is good for blood pressure here. If onyx is good for blood pressure after the experiment, this means it is something good. I think it will be good research.
> I: What kind of a research do you plan? In addition, how would be your research?
> S: I would do my research with 50 people like yours, not with 15-20 people. I would put the crystal into their hands, and I would want them to keep their hands near their hearts as blood pressure relates to heart. I would do the experiment for two hours, not for one hour. And I would take notes continuously for these two hours.
> I: What would you write as a note?
> S: I would ask how it was going and if it worked. I would take notes of their blood pressure and how they felt themselves. (12Y)

In her quotation, she stated that she would prefer conducting the same design of the study, except number of the participants. She also asserted that the number of the

participant must be increased so that the persuasiveness of the research study would be increased. Additionally, she was planning to collect data just by asking the patients about their feelings instead of measurement.

Other weakness of the research study stated by the four students was the absence of the comprehensive information about duration of the treatment period. They stated that the researcher asked the patients to hold the crystal for one hour, but they did not know what the real duration of decreasing blood pressure level without treatment was. The students also stated that in order to interpret effectiveness of crystal on blood pressure in such a research study, the duration of the treatment must be arranged properly. This was evident in the following quotation;

> S: I think a 15-people group is a good, logical idea. However, I cannot comment exactly as I do not know what to balance in one hour or how long we can balance our blood pressure. More information should have been given about timing.
> I: For example, if blood pressure already got balanced itself in one hour what would you say?
> S: If blood pressure already got balanced itself in one hour, there would be no need in onyx. You put your hand on your heart unnecessarily for one hour. However, onyx may balance blood pressure in a shorter time.
> I: So, what kind of research can we do in order to make the poor sides up?
> S: Whether this crystal affects the blood pressure in a shorter time or not should be searched. Alternatively, whether blood pressure increases or not when onyx is kept near heart for a few days or weeks may be learned. This would be more logical.
> I: Can we say that onyx can balance blood pressure or not after such kind of research?
> S: We can understand that onyx worked if it stayed near your heart and your blood pressure did not increase for a few days. By this way, we can say that onyx if effective on blood pressure. (2B)

As stated in his quotation, he wanted to test if the crystals decreased high blood pressure in shorter time than ideal time. On the other hand, his other suggestion was based on long term use of the crystals and his indicator showing effectiveness of crystals was having no high blood pressure during this time.

Interestingly, three students were more skeptical toward the research process presented in the scenario and critically evaluated the process although they indicated

that it was a suitable research process to test the idea claimed in the scenario. One of them questioned that why the doctors do not prescribe crystals to the patients as a treatment. Moreover, she stated that seeing that the crystals were very promising in treatment, the doctors should have used them to treat their patients. Nevertheless, due to her positive attribution to crystals she implied that if the doctors knew how effective the crystals were on health, they could use and suggest it to their patients. Her hesitation and confusion were evident in the following quotation;

> S: It seems like proper research. It may have had positive effects. However, I have some questions in my mind. We also have doctors devoting themselves to high blood pressure even if crystals are good for this disease. I would think why they have not made anything medical with these crystals.
> I: Why do you think they have not made anything medical with these crystals?
> S: Perhaps doctors may think that they are not useful. They may not believe that these crystals are effective. They may not have tried before, as this way has not come to their minds. In fact, if they believe that it is effective, they can do better research. (7G)

Although it was seen that she was criticizing the so-called effectiveness of crystals, she had indeed tendency for accepting that crystals was probably effective on health. Therefore, she would be referred as semi-skeptic.

Furthermore, other students (n=2) emphasized possibility of the psychological effect. They reported that although the crystals were not effective in real life, due to the psychology or the expectancies, the people who used crystals would have felt relief. Likewise, they noticed that the people had been told and had been primed to expect positive outcome before applying the crystal so that they psychologically would have felt treated. In addition, two of them suggested two different research designs to eliminate the rival explanation derived from psychological expectancy. The first design was based on the application without awareness of being treated. The assumption underlying the student's design was that if the people used crystals without awareness, they did not develop any expectancy for being relieved and consequently the asserted effectiveness of crystals would have been revealed directly. Nevertheless, this design was not based on the controlled testing procedure.

On the other hand, one girl suggested a research design including control group and experimental group. In her research design, half of the group was being told about the asserted effectiveness of crystals and the other half was being treated without being informed about crystals. In her research design, both groups had crystals healing. At the end, she suggested comparing two groups with each other. Although she noticed that she needed two equal groups, she was not aware of that she could not reveal if crystals were effective on health or not in such a research design. Her research design was as follows;

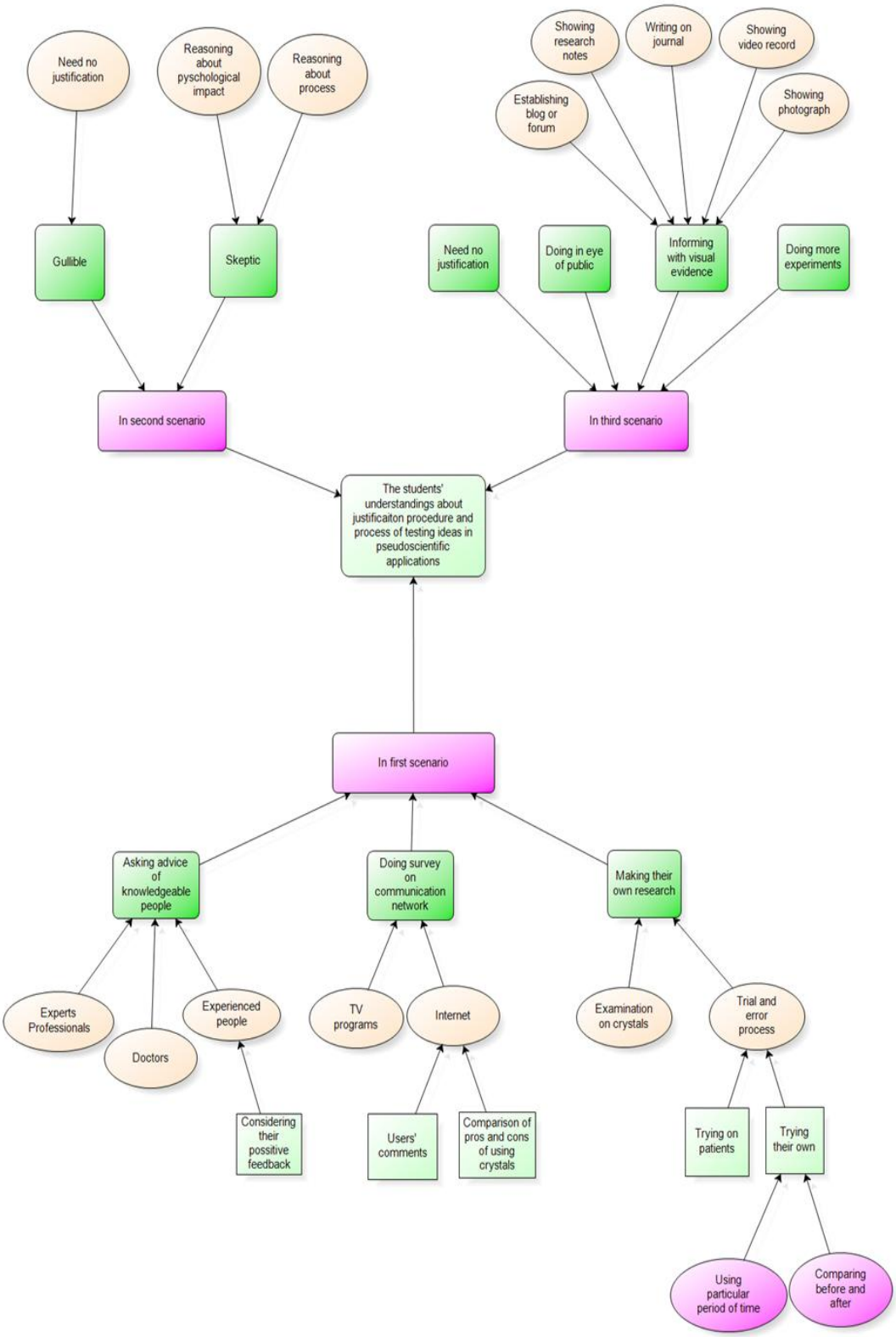
> S: But I think that this crystal may have effects on diseases but it may also be related to brainpower. You may believe in this. As long as you think that you believe in this, such kind of a thing may occur.
> I: Ok, how can we test it?
> S: For example, there are 15 people. The researcher would say to eight of these 15 people that I believe that this crystal would decrease your blood pressure. He would say that this is a treatment but he would not say anything about onyx to the rest of the group. He may distinguish in this way. One of the groups would use the crystal consciously; the other one would use it unconsciously.
> I: Would he give onyx to the second group?
> S: Yes, both groups would use the crystal. Such kind of a thing could be done. Then, he would really understand whether onyx were useful or not. (1A)

Consequently, the analysis of middle school students' interpretations about research process presented in the scenario revealed the fact that they did not realize the flawed research process used in the scenario and all of them referred ill-designed pseudoscientific research process as appropriate research design to test idea claimed in the scenario. It could be concluded that just as pseudoscientists did, including some clues might gave the appearance of being scientific namely; indicating being held by researcher, indicating the number of participants, informing about participants, and making measurement. All of them would have positive influence on the students' perceived value of the research design being presented in the scenario. So that just three of them were skeptical toward research process used in the scenario and questioned the effect of one of the rival explanation (psychological impact). According to the results in this section, it could be concluded that the students were not able to apply science process skills such as controlling variable and designing experiment in such a pseudoscientific context related to crystals and crystal healing.

Although they criticized some weaknesses of the research process, almost all of the students were gullible in realizing the flawed research process used in the scenario. They had some difficulties in realizing absence of control group, pre-measurement, and duration of real time of getting relief by hypertension.

RQ3. How do the students understand justification procedure and process of testing ideas in pseudoscientific applications related to crystals?

To answer RQ3, the researcher was interested in the students' own research processes. The researcher provided them pseudoscientific claims and then asked them to design a research (an experiment) to test the idea asserted in these pseudoscientific claims. In this process, the related data came from the students' views about first, second, and third scenarios. The related data were presented in Model 3.



Model 3. The students' understandings about justification procedure and process of testing ideas in pseudoscientific applications related to crystal healing

Firstly, the students were asked to suppose that they had a relative who had high blood pressure disorder and this relative wanted to test whether s/he could use the carnelian that was recommended to her/him in order to remedy her/his high blood pressure disorder. After that, students were asked to put forward a research design (an experiment) in order to test this claim. The result revealed that, contrary to expectation of the researcher, the students were not able to design a basic research process to test an idea. Similarly, as previously stated in RQ2, almost all of the students basically indicated superficial research processes which were not based on scientific principles. The basic procedures proposed by the students were that taking advice of knowledgeable people, doing survey on communication networks, and making their own research. Eleven students preferred to ask knowledgeable people' advices about crystals in order to test the idea presented in the first scenario. Five of them stated that they would prefer to ask experts or professionals who were supposed to know more about crystals in order to get direct information about if carnelian was effective on high blood pressure. Six of eleven preferred to ask doctors' advices when they needed to test an idea about crystal healing. Two related quotation exemplifying the students who preferred to ask both doctors' and experts' advices were given below;

> S: I would try to prove it myself first before advising it to my close relatives. For instance, there are TV programs that my mother watches everyday, she watches them whenever I go home in the afternoons. There is a master there like a doctor. He talks about herbs on TV and everybody calls him. I would find someone like him and ask my questions to him. I would ask different people and prepare a report. I would prepare a report by looking at different web sites on the internet.
> I: Then, what kind of research would you do in order to test it?
> S: While searching something, I usually do that. I would write the positive and negative sides of onyx. If negative sides of the crystal were very foolish, I would apply this. However, if positive sides of the crystal were not so important and the negative sides of it were really serious points, I would continue searching it.
> I: What do you mean with "continue searching"?
> S: We have a neighbor raising all kinds of herbs in her garden. And she usually knows everything about alternative medicine. I would ask her and various doctors on TV. I would search for people having knowledge about these crystals and call them. In other words, I would consult the experts. If these were serious, in other words, if people benefited from them, I would use them. (2B)

> S: I would consult to my relatives first. Then, I would probably consult to an expert.
> I: Who would this expert be? What kind of an expert would he be?
> S: I would get information from the doctors treating these kinds of diseases. In other words, I would do little research about it. As I have just mentioned, I would consult to experts whether there were really something like that. I would talk to people being interested in crystals. (14Z)

Nine of them stated that they would ask more knowledgeable and experienced people who tried out the crystal before in order to learn if the crystal was effective on high blood pressure disorder or not. They chose simple way of getting knowledge, which was asking experienced people about the crystals' effectiveness rather than constructing their own knowledge. The quotation showing the student's reliance on more experienced people was as follows;

> S: I would search people using them. In other words, I would search with whom these crystals are used. Later, I would visit them and ask whether it really worked or not. Because they have used and experienced the most efficacious. Then, if I think that it really worked after I got information from the users, I would try it saying that trying it may be useful.
> I: How would you decide to use them?
> S: Frankly speaking, if most of the users said that they have seen positive effects of them, I would also prefer using them. However, if most of the users say that it did not work, I would not use them.
> I: So, would you need to test it?
> S: I would just ask people. I would gather information by asking people. For example, I would ask him what his doctor has said to him about them. As doctors are also experts about blood pressure disease, I would consult to a doctor if they were really useful or not. However, I would consult to people experiencing it beforehand first. (7G)

As understood from her quotation, she preferred choosing simple way of getting knowledge from others than constructing their own knowledge. She had tendency for believing and doing what experienced people told. She thought that if most of the experienced people suggested using carnelian crystal in order to remedy high blood pressure disorder, she would prefer using this treatment for the same intent.

The other attempt proposed by the students was based on doing survey on communication networks such as TV programs and the Internet. Although most of the students referred the Internet as an unreliable knowledge source, interestingly, ten

students preferred making a search about the so-called effectiveness of the crystals on the Internet. Two students preferred doing a survey by reexamining available television programs promoting crystals. The quotation indicating the students' tendency for doing survey about crystals from the Internet or TV programs was as follows;

> S: I would do research on the internet. I would watch TV programs talking about them attentively. I would behave like that. I would do things like that. I would mostly do research.
> I: What do you mean by research?
> S: I would gather information about the positive and negative sides of them on TV or internet. In addition, I would comment on this information in my own way.
> I: How would you decide?
> S: If they said that there were generally positive effects of them, I would advise my grandmother to use them. If I advise, she will use them. She already watches these kinds of programs. (1A)

On the other hand, twelve students additionally considered designing their own research in addition to using second hand information. The basic procedure proposed by the students was based on trial and error process. In a similar vein, the basic research process for them was to see whether a treatment was effective or not by trying it out for a particular period. Nine of them just suggested their relatives to use a crystal to see if it was effective and they believed that if it was really effective, their relatives probably feel this relief. The students' reasoning patterns were below;

> S: As I know something about it, I advise it. When I advise it, I would say that I have used it, you can also use it. However, if I have not used it before, I would present a lot of information about it for instance. For example, there is a lot of information being told by experts, you can understand that it is very useful if you read or try to learn. There are many books explaining that they are useful. Trying it will not be harmful.
> I: But your grandfather really wants to test it.
> S: If he wants to test it, he must use it. There is no other alternative. I have used it and said that it is useful. However, he may not believe in me; for this reason, he will test it whether it works or not or whether it is good or not. I will neither eat nor swallow it. I will keep it here. In other words, when I put this crystal near me, it will not give any harm to me. Trying it will not be harmful. For this reason, I would advise my grandfather to use it. He would buy and use it; then, he would see the effects of it. If it were effective, he would definitely feel it. In other words, his blood pressure would decrease. If his blood pressure decreased, he would understand that it worked. (9M)

As understood from her quotation, she was inherently disposed to believe so-called effectiveness of the crystal healing. Thus, she thought that this effect of crystal would be released directly by just using it. Other related quotation was given below;

> S: I would advise him to lie down, and then I would say him to put the crystals onto one part of his body. I would want him to stay put for a while. After all, if it were effective, we can say that it worked.
> I: How would you understand that whether it worked or not?
> S: After all, if it worked, he would feel that. It would probably affect positively if it were considered as effective. In addition, his blood pressure would decrease I suppose. Moreover, if his blood pressure did not decrease, the crystals were a lie. We would quit using them. (14Z)

In her quotation, she believed that if it was claimed to be effective, the crystal would be effective on high blood pressure disorder. Additionally, it was obvious that her research design was based on personal or subjective decision based on trial and error process.

Similarly, seven of them pointed out importance of period of time in their superficial research design. They suggested their relatives to use a crystal for a particular period of time. They believed that because of the nature of the crystal, it would take more time to have an impact on patients so that the crystals must be used for a long time to get their benefit. Related quotation was as follows;

> S: I have just one thing to say my grandmother. Try that, if it works, continue using it. I think she should constantly use it for one year. I do not think it will be useful in a few months. They are eventually crystals. However, I would advise her to talk to people saying that they are effective on their diseases.
> I: I could not understand what you mean by saying experience.
> S: She would take onyx and use it in the way they say, they would explain her how to use it. She would try, if she felt herself good in a long time and her blood pressure did not increase, her blood pressure might sometimes increase because this is eventually a crystal. I would advise her to continue using it if it worked. (12Y)

Her quotation reflected both her distrust on crystals and her disposition to this type of treatments. She did not think that crystal would be effective in a short period of time, at the same time she also had an expectation about its effectiveness as long as it was used for longer period of time. Moreover, her reasoning pattern leaded to conclusion

that, the decrease in frequency of having high blood pressure was an indicator showing effectiveness of crystal after using for a long period of time.

Moreover, just three of them detailed their research processes and they were aware of at least necessity of measuring blood pressure before and after the treatment based on crystal healing. They also realized that in order to see if the crystal was effective on high blood pressure disorder, they needed to compare the result at the beginning and at the end of the treatment. Furthermore, three students preferred doing investigation on crystals and finding out the inner material of the crystal that would have effect on the diseases. The student's quotation presenting comparison of result at the beginning and at end of the treatment was evident as follows;

> S: Whether it works or not can only be tested by using it. We cannot test it in a different way. He will take and use it. He will decide whether it works or not.
> I: How should he use it?
> S: First, he will decide how to use it. He will learn the ways of using it. Then, he will begin using it.
> I: How will he test whether the crystal is useful or not?
> S: After he uses the crystal, he will measure his blood pressure with sphygmomanometer. Actually, we would measure our blood pressure before and after we used the crystal. We would compare these two measures. Then we would decide whether the crystal were effective or not. (6F)

Additionally, three students thought that if they wanted to see if the carnelian was effective on high blood pressure, they must design a study with hypertension patients. Moreover, they stated that in order to accept that this crystal was effective on high blood pressure; the patients with high blood pressure disorder must report their reliefs as a result of treatment. This was evident in below quotation;

> S: First of all, I would try to obtain information from different points. I think this cannot be gained by obtaining information from just one point. I would try to obtain information from people neighborhood that have already used this crystal and benefited from it. I would talk to a lot of people who have used it. I would begin using the crystal if those people have already benefited from it.
> I: What would you do as research to test this idea?
> S: Well, everybody should try it. I do not know any other kind of research. For example, I would test it on people with high blood pressure. Because if that these crystals are good for people with high blood pressure is mentioned, they must try them. Otherwise, we

> cannot understand whether they are effective or not. I would tell people to use these crystals themselves. They would buy and use them. They would see whether their disease is getting better or worse.
> I: Can you please give more details?
> S: I would invite people with high blood pressure. I would ask them to take a crystal and use it. They would use them. I would say that this information were reliable if I had a positive result from the experiment or if a lot of people trying them said that they have had positive effect from the crystals. Of course, we cannot say that these crystals are 100 % reliable because we do not have any evidence but this experiment would give us remarkable opinion.
> I: Why can't we say that these crystals are 100 % reliable?
> S: We must have all people with high blood pressure try these crystals in order to learn whether these crystals are 100 % reliable or not. If these crystals were effective on all these people, then, we could say that these crystals were effective. (11T)

Secondly, the students were asked to suppose that you had experienced the increase of your level of concentration due to the use of red coral for a couple of days. After that students were asked to what kind of knowledge they would derive from this experience. The researcher aimed to see whether students derived knowledge stating crystal quartz increased concentration from only personal experience. By this way, the researcher questioned the students' justification processes. That is to say, it was questioned whether it was enough to experience something in order to construct knowledge for students or they needed to justify their experience or they were searching for more evidence and information to justify their knowledge claim. The result revealed that more than half of the students were very gullible in knowledge construction process and they used biased and flawed knowledge construction process that was resembled to that of pseudoscientists do instead of asking for justification. Nine of them stated that they could directly construct knowledge stating that "the red coral increases concentration" just from their own personal experience. Additionally, they had tendency to believe what they experienced. They stated that if they saw something was effective by their own eyes, it was necessary to believe its effectiveness. They did not need to justify their observation or thoughts. Without considering data or evidence about so-called effectiveness of the crystals, they had tendency to rely on personal experience or anecdotal data. The students stated having their own positive experience with red coral crystal as an indicator of effectiveness of crystal. This was evident in following quotation;

> S: If it really affected my concentration or me, I would begin thinking that it really has positive effect, I would continue using it saying that it really worked.
> I: What is the reason of your opinion that makes you think that this crystal has affected your concentration?
> S: I am the person who uses it. And I would see the effect of it on myself. This is not the same as reading it from a book or somewhere else.
> I: So, how would you test whether that this crystal worked on your concentration or not?
> S: I would use the crystal while studying. If I realized that it has had increased my concentration before, it would increase my concentration again. (7G)

> S: I would say that if onyx were effective, it would increase concentration.
> I: How have you come to this idea?
> S: It has worked even I have tried it one or twice.
> I: Well, but there may be some people who disagree with you.
> S: I think I would prove it on another person.
> I: What would you do if it did not work?
> S: Then, I would not try to make people believe in it. If it worked, that would be enough for me, I would use it. (14Z)

These two quotations exemplified the general misconception of "seeing is believing". As long as the students had experienced something by their own, they had tendency for believing in that what they feel or see was true.

On the other hand, five students were more skeptical than others were in respect to justification. At least four of them questioned the possible impact of psychology and one of them reasoned about insufficiency of process. Four students reasoned that tentative result that was supposed to be caused by crystal would be resulted from the possible impact of psychology. Representative quotations were given below;

> S: If we have bought that crystal thinking that it would be useful, in other words, if we believe that these kinds of things already work, we can say that this has happened psychologically. (11T)

> S: Nothing is certain. Perhaps I have made myself to believe in it psychologically. In fact, the crystal is not effective. It affects you in a positive way just as you believe in it psychologically. (2B)

One student stated that having experience about crystal was not sufficient in order to believe crystal's effectiveness and more research was necessary. Exemplifying quotation was as follows;

> S: The coral crystal increases concentration. Generally, it is possible. It may be good for high concentration. However, just the opposite is also possible. I cannot say that it is good for concentration because I have tried once or twice. I would behave a bit gingerly; I would not believe it right away. Trying it once or twice is insufficient. I would believe in the things being proved scientifically more. They are not experimental but more scientific because they have been proved before. I think science is something about searching something deeply. I would search more before believing in it. (13Z)

Thirdly, the students were questioned about justification in the context of third scenario. The students were challenged by asking to suppose that they implemented the same process presented in third scenario, but they did not observe any change. They were asked that how their attempt would be to justify their processes. The results revealed that the students confused justification process with convincing people to their ideas. Instead of justifying their processes by collecting new data or reorganize their research process, they preferred convincing people about knowledge claim. For instance, six students stated that they would prefer to make people informed through some knowledge source. According to four of them taking notes during their processes and showing these notes to other people was a good idea to justify their process. Additionally, other students would prefer to make people informed through their forum or blog on the Internet, journal in newspaper, photographs or video record taken during the process. Three students suggested to make explanation about their processes in the eye of the public to show that their process was true. Representative quotations were below;

> S: I would explain people why my herb has not grown when I experienced it. I would show my experiment. I would probably record it with my video camera if I succeed. I would explain what I have observed and why my herb has not grown. (3C)

> S: The thing I would do is to talk to a few people and get information from them about how to do that. In other words, I would show them the figures I have done. I would take notes while doing them. I would record the evolution by taking the photographs after two, three etc. weeks. If there were no development in the photographs, if they grew

> up like a normal flower, I would say that there were no development. However, if the things went on as Zeynep has mentioned, I would also continue supporting it. (12Y)

Only five students stated that they would prefer to do more experiment to justify their process and their observations. Although they realized the importance of repeating the testing process over and over, they were not able to realize the flawed testing process presented in the scenario and to make revision of the process in accordance with controlled experiments. Related quotation was as follows;

> S: I would try it for the third time if I could not achieve that for the first two trials. In other words, I would try more and I would take notes about them. I would explain that I have seen this on the internet, applied and has not worked. I would also present my explanation on a web site. Yes, I would do like that. I would inform people via internet.
> I: What kind of research would you do?
> S: Like in this scenario
> I: Do you need to revise something?
> S: No. If I change something, we could not compare. (1A)

On the other hand, seven students stated that they did not need any justification as long as they implemented the process by themselves. They indicated that they would prefer believing what they experienced and saw. Related quotation was presented below;

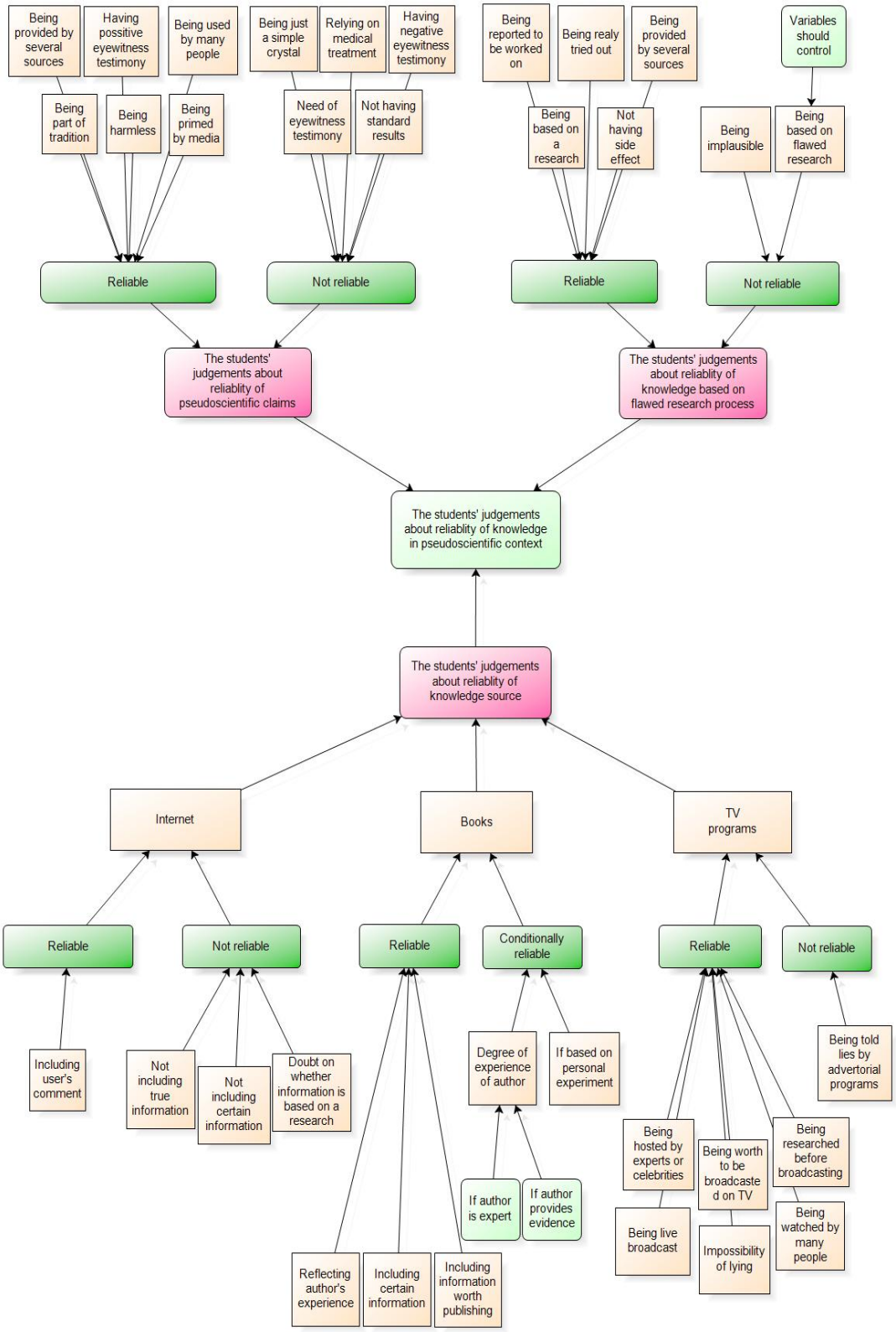
> S: I trust things I do myself. Eventually, I have not witnessed it, I have just read it. However, if I did it myself, I would trust mine. If I have witnessed it, maybe I could not say anything but I have just read that. Thus, mine would be the right one. (4C)

Briefly, in this part the findings related to the students' views about justification and testing process in the context of first, second, and third scenarios were presented. According to the results, it could be concluded that most of the students preferred justifying their knowledge claims either by constructing their own experiences about it or by asking for second hand sources such as experts, knowledgeable or experienced people, and television programs or the Internet. When they encountered new idea or observed a new thing about crystal healing, most of them did not need any justification before believing in it. They generally considered their personal experiences and ideas instead of asking for evidence. Additionally, they generally confused justification process with convincing people to their ideas. Instead of justifying their observation or claims by collecting new data or reorganize their

research processes, they preferred to show visual evidence such as photographs, video records, notes about their processes in order to make people believe that their processes were true and convincing.

RQ4. How do the students judge the reliability of knowledge in pseudoscientific context related to crystals?

The main concern of this research question was to explore the students' tendency toward reliability of knowledge based on pseudoscientific applications and to explore their views about reliability of knowledge derived from pseudoscientific application related to crystals and crystal healing that they were encountered in the interview. The students' judgments about reliability of knowledge in pseudoscientific context were presented in Model 4.



Model 4. The students' judgments about reliability of knowledge in pseudoscientific context related to crystal healing

The related data came from the students' views about several situations. Firstly, their judgements about reliability of pseudoscientific claims were questioned. In this process, the students were provided several pseudoscientific claims related to crystal healing. Secondly, the students were provided an ill-designed pseudoscientific research process (third scenario: growing a plant) that was related to a girl trying to grow a plant by using crystal quartz. This scenario exemplified the remarkable unfair testing procedure used by pseudoscientists and intended to find out the students' direct inferences about the application and their views about reliability of the knowledge being implied in the scenario. Lastly, the students were questioned about reliability of knowledge source. They were asked to judge the reliability of knowledge source which they would use in their daily life in order to get information about pseudoscientific applications, especially related to crystals and crystal healing. By this way, the students' judgements about reliability of pseudoscientific claims, reliability of knowledge based on a flawed research process, and reliability of knowledge sources were analyzed.

When the students' judgements about reliability of pseudoscientific claims were analyzed, it was revealed that for half of the students these pseudoscientific claims seemed to be reliable while other half of the students thought that pseudoscientific claims related to crystal healing seemed to be unreliable.

The students who referred pseudoscientific claims as reliable provided several reasons to explain their views. Most stated reason was being bombarded by information about crystals by several sources. Five students indicated that hearing the same information about the crystals from different sources was one of the most important factors that made them see these claims reliable. According to them, when the information about crystals or crystal healing came from different sources such as media, relatives, friends, and written sources, it increased the reliability of these claims. Representative example indicating the importance of hearing from different sources was given below;

> S: This information seems persuasive and reliable to many people. I think if it is available everywhere, it becomes more persuasive and

> reliable. I would trust more if I saw and heard about it everywhere. (4C)

According to her, as stated in her quotation, bombarding information about crystals from different sources would increase the reliability of claims related to crystal healing. The other reason was to have positive eyewitness testimony. Due to their eyewitness testimony about crystal healing that they stated it was resulted in a positive way, four students thought that these claims about crystal healing seemed to be very reliable. Related quotation was provided below;

> S: I do not like making comment about anything before trying them. However, I think these can happen. As a result, my grandmother has told something about herbs before. She has used them and I have witnessed that these herbs have worked. For this reason, I believe that crystals may also have the same effect. This is really reliable information for me. (2B)

Additionally, being used by several people, being part of tradition, not having side effect, and media priming were among the reasons which stated by the students as factors increasing reliability of claims about crystal healing.

The other part of the students thought that these claims were not reliable. For instance, six of them provided reason stating that how a small piece of crystal could do lots of things asserted in these claims. Their main concern was related to crystals and because of the nature of the material itself, they did not consider these claims as reliable. Two related quotations were as follows;

> S: I think these are not very reliable explanations.
> I: Why do you think that they are not reliable?
> S: To tell the truth, this kind of information does not sound logical for me.
> I: Why do you think that this kind of information does not sound logical?
> S: It is just a crystal. How can a crystal show this much effect? It is nonsense. How can a standard crystal cure diseases? How can a crystal cure a disease inside me? (8K)

> S: I do not think this information is very reliable. Furthermore, I do not think they are effective. I do not think a crystal can do this. If doctors cannot do anything, a crystal cannot do anything, neither. I think like that. This is a simple crystal. I think it is not logical. How can it make me to think positively? It is just a crystal. (14Z)

As stated in quotations, according to these students, asserted claims about crystals were not reasonable. They did not believe that such a simple crystal would perform assigned attributes.

