COMPARISON OF SAFETY CULTURE PERCEPTIONS OF UNIVERSITY STUDENT GROUPS

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ABSTRACT

COMPARISON OF SAFETY CULTURE PERCEPTIONS OF UNIVERSITY STUDENT GROUPS

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Although behavior-based safety has become a popular topic in recent decades, increasing the level of safety culture is still an emerging issue. Lack of awareness of safety culture among young professionals is of paramount concern not only for creating safe working environment but also for sustainable development. The main objective of this research study is to assess the safety culture among the students enrolled at Middle East Technical University (METU) and to identify potentials to be improved through management strategies and action plans. The research methodology followed in this study has two main stages as initial study and the main study. In the initial study phase, safety culture scale was developed through focus group meeting, pilot study, and expert consultations and in the main study phase, safety culture level among students was investigated through data gathering, exploratory factor analysis of the data, and interpretation of obtained results. In total, 471 students from METU participated in the study discussed herein. Research findings revealed that there is a great potential to equip students with enough knowledge and skills in the areas of emergency preparedness and response. The main novelty of this research study is that it is the pioneering study on safety culture assessment among university students in the country and it is expected to advance the current research frontiers in that area. It is also expected to start a discussion in the safety field in Turkey.

Keywords: Safety Culture Assessment, Safety Awareness, Safety Management, Academic Institutions, University Students

ÖZ

ÜNİVERSİTE ÖĞRENCİ GRUPLARININ GÜVENLİK KÜLTÜRÜ ALGILARININ KARŞILAŞTIRILMASI

Altınkaya Kurtulmuş, Gizem
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Davranış odaklı güvenlik son yıllarda popüler bir konu olsa dahi, güvenlik kültürü seviyesini artırmak hala gelişen/yükselen bir konudur. Genç profesyoneller arasında güvenlik kültürü konusundaki farkındalık eksikliği, yalnızca güvenli bir çalışma ortamı yaratmak için değil, aynı zamanda sürdürülebilir kalkınma için de endişe kaynağıdır. Bu araştırmanın temel amacı, Orta Doğu Teknik Üniversitesi'ne (ODTÜ) kayıtlı öğrenciler arasındaki güvenlik kültürünü değerlendirmek ve yönetim stratejileri ve eylem planları ile geliştirilebilecek potansiyel konuları tespit etmektir. Bu çalışmada izlenen araştırma metodolojisi, ilk çalışma ve ana çalışma olarak iki ana aşamaya sahiptir. İlk çalışma aşamasında, odak grup toplantısı, pilot çalışma ve uzman danışma oturumları ile güvenlik kültürü ölçeği geliştirilmiş ve ana çalışma aşamasında öğrenciler arasındaki güvenlik kültürü seviyesi veri toplama, verilerin açımlayıcı faktör analizi ve elde edilen sonuçların yorumlanması ile incelenmiştir. Çalışmaya ODTÜ'den toplam 471 öğrenci katılmıştır. Araştırma bulguları, öğrencilere acil durumlara hazırlık ve müdahale alanlarında yeterli bilgi ve beceri kazandırmak için büyük bir imkân olduğunu ortaya koymaktadır. Bu araştırmanın asıl yeniliği, ülkedeki üniversite öğrencileri arasında güvenlik kültürü değerlendirmesi konusunda öncü bir çalışma olmasıdır. Bu çalışmanın güvenlik kültürü alanındaki mevcut araştırma sınırlarını ilerletmesi ve Türkiye'deki güvenlik alanında bir tartışma başlatması beklenmektedir.

Anahtar Kelimeler: Güvenlik Kültürü Değerlendirmesi, Güvenlik Farkındalığı, Güvenlik Yönetimi, Akademik Kurumlar, Üniversite Öğrencileri

TO EVA AND SELİN

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To Eva: You were in my body when I went to an interview to enroll in this Master program. Now you are over two, and you are the most beautiful individual that I have ever met. We lost some time during this period, but I hope we will have plenty of time to make up for it. I love you forever and always.

This thesis is also dedicated in memory of İrem Kütük, who lost her life on the METU Campus in a senseless accident while I was in the process of writing this thesis, with the hope that this thesis will contribute to improvement of the safety conditions at METU.

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CHAPTER 1

INTRODUCTION

1.1. Background

The concept of "safety culture" had emerged after the Chernobyl accident in 1986 by International Nuclear Safety Advisory Group. In fact, the recent appeal to this term, safety culture, can be directly traced back to this accident (Flin *et al.*, 2000; Guldenmund, 2000; Glendon and Stanton, 2000; Lee and Harrison, 2000; Wiegmann *et al.*, 2002; Choudhry *et al.*, 2007; Bhattacharya, 2015; Arslan *et al.*, 2016; Warszawska and Kraslawski, 2016; Shirali *et al.*, 2016; Kim *et al.*, 2017; Gong, 2019). Since then the term has been widely used in literature such as, occupational safety, traffic safety, and patient safety.

International Nuclear Safety Advisory Group (INSAG) had introduced the concept of safety culture to the literature in the "Summary Report on the Post-Accident Review Meeting on the Chernobyl Accident", which is published by the International Atomic Energy Agency (IAEA) in 1986 (INSAG, 1986). After that, the term safety culture was also used in Basic Safety Principles for Nuclear Power Plants Report published in 1988 (INSAG, 1988). Following the publication of these two reports, the concept of safety culture has been extensively studied. However, the meaning of this concept has become subject to interpretation and there was no clear guidance for how safety culture can be assessed (INSAG, 1991).

INSAG then published a report on Safety Culture as a part of the safety series reports in 1991 (INSAG, 1991). This report was prepared as a response to the comments made after the publication of above mentioned two reports. The 1991 report aimed to clarify what concept of safety culture actually refers to, and to evaluate the general factors which would contribute to a satisfactory nuclear safety regime in detail. One of the earliest definitions of safety culture can be found in the above mentioned 1991 International Nuclear Safety Advisory Group's report. It defined the concept of safety culture as follows:

> *"Safety Culture is that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance" (International Atomic Energy Agency, 1991, p.1).*

Subsequently, a great number of researchers have contributed to the definition of safety culture and stressed the positive impact of the concept of safety culture on the accident free environment. Indeed, many studies have been conducted to measure safety attitudes in large-scale companies. These studies extended to the studies of Hawthorne in the 1930s, where attitudes of 21,216 employees of the Western Electric company in the USA were assessed by an extensive interview program (Roethlisberger and Dickson, 1939 cited from Lee and Harrison, 2000).

Before Zohar's study in 1980, qualitative methods were mainly used in the studies related to safety attitudes. Therefore, Zohar is considered as the first researcher that used quantitative method on his study focusing on the attitudes toward safety. He used the term "safety climate" and the term "safety culture" could not be found in literature at that time. However, to date there has been little agreement on what safety culture

and safety climate mean. While some researchers suggested that these two terms could be used interchangeably, many argued that they express different approaches.

After the first quantitative study of Zohar (1980), there are large number of studies that assess safety culture, especially among workers were conducted by the researchers. Although questionnaires and scales, used in these studies differ in many respects, the basic methodology for safety culture studies remains same as applying a questionnaire to a specified target group and assessing the data obtained from the questionnaires using statistical techniques.

1.2. Statement of the Problem

Many researches have been conducted to understand the level of safety culture of individuals and to design new methods to improve safety culture. In Turkey, the main approach in the industry is to provide only the relevant knowledge about safety to the workers so as to remove human factor in the workplace that might cause an accident. The solutions offered to the enterprises are based on temporary measures and it does not extend beyond a certain workplace area. It is somehow understandable that the managers only care about the area under their supervision, but universities and authorities should give more attention to build a wider spectrum of safety culture.

Most of the engineering graduates are working at hazardous places unless they are working at an office. Unfortunately, they graduate and start to work with insufficient knowledge about health and safety. However, the concept “health and safety” so significant that graduates need be equipped with comprehensive understanding and adequate knowledge about occupational health and safety before they commence their professional career.

Therefore, the main problem in the field of occupational health and safety in Turkey is that the individuals recognize the concept of occupational health and safety or even just the concept of safety later that they are expected to do. Lack of awareness of safety culture among young professionals is of paramount concern not only for creating safe working environment but also for sustainable development.

1.3. Objectives and Scope of the Study

The main objective of this thesis is to thoroughly assess the safety culture among the students enrolled at the Middle East Technical University (METU). The reason for choosing this concept is to emphasize the importance of the health and safety knowledge and to assess the awareness of students before graduation and starting to work.

The main elements of this study's objective are: (i) to demonstrate whether there is a meaningful correlation between safety culture dimensions; (ii) to examine the effect of health and safety courses on students to develop a concept of safety culture (iii) to assess whether gender is an influential factor for safety culture; (iv) to evaluate whether there is a difference between the engineering and applied and social sciences students regarding the concept of a safety culture; and (v) to reveal whether there is a relationship between the time spent at university (academic year) and the level of safety culture.

While demonstrating the current safety culture level of students in METU, another aim of this study is to start a fresh discussion in the safety field in Turkey on what can be done to improve the safety culture level of individuals before they enter into business life.

METU was chosen among the universities in Turkey to conduct the study because it is one of the oldest technical universities in Turkey and it has numerous engineering and science departments. Since one of the aims is to assess the safety culture among students studying different disciplines, such as, engineering, natural and applied sciences, and social sciences and enrolled at different programs, METU was considered as the right environment to conduct the research study. Moreover, all these programs are located at the same campus, it should thus be noted that students from different departments are subject to similar environmental and managerial conditions.

1.4. Research Methodology

This study implemented the research process flow chart developed by Kothari (Kothari, 1990, p. 11). In Kothari's original research process flow chart there were VII stages, starting from "defining the research problem" and finishing with "interpretation and reporting". All VII stages of Kothari were followed and to better implement this research study and stage IV of the Kothari's research process flow chart, which corresponds to "design research", was divided into three parts for this study. The Kothari's chart as modified by the researcher is presented in Figure 1.1.

The study divided in two parts as Initial Study: Development of the Safety Culture Scale and the Main Study: Assessment of the Safety Culture among University Students.

The initial study started with the development of preliminary safety culture questionnaire with extensive literature survey. As a result of this extensive literature survey, the first draft of the questionnaire included 87 items and safety culture scale was designed as a five-point Likert scale.

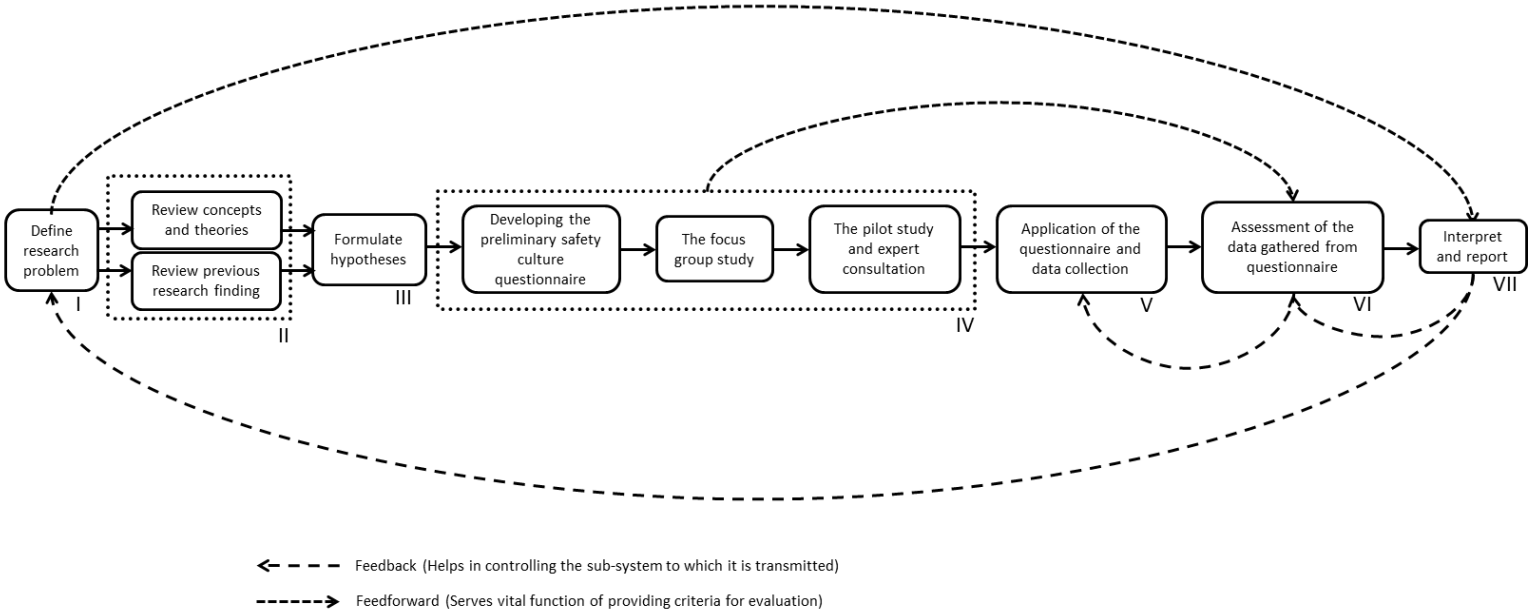

Figure 1.1. Research process in flow chart (modified after Kothari, 1990)

Once the items of the questionnaire had been decided, a focus group meeting was conducted with 23 students from Mining Engineering Department. After focus group meeting, the item number of the safety culture scale was decreased to 80. A pilot study and experts consultation sessions were conducted after focus group meeting. Total of 85 students from Mining Engineering, and Petroleum and Natural Gas Engineering Departments were participated in the pilot study. The four-dimension structure was decided for the main part of the study and the laboratory part of the study was treated as a one dimension with the expert consultation. After the initial study, the number of items was decreased to 70; and final structure of the safety culture scale has 49 items in main part of the questionnaire with four dimensions and 21 items in laboratory part of the questionnaire with one dimension.

The main study started with the application of the questionnaire and data collection. Total of 471 students from different departments and different academic years were participated in the main study. Exploratory factor analysis (EFA) was conducted for both the main part and the laboratory part of the scale separately. After EFA, the total item number of the scale was decided as 49 in which total of 33 items in main part of the safety culture scale and total of 16 items in the laboratory part of the safety culture scale.

The final factor structure decided as four-factor structure for the main part of the safety culture scale and one-factor structure for the laboratory part of the safety culture scale. After the determination of the factor structure and items in the safety culture scale, assessment of the data gathered from the questionnaire was done with identification of the relations between the dimensions of the safety culture scale and comparing the safety culture scores of the students based on the demographic variables as a final stage of the main study.

1.5. Expected Contributions of the Study

As being a pioneering research study on assessing the safety culture level of university students, the study expected to have significant contributions towards developing a safety culture within campus and in country. Research findings and obtained insights are also expected to contribute to the current scientific literature about safety culture.

More specifically, the findings of this study can (i) contribute to a better understanding of the safety culture among university students, (ii) help the faculties/university administration to determine and prioritize the OHS topics that students should have basic knowledge and awareness before graduation, (iii) guide administration to design compulsory courses for the most pressing issues and take necessary actions to improve safety at the campus, (iv) clarify the areas which need to be improved by the university administration to attain a higher level of safety culture in their organization, (v) start a discussion in the area of health and safety in Turkey about what can be done to improve the safety culture among the individuals long before they enter into business life.

1.6. Outline of the Thesis

This thesis consists of five subsequent chapters. Following the introductory chapter, Chapter 1, comprehensive literature review on safety culture and safety culture assessments is presented in Chapter 2. For better understanding of the concept of safety culture, organization culture is also referred in Chapter 2. After that, development of safety culture scale is explained in detail with the corresponding stages in Chapter 3. Chapter 4 identifies the factor structure of the safety culture scale developed after the studies described in Chapter 3 and assesses the safety culture

among university students and presents the results of the processed data. Discussions and interpretations of related to results of the study are presented in Chapter 5. Finally, the main conclusions drawn from the research results and recommendations for future studies are drawn in Chapter 6. The details of the studies conducted in these stages are explained in the following chapters of this thesis.

CHAPTER 2

LITERATURE REVIEW

2.1. Hierarchy of Needs

Maslow first introduced the concept of “hierarchy of needs” in his article “A Theory of Human Motivation” in 1943. For Maslow (1943), people are motivated to achieve certain needs and seek for higher needs in sequence. The earliest and most widespread version of Maslow's (1943, 1954) hierarchy of needs includes five motivational needs. Although, Maslow expanded the five-stage model so as to include cognitive and aesthetic needs (Maslow, 1970a) and need to transcend (Maslow, 1970b), it is often depicted as a pyramid of hierarchical levels as Figure 2.1 below (McLeod, 2014).

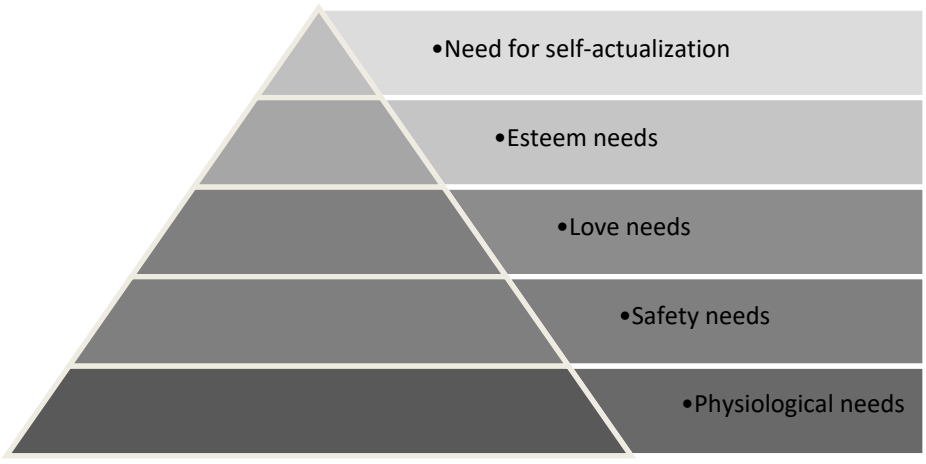

Figure 2.1. Maslow's hierarchy of needs (Maslow, 1943)

According to Maslow’s theory, the need for safety comes after physiological needs. Thus, people firstly aim to satisfy the physiological needs to a certain degree, and then

they look for accomplishing safety and security (Maslow, 1943). Maslow also claimed that the need for safety and security can be clearly observed in infants and children, for whom these needs are simple and obvious. As Maslow points out "one reason for the clearer appearance of the threat or danger reaction in infants is that they do not inhibit this reaction at all, whereas adults in our society have been taught to inhibit it at all costs" (Maslow, 1943).

It is, therefore, proper to assume that the need for safety and security is the second basic need. The needs for safety and security can include the safety of environment, employment, and resources. Although, in the ancient times the safety of environment can be considered merely as the safety of living environment, today the most important component of a safe living environment is workplace safety.

People feel safe mostly at their home besides exceptional cases such as living in war zone. It is then obvious that no workplace can make people to feel safer than their home. Therefore, the most important component of the safety stage in the Maslow's hierarchy pyramid is to feel safe in the places where the people spend most of their time, such as school and workplace, besides their home. In this respect, it is natural that the concept of OHS has become quite important around the world, and Turkey alike tries to follow the most recent developments in safety culture. The main goal of the concepts, theories, training, and practices related to the OHS is to prevent and/or reduce workplace accidents and to create safe working environment.

In fact, much of the current relevant literature, including some prominent behavior analyses, has emphasized the importance of safety culture. For instance, Geller (1996) stresses that the concept of safety is too significant, it cannot thus be simply considered as a priority because a priority can be replaced by another. Therefore, safety should become a core value so that it would never become a part of any give-and-take process (Geller, 1996).

The accident-causation models are mainly focused on the human errors during 1930s. H.W. Heinrich, a safety professional and assistant superintendent of the engineering and inspection division of the Travelers Insurance Company at the time, published "Industrial Accident Prevention, A Scientific Approach" in 1931 and this study had become one of the seminal scientific studies about the origin of accidents (Heinrich, 1931). Heinrich studied nearly 75,000 accident reports while investigating the root causes of accidents. As a result of his investigations, he found that an astonishing 88% of accidents were results of either human error or unsafe acts. Furthermore, 10% of accidents were originated from working environment, machines, and insufficient maintenance; in other words, these accidents originated from unsafe conditions. The remaining 2% of accidents were resulted from emergency conditions, such as, flooding, earthquakes, and severe weather conditions (Pasman, 2015).

In time, Heinrich's studies had become the foundation for a new approach to accident prevention and modern safety; human behavior became focus of the subsequent studies. For instance, Thygerson (1992) stated that there is a high correlation between people's values and accident prevention. Values define how people assess the importance of concepts and determine which ideals they should pursue or care since values guide people in life and give them purpose. If a person encounters a new situation, such as, a novel recreational activity, moving to a different location or carrying out new job tasks, he/she would more likely to be subject to unintentional injuries. Once the continuity of past and new experiences brakes off, a person must trust their current base knowledge of safety and depend on their value system to devise the most fitting course of action (Thygerson, 1992 as cited in Crowe, 1995).

2.2. Organizational Culture and Climate

Clarke (1999) referred the concept of safety culture as a subset of the concept of organizational culture. According to Guldenmund (2000), studies on the safety climate or safety culture reviews, without presenting a summary of the debates on

organizational culture and organizational climate, cannot be considered as fully complete (Guldenmund, 2000). Frazier *et al.* (2013) also emphasize this issue by stating that prior to giving an information about the literature review of safety culture, it is necessary to comprehend the organizational culture concept in a wider context and to understand why researchers proceed to focus on it (Frazier *et al.*, 2013). Thus, as an initial part of this literature chapter of thesis, the concept or organizational culture are discussed.

Organizational culture and climate concepts attracted great attention during the 1970s and 1980s. Simply, it was obvious that such concepts of holistic approach had an appeal for managers and the probability of obtaining an overall view of an organization was really attractive. However, because these concepts were too global and abstract, they were at risk of being almost meaningless (Guldenmund, 2000).