According to five students, people should rely on medical treatments or prescribed drugs instead of nonmedical treatments such as crystal healing. Additionally, one student stated that it was hard to believe its effectiveness until having positive experience about crystals by himself. Accordingly, he indicated that in order to decide about reliability of such claims, he needed to see its effectiveness by his own eyes. Another student indicated that the crystals did not have the same effect on the people who supposed to be cured, so that there was no standard information about their effectiveness. Lastly, other reason for seeing these claims unreliable was related to one student's eyewitness testimony of an ineffective application. Related quotation was as follows;

> S: Actually, I do not prefer. I do not trust so much. I have heard that it is good for insomnia. I know that onyx is only good for insomnia. The others do not seem reliable. However, they may also be reliable.
> I: Why don't you trust?
> S: In fact, my grandmother has used onyx. She has high blood pressure. She usually has aches. It does not work for my grandmother. Nothing positive has happened although my grandmother has used it. In fact, as it has not worked for my grandmother, I do not believe in these kinds of things. However, my mother still believes in them. (1A)

Secondly, when the students' judgements about reliability of knowledge based on flawed research process stated in the third scenario were analyzed, ten students indicated that the knowledge implied in the scenario seemed to be reliable. The most stated code was being effective as stated it reportedly works in the scenario. Six of them thought that the crystal quartz was reported to be worked on plant in the scenario so that it was a reason for believing in that it is reliable. This was evident in the following quotation;

> S: As said in the last sentence, the idea "He has observed that geranium has been expected to front to the sun but it has fronted to quartz crystal and begun growing up", has been reliable for me. I think these kinds of things may happen.
> I: Why do you think like that?

> S: They seem reliable for me. Because he has practiced this and it has worked. I think it is reliable for this reason. It is written like that here. He has seen that the effect of sunlight has been little but when he has put quartz crystal near it, the growth of geranium fronted to it and it has begun growing up more. These things have affected me. I think that geranium has taken energy from the quartz crystal as it has fronted to it. (9M)

She believed that as reportedly stated in the scenario, the plant absorbed energy emitted from crystal so that it turned towards crystal quartz instead of sun light. Due to the fact that the girl in the scenario reported she tried out crystal and then observed crystal worked on the plant, the student believed that the process stated in the scenario was very reliable.

The other reason stated by the students was being tried out by the girl to see if it could be effective. Being reported to be tried out to see if it could be effective gave the students impression that it was not a rumor about crystals and that someone tried it out and reported its effectiveness. Because of that, three students had tendency to think that what was told in the scenario was reliable. Related quotation was provided below;

> S: Now it has been tried. It is not just a rumor or claim. It has been tried the most efficaciously. He has tried it as he has seen on the TV program and the crystal has affected the growth of the flower. It has been so effective that he has told it.
> I: Why do you think like that?
> S: For example, Zeynep being mentioned here has tried that and she has achieved. She has observed that. She has taken notes and told them to us. This has affected me. In other words, this is not a rumor yet. She has tried and experienced that; it has really happened.
> I: Some people say that Zeynep's implementation and knowledge she has gained are not reliable. What is your opinion about that?
> S: She has mentioned here that she has tried that and the flower has really grown up. In other words, this information is certain, reliable. For instance, if I see that it works on TV, I think that these things already happen and work. It is certain information. It has really happened. (6F)

In fact, the above quotation provided evidence about how the student judged the reliability of knowledge according to details provided in the scenario. According to him, the knowledge implied in the scenario was certain and reliable, because the girl in the scenario tried it out to see if it was real. Thus, this pattern would change the

status of the knowledge about crystal from a rumor to a fact for the student. Additionally, this quotation provided evidence about the student's epistemological belief. According to the student, the knowledge comes from an authority or knowledgeable or experienced people. Because of this fact, as the girl presented in the scenario stated crystals' effectiveness, all the things presented in the scenario was certain and reliable according to the student.

In addition to this, two students reported that since they heard something similar about effectiveness of crystal quartz from relatives and media, or reading about its effectiveness in another source earlier made them believe that what was told in the scenario was reliable. Related quotation was as follows;

> S: I know that it has worked for my grandmother. Even I remember that I have heard from a TV program that the information natural crystals' such as crystal being useful has been mentioned. Now I have read a similar story here. I have heard a lot of things about it and I think it is reliable. I believe these crystals are reliable because of this. (12Y)

This quotation exemplified how combination of different knowledge sources strengthened the reliability of crystal healing. Hearing something positive about the crystal healing from different sources would provide enough information to make positive attribution to its reliability.

A student stated that the knowledge indicating that crystal quartz had an effect on growing up a plant was reliable, because the process implemented in the scenario had no side effect or harmful on plant. Another student stated that he believed in that the process being told in the scenario was reliable since the process implemented by the girl seemed to be a kind of scientific research. His related quotation was provided as follows;

> S: I think these kinds of things are possible. Because as it has been tested and such kind of information has been gained, this is something experimental and correct. This information is accurate.
> I: Why do you think like that?
> S: Here he has taken notes about before and after processes of the experiment; in other words, he has done the research. He has done an experiment just like in scientific research. Furthermore, after the experiment, he has observed whether there has been a difference; so,

> it seems reliable for me because of these steps. He has tested the most efficaciously. He makes the information clear by testing it. He can no longer say that whether it works or not. Because he has done scientific research. (5D)

On the other hand, just four students were skeptic about knowledge based on flawed research process stated in the third scenario. They stated that both the scenario and the knowledge implied in the scenario did not seem reliable to them. One of them stated that the girl being told in the scenario did something wrong and she should control the variables by using two separate flower pot, and then the student stated his own research process in order to see if the crystal was effective on growing up a flower. Exemplifying quotation was presented as follows;

> S: I would use two different herbs in order for one of them to test with quartz crystal and the other one without quartz crystal. In addition, I would organize them directly at first before the herb grows up. Perhaps it grows up more after sometime; because of this, two flowerpots one of which is with quartz crystal and the other one without quartz crystal should be arranged beforehand. In other words, the conditions of both flowerpots should be the same. We could understand the difference with the speed of their growth if one of them grew up faster and the other grew up slower. If the one with quartz crystal grew faster, we could say that this happened because of the effect of the quartz crystal.
> I: There are also some people who believe that the information Zeynep has gained from that experiment is both reliable and unreliable. What do you think about it?
> S: It may really be unreliable. As I have said, the herb may have begun growing up before that time. It may have grown up faster at that time. Thus, it is not reliable. She has not done something right exactly. There is just one herb and two different forms of it, one of it is in its small form and the other one is from further process. Here, she uses the quartz crystal in further processes. In other words, the herb may have begun growing up before that time. However, in my experiment, I would put quartz crystal to one of them and nothing to the other when they were both small. I would prepare the conditions before the herbs grew up. (8K)

Apparently, in his quotation, he emphasized his doubt on the process presented in the third scenario. He explained his reasoning and proposed his own research process. In his own research process, he proposed using two flowerpots in order to control independent variables related to flower.

Additionally, three students thought that the research process in the scenario was not plausible. Two of them critically questioned why flower turned towards crystal quartz instead of sun light. As a matter of fact, they thought that the research process being told in the third scenario was not realistic. Related two quotations were provided as follows;

> S: I could understand its growth but not the reason why it has fronted to it. Unfortunately, it does not sound logical to me. I think fronting to it is illogical, why does a herb front to a crystal?
> I: Why do you think like that?
> S: The herb has already grown up and this is something positive. In other words, the crystal has made the herb grow up. This is something positive. It does not sound logical but…my mind has confused. If I think just its growth, it sounds reliable, I would trust, but it does not front to the sun, this has affected to me. It should have fronted to the sun.
> I: You would expect it to front to the sun, then.
> S: I would expect it to front to the sun. If it also fronted to the sun, it would sound logical. However, it is illogical as is. (4C)
>
> S: It is about quartz crystal's spreading energy to environment. The herb may also front to the quartz crystal. Otherwise, I do not think that a herb fronts to an energy source except the sun.
> I: What do you mean with that?
> S: It does not still sound realistic to me, it is nonsense.
> I: Why does it sound unrealistic to you?
> S: It does not still sound realistic to me because it has fronted to the quartz crystal, not to the sun. I have been affected from its fronting to quartz crystal, growing up with its energy, not fronting to the sun although the sun is a huge energy source. They are nonsense. Although the crystal has energy in itself, the sun is a bigger energy source than the crystal. It should have fronted to the sun. It is not something so guaranteed. (11T)

The above quotations exemplified the students' confusion about crystals. Specifically, they were still in favor on the effectiveness of the crystals and in favor of that the crystal would have inner energy, although they criticized why flower did not turn toward the sun as a bigger energy source.

Additionally, the researcher challenged the students' views on the reliability of knowledge derived from pseudoscientific application presented in the third scenario. The researcher examined how their views about the reliability of knowledge changed when they were encountered with a different situation, which contradicted with the

situation stated in the scenario. The students were asked to suppose that they implemented the same process presented in the scenario, but they did not observe any change. Then they were asked what they would think if they encounter with a contradictory situation. The first reaction of the students was suspecting their processes or the crystal being used. Half of them relied on the process stated in the scenario and questioned their own process. They thought that if they did not observe any positive change, unlikely to the situation stated in the scenario, they might have done something wrong. Similarly, six students suspected the crystal and then argued that the crystal must be wrong or defective. Then they suggested changing the crystal and retrying. Because of reliance on process explained in the scenario, none of these students suspected the research process presented in the scenario. They indicated their expectation to get the same result being stated in the scenario. The following quotation exemplified the student's reliance on the process being told in the third scenario;

> S: I would think whether mine is wrong or I would compare Zeynep's and mine first. I would try to find a deficiency in mine as there was no difference in mine. I would examine if I did it in a right way or not.
> I: But you have completely done everything that Zeynep has done. Nevertheless, you have had this result.
> S: There would be difference in mine just like in Zeynep's experiment.
> I: Suppose that there is no difference in yours.
> S: Then, I have no idea. I must have something inadequate.
> I: You say that there is definitely something insufficient. Isn't there a possibility of her doing something wrong?
> S: She has already done that and seen the result of it. Therefore, I would think that I have done something wrong first. I would also look at Zeynep's herb. However, there cannot be a fault in Zeynep's experiment. Because she has put the herb under the sun and put a quartz crystal 15-20 cm near it. If I could not get the same result, I would try to do the same. Perhaps, she has used a different crystal but written a different name here. (5D)

For instance, in above quotation the student thought that the process explained in the scenario must be true. He specifically focused on details about the process in the scenario (e.g., stating 15-20 cm far from the flower) that would increase the reliance on the process. Therefore, the student thought that there must be something wrong in his own process. Although he was challenged by stating the process presented in

scenario might be wrong, he was still in favor of the pseudoscientific process. He stated that if he was sure that he applied the same process stated in the scenario, he thought that the different crystal must be used. Similar quotation was provided as follows;

> S: If it has worked in the first trial, it should also work in my trial. Perhaps, I would do something wrong. I would correct my fault. I would try and try again. I want that crystal work for that herb and try to make it work. I want to see that the crystal really works. If it did not work, I would really want to learn why it did not work. I would think if there were something wrong with the crystal or if I did something wrong. Considering that she has achieved that and written like that, there must be something wrong in the crystal or the things I have done. (3C)

As implied in above quotation, due to his positive outcome expectation, the student had tendency to reach the same result presented in the scenario. When the student was encountered with a contradictory situation, his reliance was not affected at all from this contradictory situation. On the contrary, he questioned his own process or the crystal being used in the process.

Besides suspicion, five students stated their disappointment and losing their reliance in such an application. They stated that if they encountered with such a contradictory situation, they thought that the main aim of this application was to trick people. Two related quotations were given below;

> S: I would try that not just on that herb but also on other herbs. If it did not work, I am not sure but I would begin to think that it might have been done in order to deceive people. People tell these kinds of stories in order to deceive people. (11T)

> S: I would think that it is a lie and I would try to explain. I would also do the same things I have seen on social media or on the internet. I would do explanations. I would think that it did not work and try to defend it. Because they make a lot of people believe in it. They deceive many people via these kinds of social media tools. There may also be trickery here. (13Z)

Moreover, the students also mentioned about some knowledge sources such as the Internet, books, and television and their reliability for the students while they stated their opinions about reliability of the knowledge based on pseudoscientific

applications. When the students' judgements about reliability of knowledge sources were analyzed, it was revealed that the less reliable knowledge source among these sources was the Internet. For instance, according to six students TV programs were considered as a reliable knowledge source in order to get information about crystals and crystal healing and five students referred books as a reliable knowledge source while two students referred the Internet as reliable knowledge source. Regarding the reliability of the Internet as a knowledge source, two students stated that since the Internet had comments of people who tried out the crystals as a treatment, the Internet was very useful and very reliable knowledge source in order to search for the effectiveness of crystals. For instance, the following quotation exemplified the students' reliance on the Internet as a knowledge source and user comments on the Internet;

> S: There is certainly something they know as a lot of people use them and advise other people to use them; there are some expressions on the internet such as "I have used them and these things have happened" etc. In other words, there is certainly something they know. Therefore, they are right to believe in them. I think I would search who has used them and whether there are effects on them or not; then, I would use them. In other words, if it worked, I would use them; but if it did not work, I would not use them.
> I: What kind of research would you do then?
> S: I would search it on the internet. They would certainly write their comments on the internet if they worked. I would search and read the given information on the internet. Overall, why would people write these comments if it did not work. If they mention that it has worked, that will be true.
> I: You have said that you would search it on the internet. So how much do you think the information on the internet is reliable?
> S: This kind of information is quite reliable because people share their own experiences and write their comments about these experiences. They share their own experiences, not hearsay information. (6F)

As it was concluded from the quotation, he equated searching on the Internet to conducting a research. The assumption underlying his views was that the comments published on the Internet were based on real experiences of people and thus reliable.

Conversely, seven students approached the Internet as a knowledge source with caution and they indicated that the Internet was not a reliable knowledge source for searching crystal healing. Three students thought that the Internet did not generally include certain knowledge. Further, one student stated that we would not be sure

whether the knowledge on the Internet derived from a result of a research process or not. Likewise, four of them thought that the Internet did not generally provide the truth, so that the Internet seemed to be unreliable to them. Representative quotation was provided below;

> S: It should be precise and accurate information so that we should trust it. In other words, we must be certain of the reliability of this information. However, finding such information on the internet is quite hard. Everybody can write whatever he or she thinks. Because of this, I do not prefer searching it on the internet. (12Y)

Regarding the reliability of the books as knowledge source, five students referred books as reliable knowledge source. Two of them stated that a book would reflect its author's experiences, since the author must have tried the treatment and shared his/her real experience. His quotation was as follows;

> S: I do not believe in everything I read on the internet. Some of them are true but some of them are false. I think this is the same as TV. Moreover, this is same as sales program and TV programs. They are full of inaccurate information. Reading a book about that is better.
> I: So how do you know that information in book is true?
> S: I read the explanation, foresight, experience of the writer while reading their book; that means he has tested it. He has also told how he has done it. He has told that I have tested it on myself and other people. On the other hand, he may have observed the experiments of scientists. He may probably be talking about these experiments. (3C)

Although he did not rely on the Internet or TV programs as knowledge source, the books seemed to be very reliable to him. Since the books were one of the important knowledge sources in school years, he would assume that the knowledge presented in books were generally based on scientific experiments and probably included results based on these experiments.

Additionally, two students thought that books or encyclopedias included certain knowledge, so that these knowledge sources were more reliable than the others in order to search for information about crystals. This was evident in the following quotation;

> S: I think research should not be done on the internet. I only do research from books and encyclopedias. However, it should be a long research process. We should gain certain knowledge with the

> research. I do not search on the internet because of this reason. Nevertheless, the information in books is certain. Otherwise, the research will not be valuable.
> I: What do you understand from the expression "research"?
> S: I think it is something about finding information in books. I do like that. (14Z)

Other two students supposed that if someone published a book, s/he must be expert, and if the book was worth publishing, the knowledge in it must be based on appropriate research process. Related quotation was given below;

> S: I do not consider the information on the internet as guaranteed. I do not believe in them as long as I witness them. If he were a good researcher; in other words, if he were an expert, my thoughts would change in a positive way. He has eventually searched it with correct methods. He has much more information if he has the ability to write a book. He has done such good research that the publisher has published his book.
> I: Why do you think that getting information from a book is reliable but getting information from the internet is not?
> S: We do not know whether it is true or not on the internet. We do not know whether he has searched it or not. I think we would believe in this information as we know that he has done a lot of research, he is a wise man and he has written a book on this topic. In addition, we believe in an expert when we see him on TV because he has definitely done research about it. Otherwise, the owners of TV channels will not let him appear on TV programs. (11T)

In above quotation, it was apparent that he categorized the knowledge sources according to his assumptions about them. For instance, according to him the books included researched knowledge published by experts and the TV programs provided knowledge based on proper investigation conducted by experts, thus these sources were referred as reliable to get information about crystals. On the other hand, the internet was referred as an unreliable knowledge source by the student.

Furthermore, four students indicated that the reliability of a book was based on some conditions that were the degree of experience of author and if it was a result of personal trial experiment. In order to make his/her knowledge source reliable, according to two students the author needed to provide evidence in the book, according to one student the author needed to be expert on crystal healing or another

treatment, and according to one student the knowledge published in the book must be based on personal try-out process about crystals.

Another knowledge source stated by the students was the television. Regarding the reliability of the TV as knowledge source, for six of the students, the television was a reliable knowledge source in order to evaluate the truthiness of the knowledge related to crystals and crystal healing. The reasons why they saw television as a reliable knowledge source were diverse. For instance, the reasons were that TV programs related to nonmedical treatments were being watched by many people, being live broadcast, being hosted by experts or celebrities, being appropriately researched before broadcasting and being worth to be broadcasted on television. Other reason stated by three students in order to indicate why they referred television as reliable knowledge source was based on the argument that if someone appeared on TV program, it was impossible to lie in the presence of many people. Two representative quotations were given below;

> S: Someone would be more reliable when s/he can appear and talk on a TV program. Internet does not seem so reliable. Because there may be a lot of fake information on the internet. I do not trust internet but TV is better. I feel someone is so reliable that s/he can appear and talk on TV. S/he is already reliable as s/he appears and talks on TV programs. TV programs would not invite her/him if s/he were not reliable. (4C)

> S: There is hearsay that not every information on TV is true so I do think that internet is not reliable. The information may be true but I do not trust internet immediately. Well, I would do research in any case. However, when the man on TV presents it, 70 million people watch him. I do not think that he may tell lies because of this. He cannot tell lies in front of all those people. I think this is quite reliable because of this. (9M)

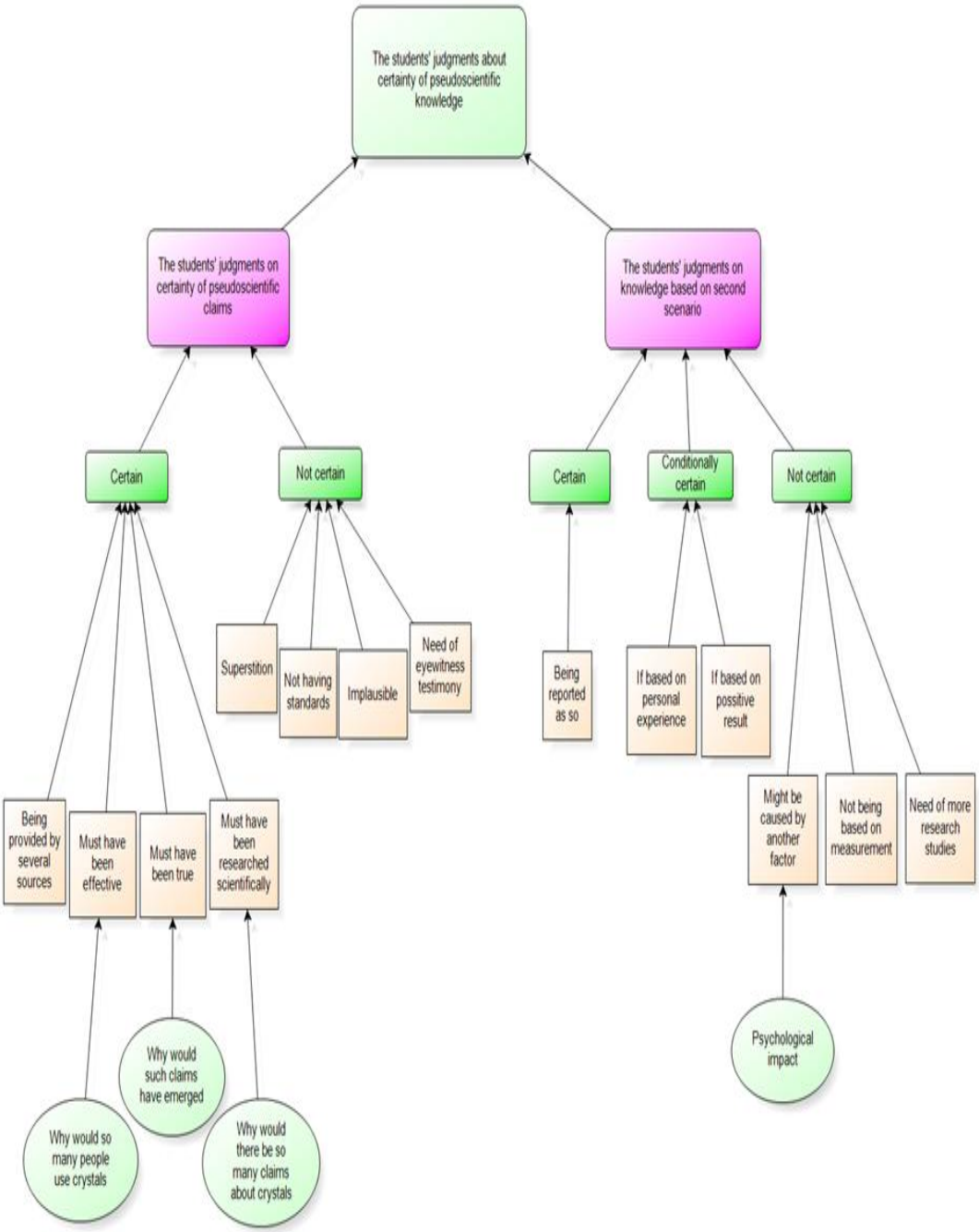
According to above quotations, the TV programs interested in particular treatments based on crystals were referred as reliable knowledge sources by the students. The assumption underlying this view was that the person invited to television program could not lie to such a large audience.

As a summary, in this part the findings related to the students' judgements about reliability of pseudoscientific claims, reliability of knowledge based flawed research process, and reliability of knowledge sources were presented. According to the results, it could be concluded that their judgements about reliability of knowledge based on crystals and crystal healing were diverse and generally based on the context. For instance, when the students were directly provided with pseudoscientific claims about crystals, more students referred these claims unreliable. However, when they were provided a scenario including pseudoscientific claims within a particular context, more students referred the knowledge implied in the scenario as reliable. In terms of the reliability of knowledge source, more students preferred television programs related to crystals and crystals healing as reliable knowledge source in order to get information about crystals and crystals healing. On the other hand, the Internet was considered unreliable knowledge source in order to get such information. Based on these results, when the students judged the reliability of knowledge based on or derived from pseudoscientific application related to crystal healing, they generally considered credibility of knowledge. The students weighted the credibility of knowledge by examining where knowledge came from, if so many sources were supporting same knowledge, if so many people believed in, if this knowledge worked as it was claimed, and if it was really tried out by someone. They did not doubt on the method by which knowledge was obtained or constructed. Furthermore, they did not question if there were empirical evidence supporting or not supporting the claim or if there was any rival hypothesis or alternative explanation about the claim.

RQ5. How do the students judge certainty of pseudoscientific knowledge related to crystal healing?

Besides the reliability of knowledge in pseudoscientific context, the students were also examined for their judgements on certainty of pseudoscientific knowledge. In science, reliability and certainty have atypical relationship with each other, while in daily life, for general population the reliability is prior condition for certainty. However, scientific knowledge is reliable and at the same time is subject to change,

therefore, it is not certain. Nevertheless, the students being interviewed in this study confused certainty with reliability. For this reason, the results were very similar to the ones in RQ4. The students' judgements on certainty of pseudoscientific knowledge related to crystal healing were presented in Model 5.



Model 5. The students' judgements about certainty of pseudoscientific knowledge related to crystal healing

Firstly, the students' judgements on certainty of pseudoscientific claims were investigated. The students were provided several pseudoscientific claims related to crystal healing and were asked their opinions about certainty of these claims. The results revealed that eight students thought these claims were very certain while six students stated these claims did not seem to be certain. Five of eight students who stated that the claims were certain reasoned that these claims (before proposed) must have been researched scientifically, otherwise why would there be so many information about crystals. The reason of the students was based on the assumption that if there were such assertive claims about crystals and their impact on health, the claimers must have tried them out on so many people before they published these claims. Accordingly, they thought that these claims must be based on scientific research so that these claims were certain. This was evident in following quotation;

> S: People have said these; that is to say, there is something like that. It has been tested and observed. I think they are scientific. If they were not scientific, why would people write nonsense things about them? Therefore, coral crystal is something people have mentioned. It has mentioned that it increases concentration so this has been tested beforehand. In other words, it has been tested on millions of people, not only a few people and this result has been found. I think I trust them.
> I: Why do you think they are convincing?
> S: I think they are convincing because these kinds of research have been done by experts and on many people. In other words, they are not just simple thoughts. They are certain, as experts have tested them on people. It could not be presented on the internet if it were something nonsense; people share them as it has been seen, done, tested whether they were useful or not and observed beforehand. (12Y)

Similar reasoning pattern was evident by five students when they talked about certainty of claims. These students though that the claims must be true and certain otherwise these claims could not have been proposed. According to the students, existence of such claims was an indicator of their certainty. Four students stated the other positive assumption about crystals. They thought that crystals must be effective as they were claimed therefore, these claims provided certain knowledge. The reason provided by them was that so many people were using these crystals for health purposes and most of them continued to use these crystals so it meant that these

crystals must be effective as it was proposed in the claims. Representative quotation was as follows;

> S: It is effective in any case.
> I: Why do you think that it is effective?
> S: Let me talk about that center again. For instance, there have been a lot of people inside the center at the opening. There have been a lot of people inside. There have also been a lot of people inside on oncoming days. Besides, I have also seen same people. In other words, people have gone there repeatedly. That many people have gone there and some people have gone there repeatedly have made me think that it has been effective. I suppose that if it were not effective, people would not go there.
> I: You think that if it were not effective, people would not go there.
> S: Yes, they would try once; then, they would quit. However, there have been some people going repeatedly. I have seen, witnessed that. I think these crystals are certainly effective. (5D)

Other two students indicated that if they heard similar claims from different sources such as television programs or relatives, this indicated that these claims must be true. Related quotations were given below;

> S: I think if it is everywhere and found in reliable sources, it is already correct and certain. I think these utterances may be reliable. They sound reliable to me. However, I must be sure that these sources are reliable. For instance, the explanations of experts about this topic sound more reliable for me. Seeing that person on TV makes me rely on the topic. I trust more to the explanations of these people. I think the explanations of these people are true. (7G)

> S: I think it will definitely be effective. I think these crystals may show these kinds of effects.
> I: What makes you think that these crystals may show these kinds of effects?
> S: I have already heard that amethyst crystal has been effective on skin diseases. I have heard that on one of the TV programs. I have also heard something about quartz crystal. This has become more positive because of these. As I have heard something about two of them on TV programs, this has become more positive. Now I am reading something about them. That is to say, they are so effective that there are TV programs and books about them. I think this information is true. (6F)

Conversely, six students stated that the claims about crystals must not be certain when they were questioned about their judgments on certainty of pseudoscientific claims. The reasons proposed by them were that being superstition belief, being

implausible, and being resulted differently according to people. Additionally, two of the students proposed condition to be accepted these claims as certain. The condition was based on necessity of having eyewitness testimony or personal experience. They stated that until they had experience about crystals as it was claimed, it was impossible to be certain.

Secondly, the students' judgments on certainty were investigated in the context of the second scenario in which they supposed that for a couple of day they have experienced the increase of their level of concentration due to the use of red coral recommended to them. Nine students stated that because of such an experience, they would directly reach the conclusion indicating that the red coral increases concentration. Five of them stated that due to the fact that their so-called relief about concentration would have been based on their own experiences, they believed in that their conclusions about crystal were certain. Their arguments was based on that if they see concrete evidence related to effectiveness of crystals by their own eyes, the knowledge derived from this experience must be certain. To state differently, seeing is believing for them. Thus, it was understood that what they experienced was certain and absolute for them. Representative quotations were as follows;

> S: I would test it on myself. I would buy the crystal. I would stay in a quitter place; actually, I cannot study in quiet places. I would definitely listen to song. I would take it and do a test. In addition, I would continue doing that if something like that definitely happened, if it increased concentration. I would believe though I would present my observations on the internet.
> I: So what would you say about the certainty of the knowledge you have gained?
> S: If I tried it and if it really worked; in other words, if it increased my concentration, this information would be certain. I would see it with my own eyes. I do not know what other people think. If I saw it with my own eyes and it worked, this information would be certain for me. (1A)

> S: You behave according to hearsay information. You use the knowledge you have heard before. And when you try them, this knowledge becomes more certain. We make it certain by experiencing. The thing we try ourselves is definitely certain. (5D)

As understood from above quotations, the students actually wanted to test what they heard about crystals. Indeed, they wanted to make certain his beliefs about crystals by trying them out. They preferred judging the certainty of the knowledge derived from pseudoscientific application just according to their experiences.

Similarly, the two of them considered their self-benefit in order to determine the certainty of what they heard or what they were suggested. Their main concern was related to the possibility of getting positive result or benefit. They indicated that if the crystals worked on themselves, it was enough for them for referring the knowledge claim as certain.

Additionally, four of them were more gullible than others. They had tendency for believing what they were told or suggested. They thought that if it was written in a source, it must be certainly true and reliable. This was evident in the quotations below;

> S: They have tried them; that is to say, they have experienced this. It has been curative. In other words, this information is certain. For instance, if I see that it works on TV, I think that it really works. That is to say, it is certain. It has really happened. (6F)

> S: If it really affected me, in other words if it really affected my concentration, I would think that it really had positive effect and I would continue using it as it seemed useful.
> I: So how would you test whether this crystal works for concentration or not?
> S: I would use the crystal while studying. As I have felt that it has increased my concentration before, it will do the same again.
> I: So what do you think about the certainty about the knowledge you have gained?
> S: If the increase of concentration is written there, the thing that increases my concentration will be that crystal. The crystal has effect on concentration anyway. They have experienced that before. (7G)

On the other hand, five other students were more skeptical than others regarding certainty of knowledge about crystals. They thought that the knowledge derived from personal observations or experiences was not certain. Three of them asserted a reason that the result coming from their experiences was not guarantee and not certain,

because the result might be caused by another variable such as psychology. Related quotation was provided below;

> S: I think coral crystal increases concentration. However, perhaps that may have happened psychologically on that day. This may have happened psychologically as we have already heard that coral crystal increases concentration. We may have felt like that. Perhaps it is not derived from the coral crystal. Perhaps I may have felt like that. We cannot definitely be sure of this. (4C)

The other student thought that these applications were not resulted in concrete solution based on data collected by measuring. He thought that knowledge derived from nonmeasurable situations was not certain. His related quotation was as follows;

> S: If we buy the crystal believing that it is beneficial, we can say that it really happens psychologically. For instance, it would stand next to me and my concentration would increase. We can say that it has increased psychologically even it has not increased. I think the increase of concentration is not something like measurable. In other words, they are not something like guaranteed. They are not certain. We cannot certainly understand that as we cannot measure concentration clearly. For this reason, we cannot understand whether the crystal is effective or not. Thus, the result is not certain. (11T)

Additionally, other two students stated that trying the crystal and then experiencing an impact must not be indicator of certainty. They thought that additional research in which more people took part should be conducted. This was evident in following quotation;

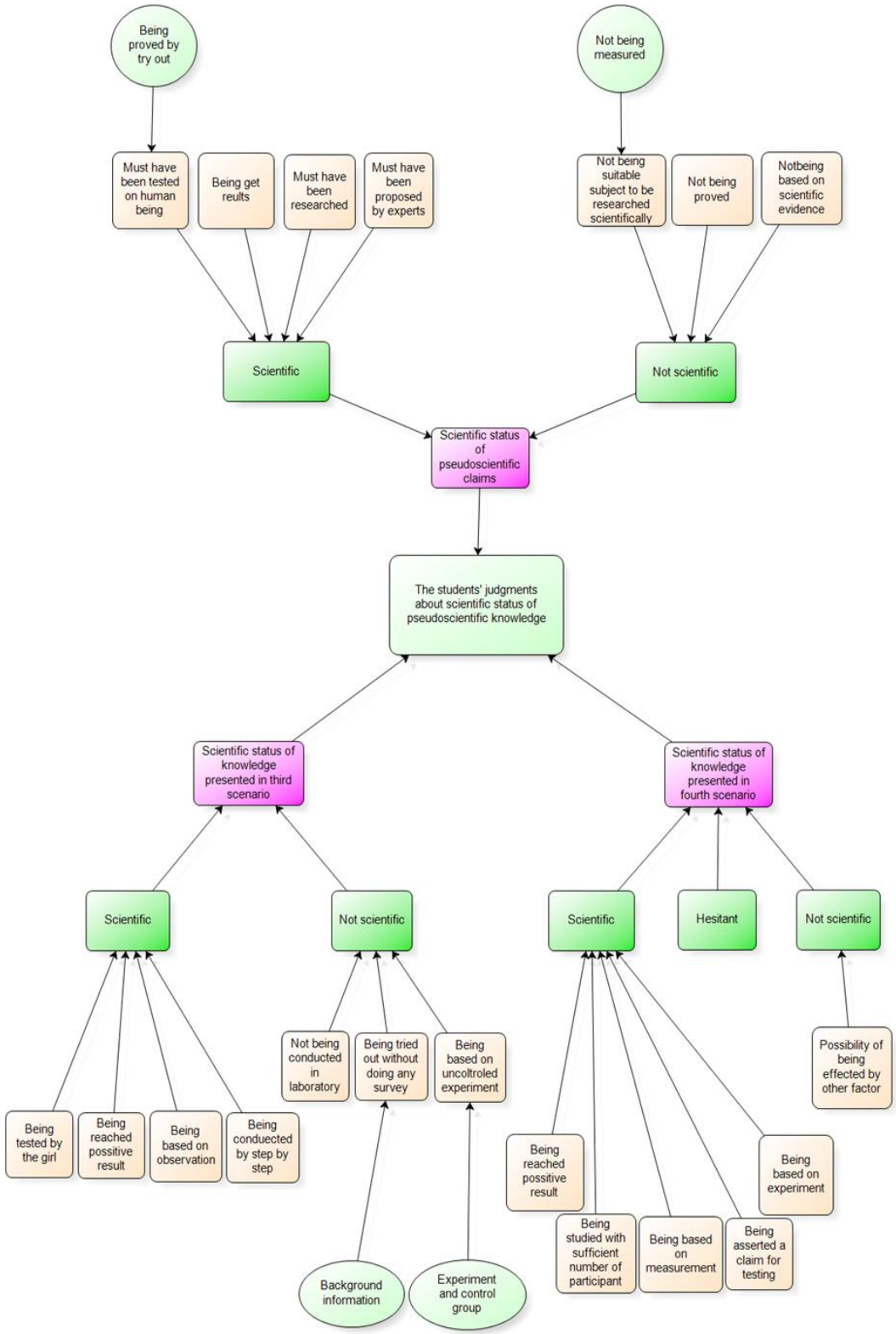
> S: I have observed that the crystal has increased my concentration in the end. In other words, I think positively about this.
> I: What do you want to say if someone asks you what you think about the certainty of your thoughts?
> S: They are not certain but maybe they work. I would use them because of this.
> I: You say that they are not certain but you would prefer using them.
> S: Yes, they are not certain but these findings are also indicators.
> I: Why do you think that they are certain?
> S: We have found that by experiencing it. We do not know whether it has such an effect or not. Perhaps it must be tested on more students. In other words, it must be searched more. I think if we could observe the same effect on all of them, we would have a positive judgment. (8K)

Consequently, the students' judgments on certainty of pseudoscientific claims and knowledge claim in the context of the second scenario were presented here. The

result revealed that in both contexts more students judged the claims as certain. Regarding their judgments on certainty of pseudoscientific claims, they approached the claims with presuppositions, especially positive presupposition. For these students, existence of such claims was referred as indicators of their positive presuppositions such as being researched scientifically, being true, and being effective. Exemplifying reasoning pattern of them was based on that if crystals could not be effective, why would be so many claims about their effectiveness. Based on this type of reasoning pattern, they thought that these claims must be true and certain. Regarding their judgement of certainty of knowledge claim based on their experiences, for most of the students, the knowledge derived from what they were experienced was certain.

RQ6. How do the students judge scientific status of pseudoscientific knowledge related to crystals?

In order to answer RQ6, the researcher directly asked the students their judgments about scientific status of knowledge derived from pseudoscientific application. The data came from students' judgements about scientific status of pseudoscientific claims, judgements about scientific status of processes presented in the third scenario (Growing a plant) and the fourth scenario (Balancing blood pressure). Related data were presented in Model 6.



Model 6. The students' judgements about scientific status of pseudoscientific knowledge related to crystal healing

Regarding pseudoscientific claims related to crystal healing, the results revealed that according to eleven students, pseudoscientific claims related to crystal healing seemed to be very scientific because of diverse reasons. For instance, eight students supposed that these claims must have been tested on the human being so that it was not just a claim anymore. Four of them also thought that, by this way the effectiveness of the crystals as asserted in the claims had been proven by trying it out on people. Representative quotation was given below;

> S: Let me give an example from my grandmother again. She has told me. She has different diseases such as high blood pressure, diabetes. She has also told me that she also has backache. She has told me to bring the crystal to her, which she has bought before. I have brought the crystal and she has put it on her back. Then, she has told that her ache has passed away. I would obviously share a topic like that and observations about it on the internet if I were a manager of a web site.
> I: What do you think about whether it is scientific or not?
> S: It is scientific. There is unproved knowledge on your hand and in order to prove it you try it. These tries would be evidence for it. By trying them out on human being, they would test if it is effective or not. Therefore, these tries are scientific. (2B)

Additionally, seven students stated that these claims were scientific since they thought that being scientific was based on getting result about effectiveness or ineffectiveness about something. They thought that if there were such results about claiming effectiveness of crystals (referring claims about crystals) it seemed to be scientific to them. Related quotation was as follows;

> S: They have searched that, so it is scientific, that is it.
> I: Why do you think that it is scientific?
> S: It is already scientific; I directly think that it is scientific. They have searched it. They have searched so they have found results like that.
> I: Why do you think it is scientific?
> S: If people believe that it has cured them, it is scientific. And if it really cures people, it really has effects. In other words, if it does not cure, how can people say that this crystal is good for this disease and that crystal is good for that disease? I mean a man or a woman gets ill and then he or she gets well; this cures these kinds of diseases or vice versa. In other words, you get a result. You get information, a result about that. It is scientific because of this. For instance, there is so much information that the crystals have been effective and these results occur in the end. (3C)

Moreover, three students referred these claims as an indicator of being a scientific research. They assumed that if there were such claims about the crystals, the effectiveness of the crystals must have been researched scientifically; otherwise, these claims could not have been proposed assertively. Representative quotation was as follows;

> S: Those men do not say that let us find a crystal in order to do something for someone. That crystal stands there and they do not know what it is. However, everybody does research. If it stands there and works for something, I would search it, I would search how it becomes, where the source of it, where it occurs. I would do research like that; this is also a kind of scientific research.
> I: Why do you characterize it as a scientific research?
> S: If it were not searched as scientifically, we would not get such kind of information. We cannot get this kind of information without research. They cannot talk so exactly without doing scientific research. Thus, they are scientific. (9M)

In addition to this, two students referred the claims as scientific since they thought that the processes by which these claims were proposed must have been conducted by experts. This was evident in the following quotation;

> S: I think it is scientific. If it were not scientific, it would not be scientific even everybody tried it. They have tested it scientifically; thus, they have gained information like that. Otherwise, people cannot say that it works for this or that.
> I: I could not understand the scientific part of your ideas here.
> S: Well, there are some people who know it but at the same time, there are also some people who have no idea about it. Experts should test it and comment on it. In other words, they must test by recognizing the positive sides of it. Experts have tested these crystals so they have gained such kind of information. (6F)

On the other hand, three students thought that claims about crystals did not seem to be scientific. One of them stated that crystal healing was not suitable subject to be investigated scientifically, because it was impossible to measure effect of crystals on health directly. Related quotation was as follows;

> S: I think this is not a topic suitable for scientific research.
> I: Why do you think like that?
> S: As it cannot be measured.
> I: What do you mean?

> S: We can measure our height and say that this is the result. However, we cannot say that the crystal has affected so. For this reason, I do not think that this is not a topic suitable for scientific research. (11T)

One of them who indicated that the claims about crystals were not scientific stated that she would prefer believing in absolutely and scientifically proven facts which were investigated scientifically to go further into the details. The other student stated that these claims were not based on any scientific evidence and thus there were no scientific explanation showing effectiveness of crystals. Thus, he did not refer these claims as scientific. This was exemplified in the following quotation;

> S: Well, I do not think this information is correct. Namely, there must be a scientific explanation. These things do not seem scientific. Frankly speaking, I have not heard any scientific explanation about them so far. Recovering and using the crystal may happen at the same time by chance. (8K)

With respect to students' judgments about scientific status of process presented in the third scenario, the result revealed that ten students referred the process as scientific experiment. The most stated reason by eight students was that effect of crystal was particularly tested by the girl trying to grow a plant by using a crystal in the scenario. According to these students, this partial attempt presented in the scenario was enough for accepting this attempt as a scientific experiment. Two related quotations were as follows;

> S: She has seen a similar application on the program. She has tested it and had the same result. This is an observation. In other words, this is an experiment.
> I: Why do you think like that?
> S: I think she has observed it. She has experienced it that it comes true. I think like that because of this. Most people believe that; in other words, most people believe that by trying themselves. I guess that. She has done his own experiment by herself. (1A)

> S: She is testing the quartz crystal on an herb. She is taking notes about the differences. Then, she is observing that the herb is fronting to the quartz crystal and begins growing up. This is an experiment. The girl has done an experiment in her house.
> I: Why do you think like that?
> S: Her trial is an experiment; for instance, her testing the quartz crystal and taking notes are totally an experiment. (10S)

Interestingly, six students referred having positive result as indicator of being scientific. They thought that science gives us positive results about effectiveness of something and all scientific experiment must be resulted positively. This was evident below;

> S: Zeynep's trail's being useful, that herb's preference the crystal instead of the sun, growing up with the crystal's energy and fronting to the crystal instead of the sun have all been observed and these observations are already a part of scientific experiment. In order for the event to be scientific, the herb's really fronting to that crystal, growing up, being thicker, developing and blossoming like in this experiment are all needed. For example, someone puts a crystal near the herb but the herb does not grow up and it even dies; then, this is not something scientific. I think this application is scientific because Zeynep's experiment is successful. Quartz crystal instead of the sun makes the herb grown up. (3C)

Furthermore, five students though that the process presented in the scenario was a scientific experiment since they noticed that one of the scientific process skills (making observation) was emphasized in the scenario. One student referred conducting a process step by step as it was in science as an indicator of being scientific. Thus, as the process presented in the scenario was conducted in a sequence, she tended to believe that this process was a scientific experiment. Related quotation was provided below;

> S: I think this is a scientific experiment. Because, she is doing the steps in a regular order. First, she is putting the herb under the sun but it does not grow up under the sun; then, she is putting the crystal near it. Just like in a scientific experiment. In other words, she has done everything by observation. It is written like that here. I think it is scientific. Observation is a part of a scientific research. (7G)

Conversely, four students were more skeptical than the others. They thought that the process presented in the scenario did not represent a scientific experiment. Except one, all the reasons they proposed were very superficial and did not point out the errors in the research design. One student thought that in order to refer something scientific, it should be conducted in a laboratory. Three students stated that the process was not a scientific experiment since the girl just tried out what she heard from TV without doing any investigation in order to construct a background for her research. This was evident in the following quotation;

> S: Because just watching it on a TV program should not be enough. Because as long as he does not search its reality and prove that, testing it will be wrong. She has had to search it in a detailed way beforehand. Think that you want to be taller; try a lot of ways to do that and suppose that you have found the right way, but this way may lead you to the mistake, as you have not done a detailed research beforehand. This is really a bad situation. I think this is not scientific because of this.
> I: Can you please give more details?
> S: Zeynep should also have searched how to use it beforehand. She has begun testing it directly without researching anything. It cannot be considered as scientific because of this. She can have a look at the former research; whether they are scientific or not is not important. In other words, she must correct her idea by giving importance to the utterances of the person who is good at that work. She must read the comments of people having tried this beforehand. In other words, she can actually understand the right and the wrong. Thus, she can learn what she must do. (2B)

Interestingly, only one student realized that the girl in the scenario did not control any variable so that the result might be biased and thus he did not refer this process as a scientific experiment.

Regarding the students' judgements about scientific status of process presented in the fourth scenario, the result revealed that eleven students thought that the research process conducted by a researcher as stated in the scenario would represent a scientific investigation, so it was very scientific. Six students referred possibility of getting result as indicator of being scientific. Additionally, studying with sufficient number of participant, making measurement, and doing experiment were other reasons asserted by the students in order to accept this process as a scientific investigation. Related quotation representing the student's view on making measurement to be accepted as scientific was given below;

> S: He has tested it on 15 people. He has done that as in the example I have done on my grandmother. He has tested both before and after the experiment as I have mentioned. If I were him, I would do research like that. I think this is scientific research.
> I: Why do you think like that?
> S: He has worked with 15 people; therefore, it cannot have happened by chance. It is good to test the measurements before end after the experiment. In other words, he can compare before and after measurements. He has worked on 15 people and made measurements.

> This kind of a research clearly shows whether this crystal has worked or not. (8K)

As stated above, the student assumed that the researcher in the scenario measured the blood pressure of the patients both before and after the treatment, and then compared his measurements in order to determine the difference between them. Although the researcher in the scenario did not measure the blood pressure of the patients before the treatment, the students assumed that it was happened.

Additionally, two students thought that the researcher in the scenario was asserting a claim about effectiveness of crystal on high blood pressure disorder, and then the researcher was testing this claim by conducting a research, so that these attempts showed that this process was a scientific investigation. This was evident in the following quotations;

> S: I would do a similar thing. In other words, I would gather people having psoriasis to test coral crystal on them and do an experiment like that. This method is a suitable one in order to test his claim and I would use the same method. He has claimed that onyx is good for high blood pressure and then tested his claim on people. This sounds scientific for me. In other words, isn't scientific research done like that? (1A)

> S: I think this is scientific research. I see a person testing the effect of a crystal on 15 people. When I say that I would take 15 people and do the same, this will not be considered as scientific research. However, here he is a researcher and he has claimed something depending on his former research.
> I: Why do you think that it can be considered as scientific research?
> S: He must prove that it is something good in order to produce something and sell it. I am doing research for this reason. I have not produced and presented it yet. I test it before presenting and look whether it is useful for people or not. If I do this to support people, this research becomes more scientific for me. If I know that and give it to people, this is not scientific research anyway. Because I already know the effect of it. However, proving something from the rough is science. (9M)

Other two students were hesitant about the scientific status of the process presented in the scenario. Only one student approached skeptically toward this process. He stated that the result of the process might be affected by many other reasons instead

of crystal. For this reason, he thought that this process did not seem to be a scientific investigation. His quotation was evident below;

> S: I think not every research is scientific but I hesitate. However, I think not every research is scientific. Because, the only feeling of people there is when they will take the crystal from their heart, as they get tired. They think of taking the crystal away. I think it will not work because of this reason.
> I: Why do you think like that?
> S: It is not very scientific. Because there will be some thoughts in people's minds and this will affect the result of the research. First, this person must continue his daily life. For example, think that you are using onyx. If you behave in a different way on purpose as you know that the onyx is near you, it is not very scientific. On the other hand, you may believe it is effective as you think you have affected from this crystal psychologically. For instance, think that your mother has high blood pressure. And you put a lot of onyx on different parts of the house. Your mother does not know that and if her blood pressure does not increase in a week and generally her blood pressure increases once or twice in a week, we can say that this crystal really works. (2B)

Briefly, when the students were asked to judge the scientific status of the pseudoscientific applications, more than half of them judged the status of pseudoscientific claims and the processes presented in the third and the fourth scenarios as scientific. The most stated reasons, common to all three contexts, were having a conclusion and trying out on human being. When the students judged the scientific status of the pseudoscientific applications, they generally considered the result of these applications. If there was a possibility of reaching a conclusion showing if the process really worked or not, especially positive conclusion, the students tended to think that this process would be scientific. Additionally, they generally looked for clues which were showing that the process was really done or conducted or tested in an experiment in which the real people took part. Therefore, the students thought that if effectiveness of crystals was tried out on human being or by human being, the results about effectiveness of crystals were not a rumor anymore, so this testing process represented a scientific research. Because of this, it could be concluded that the students were not able to distinguish scientific and pseudoscientific applications.

CHAPTER 5

DISCUSSION, CONCLUSION, AND IMPLICATIONS

This chapter presented a discussion in regard with the findings of this study based on the research questions and suggested implications for improving science education along with recommendations for future research.

5.1 Discussion

The purpose of this study was to discover and describe reasoning patterns that emerged while middle school students reflected their understandings about pseudoscientific issues. The aim was to reveal middle school students' comprehensions about aim, process, and justification of pseudoscientific applications related to crystals, and about reliability, certainty, and scientific status of knowledge that derived from these pseudoscientific applications profoundly. The primary focus in this study was to go beyond students' belief systems about pseudoscience and uncover features that oriented their belief-driven decisions in pseudoscientific applications.

This chapter addressed discussion and conclusion of the research findings and implications for further research studies. In the light of the previous research studies in the literature, the research findings were reviewed and discussed briefly. Conclusion of the research findings were discussed in a holistic perspective in which the middle school students' reasoning patterns including their understandings about pseudoscientific issues were pointed out.

As stated previously, although we have many criteria in order to differentiate science from pseudoscience, when it comes to apply these criteria to the daily practices we have also some difficulties in distinguishing science and pseudoscience. To know the criteria and to know how to apply criteria are two different skills. In order to distinguish between science and pseudoscience, people need to understand

pseudoscience and pseudoscientists' essential aims, their knowledge construction processes, and their tendencies which based on their reasoning errors.

Coker (2001) stated the essential aim of pseudoscience as "to rationalize strongly held beliefs, rather than to investigate or test alternative possibilities" (p. 1). According to him, pseudoscience is interested in favorable conclusions which address preconceived ideas and widespread misunderstandings. As explained previously, these preconceived ideas and widespread misunderstandings are generally based on some reasoning errors such as confirmation bias and some heuristics and shortcomings. According to Good (2012), "people marketing a particular pseudoscience often take advantage of one or more of these biases to convince people to believe in the effectiveness or "truth" of their product and the placebo effect does the rest" (p. 103). By giving examples of pseudoscientific applications such as faith healers, quack cancer cures, and crystal healing; Beyerstein (1995) explained the commercial interest in pseudoscience. As Beyerstein (1995) stated, "pseudosciences invite us to buy into the desirable but unobtainable dream of abundance, health, and happiness for all" (p. 32). In today marketing, painless and effortless treatments including crystal healing in which bracelets and rings made of crystals are sold to people looking for hope. To summarize, one of the essential aim of pseudoscience, especially in today marketing system, is to make money by capitalizing people's hope, despairs, reasoning errors, and also their disability of distinguishing science and pseudoscience. Commercial stake in pseudoscientific claims is pointed out by other researchers such as Bunge (2011), Coker (2001), Moore (1992), and Preece and Baxter (2000).

However, the result of this study revealed that the students were not aware of the essential aims of pseudoscience. Especially in context of crystal healing, they were not aware of the commercial stake of this type of treatments. They stated that crystals were generally used as treatments in health problems. Even, they witnessed entity of SPA centers or experienced treatment centers which were based on crystal healing. Other gullible aim of using crystals stated by the students was to help other people who were suffering from particular diseases by promoting crystals, making advice

about using crystals, or healing them with crystals. On the other hand, there were just a few numbers of students who realized the commercial stake in pseudoscience. Most of the students were very gullible about goal of pseudoscientific applications related to crystals and crystal healing. As a result of this, it could be concluded that most of the students approached crystals and crystal healing from a positive and gullible perspective. Interestingly, Robertson and Rossiter (1974) investigated the primary school children's perceptions of intent of commercials. Their aim was to investigate what attributions children had about commercials. According to result, the researchers found that the children had either assistive intent or persuasive intent. Additionally, it was revealed that the children realizing persuasive intent of the commercials tended not to trust commercials and the children approaching from assistive intent perspective had more trust in commercials. Accordingly, the students or children's gullibility depended on their attributions about the phenomenon. Most of the students in the present study attributed positive meaning such as curing, helping, advising crystals and they tended to perceived assistive intent of crystals and crystal healing, not persuasive or trickery intent of them. The students generally made pragmatic inferences about the goal of pseudoscientific applications related to crystals and crystal healing. Their reasoning about the aim of using crystals and crystal healing was fundamentally based on their pragmatic interpretations such as having been cured, having been helped, and having been advised. For this reason, it could be claimed that the students in the present study were so gullible about the aim of using crystals and crystal healing that they were very prone to pseudoscientific applications in that area.

Regarding possible research process that would be used by pseudoscientists, result of the present study revealed that the students believed that the people using crystals asserted or reached their pseudoscientific claims by applying four main research methods that were searching on the Internet for crystals, making examination on crystals, finding out by chance, and trying out the crystals. In terms of practitioners' method of trying out crystals, the vast majority of the students provided superficial research process which was a kind of trial and error method. When they thought about research process of the people using crystals, the first thing came to their mind

was “try it and see”. According to the students, people using crystals had an idea about effectiveness of crystals and by trying particular crystal for particular intent they confirmed their ideas. It could be concluded that according to the students, the meaning of making research was correcting and confirming ideas by personal trial, rather than explaining phenomena or generating explanation. For these students, direct observation was sufficient for confirming an idea or explaining a phenomenon. It could be concluded that in terms of research process, the students were close to viewpoint of pseudoscientists. They did not consider the process of collecting data, evidence, and alternative explanation. Like pseudoscientists, they neglected the essential principles of scientific investigation. Except one, they did not need to critically evaluate the pseudoscientific claims and the process about crystals’ effectiveness. They believed in knowledge or claims which were based on personal ideas or personal trial and error processes. In the light of this result, it could be concluded that the students had less sophisticated scientific epistemology which was the opposite of the idea that “knowledge comes from reasoning, thinking, and experimentation” (Elder, 2002). Similar results were reported in other studies. For instance, Solomon, Duveen and Scott (1994) investigated 11- to 14-year-old students’ images of scientific epistemology. They found that the students did not refer making research as generating and testing explanations. In another study, Driver, Leach, Millar, and Scott (1996) published young people's images of science. They interviewed with 9, 12, and 16 year-old students. As a result, they developed a framework which explained students’ epistemologies and included phenomenon-based reasoning, relation-based reasoning, and model-based reasoning. In their study, most of the students were classified into phenomenon-based reasoning group in which the students just focused on particular phenomenon and described it rather than considering variables to draw empirical generalizations and evaluating explanations in the light of evidence. Additionally, these students were found to be tended to think that direct observation was sufficient for answering scientific questions. Smith, Maclin, Houghton, and Hennessey (2000) found that in comparison classroom in which traditional teaching was implemented, most of the students indicated nature and purpose of scientific experiment as “producing a desirable outcome or a new fact” and they were classified into the “try out and find cures”

group (p.72). Similarly, most of the students in the present study thought that people using crystals thought that the particular crystal would be effective and then by trying this crystal out they reached or proved their desirable outcome.

In addition to this, when the students were provided pseudoscientific research process, they were not able to realize the flawed research process presented in pseudoscientific context related to crystals. All of the students referred this ill-designed pseudoscientific research process, which was generally implemented or reported by pseudoscientists as scientific research, as appropriate process to test an idea. In this process, the main distracters generally implemented by pseudoscientists, such as stating number of participants, possibility of getting positive results, making measurement, and being tried out, made the students think that this process was a real scientific research conducted by experts. As presented above, the students were very gullible in respect to process conducted by pseudoscientists. This result actually indicated that the students had similar reasoning patterns about research process with that of pseudoscientists. Both for the students and the pseudoscientists, it was enough to try something in personal level in order to test or prove something's effectiveness without considering essential principles of the scientific research. For this reason, it was supposed that, they were not able to recognize the lack of control of variables and proper measurement. Since the students were not aware of the flawed research process, they were also not aware of that when the method used in pseudoscientific applications are improved, the so-called positive effect that pseudoscientists report disappears (Smith, 2010).

Almost identical results were evident in the students' own research processes, which reflected their views on justification. Main hypothetical research process generally provided by the students to test an idea or verify their observation was trying out. When they were asked to design a research to explain a phenomenon or test an idea based on pseudoscientific context, the first thing came to their mind was trying it out and making direct observation. They tended to have pseudoscientific perspective in terms of research process. They generally tended to use experiential thinking based on their own experiences and observations rather than demanding rational thinking

which was the basic for scientific process. Lindeman (1998) claimed that pseudoscientific beliefs were originated from experiential thinking system. In experiential thinking, individuals organize and interpret information according to their own personal experiences and try to find shortcuts to guide next steps. In this process the main concern was their benefit and utility. The students, pragmatically, considered the effectiveness of crystals and the shortest way to judge its effectiveness was to trying it out in individual level. In terms of research and justification process, the students' reasoning based on naïve realism or "seeing is believing" perspective (Lilienfeld, Ammirati & David, 2012). According to the students, reality was exactly as they experienced it. They were not aware of the importance of the method or the rival explanations.

Apart from this, all other designs of the students to test their ideas were based on second hand information. These were generally passive sources such as television, the Internet, experts, and testimonials. Elder (2002) reported similar results that most of the 5th graders stated passive second hand sources such as family members, teachers, and books as the sources for getting scientific ideas. As a result of this, the students in the present study considered science as accumulation of knowledge which could be transferred by main sources rather than a process in which individuals were involved in order to construct their own knowledge. Similarly, Sutherland and Dennick (2002) and Metin and Leblebicioglu (2011) reported that 6th and 7th graders considered science as a body of knowledge, not a process.

Instead of testing their ideas, the students generally attempted to justify their ideas by asking more knowledgeable people. These results could be explained by Health Belief Model. According to Janz and Becker (1984), Health Belief Model (HBM) essentially deals with "the belief that a specific health action will prevent illness" (p. 2). HBM consists of four dimensions that are perceived susceptibility, perceived severity, perceived benefits, and perceived barriers. Last two dimensions were concerns of the present study. Perceived benefit can be defined as beliefs related to the effectiveness of the specific health action in reducing perceived threat of disease (Janz & Becker, 1984). According to HBM, perceived feasibility, sufficiency,

functionality, and efficacy of the action determine the decision about acceptance of this specific health action. Perceived barriers referred individual's judgment about perceived harmful against perceived effectiveness. In this judgment, individual compares cost and benefit of the action. Perceived cost might be side effect, pain, or price of the action. According to Janz and Becker (1984), in weighting perceived benefits and perceived barriers, some stimulus such as interpersonal interactions, advice from others or mass media communications were necessary to trigger the process of evaluating health related actions. The researchers referred this tendency as "cue to action" (p. 3). Accordingly, it could be concluded that the students searched for cues by asking knowledgeable people rather than testing the claims. It was also indicating that the students considered the source of claim rather than truth claim. They did not need to critically question what exactly basis for this claim was. Green (1996) acknowledged that first and foremost people encountering pseudoscientific claims should question and investigate claims no matter who proposed or supported them. Similarly, the students tended to survey communication network for testing their ideas by considering users' comments. It was quite reasonable for pseudoscientists that individual case histories or vividly presented examples influenced people more than group statistics did and the impact was long lasting (Fiske & Taylor, 1991; Pratkanis, 1995).

At this point, transformative learning theory shed light on the situation. Transformative learning theory (Mezirow, 1991) is a kind of learning grounded in unique environment of human communication. Mezirow (1991) referred it as frame of reference. In transformative learning, individual acts according to his or her references. One of the specific forms of transformative learning is communicative learning. Communicative learning simply refers "understanding what someone means when they communicate with you" (Mezirow, 2003, p. 59). In this process, individual attempts to understand rightness, sincerity, authenticity, and appropriateness of claim and does not need to assess a truth claim (Mezirow, 2003). Actually, individuals focus on assessing feelings, beliefs, and values of others. That is why, when someone recommends us an unfamiliar treatment or a medicine, we need to know how much credible s/he is for recommending the treatment or

medicine. Recommender's proficiency, expertise, experience, and testimonials determine the credibility of the claim. The fundamental attempt is to make as quick and best judgement as possible. For this reason, the students tended to apply to testimonials of others, apply to experts, and search on the Internet in order to decide on rightness, sincerity, authenticity, and appropriateness of claim rather than searching for truthiness of the claim or questioning the evidence for the claim. For this reason, when the students encountered a new situation, first and foremost they focused on the conclusion or the product of the claim in order to find out its appropriateness, rightness and utility for them rather than focusing on the process in which the claim was produced. Accordingly, it could be said that the students preferred to use authoritative sources to justify their claims. Similarly, Kittleson (2006) reported reliance on authoritative sources as justification for ideas. In her dissertation, Kittleson (2006) investigated reciprocal relationship between third graders' epistemological beliefs and practices in the context of science instruction. She reported that some of the 3rd graders believed that scientists rely on authority to justify their ideas, and they generally use computer and books to search for information and to confirm their rightness. Likewise this, the students in the present study tended to asking for help from external sources such as the Internet, experts, more knowledgeable and more experienced people in order to justify their claim rather than collecting their own data and making their own research. However, tendency of searching on authoritative sources was not a characteristic of the scientists. Generally, pseudoscientists use this type of sources such as anecdotes, testimonials, hearsay as stated in Table 1.

On the other hand, most of the students tended to believe what they experienced regarding the second (related to the level of concentration and the red coral) and the third (related to a girl trying to grow a plant and effect of crystal quartz) scenarios. In this case, if they had opportunity to experience the pseudoscientific applications by their own, they stated that they preferred to believe what they experienced and they did not need to justify their observations. As stated previously, the vast majority of the students had naïve realism. Regarding their understanding of justification, most of the students were close to reasoning pattern of pseudoscientists. They generally

considered personal ideas without need of justification or need of testing ideas. It would indicate that most of the students did not consider use of data and evidence to justify their ideas and they were not able to realize the availability of alternative explanations which would be counter to their ideas. Just few students realized that in order to justify their ideas, they needed to rule out rival explanation caused by psychological impact of preconceived ideas about effectiveness of something. By expressing the role of placebo effect in pseudoscience and the importance of controlling personal bias in science, Good (2012) stated that "believing in the effectiveness of a medical treatment can actually cause a psychological response like reduction of pain for a short period of time (p. 102). However, most of the students were not able to criticize the claims in terms of placebo effect and they did not propose a research design in which the placebo effect was controlled.

Similar reasoning pattern was evident in the students' views about reliability and certainty of knowledge source in pseudoscientific context of crystal healing. Regarding reliability of knowledge claim based on or derived from pseudoscientific application related to crystal healing, it could be concluded that the students generally considered credibility of knowledge claim. Their essential concern in judging reliability of knowledge or claim was their reliance on authoritative sources. In terms of reliability, the students displayed two major tendencies of pseudoscientists. First one was based on that pseudoscientists considered the amount of data rather than the quality of data. Likewise, as stated previously, with reliance on sources, the students considered how much sources mentioned about the claim rather than the quality of the sources. According to students, if the claim was provided by several sources, which meant that if they heard about claim from different sources, the claim must be more reliable. Nevertheless, Green (1996) expressed the biased and inconsistent structure of subjective evidence by stating that "A large number of subjective reports that seem to describe same event are no more unbiased and reliable than one, especially when the reports come from people who are predisposed to produce similar reports" (p. 18). However, the students asserted the existence of the different sources supporting the same information as evidence to show claim's truthfulness and especially its presence. Existence of such information

supported by the different social networks made the students think that “it must have been real; otherwise all the information supported by the different sources would not exist”.

According to attribution theory, an individual organizes and interprets incoming information, then infers causality, rather than scientific analytical reasoning (Heider, 1958). In accordance with attribution theory, individual constructs attribution of causal relationships (Robertson & Rossiter, 1974). However, sometimes these causal relationships are constructed in a naïve way. There are four weak causal relations. These are; A causes B, A prevents B, A allows B, and A allows not-B (Goldvarg & Johnson-Laird, 2001). As stated in previous paragraph, the students in the present study generally applied these weak reasoning processes in order to make sense of their observations and considered their biased observation as evidence rather than criticizing truth value of the information by using scientific reasoning. Based on weak reasoning pattern, the students proposed that “the claims about crystals must have been reliable, otherwise there would not be so many sources supporting the same issue”.

The second pseudoscientific tendency of the students was derived from their reliance on hearsay, anecdotes, testimony or rhetoric. According to the students, having eyewitness testimony about crystal healing or similar healing, being used by many people, and being reported to be really worked on health in a source, were essential concerns in judging reliability of claims about crystal healing. According to Baran, Kiani, and Samuel (2014), testimonials are one of the specific reasons of why many of the pseudoscientific claims seem reasonable. Testimonial is a kind of pseudoscientific source of communication. Testimonial is generally provided by people who benefited from the treatment. On the other hand, no testimonial is provided by people who did not benefit from the treatment. Because of this, mostly positive results were spread out among people. Thus, it could be concluded that the students were not aware of the biased nature of hearsay, anecdotes, testimony or rhetoric. As pseudoscientists, the students were not aware of that biased evidence based on personal ideas was not an indicator of reliability of knowledge.

According to Schommer (1990) source of knowledge is one of the five dimensions of personal epistemology. From epistemological perspective, source of knowledge refers a spectrum ranging from knowledge hold by omniscient authority and process occurred as simple transfer of knowledge from an authority (naïve view), to knowledge constructed and derived by rational thinking and reasoning (sophisticated view). Individual with naïve epistemological beliefs tended to think that knowledge was handed down by authority thus they did not question authority and the knowledge coming from authority was reliable, and quickly transferred from authority. In the present study, the students tended to apply concrete sources in order to get information. The students also mentioned reliability of knowledge source that they used to gain information about pseudoscientific context. Interestingly, although they preferred searching on the Internet in order to justify their ideas by considering users' comments or other information about crystals, when it came to reliability issue, they referred the Internet as unreliable source of information. On the other hand, TV programs related to crystals and crystal healing were referred as reliable knowledge source by most of the students. Their main argument was based on the availability of visual evidence on TV programs. In order to refer knowledge as reliable, they generally looked for concrete and visual evidence provided by TV programs.