American psychologist Schein mentioned in 1990 that the idea of organizational culture is a relatively new concept. Although psychologists have used "group norms" and "climate" concepts for a long time, the "culture" as a concept came to the fore only in the last few decades (Schein, 1990). He claims that organizational culture develops from two processes, namely solving the problems of survival in an external environmental and solving the problems related to internal integration as it takes time (Schein, 1990; Frazier *et al.*, 2013). One of the most well-known and simple definitions of an organizational culture comes also from Schein as "the way we do things around here" (Schein, 2004; Frazier *et al.*, 2013; Hopkins, 2006) and his formal definition for group culture is as follows:

> *"A pattern of shared basic assumptions that was learned by a group as it solved its problems of external adaptation and internal integration, that has worked well enough to be considered valid and, therefore, to be taught to new members*

as the correct way to perceive, think, and feel in relation to those problems (Schein, 2004, p. 17)".

Schein listed various usages of the concept of culture in the literature in his book in 1992 and he used eleven categories to describe culture which includes observed behavioral regularities, group norms, espoused values, formal philosophy, rules of the game, climate, embedded skills, habits of thinking, shared meanings and root metaphors; formal rituals and celebrations (Schein, 2004). In this study, it was seen that some of these usages of the culture concept focus on values and/or attitudes and the others focus on behaviors. Hofstede (1997) underlined the same issue; he examined whether we should focus on values or practices while defining organizational culture and he concluded that the shared perceptions of daily practices should be seen as the core of an organization culture (Hopkins, 2006). Cooper (2000) also commented on this issue and stated that the main difference between these definitions is that while most of them are either focused on people's way of thinking or people's behavior and some focus on both people's way of thinking and the way that they behave.

Guldenmund (2000) listed seven characteristics of organizational culture after discussing the difference between the climate and culture concepts in his study and stated that most of the characteristics of the culture can also be applicable for the concept of the climate. Guldenmund (2000) summarized the characteristics of organizational culture as follows: (1) it is a construct; which means that culture is not concrete but abstract; (2) it is relatively stable; so that it cannot be changed in a limited period of time which is also clearly claimed in De Cock *et al.* (1986) study that the stability period of organizational culture is at least five years (De Cock *et al.*, 1986 as cited in Guldenmund, 2000); (3) it has multiple dimensions; which means that it has many dimensions, and as the naming the dimensions is a personal preference of the researchers it is even hard to gain common understanding of its dimensions; (4) it is shared by (groups of) people; and these groups of people can be referred as the units of the organization or a nation in a broader sense; (5) it consists of various aspects

because different cultural concepts can be involved in organizational culture such as safety culture; (6) it constitutes practices; which refers a culture's influence such as its norms and values; (7) and it is functional; that is, that "the way we do things around here" as stated in Schein's (2004) study provides insight for behaviors.

2.3. The Concept of the Safety Culture

Many studies have been conducted on the meaning of the concept of safety culture since its first appearance in the literature, but no common understanding has been reached (Hale, 2000; Glendon and Stanton, 2000; Guldenmund, 2000; Lee and Harrison, 2000; Hopkins, 2006; Choudhry *et al.*, 2007). Indeed, a general theoretical framework of safety culture has not yet been developed and its relationship with organizational culture studies is weak or even absent (Choudhry *et al.*, 2007; Nielsen, 2014).

Neither is there a consensus on how to define an organization's safety culture nor there is a model developed that is widely accepted among researchers. Therefore, the concept of safety culture still remains uncertain. One way to rectify this is to accept the safety culture as a part of organizational culture, which is a broader concept. Specifically, the safety culture can be accepted as one of the parts or aspects of the organizational culture that affects behaviors and attitudes and that have an impact on the safety level of the organization (Hale, 2000; Nielsen, 2014).

There are two well-known approaches to the safety culture: one underlines that either organizations have a safety culture, or they do not have it and the other is that safety culture can be classified as either strong or weak, thus every organization has a safety culture but in different levels. Hopkins (2006) expresses this issue in his study by stating that for some researchers, each organization has some sort of safety culture that can be defined as positive or negative and/or strong or weak. For others, it can only

be said that an organization with a high commitment to safety can be treated as an organization with a safety culture. According to this approach, safety culture exists in relatively few organizations. The failure to solve these very basic contradictions is an indication of the confusion surrounding the use of safety culture term (Hopkins, 2006).

The concept of safety culture was first used in the post-accident report of Chernobyl accident prepared by INSAG for International Atomic Energy Agency (IAEA) in 1986. Although the safety culture concept emerged with this report, the report did not contain enough information about the meaning of the concept and how it could be determined and evaluated. After that, the meaning of the safety culture was discussed in many scientific studies. In 1991, INSAG published another report and focus on the meaning of the safety culture and explained what was referred when using safety culture term in Chernobyl post-accident report. The meaning of safety culture produced by INSAG was one of the first structured meanings of safety culture term. Since then many researchers have contributed to the definition of safety culture.

Guldenmund (2000) stated in his study that empirical studies on safety culture and safety climate has improved significantly in the last two decades, however, there has been no progress gained on the theory of the safety culture. The concept still has not gone beyond the initial stages of its development (Guldenmund, 2000). He reviewed more than 17 articles related to safety culture and safety climate and tried to differentiate the approach and views related to these concepts. He ranked different definitions of safety climate and safety culture, nine of them are definitions of safety climate and six of them are definitions on the safety culture from scientific literature. Nine of these definitions mention perceptions of the members of an organization while six of them refer to beliefs and/or attitudes.

As a summary, Guldenmund (2000) concluded that perceptions were highly related to the climate concept and that attitudes were thought to be a part of the cultural concept, hence, he proposed definition for safety culture as “those aspects of the organizational

culture which will impact on attitudes and behavior related to increasing or decreasing risk" (Guldenmund, 2000, p. 251).

A research conducted by Wiegmann *et al.* (2002) also reviewed existing literature for "safety culture". In this literature review, Wiegmann *et al.* (2002) listed thirteen different definitions of safety culture. The definitions listed in these articles are derived from the aviation industry and other industries such as, nuclear power, mining, and manufacturing industries. As a result, it has become obvious that the definitions based on different industries are not independent of each other and they have many commonalities.

Wiegmann *et al.* (2002) formulated a definition for "safety culture" in their article by using these commonalties among various definitions from different industries. This definition is:

> *"Safety culture is the enduring value and priority placed on worker and public safety by everyone in every group at every level of an organization. It refers to the extent to which individuals and groups will commit to personal responsibility for safety, act to preserve, enhance and communicate safety concerns, strive to actively learn, adapt and modify (both individual and organizational) behavior based on lessons learned from mistakes, and be rewarded in a manner consistent with these values (Wiegmann et al., 2002, p. 8)".*

In addition, Wiegmann *et al.* (2002) claims that safety culture implies that organizational culture exists on a continuum and that organizations can have either a good or poor safety culture. It is also maintained that safety culture is either present or absent within an organization (Wiegmann *et al.*, 2002). Nevertheless, it is clear

from the initial introduction of the concept of safety culture that it is a component of any organization that can be improved rather than simply instilled (Cox and Flin, 1998 as cited in Wiegmann *et al.*, 2002).

The first reference to safety culture as a factor of accidents is also shown in the above-mentioned post-accident report published by INSAG in 1986. The IAEA stated that one of the reasons of the Chernobyl catastrophe was existing poor safety culture in nuclear power plants in the Soviet Union at that time. The IAEA evaluated that lack of risk awareness -a defect to realize the consequences of actions -, lack of individual responsibility, and complacency were the main factors that characterized this poor culture which is partly responsible for the accident (Kanki and Sgobba, 2018).

Cox and Cox (1996) claimed that the safety culture definitions are so broad that they diminish the scientific effectiveness; hence we need higher precision (Cox and Cox, 1996 as cited in Håvold, 2005). That said, it is possible to find numerous definitions in the literature of safety culture, though many of them lack scientific precision.

2.3.1. Positive Safety Culture

According to the study conducted by Hale (2000), the elements to provide a good safety culture are the following: the importance of safety which is given by all employees; the aspects of safety and prioritization of these aspects; involvement of all parties; continual improvement that you fell you will never have a perfect safety culture and it is an area that you improve continuously; caring trust which means that all parties have their own responsibilities but they should also take care of others; open communication which includes failures and learning experiences; belief of solutions and safety improvements which means that the causes of the incidents and failures are the opportunities for safety improvement; and integration which means that integration of safe attitudes and safe practices into all part of works.

Vecchio-Sudus and Griffiths (2004) also noted that generating and sustaining a positive safety culture could be an active tool for improvement of OHS management of an organization. The crucial aspects of a positive safety culture include management commitment to OHS, management concern for the workforce, mutual trust and trust between management and employees, and strengthening the workforce. Organizations that have a real management commitment to OHS actively involving their workers in safety processes, such as, decision-making and problem-solving, can benefit from these activities by publicly disclosing the advantages of achieving a positive safety and encouraging others. Vecchio-Sudus and Griffiths (2004) have listed some major concepts of positive safety culture and they explained what should be done to achieve positive safety culture under these concepts which are summarized in the following paragraphs.

The first issue is *changing attitudes and behaviors*; one of the most important issues to change behavior is to develop hazard control methods with participation of everyone. Individuals would be more open to involve and contribute to organizational culture if they fell that it is developed based on trust and cooperation. They would also contribute more in an environment which involves consultation and communication framework in it. Training and information sharing are also crucial concepts for changing attitudes and behaviors. People provided with necessary information and training to develop their knowledge and skills are more likely to behave safely. Management commitment is also a significant part to change people's attitudes and behavior in an organization. Management must accept their role and responsibilities to achieve positive culture and to provide all necessary resources to the people in their organization.

Secondly, *management commitment*, for Vecchio-Sudus and Griffiths (2004), plays a key role in terms of promoting safety culture by allocating resources, time, inspections, walk the talk, by participating in risk assessments and consultative committee meetings, and by completing actions. Employees generally simulate management attitudes or perception; thus, it is likely that management's behavior will

reflect employees' behavior, hence, overall safety perception of the organization. If management's commitment to OHS is not clearly seen by employees, it is hard to ask employees' commitment to OHS. Therefore, the first objective of the OHS promotion may be to raise awareness of high-level management commitment to OHS.

Thirdly, *employee involvement* is also considered as an important aspect to improve positive safety culture. After reviewing several safety culture studies, Vecchio-Sudus and Griffiths (2004) stated that if employees are actively involved in decision-making and problem-solving processes related to OHS, this would highly contribute to their engagement and commitment to OHS. The involvement of employees may include participating in trainings, physical involvement of risk assessments works such as; measuring noise levels of the machineries in working environment, consultation about various hazards in work places, usage of personal protective equipment.

Vecchio-Sudus and Griffiths (2004) also suggest some promotional strategies in their paper that can improve health and safety awareness of employees. In order for these strategies to be effective, they emphasized that the most important factor is to concentrate on the positive rather than the negative and stated that activities should be enjoyable for everyone and allow communication between all levels of employees. Promotional strategies suggested in Vecchio-Sudus and Griffiths (2004) study include: *(i)* T*he mission statements, slogans and logos*; there are two important issues for shaping mission statement, one is that it should be done with involvement of both parties meaning management and employees and the other is that it should be accepted and presented by senior management. For slogans and logos, it is vital to focus the target audience and they should be catchy; *(ii) Published materials (library, statistics, newsletters);* there were lots of OHS publications that can be found in literature and these publications should easily be available for employees. Organizations can have small libraries or reading corners containing printed OHS publications so that employees can easily find out the relevant information such as, legislation, code of practices, safety instructions of specific activities, health problems. For the routine work activities - such as electrical safety, working at high places- specific leaflets can

be prepared and distributed to the employees; and *(iii) media* (posters, displays, audio-visual, e-mail, internet) is also essential to promote safety awareness. Poster and displays can be presented at different locations in workplaces. Audio-visual items, such as films and videos, can be used in trainings and these films can be shown in TVs located in tea-break areas or cafeteria. E-mail and internet can be used to promote employees who contributes positive safety culture with reporting near misses or taking proactive actions for identified hazards; another factor to further develop safety culture is *(iv) Training and seminars* which can include short talks, training on specific subjects, risk assessment, incident investigation activities; *(v) Special campaigns* are also considered by Vecchio-Sudus and Griffiths (2004) as the last activity to play important role in promoting safety culture. This may include health and safety week campaigns, health promotion by opening a gym in workplace or providing exercise opportunities for well-being and emergency response activities including role playing (Vecchio-Sudus and Griffiths, 2004).

2.3.2. Safety Culture and Safety Climate

According to Guldenmund (2000), the earliest study on safety climate is conducted by Keenan *et al.* in 1951. This study was based on introspective approach and included individuals from an automotive plant. Since then, although the theory and research methodologies have been evolved, they did not reach to the extent that a formulation of single comprehensive safety culture theory or measurement methodology that everyone agreed on (Guldenmund, 2000).

Although Guldenmund claimed the earliest appearance of the concept of safety climate is can be found in Keenan *et al.* (1951), one of the first well-known researcher that studied safety climate was Zohar, Professor of Organizational Behavior at Israel Institute of Technology. For that reason, he is also known as the person who introduced the concept of "safety climate" to the literature (Kanki and Sgobba, 2018) and is defined as a one of the key drivers of safety performance in factories. The

concept of safety climate was presented by Zohar as the common perception of safety that is shared by a group of individuals who are members of an organization (Kanki and Sgobba, 2018).

The confusion related to the meanings of safety culture and safety climate have become a growing interest in the safety literature. The researches show that some definitions of the safety climate and safety culture share some common ground while others are nearly the same. Wiegmann *et al.* (2002) listed twelve safety climate definitions in their article and showed the similarities and differences between the definitions of safety culture.

Based on this review, Wiegmann *et al.* (2002) formulated a definition for "safety climate" term. This definition is:

> *"Safety climate is the temporal state measure of safety culture, subject to commonalities among individual perceptions of the organization. It is therefore situationally based, refers to the perceived state of safety at a particular place at a particular time, is relatively unstable, and subject to change depending on the features of the current environment or prevailing conditions (Wiegmann et al., 2002, p. 10)".*

In sum, the focus of the researches conducted on the concept of the safety climate and safety culture differentiate safety climate and safety culture in many ways. For instance, some researchers claim that safety climate is related to perceptions and safety culture is related to attitudes (Guldenmund, 2000). There is also a conceptual difference argued by the researchers. It is argued that climate is measurable, but culture is not directly measurable (Mearns *et al.*, 2003); climate is a part of culture while culture has a wider spectrum (Mearns *et al.*, 2003); and climate corresponds to

a certain period of time whereas culture is continuous concept (Hale, 2000). However, even researchers who defend a conceptual distinction recognize that those who conduct empirical research on a safety climate or safety culture were not made this distinction in their studies and they are also unwilling to make these distinctions, and that, in practice, shows that terms are used interchangeably (Hopkins, 2006). Although the concepts of "safety climate" and "safety culture" are sometimes used synonymously, a consensus is emerging that whereas an organization's culture contains relatively stable characteristics involving multiple dimensions, climate is a measure of employees' beliefs and attitudes at a particular point in time (Wiegmann, 2002; Kanki and Sgobba, 2018).

2.3.3. Safety Culture and Its Dimensions

It can be observed from the safety assessment studies in the literature that there is not consensus between the researchers on the exact number of indicators reflecting the safety culture of an organization. In fact, many different organizational indicators have been proposed by the researchers. Flin *et al.* (2000) listed the dimensions of the safety culture in their review study and the dimensions revealed in these studies are varying from two to 19.

Wiegmann *et al.* (2002) also reviewed the safety culture literature across a number of industries and stated that numerous inconsistencies and often idiosyncratic identifications of these indicators make it difficult to associate the different organizational indicators identified in previous studies. However, a detailed look at these studies suggests that there are minimum of five common components identified as safety culture indicators. The identified five common indicators of an organization's safety culture are: *(i)* organizational commitment; *(ii)* management involvement; *(iii)* employee empowerment; *(iv)* reward system; *(v)* reporting system. *(i) organizational commitment* of safety can be referred as upper management's acceptance of safety as the core value or a guiding principle of an organization. The

commitment of safety is reflected in the skill of the upper-level management to show a continuous, positive attitude to safety, even in case of economic difficulties, and to consistently promote safety at all levels of the organization; *(ii) management involvement* can be defined as the involvement of both senior and middle level managers in critical safety activities within the organization. Therefore, it is reflected by the continuous supervision of safety critical operations by management, their ability to liaison with the risks of day-to-day operations, their good communication on safety matters with all level of organization and the involvement and contribution of managers to safety related organizations such as, seminars and trainings; *(iii) employee empowerment* refers to the perception or attitude of a person towards to entitlement of authority or their personal responsibilities. An empowered attitude can increase the motivation of the person and lead the person exceed the expectations related to his/her duty and also to encourage person to take responsibility for safe operation. In terms of safety culture, employee empowerment is defined as that employees have a right to speak for safety decisions and to hold themselves and other people in the organization responsible for their actions and to be proud of the safety statistics of their organizations; *(iv) reward system* is a significant component of a safety culture of an organization and is referred as the assessment of safe and unsafe behaviors and consistency of rewards and penalties after this evaluation (Reason *et al.,* 1990). A fair assessment and reward system are important in order to promote safe behavior and reduce or correct unsafe behavior (Eiff, 1999 as cited from Wiegmann *et al.,* 2002). Therefore, the safety culture of an organization creates systems supporting safe behavior and eloign unsafe behaviors. However, the safety culture of an organization is not only characterized by the existence of such reward systems, but also, it is important that the reward system applied continuously, announced to the workers and fully explained and understood by all workers; *(v) reporting systems:* "The reporting culture is one of the foundations of a true safety culture" (Eiff, 1999, p. 17 as cited from Wiegmann *et al.,* 2002). An effective and systematic reporting system is very important in order to determine the weak areas of safety management before occurrence of any undesired event. It is important for an organization to report incidents and near misses to assess reasons and take proactive measures in order to prevent any accident and thus reporting process is very crucial to improve overall

safety of the organization. Another important topic of a good reporting culture is the "free and uninhibited reporting of safety issues which people are aware of during their daily activities" (Eiff, 1999, p. 19 as cited from Wiegmann *et al.*, 2002). Hence, for the high level of reporting culture, it is important to ensure that employees were encouraged to report unsafe conditions and also feedback provided to them related to their reporting. Outcomes of the reports and actions taken based on these outcomes should also be communicated with the employees. In summary, a formal reporting system that is used comfortably by staff is important for an organization with a good safety culture. A good reporting system enables and promotes employees reporting safety issues and also enables timely and valuable responds for the organization (Wiegmann *et al.*, 2002).

The identification of the key aspects/dimensions of the safety culture is another major area that researchers are focus on. He *et al.* (2012) in their review study listed nine different researches and their safety culture elements. They also presented 32 different elements of safety culture, but this study did not provide any explanatory information about how these elements were developed. Besides, they claimed that these developed elements are key factors that influence the safety performance and the evidence of this claim is stated as experience.

Flin *et al.* (2000) also revived the safety climate researches and had listed common dimensions of the reviewed 18 scales as *management* which was assessed in 72% of the studies; the *safety system* which was assessed in 67% of the studies; *risk* which was also assessed in 67% of the studies; and additional to those *themes relating to work pressure* and *competence* assessed by the three researchers in their studies.

Another review study related to the safety climate/culture assessment is the Håvold's study which nine papers that is published between 1997 and 2002 and refers to offshore, shipping, petrochemical, manufacturing, nuclear, and construction industries reviewed in detail. The selected nine papers also cover five different countries. He

stated that stability across industries and nationalities can be seen as evidence since some of them are referred to same factors in many of these studies. He identified 11 common factors which he called as important factors. As a result of his review of the papers, Håvold found that *safety rules* was referred in eight of the paper; *management commitment to safety* was referred in seven papers; *safety behavior* was referred in six papers; *communication* was referred in five papers; *work situation* was referred in five papers; *job satisfaction* was referred in four papers; *competence* was referred in four papers; *management priorities, organizational risk* was referred in three papers; *satisfaction with safety activities* was referred in three papers; *reporting culture* was referred in three papers; and *fatalism* was referred in three papers.

2.4. Safety Culture Assessments

When reviewed studies are investigated; it was obvious that the general approach to the assessment of safety culture (or safety climate) has been evolved to using a quantitative method (Glendon and Stanton, 2000; Guldenmund, 2000, 2007; Flin *et al.*, 2000; Cooper, 2000; Choudhry *et al.*, 2007). Most of the studies used the questionnaire method for a specific target group such as, workers, students or management people. To develop a questionnaire, researchers mainly focus on the literature and they determine dimensions that they will use to formulate the questionnaire as an initial step. After dimensions to be used are clear, researchers developed items of the questionnaire. The next step is to conduct the questionnaire to a specified target group and to gather data. Finally, researcher assesses obtained data with statistical tools and analysis methods.

As mentioned above, Zohar (1980) is the first researcher that used quantitative method in his study which focused on attitudes toward safety. He used a 40-itemed scale to measure organizational climate for safety and conducted a survey in 20 industrial organizations in Israel. He followed the main approach, which starting with the developing the questionnaire, applying it and assessing the data with statistical

calculations, and this approach is still followed by the researchers today. He started his study with a literature review of the concept of safety climate and its dimensions. After an extensive literature review, he decided to use seven dimensions for the safety climate questionnaire, namely (1) perceived management attitudes towards safety; (2) perceived effects of safe conduct on promotion; (3) perceived effects of safe conduct on social status; (4) perceived organizational status of safety officer; (5) perceived importance and effectiveness of safety training; (6) perceived risk level at work place; and (7) perceived effectiveness of enforcement versus guidance in promoting safety. After the determination of these dimensions, he included them in the organizational characterizes that enabled to distinguish high- and low-accident rate companies. Based on the literature review and formulation of the dimensions, he formulated two hypotheses: (i) the common perceptions of safety in their organizations are shared by workers in different companies. The sum of these perceptions reveals the safety climate of each organization; (ii) the safety climate may vary from less preferred to more preferred and the level of safety climate in each company is expected to be related to the company's safety records. Originally seven items developed for each of the seven dimensions for the questionnaire and total of 49 items listed in the initial questionnaire. A questionnaire with 49-item was used in the pilot study which was conducted with 120 workers. Data gathered from the pilot study was assessed using statistical methods and nine items were removed as they were found to be unrelated to any of the factors. Finally, 40-item with 5-point scale was used for the main study. After the statistical analysis, Zohar concluded that the study supported both hypotheses which posited at the beginning of the study (Zohar, 1980).