Regarding certainty, the same weak reasoning pattern emerged in their views about reliability was evident. Most of the students judged pseudoscientific claims and knowledge implied in the second scenario as certain. In terms of pseudoscientific claims, their main argument was based on their positive attributions about crystals and crystal healing. Similarly, as stated in reliability part, most of the students reasoned that "crystals must have been effective, otherwise why would so many people are using these crystals", "these claims must have been true, otherwise why would such claims have emerged", or "these claims must have been researched scientifically, otherwise why would there be so many claims about crystals". Accordingly, based on this weak reasoning pattern, the students referred these claims as certain. In terms of certainty of knowledge implied in the second scenario (related

to the level of concentration and the red coral), most of the students proposed a condition. According to their condition, if they experienced something by their own, the knowledge based on this experience must have been certain. Likewise in justification part, the students had tendency to rely on what they experienced by their own and what they saw by their own eyes. Based on these results, it could be concluded that when the students judged the certainty of a knowledge claim, they did not considered any rival explanations, or the process by which this knowledge claim was obtained. In this process, they generally considered their own personal experiences and their own personal attributions related to crystals that were supposed to be caused by their weak reasoning ability.

In accordance with one of the main problems in the present study, the students' judgements about scientific status of pseudoscientific knowledge were examined. As it was expected, most of the students judged the pseudoscientific applications being used in the scenarios as scientific. Their argument was derived from their understandings about scientific inquiry. According to the students, in order to test something scientifically, it was enough to try it out on human being in a real situation. Additionally, the students believed that in order to refer a process as scientific, the positive result needed to be reached at as a product of this process. For instance, most of the students thought that pseudoscientific claims and the processes by which these claims were constructed were very scientific, because people using crystals tested their claims by trying out the crystals on human being and they got positive results showing crystals' effectiveness. In a similar manner, they thought that pseudoscientific application being used in the third scenario (related to a girl trying to grow a plant and effect of crystal quartz) was a scientific experiment due to the fact that the girl being mentioned in the scenario really tried out the crystal on the plant (being trying out) and observed that her plant grew up (getting positive result). Regarding the fourth scenario (related to a researcher who conducted unfair testing procedure with patients of high blood pressure disorder), according to most of the students, the process being mentioned in the scenario was a scientific research process. As it was stated previously, their main reason was getting positive result by making an experiment and by making measurements on blood pressure. There were

also other distractors that made the students think that these pseudoscientific processes were scientific. For instance, some clues mentioned in the scenarios such as making observation, making measurement, mentioning about number of participants, arranging processes in an order, and being applied by experts gave the appearance of being scientific. According to Good (2012), "one way to assert authority is to invoke science to support claims, and getting people to believe a claim is easier if science, or what seems to be science, is used to support the claim" (p. 98). Selective use of science, using technical language of science, and giving appearance of being scientific are some techniques used by pseudoscientists. For instance, in some cases, it is really difficult to distinguish scientific terms from pseudoscientific terms. An exemplifying instance came from Ladyman (2013) that was related to a speaker using the pseudoscientific term of "proton torpedoes". In this case, the speaker would suppose herself to have sensible scientific theory; on the other hand, her audience would suppose that her claims were scientific and true. Misleading of using technical language was evident in study of Weisberg, Keil, Goodstein, Rawson, and Gray (2008). Weisberg and her colleagues (2008) found that irrelevant information containing more technical language made university students unable to distinguish plausible and implausible explanations. Similarly, as it was reported in the present study, the students were not able to differentiate between scientific and implausible pseudoscientific applications due to the use of selective language aiming at giving appearance of being scientific. Additionally, there was consistent evidence related to the scientific status of astrology. For instance, Kallery (2001) found that majority of the teachers (59%) view both astronomy and astrology as scientific, and they cannot distinguish science and pseudoscience. Similarly, according to the results of NSB (2012), more than half (%54) of the youngest informants are more likely say astrology is very or sort of scientific. Additional result came from Turgut (2011). According to results of his study, majority of the participants who were preservice teachers hesitated to state astrology as pseudoscientific although none of them labeled it as scientific. An important and interesting result was provided by Afonso and Gilbert (2010). In their study, the students were questioned about their judgments in scientific status and working efficacy of water dowsing as a pseudoscientific context. The result showed that although most of the students

believed in the effectiveness of water dowsing, they classified it as traditional knowledge not scientific one.

Based on the results in terms of scientific status of pseudoscientific claims and applications related to crystals and crystal healing, it could be arrived that the vast majority of the students did not judge the scientific status of pseudoscientific claims and applications related to crystals and crystal healing according to availability of data and evidence based on experimentation or testing process. They just considered clues which were showing that the process was really done or conducted or tested in an experiment in which the real people took part. Therefore, the students thought that if effectiveness of crystals was tried out on human being or by human being, the result about effectiveness of crystals were not a rumor anymore, so this testing process would represent a scientific research. Because of this, it could be concluded that the students were not able to distinguish scientific and pseudoscientific applications, and they were very gullible about scientific status of the pseudoscientific claims and applications related to crystals and crystal healing.

5.2 Conclusion

The present study revealed the middle school students' thinking processes when they reasoned about given pseudoscientific claims and research designs. To put it in a different way, how middle school students' reasoning patterns and comprehensions about aim, process, and justification of pseudoscientific applications related to crystals, and about reliability, certainty, and scientific status of knowledge that derived from these pseudoscientific applications were explored. The results of the study concluded that the students were very gullible in terms of aim, process, and justification of pseudoscientific applications related to crystals, and reliability, certainty, and scientific status of pseudoscience related to crystals. When the students reasoned about given pseudoscientific claims and research designs about crystals and crystal healing in terms of given aspects, they generally used weak reasoning patterns that were closer to that of pseudoscientists, which were clarified in Table 1.

In terms of aim of pseudoscience, the students attributed positive and gullible meaning to purpose of pseudoscience. The vast majority of them were not aware of the commercial and trickery aims of pseudoscience that concealed by pseudoscientists. In respect to process and justification aspects of pseudoscience, the students were not able to critically evaluate testing and justification process used by pseudoscientists. In parallel to pseudoscientists' reasoning patterns, their understanding of research process was not based on data and evidence. In order to test an idea, they generally proposed questionable assumptions and used flawed evidence that derived from personal ideas or others' testimonials. They generally neglected alternative explanations, and believed that reality was exactly as they saw it, thus they did not need to justify their observations. According to the students, everything was known by trying out. In this process, like pseudoscientists, vast majority of the students were not aware of the essential principles of scientific investigation, especially, controlling variables and designing appropriate experiment that were based on basic scientific process skills. When it came to reliability and certainty, they again used naïve realism, and they believed that what they experienced was reliable, certain, and was not subject to change. In terms of scientific status, they did not consider scientific indicators such data, evidence, and justification. In parallel to pseudoscientists' thinking style, they believed that if an idea was tried out by someone or on someone and if the result was positive, it was enough to support that it was scientific.

To sum up briefly, it was concluded that when the middle school students reasoned about given pseudoscientific claims and research designs related to crystals, they displayed weak reasoning pattern which summarized in right column of the Table 1. Their comprehensions about pseudoscientific claims and research designs related to crystals was resemble to that of pseudoscientists who considered personal experience or testimonial as data and evidence, and were not aware of the importance of controlled experiments in science.

These results are not only important in terms of science education but in terms of responsible citizenship in daily life. Gullible citizens who have tendency toward

pseudoscientific applications without questioning, who believe what they are told without reasoning, who use personal ideas, intuitive sense, anecdotal or testimonial evidence when deciding on, and who have tendency toward testing an idea by relying on personal trial and error processes instead of applying basic science process skills would have difficulties in actively participating decision making process in social life. However, as educators we demand responsible citizenship in which the individual takes part in the decision-making and policy-making process about scientific issues, critically evaluates what is presented and served scientific or pseudoscientific, and uses rational thinking in order not to be deceived by applications that fall outside of the realm of science. For instance, Beyerstein (1995) implied the importance of social environment in which the information are delivered and maintained that "the climate in which pseudosciences thrive contributes to a decline in science literacy and critical thinking" (p. 42). Correspondingly, he went on to say that decrease in science literacy constrains citizens from being responsible decision-makers on policies. That is why, as science educators we need to increase science literacy as a precursor of responsible citizenship by emphasizing difference between science and pseudoscience.

5.3 Implications of the study

The present study provided implications for educational policy makers, science teachers, science educators and researchers.

The results of the present study revealed that the middle school students displayed pseudoscientific reasoning that pseudoscientists had instead of scientific reasoning in a pseudoscientific context of crystal healing. Basic science education in middle school curriculum needed to be reorganized in accordance with scientific reasoning, which was aimed at training those who were able to "judge claims based on lack of empirical evidence, testimonial or anecdotal evidence, unfalsiable theories or simple correlational data as weak claims" (Lawson, 1999, p. 207). For that reason, basic science education in middle school curriculum needed to involve demarcation problem between science and pseudoscience. Science learning activities which

included discussion of difference between science and pseudoscience would be designed. According to Kellyian perspective, science would be fully comprehended and would make meaningful sense only by comprehending its opposite, pseudoscience (Erduran, 1995; Kelly, 1955). For that reason, science learning environments in which the students are provided opportunity to articulate science by comparing to and differentiating it from pseudoscience should be designed. Specifically, learning outcomes of elementary and secondary school science curriculum which might promote argumentation about demarcation problem would be implemented for that purpose. Ministry of Education in Turkey (2013) revised Elementary and Secondary School Science Curriculum in terms of including Science-Technology-Society-Environment learning domain. This learning domain includes sub-domains such as socio-scientific issues, nature of science, relationship between science and technology, contribution of science to society, and sustainable development. Demarcation problem between science and pseudoscience would be meaningful context for these sub-learning domains. Additionally, learning outcomes related to earth science and health issues would be used to promote discussion about difference between science and pseudoscience in classrooms. For instance, learning outcomes related to formation of rocks and minerals in grade 5 and learning outcomes related to systems of human body and health of body in grade 6, 7, and 8 would be used to inform students about flawed processes and claims of pseudoscience. As it was pointed out earlier, science education should be reorganized including learning about realizing and evaluating flawed process and claims of pseudoscience (Ede, 2000; Good, 2012; Hodson, 2008; Hurd, 1998; Lundström & Jakopsson, 2009; Martin, 1994; Preece & Baxter, 2000; Walker, Hoekstra & Vogl, 2002).

The present study concluded that the middle school students did not transfer their scientific skills into pseudoscientific context while they reasoned about aim, process, and justification of pseudoscientific applications related to crystals, and about reliability, certainty, and scientific status of knowledge that derived from these pseudoscientific applications. One of the main reasons for this situation is the way that traditional approach to teach science and nature of science, which could not

guarantee that, the students scrutinizingly recognize, critically evaluate, and obviously reject pseudoscience (Good, 2012; Walker, Hoekstra &Vogl, 2002). For this reason, the science education should focus on scientific skills rather than science subject knowledge, which enable students to transfer their skills into daily life situation, even into pseudoscientific context (Ede, 2000). Specifically, science education should focus on strategies based on how to think and criticize a claim rather than what to think (Walker, Hoekstra & Vogl, 2002).

Based on above implication, it is obvious that the demarcation between science and pseudoscience is desirable but demanding topic in respect to science education. Due to philosophical and complex structure of demarcation, the science researchers and educators needed to designate scope of the demarcation according to grade levels and needed to develop teaching strategies by which the demarcation issue would be integrated into science education appropriately. According to Mahner's (2013) suggestion in terms of how demarcation is possible in science education, the first and foremost the science researchers and educators should identify most comprehensive unit of analysis in respect to demarcation between science and pseudoscience. The present study provided evidence to guide next step in order to determine comprehensive unit of analysis of demarcation in science education. According to results of the present study, the middle school students had difficulties in understanding; the importance of data and evidence, the difference between scientific evidence and subjective or personal evidence, the necessity of controlled experiments, the need of justification and verification, and the process of scientific investigation. Accordingly, it could be concluded that the students needed to comprehend the demarcation between science and pseudoscience primarily in respect to methodological differences, especially in middle school level. By this way, the demarcation issue would be simplified from philosophical manner to science education manner in terms of the way that middle school students would comprehend better. The present study provided both starting points presented in Table 1 and evidence in order to integrate demarcation issue in respect to middle school students.
Additionally, these methodological differences between science and pseudoscience and, their approaches to inquiry needed to be articulated explicitly by confronting the

students both scientific and pseudoscientific ideas and claims. For this reason, the pseudoscience should be handled in an explicit way in science education (Good, 2012; Preece & Baxter, 2000).

5.4 Recommendations for future research

In the present study, the specific pseudoscientific context of crystal healing was used in order to reveal middle school students' comprehensions about aim, process, and justification of pseudoscientific applications related to crystals, and about reliability, certainty, and scientific status of knowledge that derived from these pseudoscientific applications. Therefore, the results of the present study were limited by the context used in the study. For this reason, similar investigations would be designed in other pseudoscientific contexts in order to reveal middle school students' comprehensions about aim, process, and justification of pseudoscientific applications, and about reliability, certainty, and scientific status of knowledge that derived from different pseudoscientific contexts.

Secondly, according to Whittle (2004)'s recommendation, it is needed to do more research investigating developmental stages of pseudoscientific beliefs and dispositions to pseudoscience, thus it is needed to conduct research with young children in order to understand how they reason while they encounter such an enterprise. Therefore, it would also be valuable to explore how younger students in lower levels would articulate pseudoscience in a specific context.

Additionally, the students' comprehensions about pseudoscience should be investigated by comparing their comprehensions about science. The further research would be designed in order to explore students' approaches to inquiry in both scientific and pseudoscientific context. By this way, the researchers would determine similarities in students' approaches to inquiry in both scientific and pseudoscientific context, which would be one of the main reasons for why the students judged pseudoscience as scientific.

Finally, further research is needed to explore the effectiveness of the science learning activities aiming at introducing methodological differences between science and pseudoscience explicitly on students' dispositions to pseudoscience and on their comprehensions about pseudoscience.

To sum up briefly, further research should be conducted in order to understand why students have pseudoscientific beliefs by going beyond students' belief systems about pseudoscience, and uncovering features that orient their belief-driven decisions in pseudoscientific applications.

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APPENDICES

APPENDIX A. Interview Protocol

Interview Questions

I want to talk about crystals with you today. I am interested in your views about crystals. You don't have to be an expert in crystals. It is enough to express your ideas clearly. If you are ready let's begin.

Introduction

1. What does come to your mind when I ask you talk about crystals?
2. What do you know about crystals? Can you please tell me what do you know and hear about crystals?
3. Where do you learn about crystals?
4. What are the purposes of using crystals?
5. What is the purpose of people using crystals?
6. What do you know about crystal healing?
7. Have you ever been witness to crystal healing? How? Can you please give details?
8. What are the purposes of crystals healing?
9. What is the purpose of people applying crystal healing?

Pseudoscientific Claims

Recently some people have asserted claims stating that crystals are positively effective on human health. As I told you, these are just claims. Some of the attributions claimed by these people are that;

- **Carnelian** encourages positive thinking, is beneficial for insomnia (sleeping disorder) and regulates the blood pressure.
- **Amethyst** converts negative energy to positive, is beneficial for migraine, cardiovascular disease, and insomnia, and heals skin conditions.
- **Red coral** heals psoriasis (skin disease), regulates respiration, increases concentration, and strengthens the cardiovascular system.
- **Crystal quartz** increases concentration, protects from negative energy, is beneficial for migraine, is great for absorbing radiation emitted by cell phone and computer.

1. I have showed you these claims. Based on these claims what do you think about whether crystals would be effective on human health or not? Why?
2. By what kind of research processes have these people gained these claims about crystals? How do these claims emerge according to you?
3. Suppose these claims have been emerged by such kind of research you just explained, how do these people justify their knowledge about crystals?
4. What do you think about certainty of these claims? Why?
5. Suppose these claims have been emerged by such kind of research you just explained, what do you think about scientific status of these claims?
6. Would research process you just explained be considered as a scientific research process? Why?
7. What kind of criteria these research processes should fulfill in order to accept these claims as scientific?
8. Some people think that these claims are unreliable while some of them think that these claims are pretty reliable. What is your opinion about it? Why?

Carnelian-Hypertension

Suppose that you have a relative who has high blood pressure disorder. For instance your grandmother or your grandfather would be patient of hypertension. Your relative has been told that using carnelian decrease the high blood pressure. For this reason, your relative wants to test whether s/he could use the carnelian which was recommended to her/him in order to remedy her/him high blood pressure disorder.

1. What kind of research process do you suggest to your relative to test this idea?
2. How can you justify your knowledge after applying such a kind of research process?
3. What do you do in order to justify your knowledge?

Red Coral- Concentration

Suppose that a friend of you have told about red coral and told you that if you use red coral, this crystal will increase your concentration level. Suppose that taking your friend's advice, you began to use red coral crystal. After a couple of day experiences with crystal, you feel the increase of your level of concentration.

1. What kind of knowledge you would derive from this experience?
2. How do you test the accuracy of your knowledge?
3. How can you be sure about the accuracy of your knowledge?
4. What would you say if someone asks you your opinion about the certainty of your knowledge? Why?

Growing a Plant

"Zeynep loved the geranium seedling gifted by her friend and located the flower pot to the window sill which were exposed to direct sun lights. Although she irrigated the flower in a regular interval, a couple week later she observed that there were slightly improvements in her plant. At that moment, an application she watched on TV came to her mind and decided to try it. A few days ago, she watched a TV program related to crystal quartz which was introduced to be effective on increasing the level of plant growth. As she watched on TV, she located the crystal quartz far 15-20 cm from the window. A few days later, she started to note the changes on her flower. Then she remarked that in the following days she observed that her flower started to grow and turned towards crystal quartz instead of the growth in the direction of sun lights (phototropism)."

1. What do you think about this application?
2. What do you infer from this application?
3. Some people claim that this application represents a scientific experiment while others think that this application does not represent a scientific experiment. What is your opinion about it?
4. What kind of criteria this application should fulfill in order to be accepted as a scientific experiment?
5. Some people think that knowledge derived from this application are unreliable while some of them think that knowledge derived from this application are pretty reliable. What is your opinion about it? Why?

Suppose that you implemented the same process presented in the scenario, but you did not observe any changes in your plant.

6. What do you think when you encounter such a situation? Why?
7. What do you do in order to justify your knowledge?

Balancing Blood Pressure

"A researcher claims that carnelian can balance blood pressure. In order to test his/her claim, s/he decides to conduct a research with 15 individuals who are high blood pressure patients. S/he provides a palm-sized piece of carnelian piece to each patient. Then, s/he asks them to hold the carnelian near to their heart. One hour later, s/he measures the blood pressure level."

1. Some people think that such kind of research is suitable in order to test the claim of the researcher while some of them think that it is not suitable. What is your opinion about it? Why?
2. How the ideal research should be in order to test this claim according to you?

3. What would you say if someone asks you your opinion about whether this research process is scientific or not? Why?

APPENDIX B. The Turkish Version of the Interview Protocol

Görüşme Soruları

Bugün seninle doğal taşlar hakkında konuşmak istiyorum. Daha çok senin doğal taşlar hakkındaki düşüncelerinle ilgileniyorum. Bu nedenle bu görüşmeyi yapabilmek için doğal taşlar konusunda uzman olman gerekmiyor. Bu konudaki düşüncelerini bana açıkça ifade etmen benim için yeterli. Hazırsan başlayabiliriz.

Giriş

1. Doğal taşlar hakkında konuşmak istediğimi belirtince, ilk olarak aklına neler geldi?
2. Doğal taşlar hakkında neler biliyorsun? Doğal taşlar hakkında daha önce duyduklarından ve bildiklerinden bana bahseder misin?
3. Doğal taşlar hakkındaki bilgilerini nereden öğrendin?
4. Doğal taşlar hangi amaçlarla kullanılıyor olabilir?
5. Doğal taşları kullanan insanların amaçları neler olabilir?
6. Doğal taşlarla yürütülen tedaviler hakkında neler biliyorsun?
7. Daha önce doğal taşlarla yürütülen tedavilere şahit oldun mu? Nasıl? Bana biraz anlatır mısın?
8. Doğal taşlarla yürütülen tedavilerin amacı nedir?
9. Doğal taşlarla yapılan tedavileri uygulayan kişilerin amacı nedir?

Sözdebilimsel İddialar

Günümüzde bazı insanlar doğal taşların insan sağlığı üzerinde etkili olabileceğine dair iddialarda bulunuyorlar. Daha önce belirttiğim gibi bunlar birer iddia. Bu iddialardan bazılarını ise sana göstermek istiyorum.

- Akik taşı olumlu düşünmeyi sağlar, ağrılara iyi gelir, tansiyonu dengeler ve uykusuzluğa iyi gelir.

- Ametist taşı olumsuz enerjiyi olumluya dönüştürür, migren ve kalp rahatsızlıklarına iyi gelir, cilt hastalıklarına iyi gelir ve uykusuzluğu giderir.
- Mercan taşı sedef hastalığına iyi gelir, solunumu düzenler, konsantrasyonu artırır, kalbi kuvvetlendirir.
- Kristal kuvars konsantrasyonu sağlar, olumsuz enerjiden korur, migrene iyi gelir, cep telefonu ve bilgisayardan yayılan radyasyonu toplar.

1. Doğal taşlar hakkındaki iddiaları seninle paylaştım. Bu iddialara dayanarak doğal taşların insan sağlığı üzerinde etkili olup olmadığı konusunda neler düşünüyorsun? Örneğin akik taşının olumlu düşünmeyi sağladığı, ağrılara iyi geldiği, tansiyonu dengelediği ve uykusuzluğa iyi geldiği iddia edilmektedir. Sence akik taşı iddia edildiği gibi insanlar üzerinde bu etkileri gösterebilir mi? Neden?
2. Sence doğal taşlar hakkında ileri sürülen iddialara nasıl bir araştırma süreci sonucunda ulaşılmıştır? Sence bahsettiğimiz bu iddialar nasıl elde edilmiştir?
3. Bu iddiaların bahsettiğin gibi bir araştırma süreci sonunda elde edildiğini varsayarsak, bu iddiaların doğru olup olmadığından nasıl emin olmuş olabilirler?
4. Sence bu iddialar kesin midir? Neden?
5. Bu iddiaların bahsettiğin gibi bir araştırma süreci sonunda elde edildiğini varsayarsak, bu iddiaların bilimsel olup olmaması hakkında neler söylersin?
6. Sence bahsettiğin gibi bir araştırma süreci bilimsel bir araştırma süreci midir? Neden?
7. Sence bu iddiaların bilimsel kabul edilebilmesi için hangi kriterleri sağlaması gerekir?
8. Bazı insanlar bu tür iddiaların güvenilir olmadığını belirtirken bazıları ise oldukça güvenilir olduğunu belirtiyor. Senin bu konudaki fikrin nedir? Neden?

Akik-Tansiyon Senaryosu

Tansiyon rahatsızlığından şikayetçi bir yakının olduğunu farz et. Mesela babaannen veya deden tansiyon hastası olabilir. Bu yakınına, akik taşının yüksek tansiyonu düşüreceği söylenmiş. Bu nedenle, bu yakının kendisine önerilen akik taşının tansiyon rahatsızlığının tedavisinde kullanılıp kullanılmayacağını test etmek istiyor.

1. Bu yakınına düşüncesini test etmesi için nasıl bir araştırma yöntemi uygulamasını önerirsin?
2. Bahsettiğin gibi bir araştırma yöntemi sonunda, elde ettiğin bilgilerin doğruluğundan nasıl emin olabilirsin?
3. Elde ettiğin bilgilerin doğruluğunu test etmek için neler yaparsın?

Mercan-Konsantrasyon Senaryosu

Bir arkadaşının sana mercan taşından bahsettiğini ve ders çalışırken mercan taşını kullanırsan bu taşın senin konsantrasyonunu artıracağını söylediğini farz et. Arkadaşının tavsiyesine uyarak mercan taşını kullanmaya başlıyorsun. Bu denemeler sonucunda mercan taşının konsantrasyonunu artırdığını hissediyorsun.

1. Eğer birkaç kez mercan taşının konsantrasyonunu artırdığını hissedersen, bu deneyimden yola çıkarak nasıl bir bilgiye ulaşırsın?
2. Elde ettiğin bilginin doğruluğunu test etmek için neler yaparsın?
3. Elde ettiğin bilginin doğruluğundan nasıl emin olabilirsin?
4. Biri sana elde ettiğin bilginin kesinliği hakkında neler düşündüğünü sorsa neler söylemek istersin? Neden?

Çiçek Senaryosu

Zeynep, arkadaşının ona hediye ettiği küçük sardunya fidesini çok sevmişti ve saksıyı güneş alan bir pencere kenarına koydu. Bitkiyi düzenli aralıklarla sulamasına rağmen, birkaç hafta sonra sardunyanın çok az geliştiğini gözlemledi. O anda televizyonda gördüğü bir uygulama aklına geldi ve o uygulamayı denemeye karar verdi. Birkaç gün önce televizyonda kuvars kristalinin bitkilerin büyümesini

arttırabileceğiyle ilgili bir program izlemişti. Programda izlediği gibi kuvars kristalini çiçek saksısından 15-20 cm uzağa yerleştirdi. Birkaç gün içinde sardunya bitkisindeki değişiklikleri not etmeye başladı. Sonraki günlerde sardunya bitkisinin güneşe doğru yönelmesi gerekirken kuvars kristaline doğru yöneldiğini ve büyümeye başladığını gözlemledi.

1. Bu uygulama hakkında ne düşünüyorsun?
2. Bu anlatılan uygulamaya dayanarak nasıl bir çıkarım yaparsın?
3. Bazı insanlar bu uygulamanın bilimsel bir deney olarak kabul edilemeyeceğini, bazıları ise edilebileceğini iddia etmektedir. Senin bu konudaki fikrin nedir?
4. Sence bu uygulamanın bilimsel deney kabul edilebilmesi için hangi kriterleri sağlaması gerekir?
5. Bazı insanlar böyle bir uygulamadan elde edilecek bilginin güvenilir bir bilgi olmadığını belirtirken bazıları ise oldukça güvenilir buluyor. Senin bu konudaki fikrin nedir?

Yukarıdaki uygulamayı kendi evinde tekrarladığını fakat kuvars kristalinin çiçeğin büyümesine hiçbir etkisi olmadığını gözlemlediğini farzet.

6. Böyle bir durumla karşılaşırsan ne düşünürsün? Neden?
7. Bu durumda kendi bilginin doğru olup olmadığını test etmek için neler yaparsın?

Tansiyonu Dengeleme Senaryosu

Bir araştırmacı akik taşının yüksek tansiyonu dengelediğini iddia etmektedir. Araştırmacı bu iddiasını test etmek için bir araştırma yapmaya karar verir. Yüksek tansiyon şikâyeti olan 15 hasta ile bir araştırma tasarlar. Her bir hastaya avuç içinde tutulabilecek büyüklükte bir akik taşı verir. Hastalardan akik taşını bir saat boyunca kalplerine yakın bir konumda tutmalarını ister. Bir saatin sonunda ise tansiyonlarını ölçer.

1. Görüştüğüm bazı insanlar, böyle bir araştırmanın araştırmacının iddiasını test etmesi için uygun bir araştırma olduğunu belirtti. Bazıları ise bahsedilen

araştırmanın bu iddiayı test etmek için uygun olmadığı belirtti. Senin bu konudaki fikrin nedir?

2. Sence bu iddiayı test etmek için yapılacak ideal bir araştırma nasıl olmalıdır?
3. Biri sana bu araştırmanın bilimsel bir araştırma olup olmadığı hakkında ne düşündüğünü sorsa neler söylemek istersin? Neden?

APPENDIX C. The Turkish Version of the Students' Quotations

1) 13Z
Ö: Annem çok kullanır doğal taşları veya benzer materyalleri. Hatta Haç'tan gelen taşlar iyiymiş filan diyorlar, onları annem mutlaka saklar.Genellikle birşeyleri tedavi etmek için kullanıyorlar. Sırt ağrısı için taş filan koyuyorlar. Onları duydum yani görmüştüm.
G: Nerede görmüştün?
Ö: Annemde CD var, o inanır böyle şeylere hani bardak çekme filan oluyormuş. Yüzük oluyormuş heralde stresi alan. Akik yüzük.Onu kullandı.
G: Annen sana anlattı mı iyi gelip gelmediğini?
Ö: İyi gelip gelmediğini anlatmadı ama çoğunlukla kullanıyor. Belki olur belki iyi gelir diye.Ama taşların bele iyi geldiğini söyledi. Yani oluyormuş dedi.
G: Başka bir gözlemin var mı bu konuda
Ö: Yooo. Ama bir de mercan taşını duymuştum sanki.Benim babaannem takıyor.Sedef hastalığına yakalandı.Onu geçirmek için mercan bileklikler var onu kullanıyor.
2) 3C
Ö: SPA, volkanik taşlar, onlarla yapılan masajlar, omurganın düzelmesi ve iyileşmesi, bel ağrısı veya el kırığı olunca yeşil zümrüt taşı diye bir şey vardı. Bunlar geldi aklıma. O taşlarla böyle insanların bir yerlerinin iyileşmesi geldi aklıma. Arkadaşımın annesi çoğunlukla bahsediyordu bunlardan.Onda da vardı yüzük ve bileziği.Onları kullanıyordu.İnternette de gördüm birkaç kere.İnternette gezip dolaşırken yanlışlıkla açılmıştı o tür sayfalar.Okuduydum.
G: Peki onlarla ilgili gözlemlerin neler bana anlatabilir misin.
Ö: Onu takıyordu, kolu daha iyileşiyordu daha iyiye gidiyordu. Ovuyordu birazcık.Takmadığı sürece hiç kullanamıyordu kolunu.
3) 4C
Ö: Aklıma ilk şey geldi, bu yazdı sanırım buraya biryer açılmıştı taşlarla ilgili. Bir makine vardı ve makinenin altında sürekli gidip gelen bir taş vardı bel ağrısına iyi geliyormuş. Aslında belim ağrımıyor ama arkadaşım gidiyordu ben de eşlik ettim ona. Orada bele taş konuluyordu hem de çok sıcaktı. Onu biliyorum.Aklıma direkt bu geldi.
G: Sence bu tür merkezlerin amaçları nedir
Ö: Tanıtım amaçlıydı. Bence insanlar içeride bir etki görebilirler.Bu nedenle yardım amaçlı açmışlardır bu merkezi.Bir de o ürünü daha sonra alsınlar diye satma amaçlıdır.Şimdi tanıtım yapıyorlar ki sonrasında insanlar beğensin ve alsın.
G: Sence insanların bu tür tedavilere yönelmelerinin nedenleri neler olabilir.
Ö: Bilmem hani daha inandırıcı gibi sanki. Hani doktora gidiyorsunuz doktor ilaç veriyor veya ameliyat ama burada taşlarla tedavi olabiliyorlar.Daha kolay geliyor bence insanlara.Çünkü orada taşlar hakkında bilgiler veriyorlar. Sonra örnekler veriyorlar, bu kişi buraya geldi bu taşı kullandı, bu yatağa yattı ve iyileşti gibi örnekler veriyorlar. Oradan bazı insanlar da benim yakınım da böyle oldu, iyileşti gibi şeyler söylüyorlar.Öyle oluyor. Bunları duyunca daha inandırıcı geliyor sana da.
4) 12 Y
Ö: Taşları tanıtmak olabilir. Çünkü az önce de dediğim gibi bu taşların satıldığı yerlerde tanıtım kağıtları bulunuyor.