After the first quantitative study of Zohar (1980), there were many studies conducted in order to assess safety culture especially among workers. Although the questionnaires/scales used in these studies differs in many respects, the main methodology for the safety culture studies remained as applying questionnaire to a target group of individuals and assessing the data obtained from the questionnaires using statistical approaches.

It can be easily seen in the review studies that the majority of the safety culture assessment are exploratory and not many confirmatory studies found in the literature (Glendon and Stanton, 2000; Guldenmund, 2000, 2007; Flin *et al.*, 2000; Cooper, 2000; Choudhry *et al.*, 2007).

Guldenmund (2000) also emphasizes this issue by noting that, majority of the studies examined in his article are, surprisingly, exploratory studies. Only Brown and Holmes (1986) and DeDobbeleer and Beland (1991) conducted confirmatory studies and both studies have not been able to confirm the original factor structures previously found by Zohar (1980). Moreover, this issue can be seen in Flin *et al.* (2000) paper that only three of the studies out of 18 studies reviewed in his study are confirmatory studies (such as Coyle, 1995), two of them are the same studies mentioned above by Guldenmund (2000), and the other one is Phillips *et al.* (1993), who also tried to justify Zohar's (1980) questionnaire.

In Turkey safety culture assessment also focused on enterprises. Yazıcı (2015) stated that in terms of geographic distribution, safety studies are mainly observed in European countries. There are few safety-related studies in countries with higher occupational accident rates. Except of some studies related to safety climate, and safety culture such as, Demirbilek (2005) and Öz *et al*., (2013), the safety culture has rarely been studied in Turkey (Yazıcı, 2015). Also, Ocaktan (2009), and Akalp and Aytaç (2005) and Arslan *et al.* (2016) are the some of the researchers studied safety culture in Turkey and both focused on the industry where questionnaires were conducted on workers of the specific tasks.

In their compressive review study, Dijk *et al*. (2015) tried to criticize publications on the occupational health and safety education regardless of the subject, participants, level, and the education method. They classified 121 studies according to their subject area and revealed that the studies conducted in low-income countries are very rare. One of the most remarkable implications of these studies is that most of the studies

focused on workers, yet neither the education of students nor occupational health and safety (OHS) professionals were evaluated.

Research studies, focused on students' safety culture level, revealed that the field of safety is a neglected area in academic institutions. In his study on safety and risk management in academic institutions, Meyer (2012) stated that since the 1960s, many risk analysis techniques and management methods have been introduced for industry. The main reason for their emergence was to respond to some major accidents and to improve performance, production, quality, and health of employees.

High schools and universities, or academic institutions in general, are generally considered as centers of conceptualization and theoretical modelling, yet they are not comparable to industry in terms of safety management. The academic world continues to be the center of validity testing of experiments through independent research opportunities and this makes the working environment of academy a particularly risky setting. Indeed, experiments could not always be done without experiencing an accident (Meyer, 2012).

Meyer (2012) draws attention to the fact that there have been many accidents recently in academic institutions, but only a small portion of these accidents has been publicly reported. He listed five accidents between the years of 2006 and 2011 at the universities in France, Netherland, and the USA; and people lost their lives as consequences of these accidents (Meyer, 2012).

2.5. Previous Research Studies on Safety Culture Assessments

For the formulation of the questionnaire more than 25 papers/dissertations on safety culture assessment were examined. The list of the examined papers/dissertations and

a book is given in Table 2.1. The following paragraphs summarizes some of them to give a basic scientific knowledge about these studies.

Cox and Cox (1991) had conducted a safety climate survey with the workers of a large-scale European company whose main service area is production and distribution of industrial gasses. The study was part of a broader program of development of safety culture in the company. This assessment included formulation and application of an employee attitude questionnaire. Then, an intervention to improve attitudes towards safety by using survey-based data was planned, implemented, and evaluated. This study focused on the formulation and application of the questionnaire. Data from 630 participants was used for the factor analysis and five factors derived after statistical analysis. A tentative model was described after interpretation of the results.

Crowe (1995) formulated his study to assess the safety values and safe practices among college students. Total of 1,126 students participated in Crowe's study in 1993. The main characteristic of the students was that they were all enrolled in elective health classes at eight Midwestern universities. They filled out a two-part questionnaire; one part was related to safety practices and it had 15 items, and the other part was related to safety values and it had 18 items. With this study researcher tried to show whether there is a difference between the student's safety values and safe practices in terms of gender, academic year, and geographic region. As a result, it was found out that female students have higher safety awareness than male students. Academic year is a significant criterion for safety values of the students but not for safe practices. Safety values and safety practices are not influenced by geographic region.

Table 2.1. *A detailed literature survey of existing Safety Culture Assessments*

Reference	**Area**	**Title**
Liu *et al.* (2018)	Academic institution - Medical students	Perceptions of patient safety culture among medical students: a cross sectional investigation in Heilongjiang Province, China
Kim *et al.* (2017)	Nuclear Power Plant	A methodology for a quantitative assessment of safety culture in NPPs based on Bayesian networks
Walters *et al.* (2017)	Academic institution - Tertiary students	Chemical laboratory safety awareness, attitudes and practices of tertiary students
Warszawska and Kraslawski (2016)	Academic institution	Method for quantitative assessment of safety culture
Shirali *et al. (*2016)	Petrochemical Plant	Quantitative assessment of resilience safety culture using principal components analysis and numerical taxonomy: A case study in a petrochemical plant
Yousefi *et al*. (2016)	Manufacturing - Steel Company	Validity Assessment of the Persian Version of the Nordic Safety Climate Questionnaire (NOSACQ-50): A Case Study in a Steel Company
Yazıcı (2015)	Manufacturing - Food Manufacturing	The Relationship Between Safety Culture, Aberrant Behaviors and Safety Consequences
Hossain *et al.* (2015)	Academic institution	Factors affecting OHS practices in private universities: An empirical study from Bangladesh
Bhattacharya (2015)	Maritime Industry	Measuring Safety Culture on Ships Using Safety Climate: A Study among Indian Officers

Table 2.1. *A detailed literature survey of existing Safety Culture Assessments (Cont'ed.)*

Reference	**Area**	**Title**
Frazier *et al.* (2013)	Mining, chemical, healthcare, steel, agricultural industries	A hierarchical factor analysis of a safety culture survey
Kwon and Kim (2013)	Manufacturing	An analysis of safeness of work environment in Korean manufacturing: The ‘‘safety climate’’ perspective
Thamrin *et al*. (2010)	Academic institution - Incoming university students	Time trends and predictive factors for safety perceptions among incoming South Australian university students
Ocaktan (2009)	Manufacturing - Automotive factory	Assessment of Safety Culture in an Automotive Plant
Wu *et al.* (2008)	Academic institution	A correlation among safety leadership, safety climate and safety performance
Paul and Maiti (2007)	Mining	The role of behavioral factors on safety management in underground mines
Størseth (2007)	Transportation	Affective job insecurity and risk taking at work
Sexton (2006)	Healthcare	The Safety Attitudes Questionnaire: psychometric properties, benchmarking data, and emerging research
Watson *et al.* (2005)	Manufacturing- Steel manufacturing	Dimensions of Interpersonal Relationships and Safety in the Steel Industry
Demirbilek (2005)	Textile	Occupational Safety Culture

Table 2.1. *A detailed literature survey of existing Safety Culture Assessments (Cont'ed.)*

Reference	**Area**	**Title**
Blair *et al.* (2004)	College students	Safety beliefs and safe behavior among midwestern college students
Singer (2003)	Healthcare	The culture of safety: results of an organization-wide survey in 15 California hospitals
Siu *et al.* (2003)	Construction	Age differences in safety attitudes and safety performance in Hong Kong construction workers
Glendon and Litherland (2001)	Road construction organization	Safety climate factors, group differences and safety behavior in road construction
Lee and Harrison (2000)	Nuclear	Assessing safety culture in nuclear power stations
Griffin and Neal (2000)	Manufacturing and Mining	Perceptions of Safety at Work: A Framework for Linking Safety Climate to Safety Performance, Knowledge, and Motivation
Williamson *et al.* (1997)	7 company-wide variety of types of jobs	The development of a measure of safety climate: the role of safety perceptions and attitudes
Crowe (1995)	College Students	Safety Values and Safe Practices Among College Students
Cullen *et al.* (1993)	Review	The Ethical Climate Questionnaire: An Assessment of its Development and Validity
Cox and Cox (1991)	Production and distribution of industrial gases	The structure of employee attitudes to safety: a European example
Zohar (1980)	Manufacturing	Safety Climate in Industrial Organizations: Theoretical and Applied Implications

Lee and Harrison (2000) conducted a study by using a questionnaire with 120-items in three nuclear power stations. Prior to formulating the questionnaires, seven focus group activities were performed. After focus group studies, eight domains were identified, and 120 items were placed under these domains through focus group studies. The questionnaires are distributed to individuals in three nuclear power stations and total of 683 samples were collected. Factor analysis was conducted, and 28 factors were identified under these eight domains. Biographical and work-related variables such as, job types, age, gender, days/shifts were examined in detail based on the questionnaire scores. In addition, organizational variables such as, safety rules, priority of production over safety, safety recommendation source and safety briefings are assessed in terms of their relationship with safety attitudes.

The study of Blair *et al.* (2004) is extended the study of Crowe (1995) and investigates the safety beliefs and safety behavior among Midwestern college students. Like Crowe's study (1995), the study aimed to show the relationship between the following factors: age, gender, academic year, and geographic region and safety beliefs, and behaviors. It also aimed to compare the results with the Crowe's study (1995) and to show whether there is any difference between 1993 and 2002 among Midwestern college students' safety understanding. A total of 33-item scale which was originally developed by Crowe (1995) was completed by 1,059 undergraduate students. The study also confirmed the finding that female students had higher safety awareness than male students did. The study also showed that the academic year and geographic regions had no impact on safety beliefs and safety behaviors on the contrary to Crowe's study which proved that academic year is a significant criterion for safety values of the students. Crowe did not assess age as a factor in his study. However, Blair *et al.* (2004) included age as a factor in their study and observed that it has significant impact on both safety belief and safety behavior. Comparison between the data gathered in 1993 and 2002 showed that safety awareness among both female and male college students was decreased. College students become less safety conscious in 2002 in comparison with 1993.

Wu *et al.* (2008) conducted a research study to assess potential correlation among safety leadership, safety climate, and safety performance. To this aim, a self-administered questionnaire was developed and completed by students and laboratory staff from four different universities in Taiwan. The questionnaire has three scales, namely safety leadership scale with 35 items, a safety climate scale with 46 items, and a safety performance scale with 39 items. Additionally, it has general information part which includes 12 demographic information questions. The questionnaire was conducted through 754 participants and the valid number of questionnaires that was used for the statistical analysis was 465. The first hypothesis of this study was that safety leadership and safety performance relations have an impact on developing safety climate. The partial mediation is supported by the results of the study. The second hypothesis of this study was to find whether there is any positive relationship between safety leadership and safety climate and this hypothesis was also proved by the result of the study. The third hypothesis, whether there is a positive relationship between safety climate and safety performance, was also confirmed by the results of the study. The fourth hypothesis designed between the safety performance and safety leadership concepts. The hypothesis supported by the results of the study and showed that there is a positive relationship between safety leadership and safety performance. As a conclusion of the study, Wu *et al.* (2008) stated that administration has a significant role to improve safety culture of the universities.

Thamrin *et al.* (2010) carried out a study on the students who were newly enrolled in a university in Australia based on the idea that young workers are more involved in injury statistics. The study investigated the factors related to concepts of safety skills, safety confidence, and safety attitudes. This study was also aimed to examine time trends related to these concepts. The survey tool, already developed by Aumann *et al.* (2007), was used for this study and questionnaires were distributed to incoming students in an Australian University between 2006 and 2009. The students from local environment in the South Australia were the main focus of the study. Total of 5,542 students participated in this study and more than 80% of them were local students and the data gathered from the local students were used for bivariate and multivariate

analyses. The difference between local students and international students showed that international students felt much less confident than local students in terms of the safety skills that they had. As safety attitude concept, there was no significant difference observed between local and international students. In terms of time trends, the study showed that there is no significant difference observed for any categories such as, local students, international student, local male or female students. The relation between the variables; safety training, safety confidence, and skills was significant; however, training variable was not found significantly related to safety attitudes. The study also showed that, in contrast with the safety training variable, the variables such as, gender, experiencing injury or witnessing a serious injury at work were significantly related to feeling of the students about safety issues and safety attitudes, and this outcome was consistent through the time. As a conclusion, Thamrin *et al.* (2010) revealed that there was no improvement observed over time among students related to safety concepts. A more integrated approach towards safety education should be found and it should involve both schools and workplaces.

Frazier *et al*. (2013) identified core factors for safety culture and determined which factors should be added to factor analysis of a safety culture survey that can be widely used. A total of 25,574 workers participated in this study from five different industries. The survey had 92-items and both types of factor analysis, *i.e*. exploratory and confirmatory analyses, were conducted. The compressive literature review of Frazier *et al*. (2013) revealed four common factors related to safety culture, namely management concerns for safety, personal responsibility for safety, peer support for safety and safety management system. The sub-factors under these four common factors were also listed in the study. As a result of explanatory and confirmatory factor analyses model presented with four main factors called as second-order factors. Additionally, total of 12 sub-factors under these four main factors listed in the study which are called as first-order factors.

Hossain *et al.* (2015) in their study focused on university students and staff, and the authors emphasized that this was a neglected area both in safety literature and in

Bangladesh. Hossain *et al.* (2015) claimed that the overall OHS condition and practice in Bangladeshi universities are very poor; it is even worse than many industries that have high injury rates such as, garment sector. Although one of the aims of this study was filling the gap in literature, it was also directed to determine the factors that will promote adopting OHS measures in Bangladeshi private universities. The research model and eight hypotheses based on this model were developed by Hossain *et al.* (2015) after the review of existing literature. The research methodology used to test these hypotheses was empirical and quantitative, and it includes using questionnaire and assessing the data with statistical tools. Both internal and external factors included in this study, hence, the authors stated that external factors also have significant impacts on the safety of an organization. As a result, six of the hypotheses were proved by the results of the study and only two were denied. As an external pressure factor, regulatory pressure was found to have positive influence on OHS adoption in universities, whereas mimetic and competitive pressures have no positive influence. These two are the hypotheses which were not supported by the results of the study. For the top management factors, all four related hypotheses were supported, and the top management commitment found to have a positive influence on (i) developing formal OHS policies, (ii) developing formal OHS trainings, (iii) encouraging participation in OHS tradition, and (iv) overall positive effect on OHS adoption in universities. As a final hypothesis, social factors were found to have positive effect on the adoption of OHS in universities. As a conclusion, it was observed that top management commitment and social factors have a significant role in OHS adoption in universities, and regulatory pressure, in contrast with mimetic and competitive pressures, has also significant role in OHS adoption in universities.

Yousefi *et al*. (2016) aimed to validate the Nordic Safety Climate Questionnaire (NOSACQ) and to develop Persian version of it. The original NOSACQ has 50 items under seven dimensions. These dimensions seek to measure the safety perception of both management and employees. Four-point Likert type scale was used in this study and the questionnaire was responded by 661 workers from steel industry in Iran. Total of 404 responds was used for the statistical analysis, hence, the rest of questionnaires

were not found to be fully filled. After factor analysis, the questionnaire was found to have six factors: (i) management safety commitment and empowerment, (ii) workers' safety commitment, (iii) attitude towards safety, (iv) safety priority, (v) safety participation, and (vi) communication and risk nonacceptance. Reliability of these factors were assessed using Cronbach coefficient, and minimum and maximum scores were presented for each factor. The main difference between this study and the original NOSACQ-50 study was seen as the items were loaded into six factors in this validation study, but the factor number was seven in the original one and also Yousefi *et al*. (2016) stated that the distributions of the factor under these dimensions were completely different than the original study. Confirmatory analysis was also supported the six-dimension model of Persian version and the variation was explained by the Yousefi *et al*. (2016) as it could be related to safety perception difference among Iranian workers. The average score of the safety climate was found as 2.89 and presented as acceptable score according to instruction of original NOSACQ.

Warszawska and Kraslawski (2016) proposed a new quantitative assessment method, called Assessment Tree Method, to determine the level of safety culture in an organization. The structure of this ATM is similar to fault tree method which is a common tool for investigating accidents. The proposed method was tested with 23 individuals; 20 of them were students and 3 of them staff in the university. The six-dimension decided are based on literature review and experience of the researchers, and by on the examination of the existing safety-related data such as, near miss and accident reports. The identified dimensions for this study were: knowledge and skills; awareness; flow of information; monitoring and control and supervision; management commitment and continuous improvement. After the identification of the dimensions, assessment trees were formed for every dimensions and interviews were conducted in order to assess these trees. The questions are designed according to the degree of details and the hierarchy of the questions started from the main questions and followed by general questions, intermediate questions and detailed questions. Expected answers for the questions were set prior to interviews and the following steps of the interview and sequence of the following questions were designed in terms of the answers of the

participants. The case study conducted in Department of Chemical Technology in University in Finland. Finally, the safety culture level was calculated by considering the results obtained for all the dimensions and the weight of importance of these dimensions. The assessment scale was also given by researchers and the overall safety culture level was found to be "expected level of safety culture" for the case study and recommendation given to further improve it.

Walters *et al.* (2017) examined the chemical laboratory safety awareness, attitudes, and practices among tertiary students in Trinidad. In this study, researchers also sought to find whether there is any correlation between safety awareness and safety practice concepts and to identify the predictors related to accidents in the laboratory. The self-administrative questionnaire was used to collect data from students in four institutions and at least one interview was conducted with a member of the supervisory staff. Total of 226 student participated in the data collection part of the study. The items in the questionnaires were set after a literature review, especially a review of the area of chemical safety. After initial item pool was determined, the pilot study was conducted with science graduated students and the final version of the questionnaire was generated with the comments gathered from pilot study. The final version of the questionnaire has 29 items which involves both open- and close-ended questions. The assessment of student awareness is based on hazard identification, emergency response, and waste disposal; and it showed that the students have high level of awareness for these three areas. The assessment of student attitudes exposed that the level of safety attitudes among students were low and it needed to be improved, besides there was a weak correlation observed between safety attitudes and safety practice of students. The results also showed that although the frequency of reading documents containing safety information by students should increase, most of the students use good practice in the laboratory. Only one predictor related to laboratory accidents was found as the characteristics of each institution.

Gong (2019) investigated the safety culture among university students. The study used self-administrated questionnaire with 29 items to assess the safety culture among

undergraduates and to show the difference based on the demographic characteristics of participants such as, gender and academic year. As the first stage of the study, a safety culture questionnaire was developed by reviewing the existing literature and previous questionnaires used in the safety culture assessment studies. Three dimensions were decided for the questionnaire, namely safety attitude, safety awareness, and safety behavior. Expert consultation sessions were held to decide the items under these dimensions and finally 29 items were decided to use in the questionnaire. Among 29 items, 16 items listed under safety attitude and safety awareness and 13 of them listed under safety behavior. Five-point Likert scale was used, and the safety culture level demonstrated by using mean scores of items. Total of 370 questionnaires were distributed in a university in Beijing and the number of valid questionnaires returned was 362. Item analyses were performed and average safety culture score of the university was found to be 3.76. Reliability analysis was also performed for 29 items and Cronbach's Alpha was calculated as .864. Effects of demographic variables, such as, gender and academic year, were also assessed by researcher and it was revealed that the safety culture score of female students was higher than male students. There is no significant difference observed related to academic year of the participants. Another comparison criterion was chosen as a majoring program of the students. The difference between the students majoring in OHS and the students majoring in different programs compared and it was found that the undergraduates majoring in OHS have higher average score for safety culture than students in other major programs.

CHAPTER 3

INITIAL STUDY: DEVELOPMENT OF SAFETY CULTURE SCALE

3.1. Introduction

The literature review identified that researchers intensely studied on safety culture among variety of industry. In most of these studies, researchers developed their own safety culture scales. Håvold (2005) investigated this issue by reviewing nine articles from the literature to give explanatory information about safety culture and safety climate scales.

In his study, Håvold observed that safety culture exhibits multidimensionality in the literature. He often underlined the need for designing multiple scales, which are reflected in multiple sub-dimensions to express the attitudes and opinions of researchers and participants alike. Håvold's study shows that the number of dimensions, factors and scales used to measure the safety culture/safety climate vary in size, including two factors in DeDobbeleer and Beland's study and 28 factors in Lee and Harrison's research. Håvold also stressed that many safety culture and safety climate researchers seem to develop their own scales and questions that the cases where the same scale is used for more than once is very rare. For Håvold, the reason for this rarity is that researchers cannot easily reach the data related to the previous surveys (Håvold, 2005).

Moreover, researchers may prefer to develop their own scales because of the survey universe. Most surveys in the literature mainly focus on workers working in a specific industry. While developing their own scales and surveys, researchers usually refer to

previous studies. However, they generally prefer to use their own scales since researches feel that particular scales would be more appropriate for the features of their research such as, survey area (medicine, nuclear, academic institution *etc.*) and participants (management, workers, students *etc.*).

Most scales and surveys related to the safety culture have mainly focused on the industry, then they are applied to workers. In addition, most of the scales are developed to reflect the safety culture among industry, yet little attention has been paid to the other parts of the society such as, academic staff and undergraduates/graduates.