G: Neler yazıyor bu kağıtlarda
Ö: Taşların özellikleri yazıyor. Yani bu taşı kullanırsan neye iyi gelir, seni nasıl rahatlatır diye
G: Yani bu şekilde insanlara tanıtıyorlar diyorsun. Başka amaçları olabilir mi
Ö: Tanıtıyorlar işte. Tanıtıyorlar ki daha çok kişi bunları kullansın. Daha çok kişi tedavi olsun.
5) 5D
Ö: Bir merkez açılmıştı. Makineler filan vardı.Onun içinde de mıknatıs gibi taşlar vardı.Hastalar yatıyorlardı orada.Tedavi oluyorlardı.Ücretsizdi.
G: Neler yapılıyordu merkezde
Ö: Bel fıtığıyla veya kemiklerle ilgili ve de taşlarla ilgili konuşma yapıyorlardı. Tanıtıyorlardı yani bir önceki seans bitene kadar. Sonra bir sonraki seans için bekleyenleri alıp konuşuyorlardı. Epeyce de kalabalıktı.Taşların ne işe yaradığını anlattılar bize.Orada kullanılan taşları tanıttılar.
G: Sence böyle bir merkez kurmadaki amaçları nelerdir?
Ö: Taşları insanlara tanıtıyorlar, taşların zararsız olduğunu ve insanları iyileştirebileceğini anlatıyorlar.
6) 6F
Ö: Bence insanlara yardım etmek istiyorlar.
G: Nasıl
Ö: Bu taşlar hakkındaki bilgilerini başkalarıyla paylaşıyorlar. Yani başka insanlar da bilsin ve kullansın istiyorlar.Kendileri gibi doktorlara güvenmeyen başka insanlar varsa bu taşları kullanabilirler diyorlar.
G: Neden böyle birşey istiyor olabilirler
Ö: Bir nedeni yok aslında kendileri gibi olan insanlara tavsiyelerde bulunuyorlar sadece.
7) 12Y
Ö: Annem her gittiğimiz yerden alıyor bu taşlardan. Sinir boşaltıyormuş.Bana biraz saçma geliyor böyle şeyler.Ama benim de evde görüntüsü filan hoşuma gidiyor.Anneme soruyorum ben arada sırada neden böyle şeyler alıyorsun diye, hoşuna gidiyormuş.İnanıyor öyle şeylere.
G: Neye inanıyor?
Ö: Annemin anlattığına göre onlar sinirleri boşaltıyormuş, negatif enerjiyi alıyormuş. Hastalıklara iyi gelebiliyormuş bazıları.Bazıları da zararlıymış.Onların pek ismini bilmiyorum.Hani sergiler açılıyor ya, sergilerde sorduk.Kitabı da vardı hatta orada.Kare kare bilgiler yazıyordu.Hatta ben boğa burcuyum.Annem bana da almıştı ondan.Eve gidince de internetten araştırdı annem.
G: Başka neler duydun taşlarla ilgili
Ö: Adı pek aklımda değil ama. Bir de biz bir gün bir yere gitmiştik.Orada masaların üstünde doğal taşlardan biri vardı.Negatif enerjiyi alıyor dediler. Böyle zamanla kararıyormuş kendi kendine o taş negatif enerjiyi aldığı için.
G: Senin çevrende doğal taşlarla ilgilenen insanlar var. Senin bu konudaki fikrin nedir?
Ö: Biz uzun süre durmadık orada ama gidip baktım ilgimi çekiyordu. Kenarları beyazdı, üstü mordu.Gittikçe siyahlaşıyordu.Doğru olabilir.
8) 3C
Ö: Bence amaçları ticari kazanç
G: Nasıl

Ö: İyileştiriyor mu iyileştirmiyor mu bilmiyorum ama ticari kazanç sağlamak istiyorlar. Bu yüzden siteler kuruyorlar.Bu sitelerde taşların özelliklerini anlatıyorlar.Şu hastalığa iyi gelir bunu iyileştirir diyorlar.
G: Ticari kazanç sağlamaya çalışıyor olabilirler diyorsun. İnsanlar neden etkisini bilmediği bir şeyi alsın ki.
Ö: Öncelikle inanıyorlar, denemek istiyorlar. Belki hastalığımın tedavisi bundadır diye deniyorlar.Öyle olunca da insan bir umut deniyor.
G: Başka amaçları olabilir mi
Ö: Olamaz bence. Sadece insanların duygularını sömürerek para kazanmak istiyorlar.
9) 11T
G: Az önce internette taşların satıldığını gördüğünü söyledin. Sence bu kişilerin amaçları neler olabilir.
Ö: Bence elbet bir yararını görmüşlerdir ki bu şekilde satışa sunabilsinler. Bence yalan söyleyecek halleri yok.Bence taşların amaçlarını yani neye yaradığını bilerek satıyorlardır diye düşünüyorum.Taşların belli bir amacı var ki satıyorlar.
G: Amaçları ne peki

Ö: Bence bilimsel araştırma veya bilimsel bir deney yapılabilecek bir konu da değil. Tansiyon düşerse her türlü düşer. Bence hani bunu satan kişiler de satıcılar da böyle düşünerek satmaya başlamış olabilir.
G: Nasıl düşünmüş olabilirler
Ö: Bu taşları satıyorlar. İnsanlar da alıyor.Ama tansiyonları düşmüyor.Satıcılar da sen böyle böyle yapmışsındır da tansiyonun düşmemiştir demek için de satıyor olabilirler bu taşları.Yani aslında kandırıyorlar insanları. Olmayınca da sen yapamamışsındır diyorlar.
10) 9M
Ö: Hani şöyle bir şey vardır. Bütün deneyleri fareler veya diğer hayvanlar üzerinde denerler ya hani adam aslında başka bir şey üzerinde giderken, bir bakmıştır ki orada başka bir şey var. Zaten icatlar da hep böyle çıkmıştır. Adamların kendi ihtiyaçlarından doğan şeylerden çıktığı için yani adam evinde bulunduyordur ama onun ne olduğunu bilmiyordur. Sadece bir süs veya aksesuar olarak kullanıyordur.Ama gittikçe onun kendisine yararı olduğu veya o varken kendini daha iyi hissettiği ortaya çıkmış olabilir. Hani Graham Bell telefonu neden icat eder. Konuşmayı daha da kolaylaştırmak için.Belki de bunlar da tedavilerin taşlarla nasıl kolaylaşacağını göstermek için yapmış olabilir. Hani bunu ortaya çıkaran kişi kendisine bir etkisinin olduğunu görüyor da çıkarıyordur.
11) 3C
G: Sence insanlar bu tür bilgilere nasıl bir araştırma süreci sonunda ulaşmış olabilirler.
Ö: Taşları inceleyerek.
G: Nasıl bir inceleme yapmışlardır sence.
Ö: Taş nasıl birşey. İçinde neler var. Atomları nasıl.Enerji yayıyor mu yaymıyor mu incelemişlerdir.Böylece birçok şey ortaya çıkar. Böylece söylendiği gibi etkli mi değil mi anlaşılır. Sonrasında da insanın derisinde denemişlerdir ortaya çıkanları göstermek için.Bir yüzük veya kolye şekline getirip denemişlerdir.Bu deneme süresince olanlara bakmışlardır.Böylece ona inanmışlardır.
12) 10S
G: Sence bu bilgiler nasıl bir süreç sonunda elde edilmiş olabilir.

Ö: İnsanlar üzerinde denenmiştir. Ona göre gruplanmıştır.Öyle olmuştur.
G: Peki nasıl bir deneme süreci bana anlatabilir misin?
Ö: Bence ilk önce bu taşlar bulunmuştur. Ondan sonra taşlar iyice araştırılmıştır, bakılmıştır.
G: Neyine bakılıyor işte, nasıl bir araştırma bu?
Ö: İnsanlar üzerindeki etkilerine bakılmıştır.
G: İşte o etkiye nasıl balkıyor.
Ö: Bunu sizin üzerinizde kullanırım. Size sorarım iyi geliyor mu gelmiyor mu diye.Sadece bir kişiye sormam tabi on kişiye sorarım. Mesela 10 kişiden 9'u iyi geliyor derse bu taş iyi demektir. Ondan sonra da ben taşı sürerim piyasaya insanları tedavi ederim. Mesela mercan taşı diyor burada, sedef hastalığı olan bir arkadaşımı çağrırım onun üzerinde denerim mesela, al bunu kullan bir hafta sonra geri gel derim. Düzenli kullanması için uyarırım.Doğru düzgün kullanmışsa ve sedef hastalığı yoksa yani bitmişse ben doğru olduğunu düşünürüm.Bu taşların özelliklerini bulmamız için de bir sürü deneme yapmamız lazım.Mesela hastalıklı olana, sorunu olana bunları denemek lazım.

13) 14Z

G: Sence taşların böyle özellikler gösterdiğini iddia eden insanlar nasıl bir araştırma süreci sonunda bu tarz bilgilere ulaşmış olabilirler.
Ö: Denemiş olabilirler bir süre boyunca ama tam olarak bilmiyorum. Onlar denediyse ve iyi geldiyse iyidir.
G: Sence nasıl bir deneme yapmışlardır bununla ilgili.
Ö: Vücudumun bir tarafına koyardım herhalde taşı, beklerdim belli bir süre. İyi geliyorsa kalırdı.
G: Ne kadar beklerdin mesela
Ö: 5-10 dk beklerdim iyi geliyorsa geliyordur zaten, o süre içinde görürüm. Gelmiyorsa da bırakırdım.
G: İyi gelip gelmediğini nasıl anlardın.
Ö: Tansiyonum çıkmışsa ve tansiyonumu indirdiyse iyi gelmiştir.
G: Yani tansiyonun çıktığı anda mı denemek gerekiyor.
Ö: Tabi öyle bir durumda denemek gerekiyor yoksa anlayamazdım nasıl etkili olduğunu

14) 8K

G: İnsanlar taşların bu tür etkiler gösterebileceğini iddia ediyorlar. Sence nasıl bir araştırma sonunda böyle bir iddiada bulunabilirler.
Ö: Bence bir adam hastaymış. Almış taşı.Hastalığının geçtiğini hissetmiş.Yani geçmiştir ondan sonra hastalık.Sonrasında da böyle düşünmüş olabilir.
G: Taşı alıp kullanmıştır ve sonrasında hastalığının geçtiğini mi düşünmüştür.
Ö: Evet ama belki hastalık zamanla zaten geçecek. Bu nedenle mantıklı gelmiyor.Yani zaten hastalık zamanla geçiyordur yani tesadüf olarak taşı almıştır aynı zamanda.Buna dayanarak taşın sayesinde geçtiğini düşünmeye başlamıştır.Aslında taşla hiçbir ilgisi olmamasına rağmen.

15) 5D

Ö: Eğer taşı doğru yere getirmişse hani burada kalbine getirmiş ya veya başka bir şekilde olması gerekirken yapmamışsa sadece kalbine yapmışsa faydalı olmaz ama eğer kalp doğru bir yerse ve her şeyi doğru bir şekilde yaptıysa faydalı olmuştur.
G: Sence böyle bir araştırma araştırmacının iddiasını test etmesi için uygun bir araştırmamıdır.

Ö: Hani hiçbir bilgi bilmezken ilk bir deneme olarak uygundur ve bunu denedikten sonra ileriki aşamalara gitmek için uygundur.
G: Hangi yönleriyle uygundur mesela.
Ö: Aslında yüksek tansiyona sahip hastaları bulması çok iyi. Yoksa başka türlü tansiyona iyi gelip gelmediğini anlayamazdı.Bu nedenle tansiyon hastalarını bulması olumlu bence.Ama bilmediğim için tam konuşamıyorum kalbe mi tutulacak başka bir yere mi.
G: Nereye konulacağı önemli demek istiyorsun sanırım.
Ö: Evet belirli bir bölge varsa oraya konulmalı. Yoksa işe yaramaz.Nasıl uygulanması gerekiyorsa öyle uygulanmalı yoksa etkisi olmaz.
16) 6F
Ö: Bence bu doğru bir yöntemdir. Çok iyi bence.
G: Neden böyle düşünüyorsun
Ö: Ellerinde tutuyorlar bu taşı yani zarar verecek bir şey yok. Kalplerinin yakınına koymalarını istemiş.Yani zararlı bir şeyi yok.Bu nedenle uygun.İnsanlara zarar vermiyor.Doğal bir şeyi kullanıyor.En azından onlardan birşey yiyip içmelerini istememiş. Hap veya ilaç vermiyor.
17) 4C
Ö: Taşın tansiyon üzerinde etkili olup olmadığını test etmek istiyor ve edebilir bu şekilde.
G: Neden böyle düşünüyorsun
Ö: Yüksek tansiyonlarını ölçer ve farka bakabilir
G: Hangi farka
Ö: En baştaki tansiyonuyla sonrakine, hani düşüş olursa gerçekleştirmiş olur amacına ulaşır bence.
18) 14Z
Ö: Bu aslında az önce benim dediğim gibi bir araştırma. Bu araştırmanın bir eksiği yok bence, çünkü zaten deniyor.Deneyim sonucu yapıyor yani.Öyle kafasına göre söylemiyor.Bir yerlerden okuyup bize anlatmıyor.
G: Daha başka neler yapılabilir bu konuda
Ö: Belki önce bilgi edinirdim. Ona göre deneyim yapardım.Sadece deneyim de olmaz aslında.
G: Acaba deney ve deneyimi karıştırıyor olabilir misin. Bir deney var bir deneyim var.
Ö: Yok, farklı aslında ikisi
G: Senin burada ifade etmek istediğin hangisi
Ö: Deneyim. Bir şeyin gerçek olup olmadığını deniyorsun.Diğerinde ise bulmaya çalışıyorsun yani deneyle.Aslında farklı.
19) 7G
Ö: Bence gerçekten olumlu bir sonuç elde edildiyse araştırmanın doğruluğu ispatlanmıştır. Yani doğru bir araştırma ve doğru bir yöntemdir eğer olumlu sonuç varsa. Sonuç olumluysa bu bilimsel bir araştırmadır.Muhtemel sonuç olumludur zaten.
20) 13Z
Ö: Bence çok iyi bir araştırma. Çünkü bir kişinin değil birçok kişinin üstünde araştırma yapıyor. Bir kişinin üstünde olsa inanılmaz belki ama birçok kişinin üzerinde etki ettiyse bence olabilir. Birçok kişi üzerinde deniyor. Tesadüfe bırakmıyor yani.Gerçek bir araştırma.

G: Sen nasıl bir araştırma yaparsın.
Ö: Birçok kişinin üstünde test ettiği için ben de aynı şeyi yapardım heralde.
21) 12Y
Ö: Bence 15 kişi bu iddiayı öne sürmek için az. Daha fazla kişiyle çalışırsa daha inandırıcı gelebilir. Bence tansiyonları aşağıda çıkarsa bence iyi bir çalışma olduğunu belirtir.Yani akik taşının tansiyona iyi geldiğini burada öne sürmüş.Denedikten sonra tansiyonuna iyi geldiyse çok iyi bir şey çıkabilir ortaya.Bence iyi bir araştırma olur.
G: Sen nasıl bir araştırma tasarlardın, senin araştırman nasıl olurdu?
Ö: Benim araştırmam baya kişiyle yani 15-20 kişi değil de 50 kişi ile aynı bunun gibi yapabilirdim. Avuçlarına taşı koyarak tansiyon nasılsa kalpten geldiği için kalbine yakın tutmalarını isteyerek denemeye çalışırdım. Bir saat değil de iki saat olarak denerdim. Ve bu iki saat boyunca herkesin basında durarak sürekli not alırdım.
G: Neyi not alırdın.
Ö: Nasıl gidiyor, iyi geliyor mu diye sorular sorabilirim. Tansiyonunuz nasıl kendinizi iyi hissediyor musunuz gibi sorular sorarak notlar alırdım.
22) 2B
Ö: Bence 15 kişi olması iyi mantıklı bir şey. Ama bir saatte neleri dengeleyebilirsiniz veya ne kadar sürede siz tansiyonunuzu dengeleyebilirsiniz bilmediğim için tam olarak yorum yapamıyorum. Süre konusunda daha çok bilgi verilmeliydi.
G: Mesela şöyle olsa zaten bir saat içinde tansiyon kendiliğinden dengeleniyor olsa ne yorum yaparsın
Ö: Eğer bir saat içinde kendi kendine dengeleniyorsa bu akik taşına gerek yok. Boşu boşuna 1 saat elinizi kalbinizin üzerinde yormuşsunuzdur.Ama daha kısa sürede dengeliyor da olabilir.
G: Peki bahsettiğin bu zayıf yönleri telafi etmek için nasıl bir araştırma yapabiliriz.
Ö: Daha kısa sürede bu taşın etki edip edemeyeceğini araştırmalı. Veya bir saat değil de birkaç gün veya birkaç hafta kalbinin yakınlarında dursa tansiyonunun çıkıp çıkmayacağını öğrenebilir. Bu daha mantıklı bir araştırma olur bence.
G: Bahsettiğin gibi bir araştırma yaptıktan sonra gerçekten akik taşı tansiyonu dengeler veya dengelemez diyebilir miyiz.
Ö: Birkaç gün boyunca akik taşı sizin kalbinizin yakınlarındaysa ve tansiyonunuz hiç çıkmadıysa bunu anlayabiliriz. Böylece taş etkili olmuştur diyebiliriz.
23) 7G
Ö: Doğru bir araştırma gibi aslında. Belki olumlu bir etki göstermiş olabilir.Ama aslında kafamda bazı soru işaretleri var. Gerçekten tansiyon hastalığına iyi geliyorsa gerçekten kendini tansiyon hastalığına adamış doktorlarımız var. Onlar neden bu taşlarla tıbba yakın şeyler yapmadılar diye düşünürüm.
G: Neden acaba.
Ö: Belki doktorlar gerçekten bunların işe yarıyor olabileceğini düşünmüyor olabilirler. Bu taşların etkili olabileceğine inanmıyor olabilirler.Akıllarına bile getirmedikleri için hiç denememiş olabilirler.Aslında etkili olduğuna inansalar daha iyi araştırmalar yapabilirler.
24) 1A
Ö: Ama mesela benim düşündüğüm bir şey var bu taşın bir etkisi vardır belki ama belki de beyin gücüyle alakalı bir şey de olabilir. Hani buna inanırsın. İnandığını düşündükçe böyle bir şey gerçekleşiyor olabilir
G: Tamam, peki bunu nasıl test edebiliriz.

Ö: Mesela 15 kişi toplamış. 8'ine derki ben böyle bir taşla uygulama yapacağım ve ben inanıyorum ki bu taş sizin tansiyonunuzu düşürecek, bu gerçekten olacak diyecek. Diğer 7'sine de bu bir tedavi diyecek ve akik taşından bahsetmeyecek.Belki böyle ayırt edebilir.Bir grup bilerek kullanacak, diğer grup bilmeden.
G: İkinci gruba da yine bir akik taşı verecek mi
Ö: Evet evet. İki grup da taşı kullanacak.Böyle bir şey olabilir.Gerçekten o zaman akik taşının yararlı olup olmadığını anlar.
25) 2B
Ö: Ben yakınıma hemen önermek yerine önce kendim bunu kanıtlamaya çalışırım. Mesela televizyonda programlar var annemin hergün izlediği, her öğlen eve gittiğimde açık olan.Bir hoca var orada doktor gibi.Otlardan bahsediyor ve herkes arıyor.Bende öyle birini bulup ona sorabilirim.Çeşitli kişilere sorup rapor hazırlarım.İnternetten çeşitli sayfalara bakarak rapor hazırlarım.
G: Bunu test etmek için nasıl bir araştırma yaparsın peki
Ö: Araştırırken ben genellikle şöyle yapıyorum. Akik taşının olumlu etkileri ve akik taşının olumsuz etkileri olarak yazarım.Eğer olumsuz etkileri çok absürt geliyorsa bunu uygularım.Ama olumlu etkileri çok küçük şeyler ve olumsuz etkileri de gerçekten ciddi şeylerse bunu araştırmaya devam ederim.
G: Araştırmaya devam ederim derken ne kastediyorsun
Ö: Bizim orada bir kadın var ve bahçesinde her türlü ot yetişir. O genelde alternatif tıp konusunda her şeyi bilir. Ona sorarım ve televizyondaki çeşitli doktorlara sorarım.Bu taşlar hakkında bilgi edinen insanları araştırıp onları ararım.Yani uzman kişilere danışırım.Eğer gerçekten ciddi bir şeyse yani insanlar fayda görmüşlerse bunları kullanırım.
26) 14Z
Ö: Önce yakınlarıma danışırdım. Sonra bir uzmana danışırdım heralde.
G: Uzman kim olurdu. Ne ile ilgili uzman
Ö: Genelde bu rahatsızlıkları tedavi eden doktorlardan bilgi alırdım yardımcı olmaları için.
Yani bunun hakkında birkaç araştırma yaparım.Dediğim gibi uzmanlara danışırım böyle bir şey var mı gerçek mi diye.Taşlarla ilgilenen kişilerle konuşurum.
27) 7G
Ö: Ben ilk olarak kimlerin kullandığını araştırırım. Yani kimler tarafından kullanıldığını.Daha sonra onların yanına gidip gerçekten bir faydası olup olmadığını sorarım.Çünkü onlar birebir kullanıp görmüşlerdir. Daha sonra aldığım bilgilere göre gerçekten olumlu olabileceğini düşünüyorsam denemekte fayda var deyip denerim.
G: Neye göre karar verirsin
Ö: Açıkçası kullananların çoğu olumlu etki gördüğünü söylerse ben de kullanmayı tercih ederim. Çoğu yok kullanma işe yaramdı derse kullanmam.
G: Peki bunu test etme ihtiyacı hisseder misin
Ö: Sadece sorarım insanlara. Sorarak bilgi toplarım deneyen kişilerden.Sorarım ki mesela doktoru bu konuda ona ne söylemiş.Yani doktorlar da tansiyon rahatsızlığı konusunda uzman oldukları için bir doktora da danışırım gerçekten bir faydası var mı yok mu diye.Ama öncelikli olarak deneyen kişilere danışırım.
28) 1A
Ö: İnternetten araştırmalar yaparım. Zaten televizyonlarda bahseden programlar var, onları dikkatlice izlerim.Böyle şeyler yaparım.Araştırma yaparım yani daha çok genellikle.

G: Araştırma derken ne kastediyorsun
Ö: Yani televizyondan veya internetten olumlu veya olumsuz özellikleriyle ilgili bilgiler toplarım. Oradaki bilgiler kendimce yorumlarım.
G:Nasıl karar verirsin
Ö: Genellikle olumlu etkiler olacağını söylüyorlarsa anneanne kullan derim. Ben kullan desem kullanır yani.Zaten çok izliyor böyle programları.
29) 9M
Ö: Zaten ben bunu tavsiye ediyorsam benim de bir bildiğim vardır. Ben bunu tavsiye ediyorsam derim ki ben de kullandım, sen de kullanabilirsin. Ama kullanmadıysam da önüne bir sürü bilgi sunarım, kanıtlamak amacıyla. Mesela uzmanlar tarafından söylenen bir sürü bilgi var ve buları okursan veya öğrenmeye çalışırsan bunun ne kadar iyi olduğunu anlayabilirsin. Bir sürü kitap var bunların iyi olduğunu gösteren.Denemekten zarar gelmez.
G: Ama deden gerçekten bunu test etmek istiyor.
Ö: Test etmek istiyorsa o zaman kullanacak. Başka yapacağı bir şey yok. Ben kullandım ve çok güzel yararlı derim. Ama bana inanmıyor olabilir bu nedenle kendisi alıp test eder çalışıyor mu çalışmıyor mu diye. İyi mi kötü mü diye.Ben bunu ne yiyeceğim ne de yutacağım.Bu burada duracak.Ben bu taşı alıp yanıbaşıma koyduğumda bana bir zararı olamayacak yani.Denemekten zarar gelmez. Bu nedenle ben de dedeme alıp kullanması söylerim. Alıp kullanacak ve kendi görecek etkisi olup olmadığını.Zaten etkiliyse dedem mutlaka hisseder onun etkisini.Yani tansiyonu düşer zaten.Tansiyonu düşerse zaten taşın etkili olduğunu anlamış olur.
30) 14Z
Ö: Yatmasını öneririm önce, sonra taşı belirli bir yerine koymasını söylerim. Bir süre kıpırdamadan durmasını isterim.Zaten iyi geliyorsa gelir.
G: İyi gelip gelmediğini nasıl anlayacaksın
Ö: Zaten iyi geliyorsa kendi hisseder iyi olduğunu. Zaten etkili olduğu söyleniyorsa etki eder heralde. Zaten tansiyonu düşer sanırım kullanınca.Gelmiyorsa da zaten yalandır. Gerçek değildir deyip bırakırız.
31) 12Y
Ö: Benim babaanneme diyeceğim tek bir şey olur. Denesin, iyi gelirse devam etsin. Bir yıla kadar bence bunu üstünde sürekli denemesi gerekir. Birkaç ayda ekti göstereceğini pek düşünmüyorum. Bunlar sonuçta taş. Ama hani yine de bunların rahatsızlığına iyi geldiğini söyleyen kişilerle de oturup konuşmasını tavsiye ederim.
G: Deneme derken ne kastediyorsun tam olarak anlamadım.
Ö: Alsın akik taşını kullansın üzerinde nasıl diyorlarsa ne şekilde yapılacaksa, zaten anlatırlar ona göre. Denesin, uzun bir zaman içinde kendisini iyi hissediyorsa tansiyonu çıkmıyorsa, arada sırada çıkabilir sonuçta bu bir taş olduğu için. Babaannemin bence kendi üzerinde deneyip iyi gelirse devam etmesini tercih ederim.
32) 6F
Ö: İşe yarayıp yaramadığını ancak kullanarak test edebilir. Başka türlü test edemeyiz. Alır kullanır.İyi geliyor mu gelmiyor mu diye bakar.
G: Nasıl kullanmalı peki.
Ö: Önce bir nasıl kullanılması gerektiğine bakar. Bunları öğrenir.Ondan sonra kullanmaya başlar.
G: Taşın etkili olup olmadığını nasıl test edecek.
Ö: Cihazları var tansiyonun onunla ölçer kullandıktan sonra. Daha doğrusu kullanmadan önce bir ölçeriz sonra kullandıktan sonra bir daha ölçeriz.İkisi

arasındaki farka bakarak karşılaştırırız. Ona göre karar veririz taş etkili olmuş mu olmamış mı.
33) 11T
Ö: Ben öncelikle birçok yerden bilgi edinmeye çalışırım. Tek bir yerden bilgi edinerek olacak bir şey değildir bu bence.Çevremde bu taşı kullanıp yararını gören insanlardan bilgi edinmeye çalışırım.Birçok kişiyle konuşurum kullanmış olanlarla.Olumlu sonuç gördülerse ben de kullanmaya başlarım.
G: Bu fikri test etmek için bir araştırma yapacak olsan ne yaparsın
Ö: Yani herkesin denemesi gerek. Bunun için başka türlü bir bilimsel araştırma bilmiyorum.Tansiyon hastalarına mesela.Çünkü tansiyona iyi gelir deniyorsa tansiyon hastaları denemeli bu taşları.Yoksa anlayamayız etkili olup olmadığını Herkese bunlardan kendilerinin kullanmasını söylerim.Alırlar kullanırlar.Hastalıklarının geçip geçmediğine bakarlar.
G: Biraz daha detaylandırır mısın
Ö: Tansiyon hastalarını davet ederim. Bir taş almalarını ve kullanmalarını isterim. Kullandılar. Olumlu sonuç alırsam yani birçok kişi olumlu sonuç aldığını söylerse bu bilgi güvenilirdir diyebilirim. Yani %100 güvenilir diyemeyiz ama çünkü elimizde kanıt yok ama yine de bize epeyce fikir verir.
G: Neden diyemeyiz.
Ö: %100 garanti mi değil mi diye bakmamız için dünyadaki tüm tansiyon hastalarına denettirmek gerekiyor. Bence hepsinde işe yarıyorsa o zaman bu taş kesin etkilidir diyebiliriz.
34) 7G
Ö: Gerçekten beni etkilediyse yani konsantrasyonumu etkilediyse gerçekten bir olumlu etkisi olduğunu düşünürüm, kullanmaya devam ederim demekki işe yarıyormuş diye düşünürüm.
G: Bu taşın gerçekten konsantrasyonu sağladığını düşünmene neden olan nedir
Ö: Taşı zaten kullanan benim. Zaten onun etkisini kendi üzerimde göreceğim. Yani bir kitaptan veya başka bir yerden okumak gibi değil ki.
G: Peki bu taşın konsantrasyonun üzerinde işe yarayıp yaramadığını nasıl test edersin.
Ö: Taşı ders çalışırken kullanırım. Zaten daha önce artırdığını hissetmişsem yine artıracaktır.
35) 14Z
Ö: Etkili oluyorsa mercan taşı konsantrasyonu artırır derim
G: Nasıl bu düşünceye vardın
Ö: Birkaç deneme de olsa iyi geldi. Ben de iyi geldiğini düşünürüm böylece.
G: Peki seninle aynı fikirde olmayanlar olacaktır
Ö: Başka biri üzerinde tekrar ispatlarım heralde.
G: Ya etkili olmazsa
Ö: O zaman kimseyi inandırmaya çalışmam. Benim için işe yaraması yeterli.Ben kullanırım.
36) 11T
Ö: Eğer o taşı öyle olacak diye aldıysak yani böyle bir şeylere faydasın olduğuna inanıp, zaten psikolojik olarak böyle oldu diyebiliriz. Mesela yanımda duruyor ve konsantrasyonum arttı.Artmasa da arttı diyebiliriz psikolojik olarak.
37) 2B

Ö: Hiçbir şey kesin değildir. Belki de ben kendimi psikolojik olarak ona inandırmışımdır.Aslında taşın hiçbir etkisi yoktur.Sadece siz ona psikolojik olarak inandığınız için o size katkı sağlıyordur.

38) 13Z

Ö: Mercan taşının konsantrasyonu artırması. Genellikle, olabilir aslında.Konsantrasyona iyi gelebilir.Ama iyi gelmeye de bilir.Yani kesin değildir.Ben birkaç kez deneyimledim diyerek buna dayanarak konsantrasyona iyi gelir diyemem.Biraz temkinli davranırım, inanmam.Birkaç deneyim yetersiz.Ben daha çok bilimsel kanıtlanmış şeylere inanırdım. Deneysel değil de daha çok bilimsel çünkü kesinlikle kanıtlanmış şeylerdir. Yapılan bir şeyin derinine doğru yapılan bir şeydir bence bilim.Ben daha çok araştırırım inanmadan önce.

39) 3C

Ö:Böyle bir durumla karşılaşınca insanların gözü önünde bitkimin neden büyümediğini açıklarım. Gösteririm onlara deneyimi.Belki yapabilirsem deneyip kamera ile kaydederim.Bitkide neler gözlemlediğimi, o bitkinin neden büyümediğini açıklarım.

40) 12Y

Ö: Benim yapabileceğim şey birkaç kişiyle görüşürüm nasıl yapabiliriz diye bilgi alırım. Nasıl anlatsam yaptığım şekilleri gösteririm.Yaparken notlar alırım.Notları onlarla paylaşırım. Bir hafta geçti iki hafta geçti, üç hafta geçti diye fotoğraf çekip fotoğraflarla durumu kaydederim. Fotoğraflarda bir gelişme gözükmüyorsa normal bir çiçek gibi büyüyorsa bunları sunarım, değişim yok derim. Ama Zeynep'in dediği gibi olursa da desteklemeye devam ederim.

41) 1A

Ö: Birincisinde olmamış, ikincisinde olmamış, üçüncüsünü yaparım. Yani daha çok deneme yaparım ve bunun hakkında notlar tutarım böyle böyle diye.Ben hani bir internet araştırma sayfasından gördüm ve uyguladım ve hiçbir işe yaramadı diye açıklama yaparım.Ben de bir internet sitesinde sunarım bu açıklamayı.Evet böyle yaparım.İnsanları internet yoluyla bilgilendiririm.

G: Nasıl bir deneme yaparsın.

Ö: Burada anlatıldığı gibi

G: Değişiklik yapma ihtiyacı duyar mısın

Ö: Ama değiştirirsem ikimizin deneylerini karşılaştıramayız ki

42) 4C

Ö: Ben kendime kendi yaptığıma güvenirim. Sonuçta onu canlı olarak görmedim sadece biryerden okudum.Ama kendim yaptım, o yüzden kendime güvenirim.Canlı olarak görseydim onunkini şahit olsaydım belki tam olarak bir şey diyemezdim ama sadece okudum sonuçta.Bu nedenle benimki doğrudur.

43) 4C

Ö: Bu bilgiler birçok insana inandırıcı ve güvenilir geliyor. Hani heryerde varsa, daha çok inandırıcı ve daha güvenilir gelir sanırım.Hani heryerde karşıma çıkarsa, birkoç yerde duyarsam daha çok güvenirim.

44) 2B

Ö:Ben denemeden hiçbir şey hakkında yorum yapmayı sevmem. Ama bunlar olabilecek şeyler bence.Sonuç olarak daha önce de otlar hakkında anneannem bu tür şeyler söylemişti.Yapmıştı yani kullanmıştı ve ağrılarına iyi geldiğine ben şahit oldum.Bu nedenle taşların da aynı etkileri gösterebileceklerine inanıyorum.Bana göre oldukça güvenilir bilgiler bunlar.

45) 8K
Ö: Çok güvenilir açıklamalar değil bence.
G: Neden güvenilir gelmedi sana
Ö: Mantıklı gelmiyor açıkçası bana bu tür bilgiler.
G: Neden mantıklı gelmedi.
Ö: Sonuçta bir taş yani. Bir taş nasıl bu kadar etki gösterebilir ki. Çok saçma. Hastalıklara nasıl iyi gelebilir ki bir normal taş. Benim içimdeki hastalığı nasıl etkileyebilir ki.
46) 14Z
Ö: Ben aslında çok güvenilir bilgiler olarak görmüyorum bunları. Ayrıca etkili olduğunu da düşünmüyorum.Bir taşın aslında bunları yapabileceğini sanmıyorum. Doktorlar bir şey yapamazsa taş hiçbir şey yapamaz. Ben öyle düşünüyorum. Basit bir taş sonuçta. Bence mantıksız. Nasıl beni olumlu düşündürecek ki. Taş yani.
47) 1A
Ö: Aslında ben tercih etmem. Güvenmiyorum pek.Hani uykusuzluğa iyi geldiği söyleniyor, ben de onu duymuştum.Akik taşının sadece uykusuzluğa iyi geldiğini biliyorum ben.Diğerleri pek inandırıcı gelmiyor.Olabilir ama yine de.
G: Neden güvenmiyorsun
Ö: Aslında benim anneannem bu akik taşını kullanmıştı. Tansiyonu var anneannemin.Ağrıları da oluyor sık sık.Anneannemin üzerinde işe yaramadı.Anneannem bunu kullanmasına rağmen olumlu bir şey olmadı.Aslında anneannemin üzerinde işe yaramadığı için biraz da güvenmiyorum bu tür şeylere.Ama annem halen inanmaya devam ediyor.
48) 1A
Ö: Burada son cümlede dediği gibi "sardunya bitkisinin güneşe doğru yönelmesi gerekirken kuvars kristaline doğru yöneldiğini ve büyümeye başladığını gözlemledi" bu inandırıcı geldi bana. Hani böyle şeyler olabilir diye düşünüyorum.
G: Neden böyle düşünüyorsun
Ö: Güvenilir geldi bana. Çünkü kendisi uygulamış bunu ve işe yaramış.Bu nedenle güvenilirdir diye düşünüyorum.Burada öyle yazıyor çünkü. Hani güneşe tuttuğunda güneşim etkisinin çok az olduğunu görmüş ama kuvars kristalini koyunca büyüme ona doğru yönelmiş ve daha da gelişmeye başlamış. Bunlardan etkilendim. O yöne dönmesi nedeniyle ondan bir enerji aldığını düşünüyorum.
49) 6F
Ö: Bu sefer denenmiş işte. Yani öyle sadece bir söylenti bir iddia değil. Birebir denemiş. Televizyonda izlediği programdaki gibi yapmış denemiş ve taş etkili olmuş çiçeğin büyümesine. Etkili olmuş ki bunu anlatmış.
G: Neden böyle düşünüyorsun
Ö: Mesela bu Zeynep denemiş ve olmuş. Bunu gözlemlemiş.Bunları not etmiş ve bize anlatmış. Bu beni etkiledi. Yani sadece bir söylenti değil artık. Kız bunu denemiş ve gerçekten olduğunu görmüş.
G: Bazı insanlar Zeynep'in yaptığı uygulamanın ve elde ettiği bilgilerin güvenilir olmadığını söylemektedirler. Senin düşüncelerin nelerdir?
Ö: Burada denediğini ve çiçeğin gerçekten büyüdüğünü belirtmiş. Yani bu bilgi kesindir,güvenilirdir. Mesela ben de televizyonda işe yaradığını görürsem gerçekten bunlar oluyor, işe yarıyor diye düşünürüm.Kesindir yani bu. Gerçekten olmuş.
50) 12Y

Ö: Babaanneme iyi geldiğini biliyorum. Hatta şimdi hatırladım, bir programda annem izlerken görmüştüm kristalin hani doğal taşların iyi geldiğini anlatıyordu.Şimdi burada da böyle bir hikaye okudum.Birçok şey duymuş oldum hakkında ve bu nedenle bana güvenilir geliyor.Bundan dolayı inanıyorum bu taşların etkili olduğuna.