In Turkey, similar results can be observed regarding the focus of surveys. During the literature review it was identified that numerous safety culture assessment have been conducted in Turkey. For instance, several master's thesis and doctoral dissertations have been written on safety culture. However, almost all these studies on safety culture are conducted in the enterprise level and are mainly about manufacturing industry. The academic dissertations archive of the Council of Higher Education-*Yükseköğretim Kurulu* (YÖK) was examined under the scope of this research and it was noticed that most surveys were conducted with professional and working individuals. In 176 dissertations found in the YÖK website in the occupational health and safety department show that only three dissertations cover students (high school students). No research is found in Turkey on the level of awareness of university students about safety culture, although some of them will probably become OHS Professionals in future.

3.2. Method and Procedure

The procedure of the Initial Study: Development of the Safety Culture Scale was composed of three main parts: (i) developing the preliminary safety culture questionnaire related to specifying the initial items of the questionnaire through

extensive literature survey; (ii) focus group meeting including both interview with the participants and applying the preliminary questionnaire; (iii) the pilot study and expert consultation sessions which consists of both the application of questionnaire to participants and experts consultation to finalize the items in the questionnaire and to determine its dimensions. Stage three composed of two different study. Because these studies conducted simultaneously there is no distinction made for the third part of the initial study.

At first 87 itemed- questioner was drafted and used in the focus group study. After the focus group meeting, the item number in the questionnaire was decreases to 80 with considering the comments from the focus group meeting participants and discussions in the focus group meeting. Considering the safety culture dimensions of other surveys in the literature, four dimensions were decided by the researcher and presented to the experts. The dimensions decided were: i. Management Approach, ii. Flow of Information/Communication, iii. Background Safety Knowledge, and iv. Safety Awareness/Behaviors. After pilot study and expert consultation sessions, total of 70 items were decided to use as a safety culture scale for the main study, 49 of them are presented in the main part of the questionnaire with four dimensions, and 21 of them are referred to the laboratory part of the questionnaire with one dimension. The following sections will present three main parts in the initial study extensively.

3.2.1. Participants and Location

The total number of the participants that completed the initial study was 108; 23 participants involved in the focus group meeting and 85 participants involved in the pilot study. The participants of this study were the students enrolled in the METU. There was no restriction either on the academic year or the department of the students. Participants were asked whether they would volunteer to participate in this study and were given a brief preliminary explanation about this research. Initial studies for this

research were also conducted at METU, because the main study aimed to target METU students.

Focus group meeting was conducted with 23 students from the Mining Engineering Department during a class session. Demographic questions were asked in order to differentiate the demographic characteristics of participants. Because the focus group meeting conducted in only one class session, the variables for department and faculty were the same for all participants. The majority of the participant was male (87%) and also the most of them aged between 17-24 (78.3%). The number of freshmen participants was eight and the others (15 of them) were senior students. The demographic information gathered from the participants of the focus group meeting presented in Table 3.1 below.

Table 3.1. *Demographic characteristic of the participants of focus group (N = 23)*

Demographic Variables	**Frequencies**	**Percentages**
	N	%
Age		
17-23	5	21.7
24-30	18	78.3
Gender		
Female	3	13
Male	20	87
Academic Year		
Junior	8	34.8
Senior	15	65.2
Faculty		
Faculty of Engineering	23	100
Department		
Mining Engineering	23	100

After the focus group meeting, a pilot study was conducted with 85 students from the Mining Engineering and Petroleum and Natural Gas Engineering Departments. The questionnaire was applied at three separate class sessions. Total of 82 questionnaires

were found to be filled out properly and data gathered from these questionnaires were used for statistical analysis. The demographic information gathered from the participants of the pilot study is presented in Table 3.2 below.

Table 3.2. *Demographic characteristic of the participants of the pilot study (N = 82)*

Demographic Variables	**Frequencies**	**Percentages**
	N	%
Age		
17-23	42	51.2
24-30	39	47.6
31-37	1	1.2
Gender		
Female	20	24.4
Male	62	75.6
Academic year		
Sophomore	30	36.6
Junior	24	29.3
Senior	26	31.7
Master Program	1	1.2
Doctoral Program	1	1.2
Faculty		
Faculty of Engineering	82	100
Department		
Mining Engineering	50	61
Petroleum and Natural Gas Engineering	32	39

3.2.2. Developing the Preliminary Safety Culture Questionnaire

Safety culture assessments were conducted by using scales picked from a variety of previous surveys and these scales were modified to fit into this specific research. For developing the initial items in the safety culture questionnaire, an extensive literature review was conducted and parallel researches reviewed for elementary guidance. One of the major references used for the development of the questionnaire was the

"Occupational Safety and Health Culture Assessment - A review of main approaches and selected tools" published by ES- European Agency for Safety and Health at Work (EU-OSHA, 2011). In addition to listing different assessment methods of the safety culture, this publication also explains and refers to some well-known safety culture questioners which are: (i) Score Your Safety Culture Checklist; (ii) Hearts and Minds Programme - Understanding Your Culture Checklist; (iii) Safety Climate Assessment Toolkit and User Guide (LSCAT); (iv) Safety Health of Maintenance Engineering (SHoMe) Tool; (v) Nordic Occupational Safety Climate Questionnaire (NOSACQ); (vi) IAEA Guidance for Use in the Enhancement of Safety Culture.

In addition to the above-mentioned EU-OSHA publication, more than 25 studies on safety culture assessment were examined for the formulation of the preliminary safety culture questionnaire as listed in Table 2.1 in Chapter 2.

When the initial items of the questionnaire were outlined by the researcher, OHS professionals working in the safety area and graduated from METU was consulted about the comprehensibility, clarity, wording of the items, and they are asked to propose further items to put into the questionnaire. As a result of this process, a total of 87 items were decided for this preliminary safety culture questionnaire, 66 of them are represented in the main part of the questionnaire and 21 of them are referred to the laboratory part of the questionnaire.

METU Human Subjects Ethic Committee approval was obtained from the Applied Ethics Research Centre of Middle East Technical to use the questionnaire (Appendix A).

3.2.3. The Focus Group Meeting

Once the preliminary items of the questionnaire had been decided, a focus group meeting was conducted with the sample student group. The data collection procedure for the study was designed in accordance with the ethical rules, thus the participants were not asked their names in the questionnaire form. At the beginning of the meeting, information about the purpose and the scope of this study was explained to the students and they were informed that the study was based on voluntary participation and that the results would be used only for scientific purposes.

The questionnaire was applied to 23 students from Mining Engineering Department during a class session. After completing the questionnaire, a discussion session was held with the students. The students were asked to give feedback to the researcher about the questionnaire's completion time, clarity, whether there are contradictory items, whether there are items they found difficult to understand and whether there is any area needed to be discussed in this questionnaire but not currently available.

After these feedbacks given by the students, the contradictory items and the items that are thought not to be contributing to the research were omitted and the items which are found to be difficult to understand were rephrased/changed according to the comments given. One of the most valuable comments related to the questionnaire was incorrect placing of three items of the questionnaire. The students argued that some items ask for facts not opinions; they cannot be thus answered using the Likert scale. In accordance with this feedback, three items were moved to the demography part of the questionnaire. Three of the items mentioned by students are as: *(i) Have you ever received a health and safety training/course at METU? (ii) Have you received any first aid training within METU and/or did you take any health and safety training that included first aid? (iii) Did you attend any emergency drills in METU?*

Additionally, after the focus group discussion, the data gathered from the questionnaires were analyzed in the Statistical Package for Social Science (SPSS) to read the data regarding the initial correlation of items. A reliability analysis was conducted by using SPSS and Inter-Item Correlation Matrix was examined in detail to identify high item correlations. The item correlations showing significantly high ratios were reassessed. As a result of this review, some items were omitted since they show high correlation to the other items, and it is realized that they were measuring the same variable. Additionally, some items are brought together and transformed to a single item. The correlation ratio between the item *(i) I have been informed about how to report on health and safety related events within METU* and item *(ii) I have been informed about how to report unsafe conditions, near misses, accidents within METU* was measured as .867. When this issue was identified from inter-item correlation matrix, the items were reviewed again, it was realized that they were almost the same question. These two items were therefore converted to a single item as *I have been informed about how to report on health and safety related events (unsafe conditions, near misses, accidents) within METU*.

After the focus group meeting, the item number was decreased to 80; 59 of them are represented in the main part of the questionnaire and 21 of them are referred to the laboratory part.

3.2.4. Pilot Study and Expert Consultation

After the focus group meeting, a pilot study was conducted. One of the goals of the pilot study was to decide on the method to be followed for the application of the questionnaire during the main study. The methods including online survey and paper distribution and applying ways such as, conducting the surveys at the class session or distributing the survey to the students and ask them to fill out and bring them back to the instructor were tested with the pilot study. The second goal of the pilot study was to create a representable sample size data that can be entered into the SPSS and to

check the reliability of the dimensions decided by the researcher and the consultant experts (N=2).

The students were given online survey links via student organizations, social media networks, and personal connections. During the first month, only six online questionnaires were filled out by the students and two of them was not complete. At the same time, some instructors from various departments distributed the hard copy of the questionnaires to the students and asked them to fill out and bring back. The return ratio did not seem promising since many students did not bring the questionnaires back. Moreover, the questionnaire was applied to 85 students at three separate class sessions in Mining Engineering, and Petroleum and Natural Gas Engineering Departments. After the assessment period, it was observed that only three of the questionnaires were not filled properly (either they were empty or filled with comical symbols). Total of 82 questionnaires were filled out properly, and it was assessed that the data gathered from these questionnaires can be used for reliability analysis of the dimensions proposed by the researcher and the experts participating to this study.

As mentioned above, at the same time with the pilot study, discussions with two experts were made in order to identify the dimensions of the safety culture questionnaire. Considering the safety culture dimensions of other surveys in the literature, four dimensions were decided by the researcher and presented to the experts. The dimensions decided were ‘‘Management Approach”, “Flow of Information/Communication”, “Background Safety Knowledge”, and “Safety Awareness/Behaviors”.

The researcher and the experts tried to place 59 items of the main questionnaire under these dimensions. The experts presented their opinion about the context of the items and whether the items are fitting for the proposed dimension. The researcher and experts determined the items that could be placed under the same dimension in the questionnaire and the items which could not be placed under any dimension were

revealed. Additionally, with this expert consultancy session, language and context of some items were revised, and some items thought to measure the same variable with other ones were excluded from the questionnaire.

Although dimension analysis process was also applied to the laboratory part of the questionnaire, it was discussed with the experts that identifying the dimensions for the laboratory part of the questionnaire would probably be unfeasible and futile, it was thus more appropriate to consider the laboratory part as a scale of one dimension.

After the pilot study and expert consultancy session, the number of items was decreased to 70; 49 of them were presented main part of the questionnaire with four dimensions and 21 of them were used in laboratory part of the questionnaire with one dimension. The number of the items under the proposed dimensions for the main part of the questionnaire is shown in Table 3.3.

Table 3.3. *Decided dimensions and number of items*

Proposed Dimensions	**Number of items**
Main Part of the Questionnaire	
Management approach	13
Flow of information/communication	6
Background safety knowledge	10
Safety awareness/behavior	20
Total	***49***
Laboratory Part of the Questionnaire	21
Whole Scale Total	**70**

3.3. Results

Total of 70 items were decided to use as a safety culture scale for the main study, 49 of them were presented in the main part of the questionnaire and 21 of them were referred to the laboratory part of the questionnaire.

Before and after the expert consultation, reliability analysis was performed to compare the overall reliability of the questionnaire in the main part of the questionnaire. Reliability analysis was performed separately for 59-itemed questionnaire (derived after focus group meeting) and 49-itemed questionnaire (derived after expert consultation) to see the tendency of the difference and to identify whether the expert consultation session had any impact on the reliability ratio of the overall scale. The Cronbach's alpha coefficients for 59 itemed and 49 itemed questionnaires were found to be .868 and .880 respectively. The difference was found to be low, therefore, it was determined that the omitted items had limited impact for the internal consistency of the scale. Reliability analysis was done for the laboratory part of the questionnaire based on the assumption that the laboratory part has one dimension. Because there was no item omitted or added to the laboratory part of the questionnaire after expert consultation session, the Cronbach's alpha coefficient was the same and it was .887 for the 21 itemed laboratory part of the questionnaire.

Table 3.4. *Proposed dimensions and Cronbach's alpha for internal consistency scores*

Proposed Dimensions	***Cronbach's alpha for internal consistency scores***
Main Part of the Questionnaire	
Management approach	.877
Flow of information/communication	.822
Background safety knowledge	.802
Safety awareness/behavior	.777
Laboratory Part of the Questionnaire	.877

Reliability analyses were also performed for the dimensions in the main part of the questionnaire developed by the researcher and the experts separately in order to have an initial idea about the internal consistency of the proposed dimensions. All four dimensions showed acceptable levels of reliability scores (Table 3.4).

The methodology that is decided to be used for the main study was to apply the questionnaire during class session by using hard copies in order to receive an effective response rate.

The final version of the Safety Culture Scale had 70 items. This final version of the scale used in the main study is presented Appendix B. The final factor structure developed after the statistical analysis of the main study was presented in the results section of the Chapter 4: Main study.

CHAPTER 4

MAIN STUDY: ASSESSMENT OF SAFETY CULTURE AMONG UNIVERSITY STUDENTS

4.1. Introduction

As mentioned above, although there are many studies on safety culture can be found in the literature, only very few of them cover the other parts of the society apart from the industry. Indeed, in his empirical study conducted in several private universities in Bangladesh, Hossain *et al.* (2015) stated that; the number of researches conducted in academic institutions are very rare comparatively to other areas, notwithstanding the fact that students and academic personnel represent a large part of the learned society. Any event that occurs due to the inadequate knowledge of safety practices at universities will have a negative impact on the present and future of the nation. More precisely, the OHS conditions of universities in developing countries are enough for any parent to be terrified; on the other hand, research in this area is very rare (Hossain *et al.*, 2015).

Moreover, in addition to the lack of literature on safety culture among academic institutions, most of the current studies are vastly interested in laboratory safety issues and intensely concentrate on the correct implementation of scientific procedures and practices (Hossain *et al.*, 2015). Numerous other areas in academic institutions are as important as laboratory safety and these areas also need attention. For instance, Hossain *et al.* (2015) emphasizes security issues, since almost serious acts of terrorism occurred every year in the USA's schools and these acts deeply shake the entire world.

Unfortunately, literature does hardly give attention to these non-technical issues that require a more holistic approach than laboratory safety (Hossain *et al.*, 2015).

In a similar vein, Thamrin's comprehensive review concluded that in recent years, there has been a growing interest in school-based workplace safety education, since employment for young people is widespread and is often supported by parents (Thamrin *et al.*, 2010). Regrettably, in his study, Blair (2004) reveals that unintentional injuries and fatalities are much higher for young people, especially young males (Blair *et al.*, 2004).

4.2. Method and Procedure

The procedure of the Main Study: Assessment of the Safety Culture among University Students was composed of two main parts; (i) the application of the questionnaire and data collection; (ii) the assessment of the data gathered from questionnaire.

Applied questionnaire, which is developed with the initial part of the study, has 70 items and two parts. The main part of the questionnaire has 49 items and this part was responded by all participants. The laboratory part of the scale has 21 items and this part was responded only by the students who are using the laboratory at METU. After data gathering, exploratory factor analysis (EFA) was made for the main part of the safety culture scale and laboratory part of the safety culture scale separately before the comparison analyses. After EFA, total of 33 items were remained in main part of the safety culture scale and total of 16 items were remained in the laboratory part of the safety culture scale. The four-factor structure for the main part of the safety culture scale and one-factor structure for the laboratory part of the safety culture scale were decided. The following sections will present two parts in the main study extensively.

4.2.1. Participants and Location

The safety culture scale prepared for this study was applied to 471 students from different departments and different academic years during 2018 Fall Semester. There were no restrictions on department or academic year for the students to be able to participate to this study. The only criteria set for the study was to be a METU student. The main purpose of choosing students from various departments was to demonstrate the difference between students from faculty of engineering and those studying in different faculties. The questionnaires were distributed either by the researcher under the supervision of the instructors during class sessions or directly by the instructors and participants were informed that participation to the study was voluntary before distribution of the questionnaires, hence all the questionnaires were received. However, during the data formulation for SPSS, nine questionnaires were found to be not fully or properly filled out, they were thus taken out. Finally, data from 462 valid questionnaires were entered the SPPS for statistical analysis. Table 4.1 shows the participants' demographic information. The majority (72.5%) of the participants were aged between 17–23 years, followed by the 24-30 years age group (26.2%). The percentages of male and female participants were 64.9% and 34.8%, respectively (Figure 4.1).

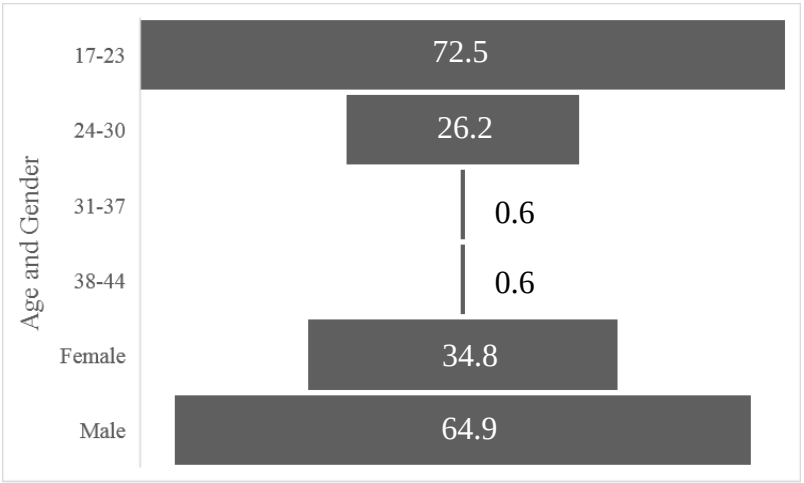

Figure 4.1. Age and gender percentages of the participants

Table 4.1. *Demographic characteristic of the participants of main study (N = 462)*

Demographic Variables	**Frequencies**	**Percentages**
	N	%
Age		
17-23	335	72.5
24-30	121	26.2
31-37	3	.6
38-44	3	.6
Total	**462**	**100.0**
Gender		
Female	161	34.8
Male	300	64.9
Missing	1	.2
Total	**462**	**100.0**
Academic Year		
Preparatory School	7	1.5
Freshmen	62	13.4
Sophomore	125	27.1
Junior	113	24.5
Senior	127	27.5
Master Program	24	5.2
Doctoral Program	4	.9
Total	**462**	**100.0**
Faculty		
Faculty of Architecture	5	1.1
Faculty of Engineering	366	79.2
Faculty of Education	50	10.8
Faculty of Economic and Administrative Sciences	11	2.4
Faculty of Arts and Sciences	30	6.5
Total	**462**	**100.0**

Table 4.1. *Demographic characteristic of the participants of main study (N = 462) (Cont'ed.)*

Demographic Variables	**Frequencies**	**Percentages**
	N	%
Department		
Mining Engineering	91	19.7
Petroleum and Natural Gas Engineering	75	16.2
Geological Engineering	72	15.6
Electrical and Electronics Engineering	35	7.6
Aerospace Engineering	31	6.7
Metallurgical and Materials Engineering	24	5.2
Elementary Mathematics Education	23	5.0
Early Childhood Education	17	3.7
Philosophy	13	2.8
Chemical Engineering	10	2.2
Elementary Science Education	8	1.7
Civil Engineering	7	1.5
Environmental Engineering	6	1.3
Sociology	6	1.3
Chemistry	5	1.1
Food Engineering	5	1.1
Architecture	4	.9
Political Science	4	.9
Psychology	4	.9
Business Administration	3	.6
Mechanical Engineering	3	.6
Physical Education and Sports	3	.6
Computer Engineering	2	.4
Economics	2	.4
Industrial Engineering	2	.4
International Relations	2	.4
Occupational Health and Safety	2	.4
City and Regional Planning	1	.2
Earth System Science	1	.2
Mathematics	1	.2
Total	**462**	**100.0**

The majority of the participants were from Faculty of Engineering (79.2%), followed by Faculty of Education (10.8%), Faculty of Arts and Sciences (6.5%), Faculty of Economic (2.4%) and Administrative Sciences and Faculty of Architecture (1.1%). In terms of academic year, 13.4% of the students were freshmen, 27.1% were sophomores, 24.5% were juniors, and 27.5% were seniors. 6.1% of the participants are studying at graduate level and only 1.5% of the participants are student at the English Language Preparatory School (Figure 4.2).

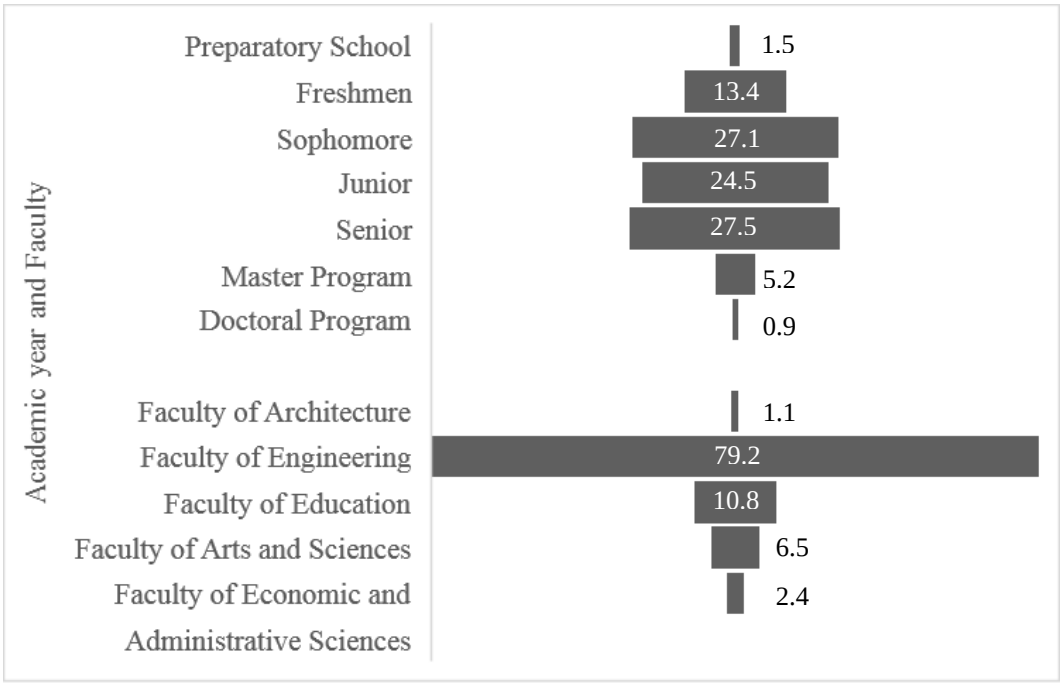

Figure 4.2. Academic year and faculty percentages of the participants

4.2.2. Application of the Questionnaire and Data Collection

After considering the results of the pilot study, the methodology chosen was to apply the questionnaire during class sessions by asking students to fill out paper copies. The questionnaire was applied to the students during course sessions by the researcher and/or instructors. Over 15 class sessions were visited directly by the researcher to

apply safety culture scale. Participants were given brief information about the main study and notified about the approval of METU Human Subjects Ethic Committee, which is shown to participants upon request. English version of the questionnaire was also prepared for the foreign students and they were readily available for each visit.