51) 5D

Ö: Bence aslında münkün böyle şeyler. Çünkü bu denendiğine göre ve böyle bir bilgiye de ulaştığına göre denenmiş ve doğru bir şeydir.Kesindir yani bu bilgi.

G: Neden böyle düşünüyorsun

Ö: Burada zaten bundan öncesi ve sonrası diye araştırma yapıp not tutmuş yani bir araştırma yapmış. Tıpkı bilimsel bir araştırmadaki gibi bir deney yapmış.Bir de sonrasında değişim olmuş diye bakmış yani bunlardan dolayı güvenilir geliyor bana.Birebir denemiş.Deneyerek aslında duyduğu bilgileri netleştiriyor.Artık kesin olarak işe yarayıp yaramadığını söyleyebilir.Bilimsel bir araştırma yapmış çünkü.

52) 8K

Ö: Birini kuvars kristaliyle denemek diğerini de kuvars kristali olmadan denemek için iki bitki kullanıyorum. Ve direk baştan itibaren yani bitki hiç daha büyümemişken bunları ayarlıyorum.Belki bir yerden sonra daha hızlı büyüyor bunun için en baştan biri kuvars kristalli diğeri kristalsiz iki saksı ayarlanmalı.Yani ikisinin de şartları aynı olmalı.Biri daha hızlı diğeri daha yavaşsa bu farktan dolayı anlayabiliriz.Eğer kristalli olan daha hızlı gelişim gösterdiyse kuvarstan kaynaklanmıştır.

G: Zeynep'in bu uygulamasından elde edilen bilginin güvenilir olduğunu düşünen insanlar da var, güvenilir olmadığını düşünen insanlar da var. Sen ne düşünüyorsun.

Ö: Güvenilir olmayabilir gerçekten. Dediğim gibi bitki o zamandan önce de büyümeye başlamış olabilir.Büyüme zamanına denk gelmiş olabilir. O süreçte daha hızlı büyümüştür belki de. Bu yüzden güvenilir değil. Çk doğru yapmamış yani.Tek bir bitki ve bitkinin bir küçükken ki hali var bir de daha ileri süreçteki hali var. Burada ileriki süreçlerde kuvars kristalini koyuyor.Yani bitki zaten büyümeye başlamıştı belki de.Ama benimkinde ikisi de yani bitkiler küçükken birine kuvars koyuyoruz diğerinde ise bir şey yok.Biktiler henüz büyümeye başlamamışken ayarlıyoruz ortamı.

53) 4C

Ö: Hadi büyümesi neyse de neden ona doğru yönelmiş onu anlamadım. Maalesef mantıklı gelmiyor bana.Ona doğru yönelmesi mantıksız bence neden taşa doğru yöneliyor.

G: Neden böyle düşünüyorsun

Ö: Bitki büyümüş aslında ve de bu olumlu bir şey. Yani taş bitkiyi büyütmüş. Olumlu bir şey.Çok da mantıklı gelmiyor ama… kafam karıştı. Sadece büyümesini düşünürsem güven veriyor, güvenirim ama güneşe dönmüyor orası beni etkiledi. Güneşe dönmeliydi.

G: Normalde güneşe dönmesini beklerdin.

Ö: Güneşe dönmesini beklerdim. Eğer bir de güneşe dönseydi mantıklı gelirdi.Ama bu haliyle mantıksız.

54) 11T

Ö: Kuvars kristalinin çevresine enerji yaydığını anlatıyor. Yöneliyor da olabilir.Yoksa başka türlü bir bitki güneşten başka bir enerjiye yönelmez diye düşünüyorum.

G: Ne kastediyorsun
Ö: Ya bana halen gerçekçi gelmiyor, saçma birşey.
G: Neden gerçekçi gelmiyor
Ö: Hani güneşe değil de kuvars kristaline yönelmesi. Güneş o kadar devasa bir enerjiyken güneşe değil de kristale yönelmesi ve büyümeye ve gelişmeye başlaması, işte bu beni etkiledi. Bunlar bence saçma.Çünkü taşın enerjisi olsa bile güneş ondan daha büyük bir enerji.Güneşe yönelmeliydi. Çok da garanti olan bir şey değil.
55) 5D
Ö: İlk önce kendiminkinin hani yanlış mı oldu diye düşünürüm veya Zeynepinkiyle kendiminkini ilk önce böyle karşılaştırırım. Eksik bulmaya çalışırım ilk önce kendimde kendiminkinde olmadığı için.Doğruluğuna yani yapıp yapamadığıma filan bakarım yani.
G: Ama Zeynep'in yaptığı her şeyi yaptın eksiksiz. Yine de böyle bir sonuç ortaya çıktı.
Ö: Zeynep'inkinde gerçekten olduysa benimkinde de olur heralde.
G: Olmadığını farzet.
Ö: O zaman pek fikrim yok ama mutlaka eksik birşeyler yapmışımdır.
G: Mutlaka biryerlerde bir şeyler olmuştur diyorsun. Hiç Zeynep'in yanlış yapma ihtimali yok mu
Ö: O zaten bunu yapmış ve sonucunu görmüş. Böyle olduğu için öncelikle kendimin hata yaptığını düşünürüm.Zeynepinkine de bakarım tabi.Ama Zeynep'inkinde bir hata olamaz.Çünkü o güneşe filan koymuş 15-20 cm mesafede kuvars kristali koymuş.Eğer ben aynısını yapamadıysam yani aynısını yapmaya çalışırım. Belki de o başka bir taş uyguladı ama buraya böyle yazmış olabilir.
56) 3C
Ö: İlk hikayede işe yaradıysa benim denememde de işe yaraması gerekir. Belki ben yanlış bir şeyler yaptım.Hatamı gidermem lazım.Tekrar denemek isterim gerçekten tekrar tekrar. O kristalin gerçekten bitkide işe yaramasını isterim ve denerim. Yaradığını görmek isterim.Yaramazsa da neden işe yaramadığını anlamak isterim.Yaramadığını açıklamak anlatmak, ya da bu neden böyle oldu.Taşta mı bir hata var veya benim yaptığım mı yanlış diye düşünürüm. O yaptığına göre ve böyle yazdığına göre taşta veya benim yaptıklarımda bir hata olmalı.
57) 11T
Ö: Sadece bu bitkide değil başka bitkilerde de bunu yapmaya çalışırım. Yaptıktan sonra da olmuyorsa bilmiyorum aldatmak için yapılıyormuş gibi geliyor insanları. İnsanları aldatmak için bu tür hikayeler anlatıyorlar
G: Nasıl yani.
Ö: Aldatmak için yapılmış olabilir. Yani bu bilgi doğru değilse öyledir.Zeynep böyle şeyler söyleyerek insanları kandırmaya çalışıyor olabilir.
58) 13Z
Ö: Yalan olduğunu düşünürüm ve açıklamak isterim. Sosyal ortamda veya internet ortamında yapılan şeylerin aynısını ben de yaparım.Açıklama yaparım ben de.Olmadığını düşünürüm ve savunurum.Çünkü birçok insanı bu şeye inandırıyorlar.Birçok insanı bu tür sosyal ortamlar sayesinde kandırıyorlar.Burada da öyle bir kandırmaca olabilir.
59) 6F
Ö: Bu kadar kişi kullanıyorsa ve tavsiye ediyorlarsa, yani internette yazıyor ben kullandım şöyle oldu böyle oldu, işe yaradı diye. Yani bir bildikleri vardır

elbet.Demekki inanmakta haklılar.Bence önce bir araştırırım kimler kullanmış, onlarda etkili olmuş mu olmamış mı ona göre kullanırım.Etkili olduysa kullanırım ama etkili olmadıysa kullanmam yani.
G: Nasıl bir araştırma yaparsın peki
Ö: İnternetten araştırırım. Bu taşlar etkili olduysa yazmışlardır illaki internete.Oradan araştırırım okurum.Sonuçta insanlar yarar sağlamasalar neden yazsınlar ki.Etkili diyorlarsa etkilidir.
G: İnternetten araştırma yaparım dedin. Peki internetteki bilgiler sence ne kadar güvenilir.
Ö: Oldukça güvenilir çünkü insanlar kendi deneyimlerini paylaşıyor ve altına yorumlarını yazıyor. Öyle kulaktan dolma bilgileri değil de kendileri denedilerse onu söylüyorlar.
60) 12Y
Ö: Birşeye inanıp güvenmemiz için kesin ve doğru bilgiler olması lazım. Yani doğru oldupundan emin olmalıyız.Ama internette böyle bilgiler bulmak çok zor.Herkes kafasına göre birşeyler yazabiliyor.Bu nedenle interneti tercih etmem.
61) 3C
Ö: İnternet sitesinde her gördüğüme inanmıyorum. Bazı şeyler doğru oluyor bazı şeyler yalan oluyor.Televizyonlarda da öyle bence.Satış programları ve kanallarında da öyle.Yalan yanlış bir sürü şeyle dolu.Gidersin bunun hakkında bir kitap bulur okursun daha iyi.
G: Peki kitaptaki bilgilerin doğru olduğunu nereden biliyorsun.
Ö: O yazarın açıklaması, öngörüleri, deneyimini görüyorum o kitabı okurken demek ki adam denemiş böyle. Nasıl yaptığını da anlatmış.Kendi üzerimde denedim, başkasının üzerinde denedim gibi.Ya da belki de bilimsel insanların yaptığı deneylerle gözlemledi. O deneyleri anlatıyordur muhtemelen.
62) 14Z
Ö: Bence araştırma internetten yapılmamalıdır. Kitaplardan yaparım sadece ben ve ansiklopedilerden.Ama uzun bir araştırma olması lazım.Kesin bilgiler elde etmemiz lazım.Bu nedenle internetten araştırmam.Ancak kitaplardaki bilgiler kesin bilgilerdir.Yoksa araştırmanın bir değeri olmaz bence.
G: Araştırma deyince ne anlıyorsun.
Ö: Bilgilerin kitaplardan bulunup okunması geliyor aklıma. Ben öyle yapıyorum.
63) 11T
Ö: Ben internetteki bilgilere garanti gözüyle bakmıyorum. Kendi gözümle görmedikçe çok da inanmamaya çalışıyorum.Eğer iyi bir araştırmacıysa yani uzmansa düşüncelerim olumlu yönde değişir.Sonuçta araştırmış, doğru yöntemlerle araştırmış bakmış.Bir kitap yazabildiğine göre epeyce bilgisi vardır.Doğru düzgün bir araştırma yapmıştır ki onun kitabını basmışlar.
G: Neden böyle bir kaynaktan okuduğunda inandırıcı geliyor da internetten okuyunca gelmiyor.
Ö: İnternette doğru olup olmadığını bilmiyoruz. Araştırıp araştırmadığını bilmiyoruz.Ama birçok araştırma yaptığını, bilgili insan olduğunu ve o kitabı yazdığını görürsek söylediği bilgilere de inanırız diye düşünüyorum.Aynı şekilde uzman birini televizyonda görürsek inanırız.Çünkü araştırmıştır mutlaka.Yoksa onu televizyona çıkarmazlardı.
64) 4C

Ö: Hani televizyona bile çıkabilmiş, daha güvenilir gelir heralde. İnternet o kadar güvenilir gelmez. Çünkü internette bir sürü yalan şey olabiliyor.İnternete güvenmem ama televizyon daha iyi. Hani televizyona kadar çıkmış gibi hissediyorum. Televizyona çıkabilmişse zaten güvenilirdir.Güvenilir olmasa TV programları onları davet etmezdi.

65) 9M

Ö: İnternette olan her bilgi doğru olmaz diye bir söylenti olduğuna göre internet bana göre güvenilir değildir. Doğru bir bilgi de olabilir ama ben hemen internete güvenemem.Ne bileyim araştırırım illa ki. Ama o televizyondaki adam tanıttığında ekran başında ve 70 milyon onu izliyor. Bu nedenle yalan söyleyebileceğini pek sanmıyorum.Yalan söyleyemez bence herkesin karşısında.Bu nedenle oldukça güvenilir olduğunu düşünüyorum.

66) 12Y

Ö: Demek ki böyle bir şeyler var da söylemişlerdir. Yapılmış görülmüş bir şey.Bencebunlar bilimsellerdir.Öyle olmasa neden saçma sapan şeyleri yazsınlar ki.Demek ki üzerinde durulmuş bir şey mercan taşı.Konsantrasyonu artırır diyor demek ki denenmiş. Yani birkaç kişinin değil binlerce kişinin üzerinde denenip bu ortaya çıkmış. Bence inandırıcı geliyor bana bunlar.

G: Neden inandırıcı olduğunu düşünüyorsun

Ö: Çok iyi kişiler tarafından ve baya kişi üzerinde yapılmıştır bu araştırmalar çünkü. Yani artık bir düşünce olmaktan çıkmış.Kesindir artık bunlar. Uzmanlar bunları insanlar üzerinde test etmiş çünkü. Saçma sapan bir şey olsa internete koyulmaz, görülmüş, yapılmış, iyi geldiği araştırılmış, gözlemlenmiş ki insanlarla paylaşılıyor.

67) 5D

Ö: İllaki etkisi vardır bence.

G: Sence neden etkilidir.

Ö: Ben o merkezden bahsedeyim yine. Mesela ilk açıldığında çok kişiydi. Birçok kişi vardı içeride. İlerleyen günlerde de hala çok kişiydi.Zaten ben bir de aynı kişileri de görüyordum.Yani insanlar tekrar tekrar gidiyordu. Hem çok kişinin gitmesi hem de tekrar tekrar gitmesi faydalı olduğunu düşündürüyor. Faydalı olmasa insanlar gitmezdi sanırım.

G: Faydalı olmasa insanlar gitmezdi diye düşünüyorsun.

Ö: Evet bir kez deneyip bırakabilirlerdi. Ama birçok kez gidenler de oldu.Ben gördüm, şahit oldum.Demek ki kesinlikle etkili bu taşlar.

68) 7G

Ö: Eğer gerçekten birçok yerde ve güvenilir kaynaklarda varsa zaten doğrudur ve kesindir. Bu söylenenlerin doğru olabileceğini düşünüyorum.Bana güvenilir geliyor.Ama güvenilir kaynaklar olduğundan emin olmalıyım.Mesela bu konuda gerçekten uzmanlaşmış kişilerin yaptığı açıklamalar daha doğru geliyor. Bu kişiyi televizyonda görmek beni inandırır. Böyle kişilerin anlattıkları bilgilere daha çok güveniyorum.Bence onların anlattığı bilgiler doğrudur.

69) 6F

Ö: Kesinlikle etkili olur bence. Ben taşların bu tür etkiler gösterebileceğini düşünüyorum.

G: Burada etkili olduğunu düşünmene neden olan ne oldu peki.

Ö: Ametist taşının bir kere cilt hastalıklarına iyi geldiğini duymuştum. Bir televizyon kanalında duymuştum.Kristal kuvarsı da duydum bir kere televizyonda. O yüzden daha olumlu geldi bana. Özellikle bu ikisini televizyonda duyduğum için daha

inandırıcı geliyor.Şimdi burada da okudum.Demekki bunlar etkili ki böyle şeyler var. Bu bilgilerin doğru olduğunu düşünüyorum.

70) 1A

Ö: Denerdim kendi üzerimde. Alırdım taşı.Sessiz bir ortama geçerdim ki ben aslında sessiz ortamda çalışamam.Mutlaka şarkı filan dinlerim. Yanıma taşı alıp test çözmeye çalışırdım. Hani böyle bir şey gerçekten oluyorsa yani konsantrasyon sağlıyorsa devam ederdim.İnanırdım ve bu gözlemlerimi de yine internet ortamına sunardım.

G: Peki elde ettiğin bilginin kesinliği hakkında ne düşündüğünü sorsam ne dersin.

Ö: Eğer ben onu denediysem ve hani gerçekten oluyorsa yani beni konsantre ediyorsa kesindir tabiki. Ben bunu kendi gözlerimle görmüş olurum.Başkaları ne düşünür bilemem.Ben kendi gözümle gördüysem ve işe yaradıysa benim için kesindir.

71) 5D

Ö: Sonuçta etraftan duyduğunuz bilgilerle hareket ediyorsunuz. Daha önce duyduğunuz bilgileri kullanıyorsunuz. Bu bilgiler netleşiyor, daha da net oluyor deneyince yani görmüş oluyoruz kendi denememizde söylenen bilgiler kesin mi değil mi. Deneyerek kesinleştirmek istiyoruz. Kendi denediğimiz şey elbetteki kesindir.

72) 6F

Ö: Denemişler demekki bunu görmüşler. Bir şifa bulmuşlar bundan.Yani bu bilgi kesindir.Mesela ben de televizyonda işe yaradığını görürsem gerçekten bunlar oluyor, işe yarıyor diye düşünürüm.Kesindir yani bunu.Gerçekten olmuş.

73) 7G

Ö: Gerçekten beni etkilediyse yani konsantrasyonumu etkilediyse gerçekten bir olumlu etkisi olduğunu düşünürüm ve kullanmaya devam ederim demek ki işe yarıyor diye.

G: Peki bu taşın konsantrasyonun üzerinde işe yarayıp yaramadığını nasıl test edersin.

Ö: Taşı ders çalışırken kullanırım. Zaten daha önce artırdığını hissetmişsem yine artıracaktır.

G: Peki elde ettiğin bilginin kesinliği hakkında ne düşündüğünü sorsam ne dersin.

Ö: Zaten bu taşın konsantrasyonu artırdığı yazıyorsa konsantrasyonu artıran şey bu taş olacaktır. Zaten taş böyle bir etki gösteriyormuş. Bunu daha önceden deneyip bulmuşlar.

74) 4C

Ö: Mercan taşı konsantrasyonu artırır diye düşünürüm. Ama belki o gün psikolojik olarak da öyle olmuş olabilir.Hani mercan taşı konsantrasyonu artırıyormuş hani psikolojik olarak da öyle duyduğumuz için olmuş olabilir.Öyle hissetmiş olabiliriz.Mercan taşından dolayı değildir belki de.Belki ben öyle hissetmişimdir.Bu nedenle tam emin olamayız.

75) 11T

Ö: Eğer o taşı öyle olacak diye aldıysak yani böyle bir şeylere faydasın olduğuna inanıp, zaten psikolojik olarak böyle oldu diyebiliriz. Mesela yanımda duruyor ve konsantrasyonum arttı.Artmasa da arttı diyebiliriz psikolojik olarak. Bence konsantrasyonun arttırması öyle pek de ölçülen bir şey değil. Yani bunlar garantisi olacak şeyler de değil. Kesin değil yani. Konsantrasyon net olarak ölçülemediği için

bunu net olarak anlayamayız. Bu nedenle de taş bize etkili midir değil midir anlayamayız. Bu nedenle sonuç kesin değildir.
76) 8K
Ö: Sonuçta arttırdığını gözlemlemişimdir. Yani bu konuda olumlu düşünürüm.
G: Biri sana düşüncelerinin kesinliği hakkında neler düşündüğünü sorsa neler söylemek istersin.
Ö: Kesin değil ama işe yarar belki de. O yüzden kullanırım.
G: Kesin değildir ama yine de kullanırım diyorsun
Ö: Evet, kesin değil ama yine de bir gösterge
G: Neden kesin olmadığını düşünüyorsun
Ö: Sonuçta deneyerek vardık böyle bir yargıya. Tam olarak böyle bir etki veriyor mu vermiyor mu bilemeyiz.Belki daha çok öğrenci üzerinde denenebilir.Daha çok araştırılmalı yani.Mesela hepsinde de aynı etkiyi gösterirse olumlu bir yargıya varabiliriz bence.
77) 2B
Ö: Ben anneannemden örnek vereyim yine. O bana söylemişti. Onun tansiyonu şeker hastalığı çeşitli hastalıkları var. Bana bir de bel ağrısı olduğunu söyledi.Benden evde daha önceden bulunan yani daha önceden almış olduğu taşı getirmemi istedi.Taşı getirdim ve beline koydu.Onu birkaç başörtü ile beline bağladı.Daha sonra ağrısının geçtiğini söyledi.Ben de açıkçası bir site yöneticisi olsam böyle bir konuyu ve gözlemi internette paylaşırdım.Denenmiş olarak gerçek doğru bilgi olduğunu bildiğim için.
G: Peki sence bu denemeler bilimsel midir.
Ö: Evet bilimsel olabilir. Çünkü siz deniyorsunuz onu, ortada kanıtı olmayan bir bilgi var. Bunu kanıtlamak için, yani bilimsel yoldan kanıtlamak için deniyorsunuz.Bu denemeler bunun kanıtı olabilir.Yani insanlar üzerinde deneyerek etkili olup olmadığını kanıtlayabilirler.Zaten bu bilgileri de o denemelerin sonunda elde etmişlerdir.Yani bilimsel denemelerdir bunlar.
78) 3C
Ö: Bilimseldir yaaa araştırmışlar işte o kadar.
G: Neden bilimsel olduğunu düşünüyorsun.
Ö: Bilimsel işte, direk aklıma bilimsel olduğu geldi. Araştırmışlar.Araştırmışlar ki böyle sonuçlar ortaya çıkmış.
G: neden bilimsel olduğunu düşünüyorsun
Ö: İyileştirdiğine inanıyorlarsa bilimseldir ve gerçekten iyileştiriyorsa vardır bir gücü. Yani iyileştirmese insanlar bunları nasıl ortaya çıkarıp bu taş buna iyi geliyor şu taş şuna iyi geliyor diyebilsinler ki. Adam veya kadında rahatsızlanma, rahatsızlığı düzeltme, bu tür şeyleri tedavi etmesi veya kötü yola gitmesi.Yani bir sonuç görüyorsunuz.Elinizde onunla ilgili bir bilgi bir sonuç oluyor.Bu nedenle bilmseldir.Örneğin birçok bilgi var ya demekki taşlar etkili olmuş ki bu sonuçlar ortaya çıkmış.
79) 9G
Ö: Yaaa adamlar zaten ben birilerine bir şey yapmak için bir taş bulayım diye bir şey demiyordur. O taş orada vardır ama onun ne olduğunu bilmiyordur. Ama her insan araştırma yapar. O orada duruyorsa ve bir yararı varsa ben bunu araştırırım, nasıl oluyor, kaynağı nerede, nerelerde çıkıyor. Onun gibi bir araştırma yaparım hani bu da bir bilimsel araştırmadır illa ki.
G: Neden bilimsel araştırma olarak nitelendiriyorsun

Ö: Bilimsel olarak araştırılmasa bu tür bilgiler elde edilemezdi. Araştırmadan bu tür şeyler ortaya çıkmazdı.Bilimsel bir araştırma yapmadan bukadar net konuşamazlardı.Demekki bilimseldir bunlar.
80) 6F
Ö: Bilimseldir bence. Yani bilimsel olmasa herkes öyle kafasına göre denese bilimsel olmaz.Bilimsel olarak denemişler ki böyle bilgiler ortaya çıkmış.Yoksa insanlar şuna iyi geliyor buna iyi geliyor diyemezdi.
G: Burada bilimle ilgili olan kısmı neresi onu anlayamadım.
Ö: Yani bilen var bilmeyen var öyle kafasına göre herkesin denememesi lazım. Uzman kişilerin bunu denemesi ve söylemesi gerekir.Yani olumlu yönlerini bilip öyle denemeleri gerekir.Uzman kişiler bu taşları denemiş olmalı ki bu tür şeyleri ortaya çıkarmışlar.
81) 11T
O: Bana göre bilimsel olarak araştırılabilecek bir konu değil.
G: Neden böyle düşünüyorsun
Ö: Ölçülemediği için.
G: Nasıl yani
Ö: Boyumuzu ölçeriz ve sonuç bu deriz. Ama taş şu kadar etkiledi diyemeyiz. Bu nedenle bilimsel olarak araştırılacak bir konu olmadığını düşünüyorum.
82) 8K
Yani bu bilgilerin doğru olduğunu düşünmüyorum.Sonuçta bilimsel bir açıklaması olması gerekirdi yani.Bunların bilimsel bir yanı yok gibi.Açıkçası ben bunlarla ilgili hiçbir bilimsel açıklama duymadım.Zaten hastalığın iyileşmesiyle taşın kullanılması tesadüfen aynı zamana denk gelmiş olabilir.
83) 1A
Ö: Programda böyle bir uygulama görmüş. O da denemiş ve doğru çıkmış. Bu bir gözlemdir.Deneydir yani.
G: Neden böyle düşünüyorsun
Ö: Gözlem yapmış, ben öyle düşünüyorum. Uygulama yapmışki gerçekleşmiş, ben bu yüzden böyle düşünüyorum.Çoğu insan da böyle inanıyordur zaten, yani kendi kendine deneyerek.Öyle tahmin ediyorum.Kendi deneyini kendisi yapmış.
84) 10S
Ö: Kuvars kristalini bitkide deniyor. Not ediyor değişiklikleri. Sonra bitkinin kuvars kristaline doğru yöneldiği ve büyümeye başladığı gözlemleniyor.Bir deneydir yani bu. Kız kendi evinde bir deney yapmış.
G: Neden böyle düşünüyorsun
Ö: Denemesi deney niteliği taşıyor, mesela kristali deniyor, bu deney niteliği taşır, not etmesi.
85) 3C
Ö: Zeynep'in denemesinin işe yaraması. O bitkinin güneş yerine taşı istemesi. O taştan gelen enerjiyle büyümesi. Güneş yerine ona yönelmesi ve büyümesi, bunları gözlemlemiş ve bu gözlemler zaten bilimsel bir deneyin parçasıdır.Bilimsel olabilmesi için bu deneydeki gibi bitkinin gerçekten o kristale yönelmesi.Sonra o etkilerini göstermesi, büyümesi, kalınlaşması, gelişmesi veya çiçek açması lazım. Mesela bitkinin yanına bir taş koydular ancak bitki büyümedi hatta öldü. O zaman bilimsel bir şey olmaz. Bence bu uygulama bilimsel bir şey çünkü Zeynep'in deneyi başarılı. Güneş yerine kristal büyütüyor bitkiyi.
86) 7G

Ö: Bence bilimsel bir deneydir. Çünkü gerçekten olayları düzgün bir sırada yapıyor.İlk güneşe koyuyor güneşte büyümüyor sonra o taşı koyuyor.Aynı bilimsel bir araştırmada olduğu gibi.Yani her şeyi gözlemleyerek yapmış.Burada öyle yazıyor.Bence bilimsel.Gözlem yapmak bilimsel bir araştırmanın parçası.

87) 2B

Ö: Çünkü sadece televizyon programından izlediğiyle olmaması gerekir. Çünkü bunun gerçekliğini araştırıp kanıtlamadığı sürece bunu denemek yanlış olur.Öncesinde detaylı araştırmalıydı.Yani siz uzamak için birçok yol deniyorsunuz ve doğru yolu bulduğunuzu zannediyorsunuz ama öncesinde detaylı bir araştırma yapmadığınız için o yol sizi yanlışa görütebilir.Gerçekten kötü bir durum. Bu nedenle bence bilimsel değil.

G: Biraz daha açabilir misin.

Ö: Zeynep de nasıl kullanılması gerektiğini önceden araştırmalıydı. Hiçbirşey araştırmadan doğrudan denemeye başlamış.Bu nedenle çok bilimsel olduğu söylenemez. Daha önceden yapılmış araştırmalara bakabilir bilimsel olup olmaması önemli değil. Yani bu işten anlayan insanın konuşmasına bakarak fikrini düzeltmesi gerekir.Daha önce deneyen varsa böyle bir şeyi onların yorumlarını okumalı.Yani onları okuduğunda doğrusunu yanlışını öğrenir.Bu sayede ne yapması gerektiğini öğrenir.

88) 8K

Ö: 15 kişi üzerinde denemiş. Benim babaannemle ilgili örnekte verdiğim gibi yapmış.Önceden ölçüp sonrasında kullanıp tekrar ölçmüş.Benim dediğim gibi.Ben de olsam böyle bir araştırma yapardım.Bence bu bilimsel bir araştırma.

G: Neden böyle düşünüyorsun

Ö: 15 kişi ile çalışılmış yani tesadüfen olma ihtimali yok. Öncesinde ve sonrasında da ölçmüş olması güzel.Yani karşılaştırabilecek öncesini ve sonrasını.15 kişiyle deniyor ve ölçüm yapıyor.Böyle bir araştırma taşın işe yarayıp yaramadığını net olarak gösterir.

89) 1A

Ö: Ben de böyle bir şey yapardım. Hani mercan taşı için sedef hastası olan insanları bir araya toplardım ve ben de böyle bir deney yapardım. Bu yöntem araştırmacının iddiasını test etmesi için uygun bir yöntemdir ve ben de bunu kullanırdım. Hani bir iddia koymuş ortaya akik taşının tansiyona iyi geleceğiyle ilgili ve sonra bu iddiasını test etmiş insanlar üzerinde. Bu yüzden bana bilimsel geliyor.Yani bilimsel araştırmalar böyle yapılmıyor mu zaten.

90) 9M

Ö: Bence bu bilimsel bir araştırma. Ben bir insan görüyorum 15 kişiyi almış ve bir taşın etkisini araştırıyor. Ben de 15 kişi alıp aynısını uygulayayım dersem bu bilimsel bir araştırmaya girmez. Ama burada bu bir araştırmacı ve daha önceki araştırmalarına dayanarak bir iddia ortaya atmış.

G: Sence bu niye bilimsel bir araştırma olarak nitelendirilebilir

Ö: Adam ortaya bir şey koymak için bunun iyi olduğunu göstermek zorunda. Bunu satabilmek için. O yüzden araştırma yapıyorum çünkü. Ben bunu daha ortaya koymamışım.Sunmamışım.Sunmadan önce bakıyorum ki nasıl oluyor.Faydası var mı insanlara.Bir destek olabilmek için yapıyorsam insanlığa bu benim için daha da bir bilimsel araştırmadır.Ben bunu biliyorsam ve ona veriyorsam bu bilimsel araştırma olmaz zaten.Çünkü ben bunun nasıl bir etki göstereceğini artık biliyorumdur.Ama sıfırdan birşeyin etkililiğini göstermek bilimdir.

91) 2B
Ö: Bence her araştırma bilimsel değildir ama tereddütte kalıyorum. Ama değildir bence.Çünkü orada insanların yaşadıkları tek duygu bu taşı kalbimin üzerinden ne zaman çekeceğim artık yoruldum.Ne zaman bırakacağım duygusudur.Bunun için işe yarayacağını sanmıyorum.
G: Neden
Ö: Çok bilimsel değildir. Çünkü insanların kafasında bazı düşünceler oluşacak ve bu da araştırmanın sonucunu etkiler.Öncelikle o insanın normal yaşamına devam etmesi gerekir.Mesela siz bu akik taşını kullanıyorsunuz diyelim.Siz o akik taşının orada olduğunu bile bile bildiğiniz için ona göre davranıyorsanız bu çok bilimsel değildir.Ya da bu taştan etkilendiğinizi düşündüğünüz için veya psikolojinizi etkilediği için buna inanıyor olabilirsiniz.Mesela anneniz tansiyon hastası diyelim.Siz evin çeşitli yerlerine bol miktarda akik taşı koydunuz. Anneniz bunu bilmiyor ve bir hafta içinde annenizin hiç tansiyonu çıkmadıysa ve genelde haftada bir ya da iki kez çıkan bir insansa bu taşın gerçekten kesinlikle diyebiliyorum bu konuda kesinlikle bu taşın işe yaradığını söyleyebiliriz.

APPENDİX D. Turkish Summary

ORTAOKUL ÖĞRENCİLERİNİN DOĞAL TAŞLARLA İLGİLİ SÖZDEBİLİMSEL UYGULAMALAR HAKKINDAKİ ALGILARI VE MANTIKSAL DÜŞÜNME DESENLERİ

Giriş

Günümüzdeki bilim eğitiminin en temel amaçlarından biri bilim ne olduğunu ve nasıl yapıldığını kavrayan bilim okur-yazarı bireyler yetiştirmektir. Bilim okur-yazarlığı sadece bilimi ve bilimin doğasını anlamayı değil aynı zamanda bilimi sözdebilimden ayırabilme becerisini de gerektirir. Hurd (1998) bilim okur-yazarı bireylerin özelliklerini şu şekilde sıralamıştır:

- Bilimsel teorileri dogmatik fikirlerden, bilimsel verileri ise efsane veya söylencelerden ayırır.
- Bilimsel bir araştırmanın nasıl yapıldığını ve bu süreçte bulguların nasıl geçerli hale getirildiğini anlar.
- Bilimi sözdebilimden ayırır.
- Olguların ötesine geçen bilimsel bilgileri üretmek için bulguların nasıl analiz edileceğini ve işleneceğini bilir.
- Kanıtları propagandadan ve bilimsel bilgileri ise fikirlerden ayırır.
- Bilimsel kavramların, kanunların ve teorilerin değişmez yapılar değil aksine sürekli gelişen yapılar olduğunu fark eder.

Sözdebilimsel inançları kapsayan bir diğer bilim okur-yazarlığı tanımı Hodson (2008) tarafından yapılmaktadır. Hodson sadece bilim sözdebilim arasındaki ayrım problemine değinmemiş aynı zamanda bilim ve bilim olmayan arasındaki ayrımın önemini dile getirmiştir;

> Tam anlamıyla bilim okur-yazarı olmak için, öğrencilerin iyi bilim, kötü bilim ve bilim olmayan arasındaki ayrımı yapabiliyor olması, neye inanacağı

> konusunda eleştirel kararlar verebiliyor olması ve kişisel, sosyal ve iş yaşantısında bilgiye dayanan kararlar verirken bilimsel bilgiyi kullanabiliyor olması gerekmektedir. Kısacası, öğrencilerin bilimin eleştirel kullanıcısı (critical consumers of science) olmaları gerekir (Hodson, 2008, p. 3).

Hurd (1998) ve Hodson (2008)'un vurgusuna benzer olarak Martin (1994) de sözdebilimsel iddiaları tanımayı ve değerlendirebilmeyi bilim okur-yazarlığının bir parçası olarak ifade etmiştir. Martin (1994)'in bilim eğitiminin amacı konusundaki vurgusu bilimsel olabilmekten ziyade bilimi anlama ve öğrencileri "günlük yaşantılarında bilimsel tavırla düşünüp davranacak" şekilde yetiştirme üzerinedir (Martin, 1994, p. 357). Bu bağlamda düşünüldüğünde Martin (1994) sözdebilimsel ve paranormal inançlar hakkında eleştirel düşünebilmeyi öğrenme becerisini bilim okur-yazarı olmanın bir parçası olarak ifade etmektedir.

Fakat, Ede (2000) bilim eğitiminin bilim okur-yazarı yetiştirme konusundaki eksikliklerini dile getirmektedir. Ede (2000) eskiye oranla bilim eğitim-öğretiminin artmış olmasına rağmen bu artışın doğal bir yansıması olarak beklenen mantıksız düşünme konusunda anlamlı bir düşüş (significant drop in irrationality) yaşanmamasını eleştirmektedir; "Eğer öğrenciler fen sınıflarından bilimsel fikirlere nasıl ulaşıldığını gerçekten öğrenmeden veya bilimin ne için yapıldığını anlamadan çıkıyorlarsa, birçok insanın neden sözdebilime yatkın olduğunu anlamak zor değildir" (Ede, 2000, p. 50). Benzer olarak Good ve Slezak (2011) bilim okur-yazarlığında bilim sözdebilim ayrımının önemini bir soru sorarak vurgulamaktadır; "Eğer insanlar sıklıkla karşılaşılan sözdebilimsel uygulamaları ayırt edemiyorlarsa, bilim okur-yazarı olarak kabul edilebilirler mi?" (Good & Slezak, 2011, p. 401). Bu bağlamda bakıldığında sözdebilimsel inançları tanıma, değerlendirme ve ayırt etme bilim okur-yazarlığının vazgeçilmez bir parçası niteliğindedir. Bu nedenle birçok araştırmacı, bilim sözdebilim ayrımı, sözdebilimsel iddialar ve inançlar, sözdebilimsel inançlardaki artış gibi konuların bilim eğitimcilerinin ilgilenmesi gereken temel konular olduğunu ve sözdebilimsel iddiaları tanıma, değerlendir ve ayırt etmeyi öğrenmenin bilim eğitim-öğretiminin bir parçası olması gerektiğini

vurgulamaktadır (Ede, 2000; Good, 2012; Lundström & Jakopsson, 2009; Martin, 1994; Preece & Baxter, 2000; Walker, Hoekstra & Vogl, 2002).

Şüphesiz günümüzde birçok ülke sorumluluk sahibi vatandaşlar yetiştirmeyi amaçlamaktadır. Bilim okur-yazarlığı ise sorumluluk sahibi vatandaşların yetiştirilmesine katkı sağlayacak en önemli unsurlardan biridir. Bilim eğitiminin en temel amaçlarından biri bilimin ne olduğunu ve nasıl yapıldığını kavrayan bilim okur-yazarı bireyler yetiştirmektir. Bilim okur-yazarlığı, birçok ülkenin en temel amaçları arasında yer almasına rağmen birçok araştırma öğrencilerin istenilir düzeyde bilim algısına sahip olmadığını göstermektedir (BouJaoude & Abd-El Khalick, 1995; Carey, Evans, Honda, Jay & Unger, 1989; Kang, Scharmann & Noh, 2005; Metin & Leblebicioglu, 2011; Sutherland & Dennick, 2002). Paralel olarak yine birçok araştırma öğrencilerin hatta öğretmenlerin bile birçok sözdebilimsel inanca sahip olduğunu göstermektedir (Martin, 1994; Preece & Baxter, 2000). Bilim eğitimi almış olmalarına rağmen, öğrencilerin hem bilimi anlamakta hem de bilimi sözdebilimden ayırt etmede zorluklar yaşadıkları görülmektedir. Bununla birlikte, öğrencilerin sözdebilimsel inançları önemli olmasına rağmen bilim eğitiminde göz ardı edilen unsurlardan biridir.

Bilim ve sözdebilim, birçok benzerliğe sahipmiş gibi görünen fakat birbirinden tamamen farklı alanlardır. Sözdebilim, bilim olma görüntüsü veren ve bilimselmiş gibi görünen iddialar, uygulamalar ve tutumlar olarak tanımlanabilir (Martin, 1972). Günümüzde, çubukla su arama, astroloji ve taş şifacılığı gibi birçok sözde-bilimsel uygulama bilimselmiş gibi yürütülmektedir.

Bilim ve sözdebilim arasında kesin sınırlar olmadığı için bu ikisini birbirinden ayırmak kolay değildir. Bilim ve sözde-bilim benzer özelliklere sahipmiş gibi görünmelerine rağmen varsayımları, süreçleri ve içerikleri açısından birbirlerinden tamamen farklıdır. Bilim teorilerini ve hipotezlerini eleştirel bir biçimde test edip, veriler ışığında bunları yeniden şekillendirirken (Martin,1994), sözde-bilim verilerin niteliğinden çok niceliğiyle ilgilenir ve kendi iddialarını desteklediğini düşündüğü seçilmiş verilere odaklanarak diğerlerini göz ardı eder (Radner ve Radner, 1982). Bu

açıdan yorumlandığında, bilimsel süreçte birçok olay gözlemlenir, değişik yöntemlerle veriler toplanır, verilerden kanıtlara ulaşılır ve bunların ışığında sonuçlara varılır. Fakat, sözde-bilimsel uygulamalarda iddialar ve sonuçlar sürecin başında belirlenir ve bu sonuçları destekleyecek belirli olaylar gözlemlenerek, sonuçları desteklemeyen olaylar kapsam dışı bırakılır.

Martin (1994) sözdebilisel inançların varlığını, bilimsel araştırmanın temel süreçlerini göz ardı etmenin, bilimsel teorileri ve teorilerin veriye dayalı yapısını yanlış anlamanın ve bilimsel akıl yürütme yetersizliğinin göstergesi olarak yorumlamaktadır. Bu nedenle, öğrencilerin bilim ve bilimsel bilgi hakkındaki algılarının (bilimsel epistemolojilerinin) onların sözdebilimsel yönelimleriyle yakından ilişkili olduğu açıktır. Öğrenciler genellikle kendilerine sunulan sözdebilimsel ifadeleri eleştirel olarak sorgulayıp gerekli kanıtları bulmak yerine bu ifadeleri doğrudan kabul etmeyi seçmektedirler. Örneğin, öğrencilere doğdukları sırada gökyüzündeki güneşin ve gezegenlerin konumlarının hayatının ileriki yıllarında ne olacağını etkilediği söylendiğinde, öğrenciler bunun bilimsel bir temeli olup olmadığını sorgulamadan ve buna neden inandığını irdelemeden hareket etmektedirler. Moore (1992), bilimsel düşünme yeteneği eksikliğinin veya yetersizliğinin kişileri sözde-bilimsel inançlara daha duyarlı hale getirdiğini belirtmektedir.

Sözdebilim, bilimselmiş izlenimi veren fakat bilimsel araştırma kriterlerini sağlayamayan, bilimsel veri ve kanıt ilişkisi içermeyen ve genellikle günümüzde ticari amaç güdülerek yürütülen süreçlerdir. Astroloji, taşlarla ve bitkilerle yürütülen şifacılık ve telepati gibi sözde-bilimsel uğraşlar ve kırılan aynanın uğursuzluğu gibi batıl inançlar toplum tarafından oluşturulmakta, toplumsal genellemeler, söylentiler ve medya yoluyla yaygınlaşmaktadır. Sözdebilimsel uğraşları öven ve çoğunlukla medya yoluyla yapılan propagandalar, insanların gözündeki bilim imajını zedelemekte ve bilimin yanlış algılanmasına yol açmaktadır (Castelao-Lawless, 2002). Medyada yansıtılan bu yanlış izlenim insanların gözü önünde yapıldığı sürece her şeyin bilimsel olarak kabul edilebilir olduğu fikrini uyandırmaktadır. Bu nedenle, cemrelerin düşme zamanlarına göre tarımsal faaliyetlerin yürütüldüğü, çubukla su

kaynaklarının arandığı ve bir rastlantıya dayanılarak güneş tutulmasının depremi tetiklediğinin düşünüldüğü günümüzde bu tür sözde-bilimsel inanışların ele alınması ayrı bir önem taşımaktadır.

Bu nedenle öğrencilerin sözdebilim hakkındaki düşüncelerinin araştırılması ve buna dayanarak, bilim eğitimi programlarını bilim sözdebilim ayrımını ele alacak şekilde yeniden düzenlemek mantıklı görülmektedir. Bilim eğitimciler, öğrencilerin sözdebilimsel uygulamalar hakkında nasıl akıl yürüttüklerini bildiği sürece, fen eğitiminde öğrencileri sözdebilime inanmaya iten belirli nedenleri tartışmak ve bunların giderilmesi için programlar hazırlamak kolaylaşacaktır. Bu nedenle bu araştırma ortaokul öğrencilerinin gözünden sözdebilimsel konuların nasıl algılandığına odaklanarak, gelecek bilim öğretimi çalışmaları için kanıt üretmeyi amaçlamaktadır.

Araştırmanın Amacı

Bu araştırmanın amacı, ortaokul 8. sınıf öğrencilerinin sözdebilim hakkındaki algılarını ve sözdebilimsel uygulamalar hakkında tartışırken kullandıkları mantıksal akıl yürütme desenlerini ortaya çıkarmaktır. Daha ayrıntılı olarak, bu araştırma öğrencilerin sözdebilimsel uygulamaların amaçları, sözdebilimde kullanılan araştırma ve doğrulama süreçleri ve sözdebilimsel uygulamalardan elde edilen bilgilerin kesinliği, güvenirliği ve bilimsel statüsü hakkındaki algılarını ve mantıksal akıl yürütme desenlerini ortaya çıkarmayı amaçlamaktadır. Dolayısıyla bu araştırmanın ana amacı, öğrencilerin sözdebilimsel inançlarının ötesine giderek onları sözdebilimsel uygulamalara inanmaya yönelten faktörleri ortaya çıkarmaktır.

Araştırma Sorusu

Ortaokul 8. sınıf öğrencilerinin sözdebilimsel uygulamaların amaçları, sözdebilimde kullanılan araştırma ve doğrulama süreçleri ve sözdebilimsel uygulamalardan elde edilen bilgilerin kesinliği, güvenirliği ve bilimsel statüsü hakkındaki algıları ve mantıksal akıl yürütme desenleri nelerdir?

Araştırmanın Alt-Soruları

1) Öğrencilerin şifalı taşlarla yürütülen sözdebilimsel uygulamaların amaçları hakkındaki düşünceleri nelerdir?
2) Öğrencilerin şifalı taşlarla yürütülen sözdebilimsel uygulamalarda sözdenilimciler tarafından bilgi üretmek için kullanılan araştırma yöntemleri hakkındaki yorumları nelerdir?
3) Öğrenciler şifalı taşlarla yürütülen sözdebilimsel uygulamalardaki bir fikri test etme süreçlerini ve bilgiyi doğrulama süreçlerini nasıl anlamlandırmaktadır?
4) Öğrenciler şifalı taşlarla yürütülen sözdebilimsel uygulamalardan elde edilen bilginin güvenirliğini nasıl değerlendirmektedir?
5) Öğrenciler şifalı taşlarla yürütülen sözdebilimsel uygulamalardan elde edilen bilginin kesinliğini nasıl değerlendirmektedir?
6) Öğrenciler şifalı taşlarla yürütülen sözdebilimsel uygulamalardan elde edilen bilginin bilimsel olup olmadığını nasıl değerlendirmektedir?

Yöntem

Bu araştırma doğası gereği nitel bir araştırmadır. Bu araştırmanın amacı, ortaokul 8. sınıf öğrencilerinin sözdebilim hakkındaki algılarını ve sözdebilimsel uygulamalar hakkında tartışırken kullandıkları mantıksal akıl yürütme desenlerini ortaya çıkarmaktır. Bu nedenle nitel araştırma yaklaşımının kullanılması uygun bulunmuştur. Araştırmada temel yorumlayıcı nitel araştırma deseni kullanılmıştır. Nitel araştırma yaklaşımı, her bireyin kendi bilgisini yapılandırdığını ve bireşylerden bağımsız bir bilginin olmayacağını ifade eden postpozitivist bilim felsefesine

dayanmaktadır ve yapılandırılmış doğruyu (constructed truth) vurgulamaktadır. Benzer olarak, Merriam (1998)'a göre nitel araştırmanın dayandığı en temel felsefi varsayım, gerçeğin bireyler tarafından kendi sosyal çevreleriyle etkileşerek oluşturuluyor olmasıdır. Bu nedenle nitel araştırma, bireyler tarafından oluşturulan anlamları anlamayla ilgilenir. Bu araştırmada ise ortaokul öğrencilerinin sözdebilim hakkında kendi yaşantıları yoluyla oluşturdukları anlamlar araştırılacağı için, nitel araştırma yönteminin kullanılmasına karar verilmiştir.

Creswell (2009)'e göre, nitel araştırma bireylerin veya grupların bireysel veya sosyal bir konuya ya da probleme yükledikleri anlamları keşfetmek ve anlamak için temel bir araçtır. Bu araştırmanın konusu olan sözdebilim doğası gereği karmaşık bir konudur ve sosyal, kültürel ve ekonomik öğeleri içinde barındırır. Kendi bireysel yaşantılarımız aracılığıyla birçok kaynak tarafından sözdebilimsel inançlar bombardımanına maruz kalırız. Böyle bir durumda her birey sözdebilim hakkında kendi algısını, manasını, kavrayışını oluşturur. Bu bağlamda, bu araştırmanın amacı öğrencilerin sözdebilime yüklediği anlamları keşfetmektir. Öğrencilerin sözdebilime yüklediği anlamları açığa çıkarmak için, öğrencilerin sözdebilim hakkında ne bildikleri, sözdebilimi nasıl anlamlandırdıkları, sözdebilimin bilimsel statüsü hakkında ne düşündükleri ve buna nasıl karar verdikleri, hangi özellikleri nedeniyle sözdebilimsel uygulamaları bilimsel olarak kabul ettikleri, kendilerine sunulan sözdebilimsel inanışları test etmek için nasıl araştırma desenleri ileri sürdükleri nitel yaklaşımla araştırılmıştır.

Nitel araştırma yaklaşımı, içinde sosyal olayların anlamlarını anlamak ve açıklamak için araştırmacılara kolaylık sağlayan birçok değişik araştırma deseni içeren genel bir kavramdır (Merriam, 1998). Değişik nitel araştırma desenleri göz önünde bulundurulduğunda öğrencilerin sözdebilimsel inançlarını ve bu inançların arkasında yatan akıl yürütme desenlerini araştırmak için en uygun desen olarak temel yorumlayıcı nitel araştırma deseni seçilmiştir.

Temel yorumlayıcı nitel araştırma deseni, diğer nitel araştırma desenleri gibi bireylerin yapılandırmış olduğu anlama dayanır. Merriam (1998)'a göre temel yorumlayıcı nitel araştırma deseni, üç temel soruyla ilgilenir. Bu sorular;

1) Bireyler kendi deneyimlerini nasıl yorumlar
2) Bireyler kendi dünyalarını nasıl yapılandırırlar
3) Bireyler kendi deneyimlerine ne anlam yüklerler (Merriam, 1998, p. 23)

Bu nedenle temel yorumlayıcı nitel araştırma deseni, araştırmacılara araştırılan konu hakkında bireylerin yüklediği anlamı ve bireylerin araştırılan konuyu kültürel olarak nasıl yorumladıklarını anlama ve yorumlama fırsatı sunar. Bu araştırmada, ortaokul 8. sınıf öğrencilerinin sözdebilim hakkındaki algılarını ve sözdebilimsel uygulamalar hakkında tartışırken kullandıkları mantıksal akıl yürütme desenleri araştırılmıştır. Dolayısıyla, araştırmacı öğrencilerin sözdebilim konusundaki inançlarının ötesine geçerek, onları sözdebilimsel uygulamalara inanmaya iten nedenleri ortaya çıkarmaya çalışmıştır.

Katılımcılar

Araştırmaya kırsal kesimde yaşayan ve orada okula giden, temel bilim eğitimi almış ve kendini açıkça ifade edebilen yedi kız ve yedi erkek 8. sınıf öğrencisi gönüllü olarak katılmıştır. Whittle (2004)'ın ifade ettiğine göre sözdebilimsel inançlar neredeyse bebeklikte başlamaktadır. Ayrıca ilgili literatür genellikle lise veya üniversite öğrencilerinin sözdebilimsel inançları konusunda bizi bilgilendirmektedir (DeRobertis & Delaney, 1993, 2000; Preece & Baxter, 2000; Walker, Hoekstra & Vogl, 2002). Ortaokul öğrencileri veya daha genç grupların sözdebilim hakkındaki düşüncelerini araştıran araştırmalar ise yok denecek kadar azdır. Bu nedenle bu araştırmada 8. sınıfa devam eden ortaokul öğrencileri katılımcı olarak belirlenmiştir.

Sözdebilimsel inançlar genellikle toplumun içinde bulunduğu kültür tarafından oluşturulur ve yayılır. Aile ve sosyal çevrenin sözdebilimsel inançlara yönelim üzerindeki etkisi (Preece & Baxter, 2000) göz önüne alındığında, öğrencilerin sözdebilime yükledikleri anlamlar ve bu konudaki inançları üzerinde en etkili

faktörlerden birinin öğrencilerin içinde yaşadıkları bölge olduğu düşünülmektedir. Cemre zamanına göre tarımsal faaliyetlerin yürütülmesi, çubukla su aranması ve bitkilerle hastalıkların tedavi edilmeye çalışılması gibi çoğu sözdebilimsel inanışın ve uygulamanın toplumun kırsal kesiminde daha yaygın olduğuna inanılmaktadır. Sampson ve Beyerstein (1996) kırsal kesinlerde yürütülen geleneksel halk usulü şifacılık uygulamaları ve eğitim faaliyetlerinin bu bölgelere daha az ulaşması nedeniyle, kırsal kesimde yaşayan insanların özellikle sağlıkla ilgili konularda sözdebilimsel inançara daha duyarlı ve yatkın olduklarını belirtmektedir. Bu nedenle, bu araştırmada kırsal kesimde yaşayan ve kırsal kesimde okula devam eden öğrencilerle görüşme yapılması uygun bulunmuştur.

Veri Toplama Aracı

Bu araştırmada araştırma deseni ile uyumlu olarak, veri toplama aracı olarak yarı-yapılandırılmış görüşmeler kullanılmıştır. Görüşmelerde sözdebilimsel içerik olarak taşlarla yürütülen şifacılık konusu kullanılmıştır. Taşlar yürütülen şifacılık sözdebilimsel bir sağlık uygulamasıdır. Bu uygulama birçok araştırmacı tarafında değişik isimlerle ifade edilmektedir; kristal şifacılık (Beyerstein, 1995; Smith, 2010), kristal güç (Moore, 1992), kristal terapi (Baran, Kiani, Samuel, 2014), and kristal enerji (Smith, 2010). Bu araştırmada sözdebilimsel içerik olarak taşlarla yürütülen şifacılık konusunun seçilmesi birkaç nedene dayanmaktadır. Bu nedenlerden ilki ilgili literatüre dayanmaktadır. Sözdebilimsel inançlar konusunda yapılan araştırmaların çoğu survey araştırması niteliğindedir ve bu araştırmalarda birçok sözdebilimsel içeriğe geniş perspektifte değinilmiştir (DeRobertis & Delaney, 1993, 2000; Losh & Nzekwe, 2011; Nickell, 1992; NSB, 2002, 2012; Preece & Baxter, 2000; Walker, Hoekstra & Vogl, 2002). Fakat öğrencilerin sözdebilime yönelimlerinin daha spesifik ve derinlemesine araştırıldığı araştırmalarda ise en çok kullanılan sözdebilimel içeriğin astroloji olduğu görülmektedir. Diğer yandan, Sugarmann, Impey, Buxner ve Antonellis (2011) astroloji ile ilgili inançların psikolojik temellere dayandığından ötürü, sözdebilimsel bir içerik olarak astrolojinin bilim okur-yazarlığını belirlemek için geçerli bir gösterge olamayacağını belirtmektedir. Bu araştırmada ise öğrencilerin psikolojik etkiler altında kalmadan

akıl yürütme becerilerini kullanabilecekleri bir içerik kullanılmak istenmiştir. Bu nedenle öğrencilerin araştırma süreçleri hakkında düşünmesini sağlayacak daha somut bir içerik kullanılması gerekmektedir. Bu nedenle somut materyallerin kullanıldığı, öğrencilerin test etme süreçleri hakkında konuşurken düşünmelerini ve araştırma desenleri oluşturmalarını kolaylaştıracak taşlarla yürütülen şifacılık konusu sözdebilimsel içerik olarak belirlenmiştir.

Ayrıca taşlarla yürütülen şifacılık konusu test edilebilir, reddedilebilir ve yanlışlanabilir bir sözdebilimsel uygulamadır. Aynı zamanda jeoloji veya yerbilimi ile ilişkilendirilebilir. En önemlisi ise taşlarla yürütülen şifacılığın insan sağlığı üzerinde olumlu etkiler gösterdiğini belirten hiçbir bilimsel kanıt olmamasına ragmen, taşlarla tedavi yürüten uygulayıcılar bu uygulamaların bilimsel olduğunu iddia etmektedir. Tüm bu nedenlerden dolayı ve bu kriterleri sağladığı için gerçek bir sözdebilimsel uygulama olan taş şifacılığı içerik olarak seçilmiştir.

Araştırmada kullanılan görüşme protokolü dört bölümde organize edilmiştir; giriş, sözdebilimsel iddialar, hipotetik durumlar ve eksik tasarlanmış sözdebilimsel araştırma süreçleri. Görüşme sırasında öğrencilere sözdebilimsel iddialar ve sözdebilimsel senaryolar sunulmuştur ve öğrencilerin sözdebilim hakkındaki görüşleri bu iddialar ve senaryolar üzerinden sorgulanmıştır. Giriş bölümünde öğrencilerin doğal taşlar hakkındaki ön bilgileri yoklanmıştır. Sözdebilimsel iddialar bölümünde öğrencilere toplum tarafından yaygınlaştırılan, taşların insan sağlığı üzerinde olumlu etkiler gösterebileceğini ifade eden gerçek sözdebilimsel iddialar sunulmuştur. Bu iddialardan bazıları şöyledir;

- Akik taşı olumlu düşünmeyi sağlar, ağrılara iyi gelir, tansiyonu dengeler ve uykusuzluğa iyi gelir.
- Ametist taşı olumsuz enerjiyi olumluya dönüştürür, migren ve kalp rahatsızlıklarına iyi gelir, cilt hastalıklarına iyi gelir ve uykusuzluğu giderir.
- Mercan taşı sedef hastalığına iyi gelir, solunumu düzenler, konsantrasyonu artırır, kalbi kuvvetlendirir.
- Kristal kuvars konsantrasyonu sağlar, olumsuz enerjiden korur, migrene iyi gelir, cep telefonu ve bilgisayardan yayılan radyasyonu toplar.

Bu bölümün ilk amacı öğrencilerin sözdebilimsel uygulamalarla ilgili yönelimlerini ortaya çıkarmak ve bu tür iddialara inanıp inanmadıklarını belirlemektir. İkinci amacı ise bu tür iddiaların nasıl bir süreci sonucunda ortaya çıkmış olabileceği konusunda, iddiaların güvenirliği, kesinliği, bilimsel olup olmaması konusunda öğrencileri düşündürmektir.

Üçüncü bölüm iki adet hipotetik senaryo içermektedir. Bu senaryolarda sözdebilimsel iddialara dayanan iki hipotetik durum kullanılmış ve öğrencilerden bu iddiaları test etmeleri için kendi araştırma desenlerini tasarlamaları istenmiştir. İlk senaryo Akik-tansiyon senaryosudur. Öğrencilere şöyle bir görev verilir; "Tansiyon rahatsızlığından şikayetçi bir yakının olduğunu farz et. Mesela babaannen veya deden tansiyon hastası olabilir. Bu yakınına, akik taşının yüksek tansiyonu düşüreceği söylenmiş. Bu nedenle, bu yakının kendisine önerilen akik taşının tansiyon rahatsızlığının tedavisinde kullanılıp kullanılmayacağını test etmek istiyor." Bu aşamada öğrencilerin bu iddiayı test etmek için araştırma desenleri oluşturmaları istenir ve bu desenler üzerinden öğrencilerin araştırma süreçleri, test etme ve doğrulama süreçleri hakkındaki düşünleri yoklanır.

Üçüncü bölümdeki ikinci senaryo mercan-konsantrasyon senaryosudur. Bu senaryoda öğrencilere konsantrasyonla ilgili bir hipotetik durum sunulur; **"**Bir arkadaşının sana mercan taşından bahsettiğini ve ders çalışırken mercan taşını kullanırsan bu taşın senin konsantrasyonunu artıracağını söylediğini farz et. Arkadaşının tavsiyesine uyarak mercan taşını kullanmaya başlıyorsun. Bu denemeler sonucunda mercan taşının konsantrasyonunu artırdığını hissediyorsun." İkinci hipotetik durumla öğrencilerin karar verme süreçlerinde nasıl bir akıl yürütme süreci kullandıkları, doğrulama süreçlerine ihtiyaç duyup duymadıkları, doğrulamak için neler yaptıkları ve hangi kaynakları kullandıkları yoklanmıştır.

Görüşme protokolünün dördüncü bölümü iki adet eksik tasarlanmış sözdebilimsel araştırma sürecine dayanmaktadır. Bu iki senaryo; veri ve kanıta dayanmayan, değişkenlerin kontrol edilmediği ve alternatif açıklamaların göz ardı edildiği sözdebilimciler tarafından kullanılan araştırma desenlerini temsil etmektedir. Bu

senaryolar yoluyla öğrencilerin bu araştırma desenleri hakkında tartışmaları istenmiştir. Bu bölümdeki ilk senaryo şöyledir; "Zeynep, arkadaşının ona hediye ettiği küçük sardunya fidesini çok sevmişti ve saksıyı güneş alan bir pencere kenarına koydu. Bitkiyi düzenli aralıklarla sulamasına rağmen, birkaç hafta sonra sardunyanın çok az geliştiğini gözlemledi. O anda televizyonda gördüğü bir uygulama aklına geldi ve o uygulamayı denemeye karar verdi. Birkaç gün önce televizyonda kuvars kristalinin bitkilerin büyümesini arttırabileceğiyle ilgili bir program izlemişti. Programda izlediği gibi kuvars kristalini çiçek saksısından 15-20 cm uzağa yerleştirdi. Birkaç gün içinde sardunya bitkisindeki değişiklikleri not etmeye başladı. Sonraki günlerde sardunya bitkisinin güneşe doğru yönelmesi gerekirken kuvars kristaline doğru yöneldiğini ve büyümeye başladığını gözlemledi."

Bu bölümdeki ikinci senaryo ise şöyledir; "Bir araştırmacı akik taşının yüksek tansiyonu dengelediğini iddia etmektedir. Araştırmacı bu iddiasını test etmek için bir araştırma yapmaya karar verir. Yüksek tansiyon şikâyeti olan 15 hasta ile bir araştırma tasarlar. Her bir hastaya avuç içinde tutulabilecek büyüklükte bir akik taşı verir. Hastalardan akik taşını bir saat boyunca kalplerine yakın bir konumda tutmalarını ister. Bir saatin sonunda ise tansiyonlarını ölçer."

Hangi görüşme sorusunun hangi araştırma sorusunu cevaplamak için kullanıldığı aşağıdaki tabloda gösterilmektedir.

Tablo. Araştırma soruları ve görüşme sorularının eşleştirilmesi

	Araştırma Soruları	**Görüşme Soruları**
AS1	Öğrencilerin şifalı taşlarla yürütülen sözdebilimsel uygulamaların amaçları hakkındaki düşünceleri nelerdir?	Giriş Soruları 1-9
AS2	Öğrencilerin şifalı taşlarla yürütülen sözdebilimsel uygulamalarda sözdebilimciler tarafından bilgi üretmek için kullanılan araştırma yöntemleri hakkındaki yorumları	Sözdebilimsel İddialar Sorular 1-2 Akik-Tansiyon Senaryosu Sorular 1 Tansiyonu Dengeleme Senaryosu Sorular 1-2

	nelerdir?	
AS3	Öğrenciler şifalı taşlarla yürütülen sözdebilimsel uygulamalardaki bir fikri test etme süreçlerini ve bilgiyi doğrulama süreçlerini nasıl anlamlandırmaktadır?	Sözdebilimsel İddialar Sorular 3, 7 Akik-Tansiyon Senaryosu Sorular 2, 3 Mercan-Konsantrasyon Senaryosu Sorular 1, 2, 3 Çiçek Senaryosu Sorular 1, 2, 7
AS4	Öğrenciler şifalı taşlarla yürütülen sözdebilimsel uygulamalardan elde edilen bilginin güvenirliğini nasıl değerlendirmektedir?	Sözdebilimsel İddialar Sorular 8 Çiçek Senaryosu Sorular 1, 2, 5, 6
AS5	Öğrenciler şifalı taşlarla yürütülen sözdebilimsel uygulamalardan elde edilen bilginin kesinliğini nasıl değerlendirmektedir?	Sözdebilimsel İddialar Sorular 4 Mercan-Konsantrasyon Senaryosu Sorular 4
AS6	Öğrenciler şifalı taşlarla yürütülen sözdebilimsel uygulamalardan elde edilen bilginin bilimsel olup olmadığını nasıl değerlendirmektedir?	Sözdebilimsel İddialar Sorular 5, 6, 7 Çiçek Senaryosu Sorular 3, 4 Tansiyonu Dengeleme Senaryosu Sorular 3

Her öğrenci ile toplam üç kez görüşme yapılmıştır. Birinci görüşme hariç, diğer görüşmeler öğrencilerin istediği yer ve zamanda yapılmıştır. Görüşme süreleri 50 dakika ve 80 dakika arasında değişmektedir.

Veri Analizi

Verilerin analizinde Glaser ve Straus (1967) tarafından geliştirilen sürekli karşılaştırmalı analiz tekniği (constant comparative method) kullanılmıştır. Bu analiz aslında tümevarımsal yorumlayıcı analiz tekniğidir. Bu analiz tekniği ışığında veriler üç aşamada analiz edilmiştir. İlk aşama ham öğrenci görüşlerinin kodlara dönüştürüldüğü açık kodlama (open coding) aşamasıdır. İkinci aşama kodların temalarda, temaların ise kategorilerde organize edildiği eksensel kodlama (axial coding) aşamasıdır. Son aşama ise kategoriler arasındaki teorik ilişkilendirmelerin yapıldığı seçici kodlama (selective coding) aşamasıdır.