The questionnaire was anonymous; thus, participants were neither asked to write their names nor requested the exact age but just to choose from an age range. Online survey method not used, and all the questionnaires were filled out with paper copies, so there were no doubts related to anonymity of the survey, hence, there were no indirect information collected such as IP addresses. Participants were informed that the study was based on the voluntary participation in order to prevent any feeling that they have to fill out the questionnaire.

After completing the questionnaire, participants were given the communication details of the researcher again, though the details can be found in the questionnaire form as well and were encouraged to communicate should they wish to learn the results or to obtain more information about this research. The effective response rate of study is 98.1% as 462 out of 471 questionnaires were valid.

4.2.3. Assessment of Data Gathered from Questionnaire

Safety culture scale was designed as a five-point Likert scale. The items were rated 1 to 5, where 1 represents strongly disagree, 2 represents disagree, 3 represents neither agree nor disagree, 4 represents agree, and 5 represents strongly agree. The SPSS was used for the statistical data analysis. The details related to analyses were performed through the SPSS and the related results were given in the following results part.

4.3. Results

4.3.1. Exploratory Factor Analysis and Reliability Tests of the Main Part of the Safety Culture Scale

Exploratory factor analysis (EFA) was made for the main part of the safety culture scale and laboratory part of the safety culture scale separately before the comparison analyses. As the first step of the statistical analysis, the factor structure of the main part of the safety culture scale investigated by factor analysis using principal component factor extraction method.

In order to perform factor analysis, some criteria should be met. For factor analysis, the number of samples should be sufficient, and the data set should be suitable for factor analysis. These criteria were checked by calculating the Kaiser-Meyer-Olkin (KMO) coefficient and Bartlett's test of sphericity and the results of these calculations were presented in Table 4.2.

Table 4.2. *KMO coefficient and Bartlett's test of sphericity*

Kaiser-Meyer-Olkin measure for sampling adequacy		.90
Bartlett's test of sphericity	χ^2	8759.46
	Sd	1176
	p	.000

According the results, KMO coefficient is calculated as .90. As a common approach of the literature if the KMO coefficient is .70 and higher indicates that the number of samples is sufficient for factor analysis. The Bartlett's test of sphericity is used to determine whether the data set is suitable for factor analysis. The p value calculated

with this test is less than .05; this shows that the matrix refers to the relations between the items to be included in the factor analysis is different from the unit matrix in which there is no relationship between the items, so the data are suitable for factor analysis (Can, 2013). As a result, both KMO and Bartlett's tests showed that the number of samples was sufficient for the factor analysis, and the p value obtained for the Bartlett Sphericity Test was suitable for the factor analysis of the data for the 49-item main part of the safety culture scale.

Exploratory factor analysis was performed after the necessary criteria were checked and the scale was found to be suitable for factor analysis. As a result of factor analysis, 13 factors with Eigen value greater than 1 were observed (Table 4.3). The contribution of these thirteen factors to total variance was found to be 62%. The three important concepts used to decide the number of factors are Eigen values, scree plot, and explained variance by factor.

Çokluk *et al.* (2012) stated as one of the most important points to consider when deciding the number of factors is the importance of the contribution of each factor to total variance.

When the total variance table is examined, it is observed that the first four components contribute significantly to the variance and after the fourth component, the contribution to the variance decreases. Furthermore, when the scree plot graph was examined, the slope after the fourth point formed a plateau. The contribution of the components after the fourth point to the variance is both small and approximately the same. In light of this information, it was decided that the number of factors should be four.

Table 4.3. *Total variance explained*

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	10.74	21.91	21.91	10.74	21.91	21.91
2	4.20	8.57	30.48	4.20	8.57	30.48
3	2.78	5.67	36.15	2.78	5.67	36.15
4	1.91	3.90	40.05	1.91	3.90	40.05
5	1.56	3.19	43.24	1.56	3.19	43.24
6	1.49	3.05	46.28	1.49	3.05	46.28
7	1.24	2.53	48.81	1.24	2.53	48.81
8	1.17	2.40	51.21	1.17	2.40	51.21
9	1.12	2.29	53.49	1.12	2.29	53.49
10	1.09	2.22	55.71	1.09	2.22	55.71
11	1.06	2.16	57.87	1.06	2.16	57.87
12	1.01	2.06	59.94	1.01	2.06	59.94
13	1.01	2.06	62.00	1.01	2.06	62.00

Rotation process was performed to better interpret the results of factor analysis. To decide the rotation techniques between orthogonal and oblique, component correlation coefficients between the factors were calculated and correlation values in the component correlation matrix were taken into account as Tabachnick and Fidell (2007) recommended. Tabachnick and Fidell (2007) stated that one of the best ways to decide between orthogonal and oblique rotation is to start to analyses with oblique rotation by forcing the factor structure with the decided number of factors and look at the correlations among factors. After examining the factor correlations matrix, if correlations found exceeded .32, then it is enough variance to warrant oblique rotation. However, if the correlations indicated lower values (lower than .32) orthogonal rotation should be chosen (Tabachnick and Fidell, 2007). When the component correlation matrix was analyzed, it was observed that the correlation coefficient between some factors remained below .32 and low correlation coefficient values observed between Factor 3 and other three factors.

Additionally, Keiffer (1998) stated that; it is almost impossible to find unrelated factors in real life, but since the aim of the study is to create a model and to obtain the most appropriate number of "independent" factors possible, it is generally accepted to make factor extraction with varimax rotation which is an orthogonal method (Yaşlıoğlu, 2017).

Based on the above-mentioned literatures, varimax rotation method was decided to use for factor analysis. There is no consensus on what thresholds should be used for factor loading cut-off in the factor analysis. Hair *et al.* (1998) listed several factors loading cut-off values based on sample size. On contrary, Field (2005) promoted Guadagnoli and Velicer (1988) suggestion which claims that a factor is reliable if it has four and more loadings with at least .6 value and not dependent to sample size. Tabachnick and Fidell (2007) supported the Comrey and Lee (1992) who recommended using stricter factor loading cut-offs starting from .32 (poor), .45 (fair), .55 (good), .63 (very good), and ending with .71 (excellent). The factors loading cut-off value was taken out as .45 in order to select the items with high contribution to the variance and to keep the internal consistency of the factors high.

A principle component analysis with varimax rotation run with the cut-off value .45 and by forcing the factor number as four. As a result of factor analysis, total of 16 items were excluded from the scale considering the factor loading cut-off value and not being compatible with the loaded factor. Total of 12 items were not loaded any factors in four factor structure with cut-off .45. Total of four items were removed because they were loaded the different factor than initially decided by the experts and when the items assessed it was identified that they were not compatible with the content of the factor that they were loaded (Table 4.4). Item 46 was loaded in the factor 1 as it is initially placed in the factor 3 by the experts. When the item assessed, it was decided that it is compatible with the factor it was loaded. So, item 46 moved to the factor 1 and was not deleted.

Table 4.4. *Items removed after EFA from the main part of the scale*

Items removed thus they were not compatible with the content of the factor they were loaded				
Items	**Factor 1**	**Factor 2**	**Factor 3**	**Factor 4**
Item 26. I know how to report any unsafe conditions/near misses/accident I experienced at METU.	.17	**.65**	-.18	.30
Item 25. I know who I need to communicate the problems/doubts about health and safety issues in METU to.	.24	**.58**	-.06	.32
Item 33. If any instructor around me is acting in a manner I believe to be unsafe, I warn her/him.	.09	**.53**	.29	-.05
Item 42. When I encounter any unsafe conditions, I report it to the required parties.	.09	**.48**	.28	.12
Item which were not loaded any factors with cut-off .45				
Items	**Factor 1**	**Factor 2**	**Factor 3**	**Factor 4**
Item 45. I think the academic personnel have sufficient knowledge about health and safety.	.43	.22	.12	.20
Item 14. I have been informed about safe and unsafe behaviours regarding my circumstances.	.42	.21	.16	.38
Item 49. When I encounter any unsafe conditions, I report it to the required parties.	.40	.39	.19	.10
Item 29. I am satisfied with the health and safety information I received at METU.	.35	.44	-.01	.37
Item 34. Students who work unsafe are often warned by other students.	.18	.39	.33	.02
Item 19. I think I have not been adequately informed about what measures are taking in health and safety issues at METU.	.09	.38	-.15	.06
Item 47. I believe that I can contribute to improving health and safety issues at METU.	.10	.20	.39	.20
Item 43. I think that accidents at METU (work accidents) are caused by lack of training.	-.13	.18	.32	-.23
Item 38. It is the responsibility of management to prevent accidents that may occur in METU.	-.16	-.16	.32	-.05
Item 24. I know what the concept of “near misses” means.	.02	-.05	.32	.31
Item 41. I sometimes do not comply with the safety rules, when not following them will save me time.	.05	-.02	.18	.11
Item 28. I believe that I will have enough knowledge about basic health and safety concepts when I graduate from the university.	.19	.26	-.05	.37

Total of 33 items were remained in the main part of the safety culture scale. The factor structure of the main part of the safety culture scale and factor loadings, percentage of explained variance and Cronbach's alpha internal consistency score of the factors is shown in Table 4.5.

After the factor analysis the names of the factors re-assessed, hence 16 items removed from the main part of the scale. Since the proposed four factor structure did not change, factor names determined in the initial study remained as they were.

Factor analysis revealed that 14 items loaded in the first factor which contributed 21.89% of the total variance. The name of this factor not changed and remained as *"management approach"* and factor loading values for this factor varied between .80 and .45. Cronbach's alpha internal consistency score was calculated as .90. Factor analysis revealed that four items loaded in the second factor which contributed 8.56% of the total variance. The name of this factor also remained the same *"flow of information/communication"*. Factor loading values for this factor varied between .66 and .58 and Cronbach's alpha internal consistency score was calculated as .86. Factor analysis revealed that 10 items loaded in the third factor which contributed 5.67% of the total variance. The name of this factor not changed and remained as *"safety awareness/behavior"* and factor loading values for this factor varied between .68 and .48. Cronbach's alpha internal consistency score of the third factor was calculated as .78. Factor analysis revealed that 5 items loaded in the fourth factor which contributed 3.89% of the total variance. The name of this factor was not changed and remained as *"background safety knowledge"* and factor loading values for this factor varied between .66 and .54. Cronbach's alpha internal consistency score of the fourth factor was calculated as .72.

The Cronbach's alpha for internal consistency scores for the main part of the scale with 33 items was found as .89.

Table 4.5. *Factor structure of the main part of the safety culture scale*

	Factor Loadings			
Items	**Factor 1**	**Factor 2**	**Factor 3**	**Factor 4**
Item 9. In METU, management takes the necessary measures to ensure and improve the health and safety conditions.	**.80**	.08	-.01	.16
Item 3. When a health and safety problem arises in METU, management takes a decisive role.	**.76**	.11	-.02	-.02
Item 2. Management quickly solves health and safety problems at METU.	**.74**	.20	.01	-.02
Item 10. Management monitors and evaluates the measures taken to ensure and improve health and safety conditions at METU.	**.72**	.09	.00	.19
Item 7. In METU, health and safety related policies/plans/procedures are sufficient.	**.69**	.17	-.05	.01
Item 4. Health and safety issues are ignored at METU.	**.68**	.10	.06	.00
Item 6. Corrective measures are always taken when issues related to health and safety (laboratory work, service conditions, etc.) are conveyed to management at METU.	**.66**	.13	-.02	.14
Item 11. In METU, management follows a participatory policy in the evaluation of health and safety issues and evaluates the opinions of the participants from all parties (academic personnel, administrative staff, students, etc.).	**.63**	.25	-.04	.03
Item 8. In METU, health and safety-related policies/plans/procedures are announced to all parties and are easily accessible when requested.	**.61**	.10	.05	.13
Item 1. Health and safety is one of the top priority issues at METU.	**.58**	.15	.09	-.01
Item 5. METU has effective tools for communicating health and safety issues to management.	**.56**	.12	.13	.14
Item 46. I think it will be well received when I make a recommendation to the management about health or safety.	**.56**	.30	.06	.05
Item 13. In the context of any off-campus trip in the scope of my lectures, management (METU management and academic personnel) takes the necessary safety measures on my behalf.	**.51**	.08	.16	.12
Item 12. The academic personnel (professors, associate professors, doctors, lecturers and research assistants) are interested in my safety in my studies (e.g. laboratory work).	**.45**	.10	.24	.26
Item 16. I have been informed about how to report on health and safety related events (unsafe conditions, near misses, accidents) within METU.	.33	**.66**	-.13	.13
Item 15. I have been informed about which of the events related to health and safety should be reported in METU.	.37	**.64**	-.07	.11

Table 4.5. *Factor structure of the main part of the safety culture scale (Cont'ed.)*

Factor Loadings				
Items	**Factor 1**	**Factor 2**	**Factor 3**	**Factor 4**
Item 17. When I felt a problem in terms of health and safety in METU, I was informed about who to talk to.	.28	**.62**	-.12	.24
Item 18. I was informed about what could qualify as unsafe conditions in the campus that might affect me.	.35	**.58**	-.06	.24
Item 37. I think that investigating accidents will contribute to health and safety improvement.	.03	-.20	**.68**	.05
Item 36. I think near misses should be investigated.	-.04	-.19	**.63**	-.00
Item 44. I think that emergency drills should be carried out at METU regarding emergency situations.	-.08	-.13	**.59**	-.05
Item 48. Being notified about the health and safety related issues in METU motivate me to contribute to the improvement of said conditions.	.06	-.03	**.57**	-.04
Item 35. I warn my friends about unsafe working conditions in my surroundings.	.18	.32	**.57**	-.01
Item 32. If I have friends around me who are acting in an unsafe manner, I warn them.	.07	.32	**.55**	-.12
Item 40. I think that personal protective equipment should be used in all necessary conditions.	.01	-.02	**.52**	.18
Item 31. I feel responsible for the safety of others, as well as my own safety.	.27	.10	**.52**	.15
Item 30. When I am on campus, I feel responsible for my own safety.	.24	-.15	**.51**	.16
Item 39. I feel responsible for preventing accidents at METU.	.07	.21	**.48**	-.06
Item 22. I know the location of the "emergency exits" of the faculty buildings that I frequently visit.	.09	.20	.04	**.66**
Item 23. I know the locations of the "emergency assembly areas" of the faculty buildings that I frequently visit.	.08	.22	-.01	**.64**
Item 21. I know what an "emergency assembly area" means.	.04	-.11	.22	**.63**
Item 20. I know enough about what to do in an emergency situation.	.20	.28	-.03	**.60**
Item 27. I know basic first aid.	.05	.28	.02	**.54**
Eigenvalue	**10.72**	**4.19**	**2.78**	**1.9**
Percentage of explained variance (%)	**21.89**	**8.56**	**5.67**	**3.89**
Cronbach's alpha	**.90**	**.86**	**.78**	**.72**

*Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization

4.3.2. Exploratory Factor Analysis and Reliability Tests of the Laboratory Part of the Safety Culture Scale

Abovementioned steps of the factor analysis were also followed for the laboratory part of the safety culture scale. KMO and Bartlett's test of sphericity were calculated in order to identify if the laboratory part of the scale has sufficient number of samples for the factor analysis and also collected data is suitable for the factor analysis. The results of these calculations were presented in Table 4.6.

Table 4.6. *KMO coefficient for sampling adequacy and Bartlett's test of sphericity*

Kaiser-Meyer-Olkin measure for sampling adequacy		.92
Bartlett's test of sphericity	χ^2	4138.33
	df	210
	p	.000

According the results, both KMO and Bartlett's tests showed that the number of samples was sufficient for the factor analysis, and the p value obtained for the Bartlett's Sphericity Test was suitable for the factor analysis of the data for the 16-item laboratory part of the safety culture scale.

Exploratory factor analysis was performed after the necessary criteria were checked and the laboratory part of the safety culture scale was found to be suitable for factor analysis. As a result of factor analysis, 5 factors with Eigen value greater than one were observed (Table 4.7). The contribution of these 5 factors to total variance was found to be 65%. Çokluk *et al.* (2012) stated as one of the most important points to consider when deciding the number of factors is the importance of the contribution of each factor to total variance. When the total variance table is examined, it is observed that the first component contributes significantly to the variance, and after the first component, the contribution to the variance decreases. The first factor explains the 40% of the total variance, which is very high compare to the next factors. The second

factor explains the 9% of the total variance which is significantly low compare to the first factor.

Furthermore, when the scree plot graph was examined, the slope after the first point formed a plateau. The contribution of the components after the first point to the variance is both small and very close to each other. Considering this information, it was decided that the number of factors should be one and following statistical analysis was conducted for the one-factor structure of laboratory part of the scale.

Table 4.7. *Total variance explained*

Component	**Initial Eigenvalues**			**Extraction Sums of Squared Loadings**		
	Total	**% of Variance**	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**
1	8.585	40.880	40.880	8.585	40.880	40.880
2	1.951	9.292	50.172	1.951	9.292	50.172
3	1.241	5.908	56.080	1.241	5.908	56.080
4	1.075	5.117	61.197	1.075	5.117	61.197
5	1.030	4.905	66.102	1.030	4.905	66.102

The factor loading cut-off value was taken as .45 in order to select the items with high contribution to the variance and to keep the internal consistency of the factor high. A principle component analysis with varimax rotation run with the cut-off value .45 and by forcing the factor number as one. As a result of factor analysis, five items were excluded from the scale considering the factor loading cut-off value. These five items were not loaded in 1-factor structure with cut-off .45 (Table 4.8).

Table 4.8. *Items removed after EFA from the laboratory part of the scale*

Items which were not loaded any factors with cut-off .45	
Items	**Factor 1- Factor Loading**
Lab-Item 6. I have received a special health and safety training related to working conditions in the laboratory.	.44
Lab-Item 15. I don't know what to do when I encounter unsafe conditions while working in the laboratory.	.24
Lab-Item 19. If I'm going to do a new study in the laboratory, the degree of risk of this study is of interest to me.	.22
Lab-Item 16. I know what to do of the event of an accident in the laboratory.	.15
Lab-Item 20. If I find that the equipment is broken while working in the lab, I will try to fix it.	-.08

Total of 16 items were remained in the laboratory part of the safety culture scale. The factor structure of the laboratory part of the safety culture scale and factor loadings, percentage of explained variance and Cronbach's alphas internal consistency score of the factor are shown in Table 4.9.

Factor loading values for this factor varied between .80 and .50. Cronbach's alpha internal consistency score of the laboratory part of the safety culture scale was calculated as .934. The Cronbach's alpha internal consistency score shows that the laboratory part of the scale has internal consistency.

Table 4.9. *Factor structure of the laboratory part of the safety culture scale*

Factor Loadings	
Items	**Factor 1**
Lab-Item 10. I know the personal protective equipment that I need to use while working in the laboratory.	.81
Lab-Item 9. I know the risks I might face while working in the laboratory.	.81
Lab-Item 2. I was informed about the risks that I might encounter before the laboratory work.	.78
Lab-Item 3. I was informed about the personal protective equipment that I must use during laboratory work.	.78
Lab-Item 5. I was informed about where to find safety information on hazardous substances used in the laboratory (e.g. information on chemicals, safety data sheets).	.74
Lab-Item 11. I know what tools/materials I am authorized to use when working in the laboratory.	.74
Lab-Item 17. I am aware of the consequences of the hazards that I may encounter in the laboratory	.74
Lab-Item 12. I know where to find the safety information about the hazardous substances used in the laboratory (e.g. information on chemicals, safety data sheets.)	.74
Lab-Item 4. I was informed about which equipment / materials I am authorized to use while working in the laboratory.	.73
Lab-Item 18. I think I am sufficiently informed of the safety issues prior to working in the laboratory.	.73
Lab-Item 1. I was informed about who is responsible for health and safety during laboratory work.	.73
Lab-Item 8. I know who is responsible for health and safety issues while working in the laboratory.	.72
Lab-Item 7. I know the safety rules (eating/drinking, cell phone use, etc.) that I must follow when working in the laboratory.	.68
Lab-Item 13. I know the location of emergency equipment in the laboratory (first aid cabinet, eye shower, fire extinguisher, etc.).	.62
Lab-Item 14. I know how to use the emergency equipment located in the laboratory (eye wash, fire extinguisher, etc.).	.55
Lab-Item 21. When I work in the laboratory, I follow the safety rules even when no academic personnel are present.	.53
Eigenvalue	8.59
Percent of explained variance (%)	40.89
Cronbach's alpha	0.93

*Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization

4.3.3. Demographic Questions Related to OHS Course

In order to identify the number of participants who received occupational health and safety course, two questions were asked in the demographic part of the questionnaire. Initially (in the focus group meeting and pilot study) there was only one question asked and this was whether the participants received any OHS course in METU. However, because the application time of the questionnaire, the question was divided into two. The reason for that in order to be able to distinguish the participants completed the OHS course and the participants just receiving the OHS course. The questionnaire applied in the 2018 Fall Semester, so the participants who were stated they were receiving the OHS course in this semester cannot be treated as they had received full OHS course as they were not completed even half of the semester.

Although, these questions formulized with above mentioned approach, when entering the data gathered from questionnaire to SPSS, it was identified that the questions were misinterpreted by the participants and majority of the participants who responded as they were taking OHS in this semester also responded yes to the question "Have you ever received a health and safety training/course at METU?" As a result, with these questions it was impossible to distinguish the participant who were currently taking the OHS course and who received and completed the full OHS course in previous semesters.

The frequencies of the participants responded these two questions are presented in below tables just to give and idea about the situation related to OHS course. Note that majority of the students who responded as a yes to question 7 also responded as a yes to question 8.

The first question asked related to OHS course was: "***Question7: Are you taking a health and safety training/course at METU during this semester?*** This was a question with two possible answers with yes and no. For the participant who said yes to this question also asked to give the name of the course with the phrase "*If yes, please give the name of the course: (such as Department Course, Elective Course or OHS* 101). The frequencies of the response of this question is given in Table 4.10 below (Figure 4.3).

Table 4.10. *Question7: Are you taking a health and safety training/course at METU during this semester?*

Responds	N	Percentage
Yes	124	26.8
No	338	73.2
Total	**462**	**100**

The second question asked related to OHS course was: "***Question8: Have you ever received a health and safety training/course at METU?*** This was a question with two possible answers with yes and no. For the participant who said yes to this question also asked to give the name of the course with the phrase "*If yes, please give the name of the course: (such as Department Course, Elective Course or OHS 101)*. The frequencies of the response of this question is given in Table 4.11 below (Figure 4.3).

Table 4.11. *Question8: Have you ever received a health and safety training/course at METU?*

Responds	N	Percentage
Yes	78	16.9
No	384	83.1
Total	**462**	**100**

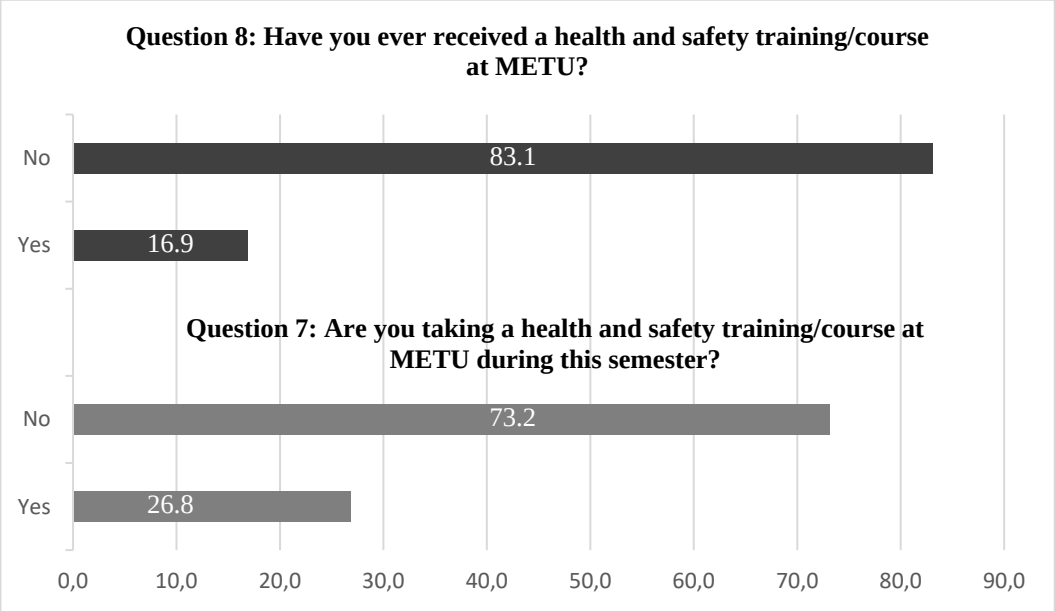

Figure 4.3. Health and safety training

Detailed analysis can be done to distinguish the participants who were currently taking the OHS course and who received and completed the full OHS course in previous semesters by using the academic year and studying period in METU variables and also with the answer that they were stated the name of course they are receiving or already received.

4.3.4. Demographic Questions Related to Emergency Preparedness and Response

Emergency response is the one of the very first area that needs to be improved if any weakness present in any organization. Because of that, in order to identify the current conditions related to emergency situations, two related questions were asked. The two important area related to emergency were identified by the experts and researchers as practicing safety drill and knowing the basic first aid. These two have a significance importance related to emergency response. The practices carried out in order to be

ready for the emergency situations are very crucial for the students. If students experienced emergency situations with emergency drills and know how to react in an event with possible injury by knowing the basic concepts of the first aid, it is possible to say they can deal with the emergency situations with more self-confidence. These areas also identified as the areas need an urgent improvement and also it is very easy to improve the awareness in these areas in a very limited time.

The first question asked related to emergency was: "***Question 9: Have you received any first aid training within METU and/or did you take any health and safety training that included first aid*?".** This was a question with three possible answers as (i) first aid training received, (ii) first aid training not received, and (iii) this was one of the subjects of the health and safety training I received. The frequencies of the responses of this question is given in Table 4.12 below.

Table 4.12. *Question 9: Have you received any first aid training within METU and/or did you take any health and safety training that included first aid?*

Responds	**N**	**Percentage**
First aid training received	28	6.1
First aid training not received	401	87.0
This was one of the subjects of the health and safety training I received	32	6.9
Total	**461**	**100**

As seen in the Table 4.12, majority of the students have not received any first aid training within METU. The percentage of the students who have not received the first aid training is 87%. This shows that majority of the students did not know how to react in case of any event that needed basic knowledge about the first aid (Figure 4.4).

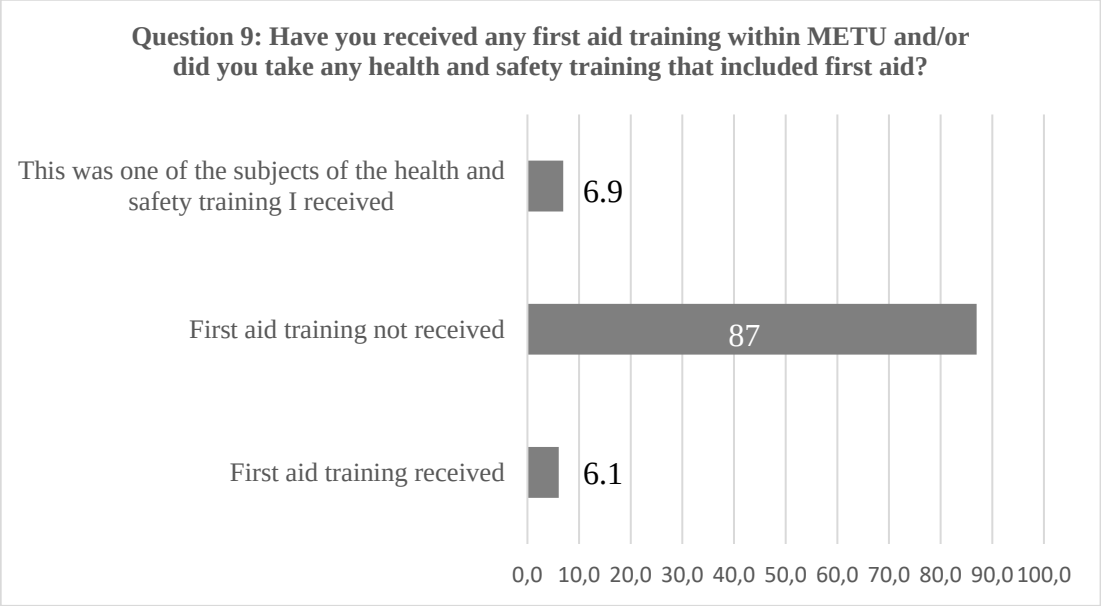

Figure 4.4. First aid training

The second question asked related to emergency was: ***"Question 10. Did you attend any emergency drills in METU?"*** This was a question with two possible answers as (i) Yes I did, (ii) No I did not. The frequencies of the responses of this question is given in Table 4.13 below.

Table 4.13. *Question 10: Did you attend any emergency drills in METU?*

Responds	N	Percentage
Yes I did	11	2.4
No I did not	450	97.6
Total	**461**	**100**

As seen in the Table 4.13, majority of the students did not attend any safety drill in METU. The percentage of the students who were not attended any safety drill in METU is 97.6%. To conduct safety drills is an important element of the emergency response activities in order to know how to react in case of emergency, where the

emergency exists and where is emergency assembly areas. This shows that majority of the students did not practice how to react in an emergency case (Figure 4.5).

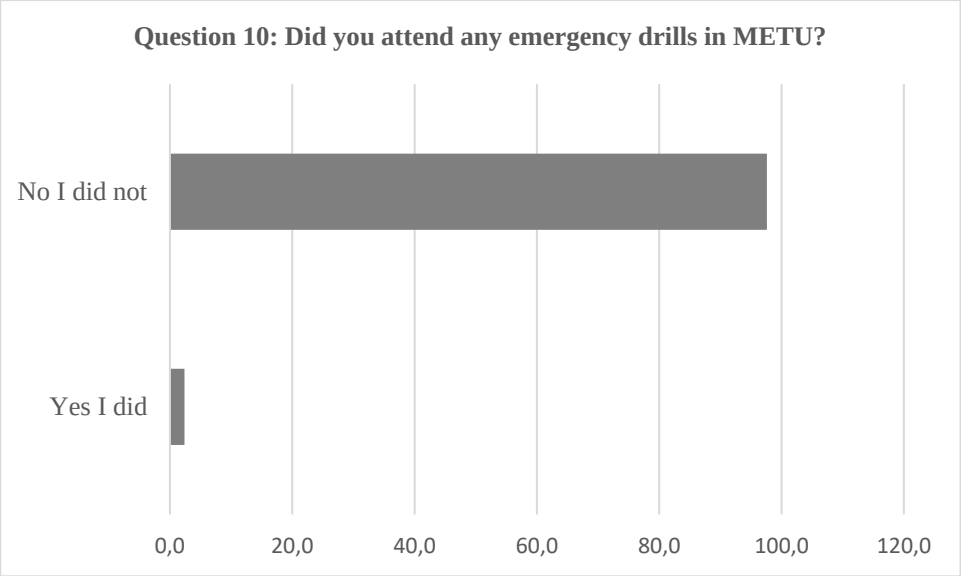

Figure 4.5. Did you attend any emergency drills in METU?

4.3.5. Effects of Demographics Variables

After the determination of the factor structure and items in the safety culture scale; parametric analysis techniques were used in order to compare the safety culture scores of the students who participated in the study based on age, gender, department and faculty, and academic year variables. The difference between these groups based on the demographic variables were analysis and discussed.

Parametric tests are needed to be conducted based on several criteria. These criteria were checked before the analysis was performed. First, it was investigated whether there are out of range values in the data set that makes the normal distribution difficult. In order to determine the out of range values in the data set, the box plots were created,

and three out of range values were determined. The observations were removed based on these calculated values before the following analyses. Total of 459 responses from the participants were used for the following analysis.

After this stage, it was investigated whether the scores obtained from the main part of the safety culture scale and the laboratory part of the safety culture scale have normal distributions. In order to meet the criterion of normal distribution, the skewness and kurtosis coefficients are required to be within ± 1 range (George and Mallery, 2010). It was determined that the skewness and kurtosis values of the distributions were found to be close to normal (Table 4.14). According to this result, it is understood that it is appropriate to use parametric tests in data analysis.

Table 4.14. *Skewness and kurtosis values*

Variables	**Skewness**		**Kurtosis**	
	Statistic	**Std. Error**	**Statistic**	**Std. Error**
Management Approach	-.37	.11	.48	.23
Flow of Information/Communication	.40	.11	-.05	.23
Safety Awareness/Behavior	-.28	.11	.65	.23
Background Safety Knowledge	.01	.11	-.15	.23
Main part of the scale	.13	.11	.58	.23
Laboratory part of the scale	-.23	.13	.82	.26

In this study, independent samples t-test was used for comparison according to two variables and one-way analysis of variance (ANOVA) was used to compare more than two variables. Levene's F test was used to determine whether the variances were homogeneous and for the one-way analysis of variance, the Welch's test was used when the variances were not homogeneous. Gathered data were analyzed using SPSS 25.0. The statistical results were interpreted with a 95% level of confidence.

By using Pearson Correlation Analysis technique, the relationships between the scores of the factors in the main part of the safety culture scale were examined. Pearson Correlation Analysis requires the assumption of normal distribution to be met. When this assumption is met, the strength and direction of the linear relations between variables can be calculated with the help of the Pearson Correlation Analysis technique. The Pearson correlation coefficients obtained can be interpreted as follows; 0 to ± .29 weak relationship, .30 to ± .69 moderate relationship, and .70 to ± 1.0 if the high-level relationship (Çokluk *et al.*, 2012). The Pearson correlation coefficients obtained as a result of analysis are presented in Table 4.15 below.

Table 4.15. *Pearson correlation coefficients*

Variables	**1.**	**2.**	**3.**	**4.**	**5.**
Management approach					
Flow of information/communication	.52**	1			
Safety awareness/behavior	.18**	.03	1		
Background safety knowledge	.32**	.39**	.14**	1	
Total	**.85****	**.68****	**.48****	**.61****	**1**

**p<.01; N=459

When the Table 4.15 is examined, the relation between variables identified as: a weak, positive, and statistically significant relationship between management approach and safety awareness/behavior (r=.18; p <.01); a moderate, positive, and statistically significant relationship between management approach and flow of information/communication (r=.52; p <.01); a moderate, positive, and statistically significant relationship between management approach and background safety knowledge (r=.32; p <.01); a high, positive, and statistically significant relationship between management approach and total score of the main part of the safety culture scale (r=.85; p <.01); a moderate, positive, and statistically significant relationship between flow of information/communication and background safety knowledge

(r=.39; p <.01); a moderate, positive, and statistically significant relationship between flow of information/communication and total score of the main part of the safety culture scale (r=.68; p p <.01); a weak, positive, and statistically not significant relationship between flow of information/communication and safety awareness/behavior (r=.03; p <.01); a weak, positive, and statistically significant relationship between safety awareness/behavior and background safety knowledge (r=.14; p <.01); a moderate, positive, and statistically significant relationship between safety awareness/behavior and total score (r=.48; p <.01); a moderate, positive, and statistically significant relationship between background safety knowledge and total score of the main part of the safety culture scale (r=.61; p <.01).

As the management approach score increases, there is an increase in the flow of information/communication, safety awareness/behavior, background safety knowledge and total scores were observed. As the flow of information/communication score increases, there is an increase in safety awareness/behavior, background safety knowledge, and total scores were observed. As the safety awareness/behavior score increases, there is an increase in background safety knowledge and total scores were observed. As the background safety knowledge score increases, there is an increase in total scores were observed.

4.3.6. Effects of Demographics Variables – OHS Course

To identify the difference between the participants who received OHS course and who did not, the question 7 and question 8 examined together. The distinction is designed to those who say “no” to both questions and those who say “yes” to any of these two questions. The comparison of the safety culture scores of the participants by OHS course is presented in Table 4.16.

When the Table 4.16 is examined, it is understood that the average scores of the background safety knowledge do not show a statistically significant difference according to groups ($p > .05$). However, the average of the scores of the management approach, flow of information/communication, safety awareness/behavior factors and total mean score of the main part of the safety culture scale differed statistically between the groups ($p < .05$).

The average scores of the management approach, flow of information/communication, safety awareness/behavior factors and total mean score of the main part of the safety culture scale of the participants who either received OHS course in previous semesters or receiving OHS course in the semester when questionnaire was applied were found to be significantly higher.

Table 4.16. *The comparison of the safety culture scores of the participants by OHS course*

Variable	**OHS Course Received**	**N**	**Mean**	**Sd**	**t**	**p**
Management approach	Yes	139	3.25	.52	2.89	<.01
	No	320	3.10	.53		
Flow of information/communication	Yes	139	2.56	.89	3.43	<.01
	No	320	2.27	.81		
Safety awareness/behavior	Yes	139	3.96	.47	3.03	<.01
	No	320	3.83	.43		
Background safety knowledge	Yes	139	2.98	.74	1.87	.06
	No	320	2.83	.77		
Total score	**Yes**	**139**	**3.34**	**.43**	**3.97**	**<.01**
	No	**320**	**3.18**	**.40**		

4.3.7. Effects of Demographics Variables - The age

The majority (72.5%) of the participants were aged between 17–23 years, followed by the 24-30 years age group (26.2%). As can be seen in the Table 4.1 in section 4.2.1, there were only three participants were aged between 31-37 and it is the same for the age group 38-44. Because the number of the participants in these age groups were very low, the calculation was made with not taken these two groups into consideration. The comparison of the safety culture scores of the participants by age groups is presented in Table 4.17.

Table 4.17. *The comparison of the safety culture scores of the participants by age groups*

Variables	**Age**	**N**	**Mean**	**Sd**	**t**	**p**
Management approach	17-23	334	3.16	.51	1.43	.15
	24-30	119	3.08	.60		
Flow of information/communication	17-23	334	2.39	.86	1.53	.13
	24-30	119	2.25	.79		
Safety awareness/behavior	17-23	334	3.85	.44	-1.31	.19
	24-30	119	3.91	.45		
Background safety knowledge	17-23	334	2.83	.75	-1.98	.049
	24-30	119	2.99	.80		
Total score	**17-23**	**334**	**3.23**	**.40**	**.12**	**.91**
	24-30	**119**	**3.22**	**.44**		

When the Table 4.17 is examined, it is understood that the average scores of the management approach factor, flow of information/communication factor, safety awareness/behavior factor and total mean score do not show a statistically significant difference according to age groups ($p > .05$). The average of the scores of the participants in different age groups for these three factors and total mean score are very close to each other. However, the average of the score of the background safety knowledge differed statistically between the age groups ($p < .05$). The average score

of the background safety knowledge of the participants who were in the 24-30 age group was found to be significantly higher than the participants who were in the 17-23 age group.

4.3.8. Effects of Demographics Variables - The gender

The percentages of male and female participants were 64.9% and 34.8%, respectively. One of the respondents did not disclose her/his gender. The comparison of the safety culture scores of the participants by gender is presented in Table 4.18. When the Table 4.18 is examined, it is understood that the average scores of the management approach, flow of information/communication, and safety awareness/behavior factors do not show a statistically significant difference according to gender ($p > .05$). On the other hand, the average score of the background safety knowledge factor and total mean score differed statistically by gender ($p < .05$). The average score of the background safety knowledge and total mean score of male students were found to be significantly higher.

Table 4.18. *The comparison of the safety culture scores of the participants by gender*

Variables	**Gender**	**N**	**Mean**	**Sd**	**t**	**p**
Management approach	Female	161	3.08	.57	-1.84	.07
	Male	297	3.18	.51		
Flow of information/communication	Female	161	2.26	.84	-1.79	.08
	Male	297	2.41	.84		
Safety awareness/behavior	Female	161	3.92	.39	1.74	.08
	Male	297	3.84	.47		
Background safety knowledge	Female	161	2.63	.69	-5.34	<.01
	Male	297	3.01	.76		
Total	**Female**	**161**	**3.17**	**.42**	**-2.29**	**.02**
	Male	**297**	**3.26**	**.41**		

4.3.9. Effects of Demographics Variables - The Faculty and the Department

The majority of the participants were from Faculty of Engineering (79.2%), followed by Faculty of Education (10.8%), Faculty of Arts and Sciences (6.5%), Faculty of Economic (2.4%) and Administrative Sciences and Faculty of Architecture (1.1%). The comparison of the safety culture scores of the participants studying in faculty of engineering and other faculties is presented in Table 4.19.

Table 4.19. *The comparison of the safety culture scores of the participants studying in faculty of engineering and other faculties*

Variable	Faculty	N	Mean	Sd	t	p
Management approach	Faculty of Engineering	363	3.21	.50	4.85	<.01
	Other faculties	96	2.91	.61		
Flow of information/communication	Faculty of Engineering	363	2.44	.84	4.65	<.01
	Other faculties	96	2.02	.79		
Safety awareness/behavior	Faculty of Engineering	363	3.85	.46	-1.14	.26
	Other faculties	96	3.91	.37		
Background safety knowledge	Faculty of Engineering	363	2.97	.73	5.17	<.01
	Other faculties	96	2.53	.78		
Total score	**Faculty of Engineering**	**363**	**3.27**	**.39**	**4.92**	**<.01**
	Other faculties	**96**	**3.05**	**.45**		

When the Table 4.19 is examined, it is understood that the average score of the safety awareness/behavior factor do not show a statistically significant difference compared to the faculty of engineering and other faculties (p >.05). On the other hand, the average scores of the management approach, flow of information/communication, and background safety knowledge factors and total mean score show a statistically significant difference between the faculty of engineering and other faculties (p <.05). The average scores of the management approach, flow of information/communication, and background safety knowledge factors and total mean score of the students studying in the faculty of engineering were found to be significantly higher.

The comparison of the safety culture scores of the participants by enrolled faculties is presented in Table 4.20.

Table 4.20. *The comparison of the safety culture scores of the participants by enrolled faculties*

	Faculty	N	Mean	Sd	F	p	Comparison
Management approach							
1	Faculty of Architecture	5	2.73	.24	7.72	<.01	2>1, 2>3, 2>4
2	Faculty of Engineering	363	3.21	.50			
3	Faculty of Education	50	2.90	.53			
4	Faculty of Economic and Administrative Sciences	11	2.94	.58			
5	Faculty of Arts and Sciences	30	2.97	.78			
Flow of information /communication							
1	Faculty of Architecture	5	1.80	.65	5.25	<.01	2>1, 2>4
2	Faculty of Engineering	363	2.44	.84			
3	Faculty of Education	50	2.04	.76			
4	Faculty of Economic and Administrative Sciences	11	1.86	.56			
5	Faculty of Arts and Sciences	30	2.08	.93			

Table 4.20. *The comparison of the safety culture scores of the participants by enrolled faculties. (Cont'ed.)*

	Faculty	N	Mean	Sd	F	p	Comparison
Safety awareness /behavior							
1	Faculty of Architecture	5	3.94	.17	.59	.67	-
2	Faculty of Engineering	363	3.85	.46			
3	Faculty of Education	50	3.90	.34			
4	Faculty of Economic and Administrative Sciences	11	4.04	.34			
5	Faculty of Arts and Sciences	30	3.88	.46			
Background safety knowledge							
1	Faculty of Architecture	5	2.44	.54	7.25	<.01	2>1, 2>4
2	Faculty of Engineering	363	2.97	.73			
3	Faculty of Education	50	2.48	.74			
4	Faculty of Economic and Administrative Sciences	11	2.33	.58			
5	Faculty of Arts and Sciences	30	2.68	.94			
Total score							
1	Faculty of Architecture	5	2.94	.20	6.27	<.01	2>1, 2>3, 2>4
2	Faculty of Engineering	363	3.27	.39			
3	Faculty of Education	50	3.03	.40			
4	Faculty of Economic and Administrative Sciences	11	3.03	.35			
5	Faculty of Arts and Sciences	30	3.10	.58			

When Table 4.20 is examined, it is understood that the average score of the of safety awareness/behavior factor do not show a statistically significant difference compared to the faculties ($p > .05$). On the other hand, the average scores of the management approach, flow of information/communication, and background safety knowledge factors and total mean score show a statistically significant difference compared to faculties ($p < .05$). In general, the average scores of the management approach, flow of information/communication, and background safety knowledge factors and total mean score of students studying in the faculty of engineering were found to be significantly higher than the students of the other faculties and the average scores of the of students studying in the faculty of architecture were lower than the students of the other faculties.

4.3.10. Effects of Demographics Variables - The Academic Year

In terms of academic year, 13.4% of the students were freshmen, 27.1% were sophomores, 24.5% were juniors, and 27.5% were seniors. 6.1% of the participants are studying at graduate level and only 1.5% of the participants are student at the English Language Preparatory School. As can be seen in the Table 4.1 in section 4.2.1, there were only 7 participants are student at the English Language Preparatory School.

Because the number of the participants is were very low, the calculation was made with not taken the students from English Language Preparatory School into consideration. Additionally, because of the low number of participants student from master programs and doctoral programs combined for the analysis. The comparison of the safety culture scores of the participants based on the academic year is presented in Table 4.21.

When the Table 4.21 is examined, it is seen that the average scores of the safety awareness/behavior and background safety knowledge factors and total mean score do not show a statistically significant difference according to the academic year ($p > .05$). On the other hand, the average scores of the management approach and flow of information/communication factors show a statistically significant difference based on academic year ($p < .05$).

The average scores of the management approach of the freshmen were found to be significantly higher than those of the junior and senior students. Additionally, the average scores of the flow of information/communication factor of the freshmen were found to be significantly higher than those of the senior and graduated students.

Table 4.21. *The comparison of the safety culture scores of the participants based on the academic year*

Variable		Academic year	N	Mean	Sd	F	p	Comparison
Management approach	1	Freshmen	62	3.41	.44	5.14	<.01	1>3, 1>4;
	2	Sophomore	125	3.14	.49			
	3	Junior	110	3.06	.55			
	4	Senior	127	3.08	.56			
	5	Graduate Programs	28	3.14	.62			
Flow of information /communication	1	Freshmen	62	2.71	.93	3.65	<.01	1>4, 1>5;
	2	Sophomore	125	2.37	.79			
	3	Junior	110	2.33	.84			
	4	Senior	127	2.23	.82			
	5	Graduate Programs	28	2.24	.81			
Safety awareness /behavior	1	Freshmen	62	3.75	.53	1.87	.11	-
	2	Sophomore	125	3.88	.39			
	3	Junior	110	3.85	.40			
	4	Senior	127	3.89	.47			
	5	Graduate Programs	28	4.00	.43			
Background safety knowledge	1.	Freshmen	62	2.82	.67	1.96	.10	-
	2.	Sophomore	125	2.88	.76			
	3.	Junior	110	2.74	.82			
	4.	Senior	127	3.00	.75			
	5.	Graduate Programs	28	3.01	.73			
Total Score	1.	Freshmen	62	3.34	.43	1.91	.11	-
	2.	Sophomore	125	3.23	.36			
	3.	Junior	110	3.17	.44			
	4.	Senior	127	3.21	.43			
	5.	Graduate Programs	28	3.28	.45			

4.3.11. The Laboratory Part of the Safety Culture Scale

Coefficients relating to relationships between the main part of the safety culture scale and laboratory part of the safety culture scale is presented in Table 4.22.

Table 4.22. *Coefficients relating to relationships between the main part of the safety culture scale and laboratory part of the safety culture scale*

Variable	Score of the laboratory part of the safety culture scale
Management approach	.37**
Flow of information/ communication	.24**
Safety awareness /behavior	.39**
Background safety knowledge	.33**
Total score	**.49****

**p<.01; N=358

When the Table 4.22 is examined, the relation between variables identified as: a weak, positive, and statistically significant relationship between flow of information/communication factor and laboratory part of the safety culture scale (r=.24; p <.01); a moderate, positive, and statistically significant relationship between management approach factor and laboratory part of the safety culture scale (r=.37; p <.01); a moderate, positive, and statistically significant relationship between safety awareness/behavior factor and laboratory part of the safety culture scale (r=.39; p <.01); a moderate, positive, and statistically significant relationship between background safety knowledge factor and laboratory part of the safety culture scale (r=.33; p <.01); and a moderate, positive, and statistically significant relationship between total score of the main part of the scale and laboratory part of the safety culture scale (r=.49; p <.01).

Table 4.23. *The comparison of the safety culture scores of the participants based on the laboratory usage*

Variable	Laboratory usage	N	Mean	Sd	t	p
Management approach	Not using laboratory	101	2.95	.59	-4.18	<.01
	Using laboratory	358	3.20	.51		
Flow of information/ communication	Not using laboratory	101	2.00	.84	-4.84	<.01
	Using laboratory	358	2.45	.82		
Safety Awareness/ behavior	Not using laboratory	101	3.87	.41	.14	.89
	Using laboratory	358	3.87	.45		
Background safety knowledge	Not using laboratory	101	2.54	.76	-5.10	<.01
	Using laboratory	358	2.97	.74		
Total score	**Not using laboratory**	**101**	**3.06**	**.42**	**-4.82**	**<.01**
	Using laboratory	**358**	**3.28**	**.40**		

As the average scores of laboratory part of the safety culture scale increase, there is an increase in the management approach, flow of information/communication, safety awareness/behavior, background safety knowledge factors and also total scores of the main part of the scale was observed. The 78% percentage of the participants stated that they are using the laboratories in METU for their courses whereas the 22% percentage stated that they are not using laboratories in METU. The comparison of the safety culture scores of the participants based on the laboratory usage is presented in Table 4.23.

When the Table 4.23 is examined, it is understood that the average scores of the safety awareness/behavior factor do not show a statistically significant difference according to participants who are using the laboratory in the university and who are not ($p > .05$). On the other hand, the difference between the average scores of the management approach, flow of information/communication, and background safety knowledge factors and total mean score is statistically significant ($p < .05$). The average scores of management approach, flow of information/communication, and background safety knowledge factors and total mean score of the students who are using the laboratory in the university were found to be significantly higher.

4.3.12. Total Safety Culture Scores

The mean safety culture scores of the factors in the main part of the study and total mean score gathered from the main part of the scale by the all participant is presented in Table 4.24.

Table 4.24. *Average scores gathered from the main part of the scale*

Variable	N	Minimum	Maximum	Mean	Sd
Management approach	459	1.29	4.71	3.14	.54
Flow of information/ communication	459	1.00	5.00	2.36	.84
Safety Awareness/ behavior	459	2.50	5.00	3.87	.44
Background safety knowledge	459	1.00	5.00	2.87	.77
Total	**459**	**1.91**	**4.91**	**3.23**	**.41**

The average score of each factor was analyzed in order to identify the weak and strong areas of the students related to safety in METU. The average score for each factor ranged from 2.36 to 3.87. Table 4.24 shows the ranking of the average score of each

factor. The minimum and maximum values indicate that the lowest average score and highest average score gathered from the participants.

The total mean score of the laboratory part of the scale and total core of the participant from whole scale (included both main and laboratory part) is also presented in Table 4.25.

The average score of safety culture from the main part of the scale calculated as 3.23. The significant difference between the factors is observed. The lowest total average score gathered from the flow of information factor which is 2.36. This is followed by the background safety knowledge as 2.87. The total average scores for the management approach and safety awareness/behavior stayed between the 3 and 4 and they are 3.14 and 3.87, respectively. The highest score gathered from the safety awareness/ behavior factor.

As seen in the Table 4.25, the average score of the laboratory part of the scale is 3.60 and it is lower than the average score of the safety awareness factor and higher than the average scores of the other three factors. The average total score of safety culture from the laboratory part of the scale calculated as 3.40. This is higher than the average score calculated for the main part of the scale which is 3.23.

Table 4.25. *Total mean scores*

Variable	**N**	**Minimum**	**Maximum**	**Mean**	**Sd**
Laboratory part of the scale	358	1.14	5.00	3.60	.58
Total	358	2.04	4.80	3.40	.41

CHAPTER 5

DISCUSSIONS AND INTERPRETATIONS

5.1. Summary of Research Study

As mentioned before, although, many studies conducted for the assessment of the safety culture, it is hard to find a study that focused on university students. In the literature, majority of the safety culture assessment studies aimed to identify the safety culture among the workers and safety culture level of the specific enterprises. In this current study, it is aimed to assess safety culture among the university students and reveal the safety culture level of the METU. The current study provided a significant contribution to the literature by assessing the safety culture among the university students.

As a scope of this study, safety culture among university students were investigated. The study was divided into two parts as initial study: Development of the Safety Culture Scale and the Main Study: Assessment of the Safety Culture among University Students. The initial study started with the developing the preliminary safety culture questionnaire related to specifying the initial items of the questionnaire. Extensive literature survey conducted in order to develop very first draft of the questionnaire. As a result of this extensive literature survey, the first draft of the questionnaire included 87 items; 66 of them are represented in the main part of the questionnaire and 21 of them are referred to the laboratory part of the questionnaire. Safety culture scale was designed as a five-point Likert scale. The items were rated 1 to 5, where 1 represents strongly disagree, 2 represents disagree, 3 represents neither agree nor disagree, 4 represents agree, and 5 represents strongly agree.

Once the items of the questionnaire had been decided, a focus group meeting was conducted with 23 students from Mining Engineering Department. Based on the feedback collected in the focus group meeting and results of the examination of the inter-item correlations, the item number was decreased to 80; 59 of them are represented in main part of the questionnaire and 21 of them are referred to the laboratory part.

As a final stage of the initial study; a pilot study and experts consultation sessions were conducted simultaneously after the focus group meeting. Total of 85 students at from Mining Engineering and Petroleum and Natural Gas Engineering Departments were participated the pilot study. The proposed dimension decided with the experts during expert consultation sessions. The four-dimension structure was decided for the main part of the study and the laboratory part of the study was treated as a one dimension. After the pilot study and expert consultancy session, the number of items was decreased to 70; 49 of them are presented main part of the questionnaire with four dimensions and 21 of them are used in laboratory part of the questionnaire with one dimension.

After the initial study, the methodology to be used for the main study was decided as applying the questionnaire during class session by using hard copies in order to receive an effective response rate. The main study started with the application of the questionnaire and data collection. Total of 471 students from different departments and different academic years were participated the main study. Data gathered from 462 valid questionnaires were entered the SPPS for statistical analysis.

Exploratory factor analysis was conducted for the main part and the laboratory part of the scale separately. After EFA, total of 33 items were remained in main part of the safety culture scale and total of 16 items were remained in the laboratory part of the safety culture scale. The four-factor structure for the main part of the safety culture

scale and one-factor structure for the laboratory part of the safety culture scale were decided.

After the determination of the factor structure and items in the safety culture scale, assessment of the data gathered from the questionnaire was done with comparing the safety culture scores of the students based on the demographic variables as a final stage of the main study.

5.2. Discussion and Interpretation of Results

Although, there was misinterpretation occurred among the participants related to OHS course questions, overall results showed that the average score of the main part of the questionnaire of the participants who either received OHS course in previous semesters or receiving OHS course in the semester when questionnaire was applied were found to be significantly higher. These show that the OHS training is a tool that improves the safety culture among students.

The OHS education is a neglected area in Turkey. Only after starting to work, individuals begin to take education and able to obtain conceptual knowledge about occupational health and safety. At no stage of their education, individuals are provided with sufficient information on health and safety. Even more surprisingly, the OHS education is neglected by the higher education institutions. For this reason, individuals start working without any awareness of occupational health and safety.

Unfortunately, individuals are expected to become competent on occupational health and safety within a very short time, and to immediately contribute to establishing safety culture in the country. These expectations, to say the least, are futile. Be that as

it may, most studies in the field of safety culture have focused only on business life and the little known about the OHS education in higher institutions.

In recent years, OHS undergraduate and graduate programs have gained attention in Turkey. Many technical universities have OHS programs and modules now in order to prepare students to be OHS professionals. Although there was no compulsory course provided for university students when this study planned, OHS courses had recently become compulsory in the faculties where students, after graduation, will have a right to become occupational safety specialists based on 6331 numbered Occupational Health and Safety Law in Turkey. The compulsory course started in the 2018 spring semester in METU.

Based on the result of the study, it is easy to realize that safety trainings need to be offered to the students in METU regardless of the enrolled faculty/department. There is an orientation process already conducted in METU at the first academic year of the students. The basic safety training can be a part of this orientation process and can provide basic safety information related to studying at METU.

The one of the first areas need to be improved found related to emergency response activities. The data gathered from the students showed that majority of the students were not received basic first aid training. This result also supported with the responds of the item 27 of the five-point Likert part of the questionnaire. The item 27 was asked as ***"I know basic first aid"*** and the frequency percentages of the answers are shown in the Figure 5.1. The outcome shows that majority of the students are not confident about their knowledge related to the first aid applications.

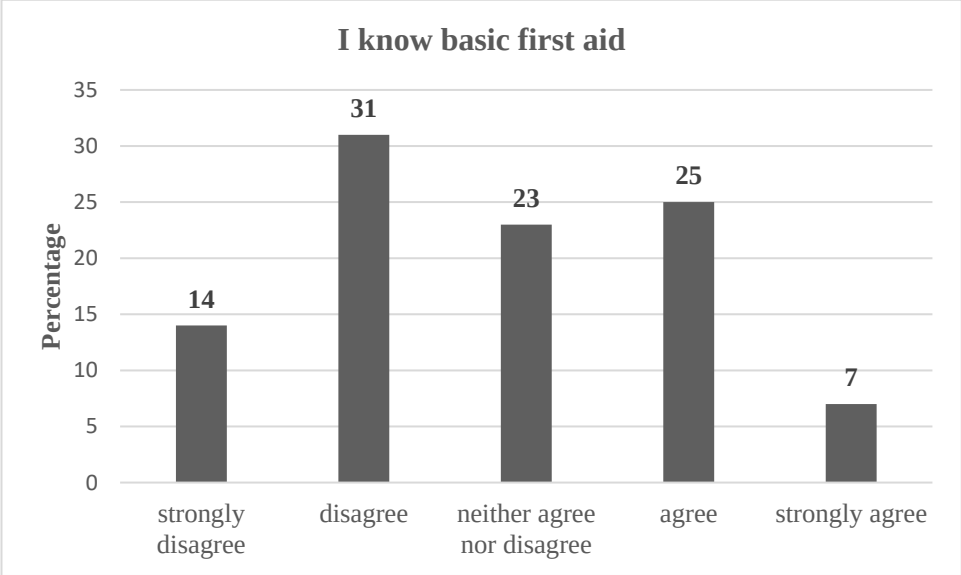

Figure 5.1. Item 27. I know basic first aid

Another item related to emergency situations was asked in order to identify whether student participated any emergency drill in METU. The majority of the students stated that they were not participated any emergency drill in METU. This result also supported with the responds of the items 20, 22 and 23 of the five-point Likert part of the questionnaire. The Likert type items 20, 22 and 23 was asked as ***"I know enough about what to do in an emergency situation", "I know the location of the "emergency exits" of the faculty buildings that I frequently visit" and "I know the locations of the "emergency assembly areas" of the faculty buildings that I* frequently visit",** respectively. The frequency percentages of the answers are shown in the Figure 5.2. The outcome shows that majority of the students are not confident about their knowledge related to emergency response issues; they did not know the location of the "emergency exits" at the faculty buildings. And they did not know the location of the locations of the "emergency assembly areas" at the campus.

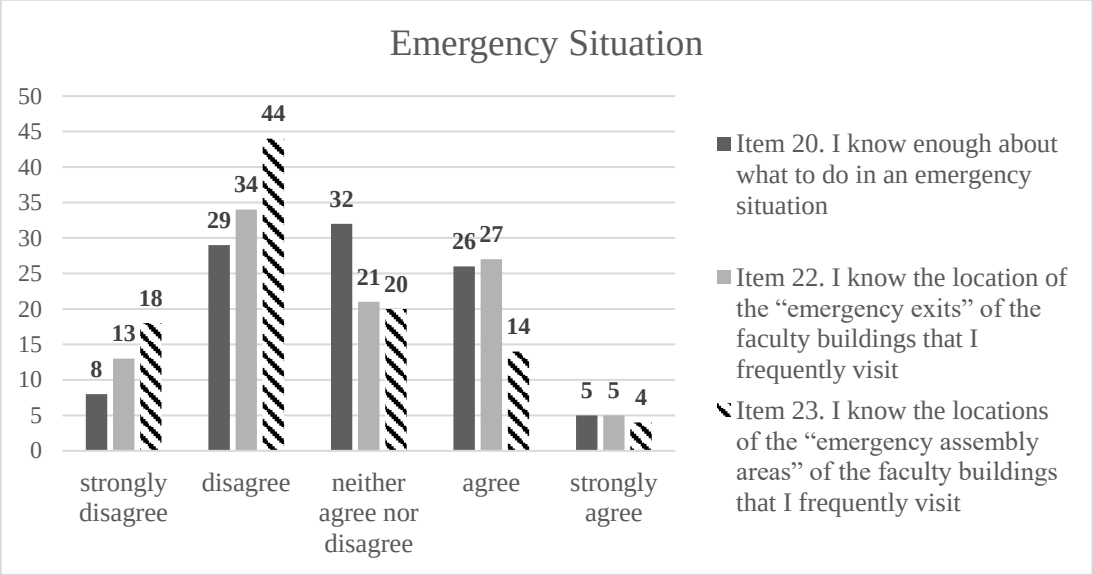

Figure 5.2. Item 20, 21 and 22

Based on the result of the study, it is easy to realize that emergency response element of the safety area needs to be improved urgently. This subject can also be inserted in the orientation process already conducted in METU at the first academic year of the students. The basic knowledge about the emergency issues such as, location of the emergency exits and emergency assembly areas, emergency telephone numbers, the name and the contact information of the emergency responsible of the university can be provided in the orientation process.

The result of the comparison of total score based on age shows that background safety knowledge factor is the only factor that showed difference between the age groups 24-30 and 17-23. The average score of the background safety knowledge of the students who were in the 24-30 age group was found to be significantly higher than the students who were in the 17-23 age group. However, this outcome cannot be proved with the result of the comparison of the total scores of the participant based on the academic year. The average scores of the safety awareness/behavior and background safety knowledge factors and total mean score do not show a statistically significant difference according to the academic year.

The comparison between the students enrolled faculty of engineering and other faculties was investigated. Except the safety awareness/behavior factor, the average scores of the other three factors, and total mean score showed a statistically significant difference between the students enrolled in faculty of engineering and in other faculties and factor scores as well of total scores of the students studying in the faculty of engineering were found to be significantly higher. This outcome also consistent with the total scores of the students who were either receiving or already received OHS course. The average score of the main part of the questionnaire of the students who either received OHS course in previous semesters or receiving OHS course in the semester when questionnaire was applied were found to be significantly higher. When cross relation between the OHS course questions and the enrolled faculty was analyzed, it was seen that %97 of the students who stated that they were receiving OHS course in the semester when questionnaire was applied are enrolled in the faculty of engineering and 94% of the students who stated that they received OHS course in previous semesters are enrolled in the faculty of engineering.

The result of the comparison of factor scores on a gender shows that background safety knowledge is the only factor that showed difference between female and male students. The average scores of the background safety knowledge of male students were found to be significantly higher than female students. This result can be interpreted with the faculty variable. When cross relation between the gender and the enrolled faculty was analyzed, it was seen that %55 of the female students are enrolled in the faculty of engineering whereas 92% of the male students are enrolled in the faculty of engineering. So, this difference can cause the difference in background safety knowledge among female and male student

In terms of academic year there is no difference found related to safety awareness/behavior and background safety knowledge factors and total mean score. However, the average scores of the management approach factor of the freshmen were

found to be significantly higher than those of the junior and senior grade students. Additionally, the average scores of the flow of information/communication factor of the freshmen were found to be significantly higher than those of the senior and graduated students. This outcome shows that, the factors scores of management approach and flow of information/communication is decreased with the increase of the academic year of the students. The freshmen have more positive sense towards management of METU and this is decreasing with the time they are spending in the METU.

The outcome of the comparison of the laboratory part of the scale with the factors in the main part of the scale shows that there is a positive relation between the average scores of the laboratory part of the scale and factors and total scores of the main part of the scale. Except the safety awareness/behavior factor, the average scores of the other three factors and total score of the students who were using the laboratory in the university were found to be significantly higher.

This outcome can be proved if there is an evidence shows that the special health and safety training provided to the student who are using the laboratories in the university. On the contrary, the responds of the item 6 of the laboratory part of the scale show that there is no specific training provided to the students who are using the laboratories. The item 6 was asked as ***"I have received a specific health and safety training related to working conditions in the laboratory"*** and the percentages of the answers are; 17% strongly disagree, 42% disagree, 19% neither agree nor disagree, 17% agree, 5% strongly agree. The outcome shows that majority of the students did not receive any specific health and safety training related to working conditions in the laboratory.

The laboratory environments in the universities are the most risky environments. Peplow and Marris (2006) comments that academic laboratories are apparently more

dangerous than industry, as these laboratories have a loose safety approach. As cited in Peplow and Marris (2006), James Kaufman - president of the Laboratory Safety Institute in Natick Massachusetts - claimed that the accident rate in universities is 10 to 50 times higher than the chemical industry (Peplow and Marris, 2006). It is important for the students who use the laboratories to know that the hazards present at the laboratories, safety rules that they need to obey, personal protective equipment need to be used and the emergency response related subjects such as, safety information on hazardous substances and location of the safety data sheets of the chemicals.

As a final, total scores compared based on the factor and the parts of the scale. Safety awareness/behavior factor of the scale had the highest average score (3.87 out of 5). This is followed by management approach factor (3.14). The average score of the flow of information and background safety knowledge shows the lowest values and they both stayed below the three (2.36 and 2.87, respectively). The outcome of the average scores shows that the actions related to improvement the flow of information/communication and background safety knowledge areas need to be taken as a first step. As mentioned above offering OHS or basic health and safety courses to the students will have a positive effect on the overall safety culture among the students. For the results shows that there is a weakness about passing the safety related information such as rules, programs, systems to the student. Management should have a system to communicate the safety issues with the student and should ensure the student know what they need to do in terms of safety related issues.

The total average scores also proved that the overall safety culture is higher for the student who are using laboratory in METU. As mentioned before this can be explained as majority of the students using the laboratories is studying in the engineering departments.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.1. Conclusions

With the findings of this research, the overall understanding of the safety culture among the students in METU was assessed. Effects of demographic variables and the weaknesses and strengths of the safety culture in METU were also investigated with the results of this study. The obtained results and research findings showed that the overall objectives of the study were successfully accomplished.

According to the results the following main conclusions have been drawn from the study:

- Assessment of the safety culture among the students from different disciplines shows the **engineering students have higher scores in all dimensions in the safety culture scale**, except safety awareness/behavior, **as well as the high total score**. This result can give a significant information to the university administration to develop safety management strategies for the METU. The mentioned result can be considered as the strength of the safety culture in METU as there is a great possibility for the students graduated from faculty of engineer to work in a risk environment.

- The importance of the OHS training and courses were also proved by the results. The study shows that **safety culture level among the student who received any OHS course is higher.** As mentioned before, the compulsory courses offered for some departments in universities in recent years.

- On the other hand, the one of the critical weakness of the safety culture in METU is seen clearly as emergency preparedness and response. The results revealed the weaknesses in emergency preparedness and response activities by showing that **majority of the students were not participated any safety drill, not know the locations of the emergency exits and emergency assembly areas and also have no proper first aid training.**

- The other critical weakness of the safety culture in METU found related to laboratory safety. **The majority of the students who are using laboratories in METU stated that they did not receive any specific health and safety training before they started to work at the laboratories**.

- The average scores of the management approach and flow of information/communication factor showed that the freshmen have more positive sense towards management of METU and this is decreasing with the time they are spending in the METU.

- Total scores of the safety culture survey indicated that the weaknesses were observed in the flow of information/communication and background safety knowledge dimension. These areas can improve with offering OHS courses to all students and ensuring the good communications between the administration and the students.

- Based on the result of this current study, the idea of the many researchers as the field of safety is a neglected area in the academic institution is also proved. The areas need urgent attention was identified as a scope of this study.

6.2. Recommendations

According to the results, the changes that should be made as soon as possible are as follows:

- The management commitment should be improved. Administration representatives should become easily reachable and good communication between the all parties in the university should developed. The administration should involve the students, academic personnel and administrative staff in the decision-making process related to safety.

- Students from other than the faculty of engineering should be involved in safety management strategies and should be paid more attention.

- The great care should be given all student at METU and basic OHS and/or basic health and safety courses should be offered for all of them regardless of the enrolled faculty/department. There is an orientation process already conducted in METU at the first academic year of the students. The basic safety training can be a part of this orientation process and can provide basic safety information related to studying at METU.

- The urgent development of emergency preparedness and response strategies needed for METU including development and announcement of emergency response teams, conducting fire and evacuation drills, offering basic first aid course, offering workshops related to emergency issues.

- Basic emergency preparedness and response training should be given to the students and should be supported by emergency response practices such as safety drills. The basic emergency preparedness and response information should be given to all student during orientation process.

- Clear and easy reporting system should be in place and administration should be ensured all parties are aware of this reporting system. The reports should be communicated with all parties (METU e-mail system can be used for this) and the resulting actions should also be stated in these reports.

- A compressive laboratory safety program should be developed to improve laboratory safety by continuous training and monitoring programs. Special training should be offered to all individuals who will use the laboratories at METU. No one should start working at the laboratory prior to receive basic health and safety training related to laboratory conditions including the safety rules, emergency response actions and usage of personal protective equipment.

Although this study gives an overview of the safety culture in METU, the students are not only stakeholder of the university. To have a better understanding among safety culture in the universities, other stakeholders such as, administrative and academic staff should also be the participants of safety culture studies at the universities. For the future studies, this study can be modified with involvement of all parties at the university environment. This study can also be expanded and conducted in the other

universities in Turkey in order to understand the safety culture among the university students in Turkey.

In view of the results of this study and above-mentioned recommendations, the following strategy is proposed to enhance the current level of safety culture in the university:

- As the first step; the gap analysis study, focusing on health and safety management system requirements, should be conducted by the competent experts in order to identify the weaknesses of the safety organization/management of METU.

    - The gap analysis report should at least include: the explanation of the identified gaps and required studies to cover these gaps. The prioritization can be done (if desired) for the gaps as high priority, moderate priority, and low priority. Based on these classifications, it is possible to start taking actions to cover these gaps from high priority gaps.

- As the second; Action Plan should be prepared. The findings of the gap analysis need to be supported and followed by an action plan to describe the actions to be taken to close the identified gaps. So, after the gap analysis action plan should be prepared to cover the identified gaps.

    - The action plan should include at least: the identified gap; the details related to identified gap (reference document related to this gap such a law, regulation, standards); the description of the action to cover this gap; the proposed time frame for the completion of the action;

responsivity for the action; and indicator for the completion of the action.

- As the third the items in the action plan should be completed based on the priority and time frame stated in the action plan.

The example for action plan is presented in Appendix C based on the results of this current study and taken in to consideration of the urgent issues identified with this current study and researcher's experience in occupational health and safety field[a].

After covering the identified gaps, with monitoring programs, safety performance of the METU should continuously monitored. Health and safety monitoring programs should asses the effectiveness of the safety plans and procedures, applicability of control strategies and results of the safety inspections and it should at least include the monitoring of trainings (duration, participant, additional training needs), incident/accident/near miss records (reports, investigations, identified measure for reoccurrence), emergency exercises (including emergency drills, fire drills, emergency response equipment such as, fire extinguisher, emergency warning systems, emergency eye wash stations) and internal/external inspection records.

[aa] Note that this action plan only presented as an example, the detailed action plan should be prepared after the gap analysis studies.

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APPENDICES

A. Ethical Permission

UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
APPLIED ETHICS RESEARCH CENTER

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06 Haziran 2018

Konu: Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi: İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Doç. Dr. Nuray DEMİREL

Danışmanlığını yaptığınız yüksek lisans öğrencisi Gizem ALTINKAYA'nın **"Orta Doğu Teknik Üniversitesi'nde Öğrencilerin Güvenlik Kültürü Düzeyinin Değerlendirilmesi Üzerine Bir Araştırma"** başlıklı araştırması İnsan Araştırmaları Etik Kurulu tarafından uygun görülerek gerekli onay **2018-SOS-103** protokol numarası ile **08.06.2018 - 30.12.2018** tarihleri arasında geçerli olmak üzere verilmiştir.

Bilgilerinize saygılarımla sunarım.

Prof. Dr. Ş. Halil TURAN
Başkan V

Prof. Dr. Ayhan SOL
Üye

Prof. Dr. Ayhan Gürbüz DEMİR
Üye

Doç. Dr. Yaşar KONDAKÇI
Üye

Doç. Dr. Zana ÇITAK
Üye

Doç. Dr. Emre SELÇUK
Üye

Dr. Öğr. Üyesi Pınar KAYGAN
Üye

B. Safety Culture Scale

Dear Participant,

This research is being conducted in order to determine the students' perspective on safety culture and to determine the studies that can be done in the future in order to establish a safety culture by presenting the current studies in METU. The research will only be as meaningful as the attentiveness and sincerity of your answers. I would like to thank you for your interest and contributions in completing this questionnaire, which will be used only for scientific research purposes.

You can contact the following individuals to learn the results of the study or to learn more about this research.

Gizem Kurtulmuş, e-mail: gizemaltinkaya@gmail.com

Prof. Dr. Nuray Demirel, e-mail: ndemirel@metu.edu.tr

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1. Age:

□ 17-23 □ 24-30 □ 31-37 □ 38-44 □ 44 and over

2. Gender:

□ Female □ Male

3. Faculty:

□ Faculty of Architecture

□ Faculty of Engineering

□ Faculty of Education

□ Faculty of Economic and Administrative Sciences

□ Faculty of Arts and Sciences

4. Department: …….

5. Year:

□ Preparatory School

□ 1.Year □ 2.Year □ 3.Year □ 4.Year

□ Master Program □ Doctoral Program

6. For how many years have you been studying at METU? ……..

7. Are you taking a health and safety training/course at METU during this semester?

□ Yes □ No

If yes, please give the name of the course: (such as Department Course, Elective Course or OHS 101)……..

8. Have you ever received a health and safety training/course at METU?

□ Yes □ No

If yes, please give the name of the course: (such as Department Course, Elective Course or OHS 101)……..

9. Have you received any first aid training within METU and/or did you take any health and safety training that included first aid?

□ First Aid Training Received □ First Aid Training Not Received □ This was one of the subjects of the health and safety training I received

10. Did you attend any emergency drills in METU?

□ Yes I did □ No I did not

Please select the one that best suits you for the following expressions and mark the relevant box with "X".

QUESTIONS		**Strongly Disagree (1)**	**Disagree (2)**	**Neither Agree Nor Disagree (3)**	**Agree (4)**	**Strongly Agree (5)**
1	Health and safety is one of the top priority issues at METU.					
2	Management quickly solves health and safety problems at METU.					
3	When a health and safety problem arise in METU, management takes a decisive role.					
4	Health and safety issues are ignored at METU.					
5	METU has effective tools for communicating health and safety issues to management.					
6	Corrective measures are always taken when issues related to health and safety (laboratory work, service conditions, etc.) are conveyed to management at METU.					
7	In METU, health and safety related policies/plans/procedures are sufficient.					

QUESTIONS		Strongly Disagree (1)	Disagree (2)	Neither Agree Nor Disagree (3)	Agree (4)	Strongly Agree (5)
8	In METU, health and safety-related policies/plans/procedures are announced to all parties and are easily accessible when requested.					
9	In METU, management takes the necessary measures to ensure and improve the health and safety conditions.					
10	Management monitors and evaluates the measures taken to ensure and improve health and safety conditions at METU.					
11	In METU, management follows a participatory policy in the evaluation of health and safety issues and evaluates the opinions of the participants from all parties (academic personnel, administrative staff, students, etc.).					
12	The academic personnel (professors, associate professors, doctors, lecturers and research assistants) are interested in my safety in my studies (e.g. laboratory work).					

QUESTIONS		Strongly Disagree (1)	Disagree (2)	Neither Agree Nor Disagree (3)	Agree (4)	Strongly Agree (5)
13	In the context of any off-campus trip in the scope of my lectures, management (METU management and academic personnel) takes the necessary safety measures on my behalf.					
14	I have been informed about safe and unsafe behaviors regarding my circumstances.					
15	I have been informed about which of the events related to health and safety should be reported in METU.					
16	I have been informed about how to report on health and safety related events (unsafe conditions, near misses, accidents) within METU.					
17	When I felt a problem in terms of health and safety in METU, I was informed about who to talk to.					
18	I was informed about what could qualify as unsafe conditions in the campus that might affect me.					

QUESTIONS		Strongly Disagree (1)	Disagree (2)	Neither Agree Nor Disagree (3)	Agree (4)	Strongly Agree (5)
19	I think I have not been adequately informed about what measures are taking in health and safety issues at METU.					
20	I know enough about what to do in an emergency situation.					
21	I know what an “emergency assembly area” means.					
22	I know the location of the “emergency exits” of the faculty buildings that I frequently visit.					
23	I know the locations of the “emergency assembly areas” of the faculty buildings that I frequently visit.					
24	I know what the concept of “near misses” means.					
25	I know who I need to communicate the problems/doubts about health and safety issues in METU to.					

QUESTIONS		Strongly Disagree (1)	Disagree (2)	Neither Agree Nor Disagree (3)	Agree (4)	Strongly Agree (5)
26	I know how to report any unsafe conditions/near misses/accident I experienced at METU.					
27	I know basic first aid.					
28	I believe that I will have enough knowledge about basic health and safety concepts when I graduate from the university.					
29	I am satisfied with the health and safety information I received at METU.					
30	When I am on campus, I feel responsible for my own safety.					
31	I feel responsible for the safety of others, as well as my own safety.					
32	If I have friends around me who are acting in an unsafe manner, I warn them.					
33	If any instructor around me is acting in a manner I believe to be unsafe, I warn her/him.					
34	Students who work unsafe are often warned by other students.					

QUESTIONS		Strongly Disagree (1)	Disagree (2)	Neither Agree Nor Disagree (3)	Agree (4)	Strongly Agree (5)
35	I warn my friends about unsafe working conditions in my surroundings.					
36	I think near misses should be investigated.					
37	I think that investigating accidents will contribute to health and safety improvement.					
38	It is the responsibility of management to prevent accidents that may occur in METU.					
39	I feel responsible for preventing accidents at METU.					
40	I think that personal protective equipment should be used in all necessary conditions.					
41	I sometimes do not comply with the safety rules, when not following them will save me time.					
42	When I encounter any unsafe conditions, I report it to the required parties.					
43	I think that accidents at METU (work accidents) are caused by lack of training.					
44	I think that emergency drills should be carried out at METU regarding emergency situations.					

QUESTIONS		Strongly Disagree (1)	Disagree (2)	Neither Agree Nor Disagree (3)	Agree (4)	Strongly Agree (5)
45	I think the academic personnel have sufficient knowledge about health and safety.					
46	I think it will be well received when I make a recommendation to the management about health or safety.					
47	I believe that I can contribute to improving health and safety issues at METU.					
48	Being notified about the health and safety related issues in METU motivate me to contribute to the improvement of said conditions.					
49	At METU, students do not refrain from asking for help related to health and safety issues from management (academic personnel).					

If you are using a Laboratory for any course and/or study within METU, please answer the following questions.

QUESTIONS		Strongly Disagree (1)	Disagree (2)	Neither Agree Nor Disagree (3)	Agree (4)	Strongly Agree (5)
1	I was informed about who is responsible for health and safety during laboratory work.					
2	I was informed about the risks that I might encounter before the laboratory work.					
3	I was informed about the personal protective equipment that I must use during laboratory work.					
4	I was informed about which equipment/materials I am authorized to use while working in the laboratory.					
5	I was informed about where to find safety information on hazardous substances used in the laboratory (e.g. information on chemicals, safety data sheets).					
6	I have received a specific health and safety training related to working conditions in the laboratory.					

QUESTIONS		Strongly Disagree (1)	Disagree (2)	Neither Agree Nor Disagree (3)	Agree (4)	Strongly Agree (5)
7	I know the safety rules (eating/drinking, cell phone use, etc.) that I must follow when working in the laboratory.					
8	I know who is responsible for health and safety issues while working in the laboratory.					
9	I know the risks I might face while working in the laboratory.					
10	I know the personal protective equipment that I need to use while working in the laboratory.					
11	I know what tools/materials I am authorized to use when working in the laboratory.					
12	I know where to find the safety information about the hazardous substances used in the laboratory (e.g. information on chemicals, safety data sheets.)					
13	I know the location of emergency equipment in the laboratory (first aid cabinet, eye shower, fire extinguisher, etc.).					

QUESTIONS		Strongly Disagree (1)	Disagree (2)	Neither Agree Nor Disagree (3)	Agree (4)	Strongly Agree (5)
14	I know how to use the emergency equipment located in the laboratory (eye wash, fire extinguisher, etc.).					
15	I don't know what to do when I encounter unsafe conditions while working in the laboratory.					
16	I know what to do of the event of an accident in the laboratory.					
17	I am aware of the consequences of the hazards that I may encounter in the laboratory.					
18	I think I am sufficiently informed of the safety issues prior to working in the laboratory.					
19	If I'm going to do a new study in the laboratory, the degree of risk of this study is of interest to me.					
20	If I find that the equipment is broken while working in the lab, I will try to fix it.					
21	When I work in the laboratory, I follow the safety rules even when no academic personnel are present.					

Thanks again for your contributions.

C. Example for Action Plan

Action Item	Action Description	Resources, Investment Needs/ Responsibility	Planned Completion Date	Document / Completion Indicator
1	The HS policy should be developed and implemented by the management. The policy should be communicated with all relevant parties (such as students, academic staff and administrative staff) and should be disclosed in the web page of METU.	Internal Resources Assign responsibilities	Q2 2019	Completion and implementation and disclosure of HS Policy.
2	A comprehensive Health and Safety Management System should be developed and implemented. The management system documentation should be communicated with all relevant parties and should be disclosed in the web page of METU.	Internal Resources External resources Assign responsibilities	Q3 2019	Completion, implementation and monitoring of a comprehensive HS management system for all the activities carried at METU.

Action Item	Action Description	Resources, Investment Needs/ Responsibility	Planned Completion Date	Document / Completion Indicator
3	An internal monitoring plan should be developed for HS issues. Topics, KPIs, frequencies must be clearly defined in the plan.	Internal Resources Assign responsibilities	Q3 2019	Completion, implementation and monitoring of internal monitoring plan.
4	Emergency Response Plan including environmental risks should be developed and implemented.	Internal Resources External resources Assign responsibilities	Q3 2019	Development and full implementation and monitoring of the ERP and records of implementation and monitoring.
5	The emergency drills should be conducted, and trained emergency response teams should be developed and be available to respond the emergency situations. The record of emergency drills needs to be kept.	Internal Resources Assign responsibilities	Q3 2019	Record of emergency drills conducted. Development of the emergency response teams with relevant trainings.
6	The contact information of the emergency response teams should be disclosed in the web page and also in the several locations in campus such as information boards at the faculty building and dormitories.	Internal Resources Assign responsibilities	Q3 2019	Disclosed information of emergency response teams.

Action Item	Action Description	Resources, Investment Needs/ Responsibility	Planned Completion Date	Document / Completion Indicator
7	The development of a formal reporting system (including accident, incident, near misses, hazards and environmental issues) and communicate the details of this system to the relevant parties. The reporting system should be developed as an online tool in order to encourage students and personnel in METU with easy usage of the system.	Internal Resources Assign responsibilities	Q3 2019	Development and implementation of a formal reporting system.
8	The basic training related to reporting system should be incorporated in the orientation process of the student and should be provided to academic and administrative staff and other relevant parties.	Internal Resources Assign responsibilities	Q3 2019	Reporting system training provided to all parties.

Action Item	Action Description	Resources, Investment Needs/ Responsibility	Planned Completion Date	Document / Completion Indicator
9	All accident/incident and diseases should be recorded and investigated. The result of the investigation should be disclosed in the web site and commutated with all relevant parties.	Internal Resources Assign responsibilities	Q4 2019	Records of the accidents, incidents, near missed, hazards and environmental issues.
10	A systematic accident investigation system should be developed and documented. The responsibilities for accident investigation should be defined in this document.	Internal Resources Assign responsibilities	Q4 2019	Development and implementation of “a systematic accident investigation system”.
11	A compressive laboratory safety program should be developed to improve laboratory safety by continuous training and monitoring programs. Special training should be offered to all individuals who will use the laboratories at METU	Internal Resources Assign responsibilities	Q2 2019	Development and implementation of “laboratory safety program”

Action Item	Action Description	Resources, Investment Needs/ Responsibility	Planned Completion Date	Document / Completion Indicator
12	Hazardous material management plan should be developed, and the hazardous material inventory should be prepared. The SDSs of any chemical stored and used in the laboratories should be kept in the laboratories and be readily available for the emergency situations. Appropriate emergency response equipment such as eye wash stations should be available at the laboratories.	Internal Resources Assign responsibilities	Q4 2019	Up to date hazardous material inventory including SDSs. SDSs and adequate emergency response equipment readily available at the laboratories
13	A systematic “Machine/Equipment Control system” should be developed and implemented. The maintenance, repair and periodic inspection records of the Machine/ Equipment including air conditioners and water dispenser should be tracked.	Internal Resources Assign responsibilities	Q4 2019	Develop and implement “systematic Machine/Equipment Control system”. Up to date machine/equipment inventory.

Action Item	Action Description	Resources, Investment Needs/ Responsibility	Planned Completion Date	Document / Completion Indicator
14	Industrial hygiene measurements (e.g. thermal comfort, electromagnetic field, radioactivity and lighting) should be conducted as per risk assessment in the specific environments.	External Resources Assign responsibilities	Q4 2019	Industrial hygiene measurement completed, and the control measures are identified and implemented if required.
15	Traffic safety issues included in the basic training as a part of the orientation process. Trainings/workshops etc. should be planned and conducted to raise awareness among students on traffic safety issues.	Internal Resources Assign responsibilities	Q3 2019	Trainings/workshops conducted. Develop/implement written document related to traffic safety.