Bulgular

Öğrencilere sözdebilimin ve sözdebilimcilerin amaçları konusundaki düşünceleri sorulduğunda, öğrencilerin görüşleri dört temel tema etrafında yoğunlaşmaktadır. Bunlar; tedavi amaçlı kullanım, yardım amaçlı kullanım, batıl amaçlı kullanım ve ticari amaçlı kullanım. Öğrencilerin çoğu taşların tedavi amacıyla kullanıldığını ve bu taşları kullanarak tedaviler yürüten sağlık merkezlerinin olduğunu belirtmişlerdir. İlgili öğrenci görüşü aşağıda sunulmuştur;

> Ö: Annem çok kullanır doğal taşları veya benzer materyalleri. Hatta Hac'dan gelen taşlar iyiymiş filan diyorlar, onları annem mutlaka saklar. Genellikle bir şeyleri tedavi etmek için kullanıyorlar. Sırt ağrısı için taş filan koyuyorlar. Onları duydum yani görmüştüm.
> G: Nerede görmüştün?
> Ö: Annemde CD var, o inanır böyle şeylere hani bardak çekme filan oluyormuş. Yüzük oluyormuş herhâlde stresi alan. Akik yüzük. Onu kullandı.
> G: Annen sana anlattı mı iyi gelip gelmediğini?
> Ö: İyi gelip gelmediğini anlatmadı ama çoğunlukla kullanıyor. Belki olur belki iyi gelir diye. Ama taşların bele iyi geldiğini söyledi. Yani oluyormuş dedi.
> G: Başka bir gözlemin var mı bu konuda?
> Ö: Yok. Ama bir de mercan taşını duymuştum sanki. Benim babaannem takıyor. Sedef hastalığına yakalandı. Onu geçirmek için mercan bileklikler var onu kullanıyor. (13Z)

Öğrencilerin belirttiği diğer bir amaç ise taşların yardım amaçlı kullanılmasıdır. Öğrenciler çoğunlukla taşları kullanan insanların taşları tanıtarak sağlık problemi olan insanlara yardım ettiklerini düşünmektedirler. İlgili öğrenci görüşü aşağıda sunulmuştur;

> Ö: Taşları tanıtmak olabilir. Çünkü az önce de dediğim gibi bu taşların satıldığı yerlerde tanıtım kağıtları bulunuyor.
> G: Neler yazıyor bu kağıtlarda?
> Ö: Taşların özellikleri yazıyor. Yani bu taşı kullanırsan neye iyi gelir, seni nasıl rahatlatır diye.
> G: Yani bu şekilde insanlara tanıtıyorlar diyorsun. Başka amaçları olabilir mi?
> Ö: Tanıtıyorlar işte. Tanıtıyorlar ki daha çok kişi bunları kullansın. Daha çok kişi tedavi olsun. (12Y)

Tedavi ve yardım amaçlı kullanılmasının dışında bazı öğrenciler kendilerinin ve ailelerinin taşları enerji vermesi veya şans getirmesi gibi batıl amaçlı olarak kullandıklarını belirtmektedirler. İlgili öğrenci görüşü aşağıda sunulmuştur;

> Ö: Annem her gittiğimiz yerden alıyor bu taşlardan. Sinir boşaltıyormuş. Bana biraz saçma geliyor böyle şeyler. Ama benim de evde görüntüsü filan hoşuma gidiyor. Anneme soruyorum ben arada sırada neden böyle şeyler alıyorsun diye, hoşuna gidiyormuş. İnanıyor öyle şeylere.
> G: Neye inanıyor?
> Ö: Annemin anlattığına göre onlar sinirleri boşaltıyormuş, negatif enerjiyi alıyormuş. Hastalıklara iyi gelebiliyormuş bazıları. Bazıları da zararlıymış. Onların pek ismini bilmiyorum. Hani sergiler açılıyor ya, sergilerde sorduk. Kitabı da vardı hatta orada. Kare kare bilgiler yazıyordu. Hatta ben boğa burcuyum. Annem bana da almıştı ondan. Eve gidince de internetten araştırdı annem.
> G: Başka neler duydun taşlarla ilgili
> Ö: Adı pek aklımda değil ama. Bir de biz bir gün bir yere gitmiştik. Orada masaların üstünde doğal taşlardan biri vardı. Negatif enerjiyi alıyor dediler. Böyle zamanla kararıyormuş kendi kendine o taş negatif enerjiyi aldığı için.
> G: Senin çevrende doğal taşlarla ilgilenen insanlar var. Senin bu konudaki fikrin nedir?
> Ö: Biz uzun süre durmadık orada ama gidip baktım ilgimi çekiyordu. Kenarları beyazdı, üstü mordu. Gittikçe siyahlaşıyordu. Doğru olabilir. (12Y)

Az sayıda öğrenci ise taşların ticari kazanç sağlamak için kullanıldığının farkındadır. Bu öğrenciler bu taşları kullanan kişilerin hasta olan ve iyileşmek isteyen insanların duygularını sömürerek ticari kazanç elde etmeye çalıştıklarını belirtmektedirler. İlgili öğrenci görüşü aşağıda sunulmuştur;

> Ö: Bence amaçları ticari kazanç
> G: Nasıl
> Ö: İyileştiriyor mu iyileştirmiyor mu bilmiyorum ama ticari kazanç sağlamak istiyorlar. Bu yüzden siteler kuruyorlar. Bu sitelerde taşların özelliklerini anlatıyorlar. Şu hastalığa iyi gelir bunu iyileştirir diyorlar.
> G: Ticari kazanç sağlamaya çalışıyor olabilirler diyorsun. İnsanlar neden etkisini bilmediği bir şeyi alsın ki.
> Ö: Öncelikle inanıyorlar, denemek istiyorlar. Belki hastalığımın tedavisi bundadır diye deniyorlar. Öyle olunca da insan bir umut deniyor.
> G: Başka amaçları olabilir mi
> Ö: Olamaz bence. Sadece insanların duygularını sömürerek para kazanmak istiyorlar. (3C)

Özetle öğrenciler sözdebilimin ve sözdebilimcilerin amacı konusunda, bu uygulamalara olumlu ve naif bir anlam yüklemişlerdir. Öğrencilerin büyük bir çoğunluğu sözdebilimciler tarafından gizlenen sözdebilimin aldatıcı ve ticari kazanca dayalı temel amacının farkında değildir.

Öğrencilerin şifalı taşlarla yürütülen sözdebilimsel uygulamalarda sözdebilimciler tarafından bilgi üretmek için kullanılan araştırma yöntemleri hakkındaki yorumları incelendiğinde, taşları kullanan kişilerin genellikle sözdebilimsel iddialara veya sözdebilimsel bilgilere kişisel deneyimleri sonucu veya deneme yanılma süreci sonunda ulaştıklarını düşünmektedirler. İlgili öğrenci görüşleri aşağıda sunulmuştur;

> G: Sence bu bilgiler nasıl bir süreç sonunda elde edilmiş olabilir.
> Ö: İnsanlar üzerinde denenmiştir. Ona göre gruplanmıştır. Öyle olmuştur.
> G: Peki nasıl bir deneme süreci bana anlatabilir misin?
> Ö: Bence ilk önce bu taşlar bulunmuştur. Ondan sonra taşlar iyice araştırılmıştır, bakılmıştır.
> G: Neyine bakılıyor işte, nasıl bir araştırma bu?
> Ö: İnsanlar üzerindeki etkilerine bakılmıştır.
> G: İşte o etkiye nasıl balkıyor.
> Ö: Bunu sizin üzerinizde kullanırım. Size sorarım iyi geliyor mu gelmiyor mu diye. Sadece bir kişiye sormam tabi on kişiye sorarım. Mesela 10 kişiden 9'u iyi geliyor derse bu taş iyi demektir. Ondan sonra da ben taşı sürerim piyasaya insanları tedavi ederim. Mesela mercan taşı diyor burada, sedef hastalığı olan bir arkadaşımı çağrırım onun üzerinde denerim mesela, al bunu kullan bir hafta sonra geri gel derim. Düzenli kullanması için uyarırım. Doğru düzgün kullanmışsa ve sedef hastalığı yoksa yani bitmişse ben doğru olduğunu düşünürüm. Bu taşların özelliklerini bulmamız için de bir sürü deneme yapmamız lazım. Mesela hastalıklı olana, sorunu olana bunları denemek lazım. (10S)

> G: Sence taşların böyle özellikler gösterdiğini iddia eden insanlar nasıl bir araştırma süreci sonunda bu tarz bilgilere ulaşmış olabilirler.
> Ö: Denemiş olabilirler bir süre boyunca ama tam olarak bilmiyorum. Onlar denediyse ve iyi geldiyse iyidir.
> G: Sence nasıl bir deneme yapmışlardır bununla ilgili.
> Ö: Vücudumun bir tarafına koyardım herhalde taşı, beklerdim belli bir süre. İyi geliyorsa kalırdı.
> G: Ne kadar beklerdin mesela
> Ö: 5-10 dakika beklerdim iyi geliyorsa geliyordur zaten, o süre içinde görürüm. Gelmiyorsa da bırakırdım.

G: İyi gelip gelmediğini nasıl anlardın.
Ö: Tansiyonum çıkmışsa ve tansiyonumu indirdiyse iyi gelmiştir.
G: Yani tansiyonun çıktığı anda mı denemek gerekiyor.
Ö: Tabi öyle bir durumda denemek gerekiyor yoksa anlayamazdım nasıl etkili olduğunu. (14Z)

Ayrıca öğrencilerin kendilerine sunulan eksik tasarlanmış sözdebilimsel araştırma süreci ile ilgili senaryodaki araştırma eksiklerini fark edemedikleri ve genellikle sözdebilimciler tarafından kullanılan böyle bir araştırma yöntemini bir iddiayı test etmek için uygun bir araştırma deseni olarak ifade ettikleri görülmektedir. İlgili öğrenci görüşleri aşağıda sunulmuştur;

Ö: Bu aslında az önce benim dediğim gibi bir araştırma. Bu araştırmanın bir eksiği yok bence, çünkü zaten deniyor. Deneyim sonucu yapıyor yani. Öyle kafasına göre söylemiyor. Bir yerlerden okuyup bize anlatmıyor.
G: Daha başka neler yapılabilir bu konuda
Ö: Belki önce bilgi edinirdim. Ona göre deneyim yapardım. Sadece deneyim de olmaz aslında.
G: Acaba deney ve deneyimi karıştırıyor olabilir misin. Bir deney var bir deneyim var.
Ö: Yok, farklı aslında ikisi
G: Senin burada ifade etmek istediğin hangisi
Ö: Deneyim. Bir şeyin gerçek olup olmadığını deniyorsun. Diğerinde ise bulmaya çalışıyorsun yani deneyle. Aslında farklı. (14Z)

Ö: Bence çok iyi bir araştırma. Çünkü bir kişinin değil birçok kişinin üstünde araştırma yapıyor. Bir kişinin üstünde olsa inanılmaz belki ama birçok kişinin üzerinde etki ettiyse bence olabilir. Birçok kişi üzerinde deniyor. Tesadüfe bırakmıyor yani. Gerçek bir araştırma.
G: Sen nasıl bir araştırma yaparsın.
Ö: Birçok kişinin üstünde test ettiği için ben de aynı şeyi yapardım heralde. (13Z)

Özetle sözdebilimde kullanılan araştırma ve doğrulama süreçlerine gelindiğinde, öğrencilerin sözdebilimciler tarafından kullanılan hatalı test etme ve doğrulama süreçlerini fark edip eleştiremedikleri görülmüştür. Sözdebilimcilerin kullandığı akıl yürütme desenine benzer olarak, öğrencilerin bu süreçte veri ve kanıtın varlığını göz önünde bulundurmadığı gözlenmiştir. Öğrencilerin, bir iddiayı test etmek için genellikle sorgulanabilir varsayımlar ve genellikle kişisel fikirlere veya başkalarının fikirlerine dayanan hatalı kanıtlar kullandıkları görülmüştür. Öğrencilerin, genellikle alternatif açıklamaların olabileceğini göz önünde bulundurmadığı, gerçeğin her

zaman kendi gördükleri gibi olduğuna inandıkları ve bu nedenle kendi gözlemlerini doğrulama ihtiyacı hissetmedikleri gözlenmiştir. Bu çalışmada yer alan ortaokul öğrencilerine göre, bir şeyin etkili olup olmadığı kişisel bir deneme ile anlaşılabilir. Bu nedenle, öğrencilerin sözdebilimciler gibi değişkenleri kontrol etme, uygun deney tasarımı yapma gibi temel bilimsel süreç becerilerini içeren temel bilimsel araştırma prensiplerinin farkında olmadığı bulunmuştur.

Öğrenciler şifalı taşlarla yürütülen sözdebilimsel uygulamalardan elde edilen bilginin güvenirliği ve kesinliği hakkındaki düşünceleri incelendiğinde, öğrencilerin, bir uygulama gerçek insanlar tarafından veya gerçek insanlar veya nesneler üzerinde denendiği sürece bu uygulamadan elde edilecek bilginin güvenilir ve kesin olduğunu düşünme eğilimde oldukları görülmektedir. İlgili öğrenci görüşleri aşağıda sunulmuştur;

> Ö: Bence aslında mümkün böyle şeyler. Çünkü bu denendiğine göre ve böyle bir bilgiye de ulaştığına göre denenmiş ve doğru bir şeydir. Kesindir yani bu bilgi.
> G: Neden böyle düşünüyorsun?
> Ö: Burada zaten bundan öncesi ve sonrası diye araştırma yapıp not tutmuş yani bir araştırma yapmış. Tıpkı bilimsel bir araştırmadaki gibi bir deney yapmış. Bir de sonrasında değişim olmuş diye bakmış yani bunlardan dolayı güvenilir geliyor bana. Birebir denemiş. Deneyerek aslında duyduğu bilgileri netleştiriyor. Artık kesin olarak işe yarayıp yaramadığını söyleyebilir. Bilimsel bir araştırma yapmış çünkü. (5D)

> Ö: Bu sefer denenmiş işte. Yani öyle sadece bir söylenti bir iddia değil. Birebir denemiş. Televizyonda izlediği programdaki gibi yapmış denemiş ve taş etkili olmuş çiçeğin büyümesine. Etkili olmuş ki bunu anlatmış.
> G: Neden böyle düşünüyorsun?
> Ö: Mesela bu Zeynep denemiş ve olmuş. Bunu gözlemlemiş. Bunları not etmiş ve bize anlatmış. Bu beni etkiledi. Yani sadece bir söylenti değil artık. Kız bunu denemiş ve gerçekten olduğunu görmüş.
> G: Bazı insanlar Zeynep'in yaptığı uygulamanın ve elde ettiği bilgilerin güvenilir olmadığını söylemektedirler. Senin düşüncelerin nelerdir?
> Ö: Burada denediğini ve çiçeğin gerçekten büyüdüğünü belirtmiş. Yani bu bilgi kesindir, güvenilirdir. Mesela ben de televizyonda işe yaradığını görürsem gerçekten bunlar oluyor, işe yarıyor diye düşünürüm. Kesindir yani bu. Gerçekten olmuş. (6F)

Ö: Burada son cümlede dediği gibi "sardunya bitkisinin güneşe doğru yönelmesi gerekirken kuvars kristaline doğru yöneldiğini ve büyümeye başladığını gözlemledi" bu inandırıcı geldi bana. Hani böyle şeyler olabilir diye düşünüyorum.
G: Neden böyle düşünüyorsun?
Ö: Güvenilir geldi bana. Çünkü kendisi uygulamış bunu ve işe yaramış. Bu nedenle güvenilirdir diye düşünüyorum. Burada öyle yazıyor çünkü. Hani güneşe tuttuğunda güneşim etkisinin çok az olduğunu görmüş ama kuvars kristalini koyunca büyüme ona doğru yönelmiş ve daha da gelişmeye başlamış. Bunlardan etkilendim. O yöne dönmesi nedeniyle ondan bir enerji aldığını düşünüyorum. (9M)

Sözdebilimsel bilgilerin güvenirliği ve kesinliği konusuna gelindiğinde, öğrencilerin acemi gerçeklik (naive realism) bakış açısına sahip olduğu ve bu nedenle kendi kişisel deneyimlerini güvenilir, kesin ve değişmeyecek gerçekler olarak ifade ettikleri görülmüştür.

Öğrenciler şifalı taşlarla yürütülen sözdebilimsel uygulamalardan elde edilen bilginin bilimsel olup olmadığı hakkındaki düşünceleri incelendiğinde, öğrenciler tarafından var olan bir iddianın gerçekten birileri tarafından hangi koşulda olursa olsun denenmiş olması ve bu denemeler sonunda olumlu sonuç elde ediliyor olması bu tür uygulamaların bilimsel olarak kabul edilebilmesi için yeterli kriterler olarak ifade edilmektedir. İlgili öğrenci görüşleri aşağıda sunulmuştur;

Ö: Ben anneannemden örnek vereyim yine. O bana söylemişti. Onun tansiyonu şeker hastalığı çeşitli hastalıkları var. Bana bir de bel ağrısı olduğunu söyledi. Benden evde daha önceden bulunan yani daha önceden almış olduğu taşı getirmemi istedi. Taşı getirdim ve beline koydu. Onu birkaç başörtü ile beline bağladı. Daha sonra ağrısının geçtiğini söyledi. Ben de açıkçası bir site yöneticisi olsam böyle bir konuyu ve gözlemi internette paylaşırdım. Denenmiş olarak gerçek doğru bilgi olduğunu bildiğim için.
G: Peki sence bu denemeler bilimsel midir?
Ö: Evet bilimsel olabilir. Çünkü siz deniyorsunuz onu, ortada kanıtı olmayan bir bilgi var. Bunu kanıtlamak için, yani bilimsel yoldan kanıtlamak için deniyorsunuz. Bu denemeler bunun kanıtı olabilir. Yani insanlar üzerinde deneyerek etkili olup olmadığını kanıtlayabilirler. Zaten bu bilgileri de o denemelerin sonunda elde etmişlerdir. Yani bilimsel denemelerdir bunlar. (2B)

Ö: Bilimseldir bence. Yani bilimsel olmasa herkes öyle kafasına göre denese bilimsel olmaz. Bilimsel olarak denemişler ki böyle bilgiler

ortaya çıkmış. Yoksa insanlar şuna iyi geliyor buna iyi geliyor diyemezdi.
G: Burada bilimle ilgili olan kısmı neresi onu anlayamadım.
Ö: Yani bilen var bilmeyen var öyle kafasına göre herkesin denememesi lazım. Uzman kişilerin bunu denemesi ve söylemesi gerekir. Yani olumlu yönlerini bilip öyle denemeleri gerekir. Uzman kişiler bu taşları denemiş olmalı ki bu tür şeyleri ortaya çıkarmışlar. (6F)

Ö: Bilimseldir bence araştırmışlar işte o kadar.
G: Neden bilimsel olduğunu düşünüyorsun?
Ö: Bilimsel işte, direk aklıma bilimsel olduğu geldi. Araştırmışlar. Araştırmışlar ki böyle sonuçlar ortaya çıkmış.
G: Neden bilimsel olduğunu düşünüyorsun?
Ö: İyileştirdiğine inanıyorlarsa bilimseldir ve gerçekten iyileştiriyorsa vardır bir gücü. Yani iyileştirmese insanlar bunları nasıl ortaya çıkarıp bu taş buna iyi geliyor şu taş şuna iyi geliyor diyebilsinler ki. Adam veya kadında rahatsızlanma, rahatsızlığı düzeltme, bu tür şeyleri tedavi etmesi veya kötü yola gitmesi. Yani bir sonuç görüyorsunuz. Elinizde onunla ilgili bir bilgi bir sonuç oluyor. Bu nedenle bilimseldir. Örneğin birçok bilgi var ya demek ki taşlar etkili olmuş ki bu sonuçlar ortaya çıkmış. (3C)

Sözdebilimsel bilgilerin bilimsel statüsü söz konusu olduğunda, öğrencilerin bilimsel statüyü değerlendirirken veri, kanıt ve doğrulama süreçlerinin varlığını göz önünde bulundurmadığı bulunmuştur. Sözdebilimcilerin düşünme stiline benzer olarak, öğrenciler için, bir şeyin gerçek insanlar üzerinde ve gerçek insanlar tarafından denenmiş olması ve bu deneme sonunda olumlu bir sonuçla karşılaşılması, bu denemeden elde edilecek bilginin bilimsel kabul edilmesi için yeterlidir.

Sonuç

Araştırma sonuçları ortaokul 8. sınıf öğrencilerinin sözdebilimsel uygulamaların amaçları, sözdebilimde kullanılan araştırma ve doğrulama süreçleri ve sözdebilimsel uygulamalardan elde edilen bilgilerin kesinliği, güvenirliği ve bilimsel statüsü hakkında kolay kandırılabilir (gullible) bir anlayışa sahip olduklarını göstermektedir. Öğrencilerin, doğal taşlar hakkında kendilerine sunulan sözdebilimsel iddialar ve sözdebilimsel senaryolar hakkında tartışırken genellikle sözdebilimciler tarafından kullanılan basit akıl yürütme desenleri kullandıkları görülmüştür.

APPENDIX E. CURRICULUM VITAE

Personal Details

Address: AİBÜ Eğitim Fakültesi

İlköğretim Bölümü

Ofis No: 113

14280 Gölköy Bolu

Phone : (090) 374 254 0000/1671

E-mail : metin_d@ibu.edu.tr

duygum444@yahoo.com

Education

Degree	Institution	Year of Graduation
PhD	Middle East Technical University (METU), Ankara	2015
MS	Abant Izzet Baysal University (AIBU), Bolu	2009
BS	Dokuz Eylul University (DEU), İzmir	2005

Work Experience

Year	Place	Enrollment
2006- present	Abant Izzet Baysal University (AIBU), Bolu	Research Assistant

Foreign Languages

English

Workshops

4. Eğitim Bilimleri Araştırma Günleri. 19-26 Ocak 2013. Pegem Akademi, Ankara.
Inquiry Based Science Teaching: The Efficacy of Inquiry Instruction for Content Development (Dr. Bill Cobern), 18 Kasım 2011, Hacettepe Üniversitesi, Ankara.
The Competing Influence of Secularism and Religion on Science Education in America's Secular Society: Lessons to be Learned (Dr. Bill Cobern), 18 Kasım 2011, Hacettepe Üniversitesi, Ankara.
Bilim Tarihi ve Felsefesinin Bilim Öğretimi ve Araştırmalarına Katkısı, 14 Mayıs 2010, Hacettepe Üniversitesi, Ankara.
Öğrencilerin Fen Konularıyla İlgili Kavramları: Fikirleri, Etkinlikleri ve Etkileşimleri İncelemek, 31 Ağustos 2009, Yeditepe Üniversitesi, İstanbul.
Bilgisayar Destekli Nitel Veri Analizi: Nvivo8 Programının Tanıtımı Ve Uygulamaları, 22-23 Kasım 2009, Anı Yayıncılık Binası, Ankara.
Eğitimde Bir Başarı Örneği: Finlandiya, 10 Nisan 2008, TOBB Ekonomi ve Teknoloji Üniversitesi, Ankara.
Bilim Eğitimi Çalıştayı, 29-30 Mart 2008, TÜBA, Ankara.

Projects

Institution	Project	Enrollment
Bilim ve Toplum Projesi (TÜBİTAK)	Üçü Bir Arada: Doğa, Bilim ve Çocuklar Yaz Bilim Kampı 2014	Uzman Personel
Bilim ve Toplum Projesi (TÜBİTAK)	Üçü Bir Arada: Doğa, Bilim ve Çocuklar Yaz Bilim Kampı 2013	Uzman Personel
Bilim ve Toplum Projesi (TÜBİTAK)	Üçü Bir Arada: Doğa, Bilim ve Çocuklar Yaz Bilim Kampı 2011	Uzman Personel
Bilim ve Toplum Projesi (TÜBİTAK)	Üçü Bir Arada: Doğa, Bilim ve Çocuklar Yaz Bilim Kampı 2010	Uzman Personel
Bilim ve Toplum Projesi (TÜBİTAK)	Üçü Bir Arada: Doğa, Bilim ve Çocuklar Yaz Bilim Kampı 2009	Uzman Personel
Bilim ve Toplum Projesi (TÜBİTAK)	Üçü Bir Arada: Doğa, Bilim ve Çocuklar Yaz Bilim Kampı 2008	Uzman Personel

Bilim ve Toplum Projesi (TÜBİTAK)	Aladağlar Yaz Bilim Kampı 2007	Araştırmacı
Bilim ve Toplum Projesi (TÜBİTAK)	Lisans Üstü Öğrencilerin ve Genç Akademisyenlerin Eğitim İle İlgili Alanlarda Akademik Yayın Yapma Potansiyellerini Artırmaya Yönelik Kurs, TÜBİTAK Projesi 2008	Katılımcı
Bilim ve Toplum Projesi (TÜBİTAK)	Kazdağları Milli Parkı Doğa Eğitimi 2007	Katılımcı
Bilim ve Toplum Etkinliği	Bilim Danışmanlığı Eğitimi Çalıştayı TÜBİTAK BİDEP	Araştırmacı
Kurumsal (TÜBİTAK, DPT, BAP vb.)	Fen Bilgisi Öğretmen Adaylarının Sözde-Bilim, Bilimin Doğası ve Evrim Teorisine Yönelik Algıları Üzerine bir Çalışma ODTÜ-BAP	Araştırmacı
Diğer	VIII. Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi 2008	Kongre Sekretaryası
	Bilime Dokunan Küçük Eller Bilim Şenliği 2010-2014	Bilim Kurulu ve Sekreterya

Presentations

Metin, D., Çakıroğlu, J., Öztekin, C., Özdem, Y., Bilican, K. (2014). Pseudoscientific Beliefs of University Science Education Students. *International Conference on Education in Mathematics, Science and Technology (ICEMST)*, 16-18 May 2014, Konya, Turkey.

Capkinoglu, E., Metin, D., Cetin, P.S., & Leblebicioglu, G. (2014). Analysis of Argumentation Elements in Turkish Elementary and Secondary School Science Curriculum. *European Conference on Educational Research (ECER) Annual Conference*, 2-5 September 2014, Porto, Portugal.

Metin, D., Çakıroğlu, J., & Leblebicioglu, G. (2014). Ortaokul Öğrencilerinin Sözdebilim Hakkındaki Algıları ve Mantıksal Düşünme Desenleri. *XI. Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi*, 11-14 Eylül 2014, Adana, Türkiye.

Metin, D. & Yiğit, Ö. (2013). Overlap between Social Studies and Science Curricula in terms of Science-Technology-Society Approach. *European Conference on Educational Research (ECER)*, 09-13 September 2013, İstanbul.

Metin, D., Çetin, P.S., Yardımcı, E., & Leblebicioğlu, G. (2013). How children's image of scientists change when they interact with scientists at a science camp? *European Conference on Educational Research (ECER)*, 09-13 September 2013, İstanbul.

Yardımcı, E., Metin, D., & Leblebicioğlu, G. (2013) Comparison of Science Teaching Perception of Preservice Elementary Education Teachers' and Preservice Elementary Science Education Teachers. *European Conference on Educational Research (ECER)*, 09-13 September 2013, İstanbul.

Metin, D., Çakıroğlu, J., Tekkaya, C., Bilican, K., Özdem, Y. (2012). Fen Bilgisi Öğretmenliği Öğrencilerinin Bilimsel Bilgiye Bakış Açısı. *Uygulamalı Eğitim Kongresi*, Ankara.

Yiğit, E.Ö., Metin, D. (2012). Bilim, Teknoloji Ve Toplum Yaklaşımı Açısından Sosyal Bilgiler ve Fen Ve Teknoloji Öğretim Programlarının Değerlendirilmesi. *2. Ulusal Eğitim Programları ve Öğretim Kongresi*, Bolu.

Metin, D., Cetin, P.S., Yardimci, E., Berkyurek, İ., Leblebicioglu, G. (2012) Çocukların Bilim İnsanı İmajlarını Geliştirmek İçin Bir İnformal Uygulama: Yaz Bilim Kampı, *X. Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi*, Niğde.

Metin, D. & Ertepınar, H. (2011) Pre-service Elementary Science Teachers' Views about NOS in Pseudoscientific Context, *European Science Education Research Association (ESERA)*, Lyon, France.

Leblebicioglu, G.; Yalçınoğlu, P.; Metin, D. & Yardımcı, E. (2011) The Effect of Science Camp on Chıldren's Views of the Nature of Science, *European Science Education Research Association (ESERA)*, Lyon, France.

Metin, D. & Ertepınar, H. (2011) Undergraduate Science Students' Knowledge about Earthquake and Their Views about Nature of Science in Pseudoscientific Context of Earthquake, *European Conference of Educational Research (ECER)*, Berlin, Germany.

Leblebicioglu, G.; Yardimci, E.; Metin, D. (2011) The Effect of a Science Camp on Children's Conceptions of Science, *11th International IHPST and 6th Greek History, Philosophy and Science Teaching Joint Conference*, Thessaloniki, 1-5 July 2011, Greece.

Metin, D. & Bağcı Kılıç, G. (2010) Bilim Kampının Çocukların Bilimsel Model Hakkındaki Görüşlerine Etkisi*, IX. Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi*, İzmir.

Yardimci, E., Bagci Kilic, G., Metin, D. (2010) The Effect of Integrating Pre- and Post-Laboratory Discussion into Guided-Inquiry on Developing Science Process Skills, *European Conference of Educational Research (ECER)*, Helsinki, Finland.

Bagci Kilic, G. , Yardimci, E., Metin, D., Berkyurek, İ. (2010) Science Camp for Training Teachers on Developing and Supervising Science Projects and Introducing Nature of Science, *European Conference of Educational Research (ECER)*, Helsinki, Finland.

Metin, D., Bagci Kilic, G. (2009) The Effect of the Science Camp Program on Children's Views of the Tentative Nature of Science, *European Science Education Research Association (ESERA)*, İstanbul, Turkey.

Metin, D., Bagci Kilic, G. (2009) How Did a Science Camp Affect Children's Conceptions of Science? *3rd Redesigning Pedagogy International Conference* June 2009, Singapore.

Metin, D., Bagci Kilic, G. (2009) How Did a Science Camp Affect Children's Conceptions of Scientists? *3rd Redesigning Pedagogy International Conference* June 2009, Singapore.

Metin, D.; Yardımcı, E.; Bağcı Kılıç, G. (2008) Fen Alanları Öğretmenlerine Sıradışı Bilim Danışmanlığı Eğitimi, *VIII. Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi*, Abant İzzet Baysal Üniversitesi, Bolu.

Yardımcı, E., Metin, D., Bağcı Kılıç, G., "Ön ve Son Laboratuvar Tartışmasının Bilim Süreç Becerilerinin Geliştirilmesine Etkisi", *VIII. Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi*, Bolu, 2008.

Bağcı Kılıç, G., Metin, D., Yardımcı, E., Berkyürek, İ. (2007) Doğada Bilim Eğitimi, *I. İlköğretim Kongresi*, Hacettepe Üniversitesi, Ankara.

Metin, D., Koray, Ö. (2007) "Hizmet İçinde Görevli Öğretmenlerin Yeni Fen Ve Teknoloji Dersi Öğretim Programı Hakkındaki Görüşleri: Nitel Bir Çalışma", *16. Eğitim Bilimleri Kongre Kitabı*, Tokat.

Publications

Metin, D. & Leblebicioglu, G. (2015). Ortaokul 6. ve 7. Sınıf Öğrencilerinin Bilimsel Model ve Modelleme Hakkındaki Görüşlerinin Bir Yaz Bilim Kampı Süresince Gelişimi. *Eğitim ve Bilim*, 40, 177, 1-18.

Leblebicioglu, G., Metin, D., Yardımcı, E. (2012). Bilim Danışmanlığı Eğitiminin Fen Alanları Öğretmenlerinin Bilimin Doğasını Tanımalarına Etkisi. *Eğitim ve Bilim*, 37, 164, 57-70.

Metin, D. & Leblebicioglu, G. (2012). Effect of a science camp on the children's views of tentative nature of science. *Journal of Studies in Education*, Vol. 2, No 1, 164-183.

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Metin, D. & Leblebicioglu, G. (2011). How did a science camp affect children's conceptions of science?. *Asia-Pacific Forum on Science Learning and Teaching*, Volume 12, Issue 1, Article 2.

Leblebicioglu, G., Metin, D., Yardımcı, E., Berkyürek, İ. (2011). Teaching the Nature of Science in the Nature: A Summer Science Camp. *Elementary Education Online*, 10 (3), 1037-1055.

Bağcı Kılıç, G., Yardımcı, E., Metin, D. (2010). Fen Öğretiminde Değişkenler Nasıl Adlandırılmalı?. *Abant İzzet Baysal Üniversitesi Eğitim Fakültesi Dergisi*, 9(2), 13-26.

Bağci Kılıc, G., Yardımcı, E., Metin, D. (2010) Ön ve Son-Laboratuvar Tartışması Eklenmiş Yönlendirilmiş Araştırmanın Bilimsel Süreç Becerilerinin Geliştirilmesine Etkisi. *E-journal of New World Sciences Academy (NEWWSA)*, Eğitim Bilimleri (Issn: 1308 7274)

APPENDIX F. TEZ FOTOKOPİSİ İZİN FORMU

ENSTİTÜ

Fen Bilimleri Enstitüsü ☐

Sosyal Bilimler Enstitüsü ■

Uygulamalı Matematik Enstitüsü ☐

Enformatik Enstitüsü ☐

Deniz Bilimleri Enstitüsü ☐

YAZARIN

Soyadı : Metin
Adı : Duygu
Bölümü : İlköğretim

TEZİN ADI (İngilizce) : MIDDLE SCHOOL STUDENTS' REASONING PATTERNS AND COMPREHENSIONS ABOUT PSEUDOSCIENTIFIC APPLICATIONS RELATED TO CRYSTALS

TEZİN TÜRÜ : Yüksek Lisans ☐ Doktora ■

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 (1) yıl süreyle fotokopi alınamaz. ■

TEZİN KÜTÜPHANEYE TESLİM TARİHİ: