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An innovative safety education method for architectural faculties to promote a culture of prevention in line with a "Vision Zero approach"

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Abstract---Occupational safety and health (OHS) education in universities has an important role in developing and improving safety cultures in the workplace. Safety education is essential for improving necessary OSH skills, culture and knowledge, so do architects, urban planners, interior architects whose duties are regarded as the design, planning and execution of construction projects in high-risk sectors. As a consequence, there has been increasing recognition that safety education courses in the architecture faculties should have participative learning methods and resources. In order to increase preparedness for any potential future health crises parallel to the

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"Vision Zero" approach in work-related deaths, a new EU Strategic Framework was announced by the European Commission. The course described and proposed here aimed to raise awareness about OHS by teaching risks related to working environments, basic issues, basic legislation within the scope of OHS. It also aimed to cover professional liability with respect to OHS, and risks and hazards in the construction sector, as well as helping participants to analyze and evaluate the risks in workplace. This article's primary objective is to identify an innovative safety education model of the "occupational health and safety course" with a "Vision Zero" approach. The study shows that the proposed teaching method for the students of the Faculty of Architecture makes a contribution to increasing the awareness about OSH issues especially in workplaces. The types of teaching methods and the sharing of experiences at the university-level is particularly important in order to fulfill the needs of "Vision Zero" criteria.

Keywords---safety education, under-graduate OHS courses, vision zero approach, ohs in faculty of architecture

Introduction

Every year millions of accidents occur at work, many of which are fatal, and many workers die due to work-related illnesses. In response, the EU has developed a legislative framework to improve occupational safety and health (OSH) culture through a framework directive with 24 specific directives. The basis for minimum standards and common principles is the "1989 European Framework Directive on Safety and Health at Work'' that pays attention to risk prevention methods and culture, as well as employers' responsibilities. Advisory Committee on Safety and Health at Work (ACSH) helps The EU OSH legislation development process. There is also the "Senior Labour Inspectors Committee (SLIC)" that contributes to creating a safety culture by offering thoughts on the implementation of EU OSH legislation and supporting sharing ideas about labor-inspection practices. From the past 20 years, OSH objectives are defined in the line with EU OSH strategic frameworks. These objectives can be listed as (1) more concentrated positioning on common priorities; (2) facilitating cooperation; (3) initiating investment in OSH; and (4) encouraging milestone actions at workplace level (European Commission, 2021).

Recently, in line with these goals, a new EU Strategic Framework (2021-2027) was announced by the European Commission. The strategic framework concentrates on three crosscutting key purposes: awaiting and handling change in the new working environment, increasing the risk prevention approach towards workplace accidents/illnesses, and promoting the preparedness for any possible future health disasters in line with a "Vision Zero" approach to work-related deaths (European Commission, 2021). "*Vision Zero" is a transformational approach for risk prevention. It combines the three dimensions of safety, health and well-being at all levels of work* (ISSA, n.d.). This approach is built around the new Strategic Framework. Increasing awareness and capacity building are two initial

preconditions for fulfilling the goal of zero work-related deaths by 2030 (European Commission, 2021; Zwetsloot et al., 2020). Awareness raising is a continuous focus of the European Agency for Safety and Health at Work or EU-OSHA and it should be taken into consideration in university-level education. There are many studies that describe the search for a framework for the achievement of safety and the role of higher education in the improvement of safety is argued in broader point of views (Akareem and Hossain, 2016; Arezes and Swuste, 2013, 2012; Bates, 2008; Hale and De Kroes, 1997; Swuste et al., 2021).

OSH education in universities has an important part to play in providing safety cultures in workplaces and on construction sites. This is mentioned both in the European Union strategy on occupational health and safety and in the OSH strategies of the Member States (European Commission, 2021). In these circumstances, there are many academic types of research which are about occupational safety climate or occupational safety culture measurement (Kines et al., 2011 and Summers et al. 2022) and training effectiveness (Johnson et.al., 2021). Professionals need OSH education for developing the required safety culture. OSH skills, knowledge and attitudes are especially needed by architects, interior architects and city planners who will have legal duties regarding the design, planning and execution of construction projects. Professionals who will be responsible in high-risk sectors also need the same OSH skills while continuing their educational life. Developing suitable, participative learning methods and resources is necessary to establish a safety culture in the university education system.

The types of teaching methods and the sharing of experiences and resources at the university level are particularly important to contribute to the “Vision Zero” process. Vision Zero is beneficial to any workplace (construction site, mine quarry, offices etc.), enterprise or industry in all regions of the world. It provides a fresh opportunity for safety training in universities for anyone wanting to comply with rules and guidelines. Since the 19th century, safety professionals have been organized in professional associations that promote vocational courses on occupational safety (Hale and Booth, 2019; Hale et al., 2020; Hudson and Ramsay, 2019; Provan and Pryor, 2019; Pryor et al., 2019, 2015; Sánchez-Herrera and Donate, 2019; Swuste et al., 2019; Uhrenholdt Madsen et al., 2019; Wright et al., 2019). In the 1970s safety sciences was born as an academic discipline by organizing health and safety courses in vocational schools, graduate and post-graduate programs (Swuste et al., 2021). To contribute to the “Vision Zero” process, these courses are very important for the universities-departments whose graduates are eligible to become occupational safety specialists.

In this context the aim of this article is to identify the methods underpinning the “occupational health and safety course” as expressed through the educational material in the Architecture Faculty of Çankaya University. More specifically, by mobilizing theories of attitude formation, this article is trying to explore the affective and cognitive impacts of safety education on architecture faculty students, with the objective of identifying more effective ways of delivering such education models with a “Vision Zero” approach in the future. Lastly the paper emphasizes the importance of including safety and health items in syllabuses and

examinations of architecture schools and the innovative methods in the safety education.

Literature review on safety education

In this study a review of literature that is mainly about safety education has been conducted. The American author Heinrich is one of the first authors who mentioned the incorporation of occupational safety in academic curricula and engineering courses (1956). Then in another paper, Robens mentioned the necessity of the safety and health items in syllabuses and examinations of engineering schools (1972). After these, more studies appear in the literature, reporting occupational safety education. Spickett explains a post-graduate course in occupational health and safety at the Western Australian Institute of Technology, which was a brand-new topic at the time, starting to be a graduate diploma course in 1982 (1985). The course aims to prevent occupational injury and disease, and make the workplace safer by identifying the problems, quantifying them, and evaluating and controlling the processes. Eliminating or controlling danger at the workplace, evaluating the legal, industrial and professional factors, and making use of management skills are the main objectives of the course.

Spickett also covers problems faced during the semester and how they were resolved. Later, Long and Wyatt describe an approach to learning program evaluation that is used in the Master and Diploma of Occupational Health and Safety programs conducted by Worksafe Australia in conjunction with the University of Sydney (1995). The study structures the opportunities for students to learn evaluation strategies. Emphasizing the significance of receiving compulsory safety training, Becker and Morawetz evaluated whether The International Chemical Workers Union Council (ICWUC) Hazardous Waste Worker Training Program affected the attitudes and post-training activities of trained union workers (2004). Questionnaires are used methods which is applied to 55 workers, including general information about workers daily life's and their working environment.

The results shows that after training, the workers attitude towards altering worksite circumstances increasing positively and their ability about catching the changes in working environment is greater than before training. Besides, according to Wilkins (2011) and Albert and Hallowel (2013) health and safety training programs make better employee fulfillment with health and safety requirements in the construction industry. In 2012, Meyer indicated that safety is related to many different actors especially in academia and research. Scientific staff, researchers, teachers, technicians, students, external stakeholders, and short-term visitors are all responsible for safety and health procedures. The MICE strategy is a method used to improve safety at hazardous places. The author explains MICE as the Deming Wheel process of improved Plan-Do-Check-Act.

The four components of the MICE concept are Management, Information and education, Control, and Emergency. Applied concepts help to decrease the number of accidents drastically. MICE concept provides appropriate knowledge for Occupational Health and Safety issues and it helps to increase awareness

about this topic (Meyer, 2012). Samanta and Gochhayat discuss about the major challenges and possible solutions for the occupational health and safety of construction workers in India (2021). The literature review is used for a determination of the main problems in the area. Also, a questionnaire survey helps to organize and make a critical review to provide a guideline for government agencies, organizational authorities as well as supervisors of construction sites. This study indicates that lack of training, wrong postures at work and non-use of protective equipment and also a lack of proper communication constitute the major challenges. Khalid et al. define four necessary elements for an effective SMS framework in the construction industry: Safety policy (safety regulations, leadership, safety planning), safety assurance (safety compliance, performance measurement), risk management (risk assessment, safety inspection), and safety promotion (safety culture) (2021).

For the evaluation of studies on education in occupational safety and health, Dijk et al. conducted a literature review to determine preferred methods in OSH education (2015). Interactive e-cases, e-learning modules, video conferences and distance discussion boards are found as inspirational, whereas participatory workshops and educational plays have great potential to improve students' knowledge. The role of developing economies cannot be underestimated in the rise of online facilities and the quality of education. The international collaboration of OSH experts with other organizations is promising for the future. In their research, Yenisarı et al. conduct a field study in order to determine the awareness level of the employees about OHS training (2019). Academic and administrative staff interviews are used for the effect of OSH knowledge within different demographic characteristics of employees. Grytnes et al. (2021) discuss about safety learning and their proposal for this topic is getting involved into the work practice is different argument than safety learning. It is believed to be the practice itself (Gherardi, 2006; Gherardi et al., 1998; Gherardi and Nicolini, 2002, 2000; Gherardi and Perrotta, 2010).

Adaku et al. offer a conceptual framework of occupational capability measures (2021). The components of organizational capability are determined and a comprehensive literature review is done from the Scopus database in related terms of "organizational capability" and "design". The authors conclude that occupational safety and health is one of the major topics in construction projects and is often mis-applied due to misunderstandings of the Design for Occupational Health and Safety initiatives and their capability. Lastly, Swuste et al. present certain post-graduate courses on safety with an assessment of quality (2021). In doing so, general information regarding safety education throughout history is given and ten postgraduate safety courses in Europe are evaluated according to certain indicators. These indicators are determined by a review of educational models in terms of their structure, objectives, methods of transferring knowledge, and evaluation of outcomes.

This evaluation led to a conclusion that traditional indicators of safety are not sufficient in the transfer of knowledge. Accordingly, the authors suggest particular indicators for quality evaluation of safety education programs, mainly focusing on program contents, learning objectives, organization and infrastructure and perspective on pedagogy. In the literature, it is seen that

studies about OSH are published on individual (post)graduate safety courses and worker training. However, there are few studies on OSH courses in undergraduate education. In fact, in order to create safety awareness, undergrad education methods and courses are crucial. It should be also highlighted that safety education programs need well-defined contents-learning objectives-outcomes, organization, infrastructure, and academic safety literature.

Methodology

According to Swuste et al. the quality of a safety education program is based on four different aspects which are named as quality indicators: contents, learning objectives, organization - infrastructure and the pedagogy (2021). The pedagogy indicator focuses on the transfer of education which constitutes a grounding for the safety education. The students who will graduate from the Faculty of Architecture are future architects, urban planners, and interior architects who will be in charge of many different working areas from offices to construction sites. Therefore, Occupational Health and Safety courses in this faculty demand special attention to fulfill “Vision Zero'' strategies which will be applied throughout the lifetime of work experience. In this context this study tried to demonstrate the educational model of occupational health and safety as an undergraduate course given at Çankaya University Faculty of Architecture. The method of the Occupational Health and Safety course will be discussed in terms of educational material. The students who take the course are members of the Architecture Faculty of Çankaya University that consists of the Department of Architecture, City and Regional Planning and Interior Architecture. In order to increase motivation for and the participation to this course, an innovative educational model is offered (see Figure 1.b).

Swuste et al. highlight that the transformation of learning is somehow dependent on the interest of the students (2021). The method used in the Occupational Health and Safety course is developed from the Krathwohl educational model (see Figure 1.a) and the target group of this course is students of the Architecture Faculty. Their general attitude towards the lectures is mostly based on design-related issues, and the tendency towards visual techniques is taken into consideration while developing this educational model. The offered method aims to increase the quality of safety education by raising the interest of the students about safety education.

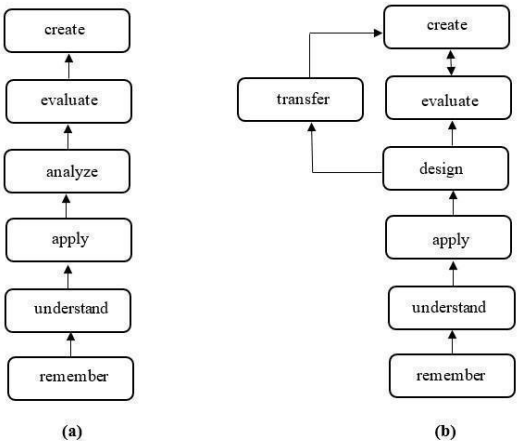


Figure 1. Educational models (a. Krathwohl, 2002; b. proposed model for the Faculty of Architecture students)

The taxonomy of the educational objectives is related to different levels of retrieved knowledge and the six levels of the structure of the cognitive process which necessitates a higher abstraction qualification in each previous step lead to the educational model's success (Swuste et al., 2021). Krathwohl's taxonomy of educational objectives and related educational model is based on these six levels (Krathwohl, 2002). As the first stage, the term "Remember" is related to retrieving knowledge from long-term memory, and placing it among newly learned memories. "Understand" is closely related to oral and written as well as graphic communication given in the lectures as a determination process. "Apply" is used to carry out a procedure from learned material. In the Krathwohl model, the "Analyze" step means that the learned data is fragmented into smaller pieces and criticism and judgements of the pieces are placed in the "Evaluate" step. The reunion of constituent parts with a discussion configures the last step as "Create" (Bloom et al., 1956).

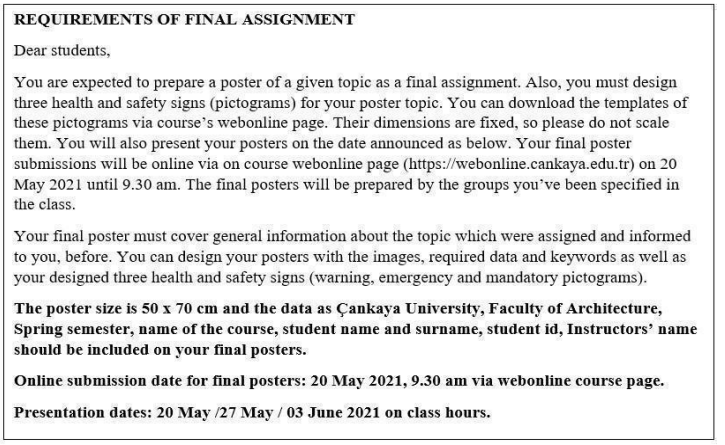
The proposed educational model differs from the Krathwohl model in certain points: the first three steps ("Remember", "Understand" and "Apply") are taken directly into the proposed method. However, the "Analyze" step evolved into the "Design" phase in the new method: the design process of their final posters as well as the pictograms is an iterative process that merges with the given critique. Since the target group of students are used to submitting their works as a final work, the evaluation of the course is held on the submitted final posters with a brief presentation of their works. There is a shortcut between "design" and "create" steps with the "transfer" stage, as a pedagogy indicator. This is because the learned knowledge from the course should be transformed into their own posters with new offered pictograms.

To apply the proposed method, a course outline was introduced at the beginning of the semester (see Table 1). The importance of health and safety education for Architecture Faculty students are highlighted at the very beginning weeks of the course. The main headings distributed over the following weeks are mostly concentrated on the construction sites and offices as working places. The possible

risks at the workplaces, analysis and mitigation methods are introduced throughout the lectures. Students also have information about the regulations and legal responsibilities of the corresponding person about occupational safety issues.

On the other hand, the final assignment, which is explained below was prepared and explained to students on the course in the 6th week of the schedule (see Figure 2). All groups of students were given different subtopics, and they were asked to design three separate pictograms for each topic. In order to be able to design a pictogram, they first need to do detailed research and understand the subject they have chosen. As a second step, they are asked to design a poster related to those designed pictograms in which they will summarize all research information to express these general studies. Since the main aim of this method is catching their areas of interest, the assignment gives them a chance to design innovative infographics/pictograms for the chosen occupational health and safety subtopics. The announcement date of the final submissions is set to give students enough time to research and prepare their designs. Unlike many programs which evaluate the course outcomes with a final test or examination or several tests during the schedule, this final assignment constitutes a design phase, submission of a poster and also a brief presentation during the final weeks. Students of the Faculty of Architecture are also familiar with this process.

The course materials that are given as recommended sources are shown in Table 1. Students can use those books, regulations, as well as online databases to research their subtopics. The main target of listed subtopics is raising awareness about risk mitigation and increasing preparedness against workplace accidents as goals of "Vision Zero" (see Table 2). These subtopics are directly related to construction sites and workplace accidents, as well as occupational diseases from different kinds of exposure.



REQUIREMENTS OF FINAL ASSIGNMENT

Dear students,

You are expected to prepare a poster of a given topic as a final assignment. Also, you must design three health and safety signs (pictograms) for your poster topic. You can download the templates of these pictograms via course's webonline page. Their dimensions are fixed, so please do not scale them. You will also present your posters on the date announced as below. Your final poster submissions will be online via on course webonline page (https://webonline.cankaya.edu.tr) on 20 May 2021 until 9.30 am. The final posters will be prepared by the groups you've been specified in the class.

Your final poster must cover general information about the topic which were assigned and informed to you, before. You can design your posters with the images, required data and keywords as well as your designed three health and safety signs (warning, emergency and mandatory pictograms).

The poster size is 50 x 70 cm and the data as Çankaya University, Faculty of Architecture, Spring semester, name of the course, student name and surname, student id, Instructors' name should be included on your final posters.

Online submission date for final posters: 20 May 2021, 9.30 am via webonline course page.

Presentation dates: 20 May /27 May / 03 June 2021 on class hours.

Figure 2. Final Assignment Requirements given to students during the semester

Table 1
Course Outline

Course Outline	
Week	Topic (s)
1	The importance of occupational health and safety in Faculty of Architecture
2	Legal responsibilities and sanctions, regulations on occupational safety
3	Occupational health and safety in construction sector
4	Occupational health and safety and working at height
5	Hazards and prevention methods that can be encountered in the office
6	Hazards and prevention methods that can be encountered on the construction site
7	Midterm
8	Building management systems
9	Fire safety systems
10	Risk analysis and assessment
11	Risk analysis and assessment
12	Disaster and emergency risk analysis
13	Emergency management
14	Occupational safety management systems

Author(s)	Title	Publisher	Year
Hughes P., Ferret E.	Introduction to Health and Safety in Construction	Elsevier	2005
Holt, J.	Principles of Construction Safety	Blackwell Science	2005
White, J.	Health and Safety Management An Alternative Approach to Reducing Accidents, Injury and Illness at Work	CRC Press	2018

Coble R.J., Haupt T.C., Hinze J.	The Management of Construction Safety and Health	CRC Press	2000
Standards and Regulations			
4857 Labor Law, 6331 Occupational Health and Safety Law			
Eurocode, ILO, OSHA			

Table 2
Subtopics that are provided to students for their final assignments

Subtopics	
Construction Safety	Working at Heights
Workplace Safety	Crane Safety
Electrical Safety	Ladder Safety
Fire Safety	Personal Protective Equipment (PPE)
Road Safety	Winter Safety in Construction
Scaffolding Safety	Summer Safety in Construction
Excavation Safety	Demolition Safety
Forklift Safety	Environmental Safety
Asbestos Safety	Pedestrians Safety
Lifting Safety	Carbon Monoxide Safety
Shopping Mall Safety	Mining Safety
Occupational Health and Safety in Hospitals	Emergency Management
Occupational Health and Safety in Schools	Earthquake Safety in Construction
Occupational Health and Safety in Social/Cultural Centers	Wind Safety in Construction
Occupational Health and Safety in Brid	First Aid
Ergonomic Risks	Training of Workers
Occupational Diseases	Working with Display Screen

	Equipment
Occupational Accidents	Manual Handling
Physical Risk Factors	Silica Dust and Protection
Chemical Risk Factors	Vibration Health Effects
Biological Risk Factors	Industrial Hygiene
Risk Assessment	Workplace Lighting
Machine Safety	Driving Safety
Power Tools Safety	Aviation Safety
Roof Construction Safety	Musculoskeletal Hazards and Risk Control

Results and Discussion

The occupational health and safety course has been designed by considering the teaching methods and the habits of the Architecture Faculty students and their expression methods. With this course, the students expressed a theoretical course by combining it with the application methods in their field. In order to fulfill the requirements of Vision Zero parameters, and also taking into consideration the process-design skills of students of the Faculty of Architecture, a two-step study is defined for the final submission. Designing three pictograms which all correspond to different circumstances: circular blue represents mandatory situations, rectangular red is used for emergencies, and triangular yellow ones are designed for warning. In Figure 3, a set of the pictograms submitted by the students at the end of the semester is presented. This table consists of the pictograms of five different student groups who got successful grades in the course. Those presented pictograms are designed according to the subtopics listed in Table 2. This group-work situation provides an interdisciplinary environment where the exchange of ideas increases creativity and different aspects of various disciplines meld within the process. Students design pictograms in an environment of information and exchange of ideas. This workflow is in parallel with the method followed in the project courses of the faculty of architecture. Preliminary research, presentation, and a design are made in the project courses with the data at hand. The method followed in the course supports students' understanding of knowledge and expression in their own practice.

Outputs of the second step are shown in Figures 4-a and 4-b. Asbestos Safety, Personal Protective Equipment, Electrical Safety, and Radiation Safety posters are presented in Figure 4-a and Wind Safety in Construction, Cold Stress Hazards, Mobile Elevating Work Platform, and Carbon Monoxide Poisoning subtopics are in Figure 4-b. These posters are chosen from eight different groups' final submissions that received high grades in the course evaluation. Their bold colors

and catchy visuals help increase understanding about their subtopics. The students' general research on these subjects, the deficiencies they have identified, and the pictograms they have internalized and designed in the area and the most significant deficiencies about the topics can be followed from these posters.

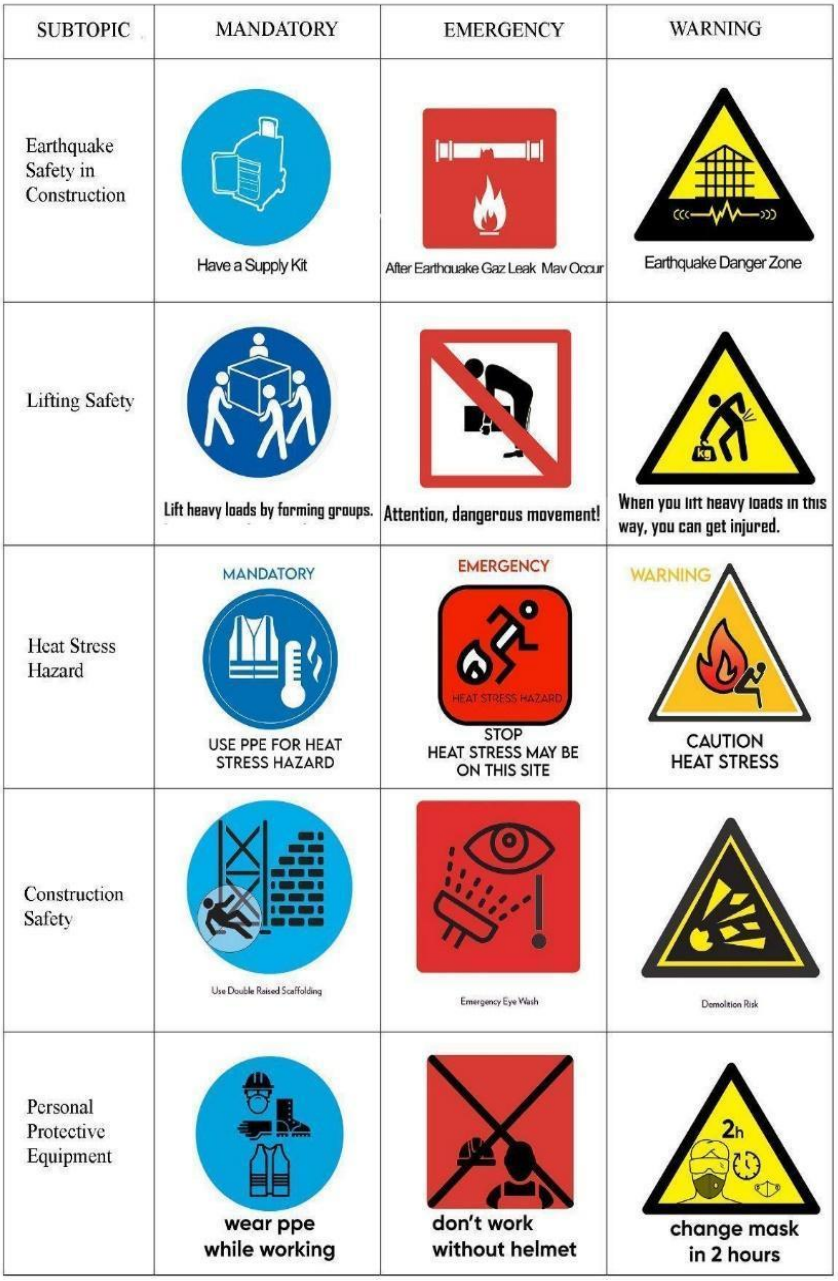


Figure 3. Selected pictogram designs of occupational health and safety students

Figure 4-a. Selected poster designs of the occupational health and safety course students

Figure 4-b. Selected poster designs of the occupational health and safety course students

Conclusion

The important role of occupational safety and health education in universities constitutes the main spine of this research. Architects, urban planners and interior architects take many responsibilities in construction sites where there are many risks to workers' lives and safety. Thus, OSH education in architecture faculties is extremely important. Meanwhile, the literature review shows that a novel approach for this education in the architecture faculties must be scrutinized in a well-defined frame. In this research, an innovative method is

proposed and applied during two semesters. The final submissions are collected and presented as an output of this paper. The European Union Strategic Framework (2021-2027) announced “Vision Zero” approach for increasing preparedness in order to prevent the future health-crises of work-related deaths (European Commission, 2021). The course outline of the proposed educational model places the “Vision Zero” criteria at the forefront.

This course is constructed on the following contents as a general framework: Terms and definitions of workers and employers, fundamental knowledge on occupational health and safety and related laws and regulations, work accidents and occupational diseases and work accidents, responsibilities of workers, employer and government, various risk factors (biological, ergonomic etc.), the health and safety problems and their solution techniques in office and construction site, protective equipment, construction accident analysis and discussion, risk assessment methods, disaster and emergency management. Upon successful completion of this course, the student will be able to:

- learn the basic concepts of occupational health and safety.
- know the causes of occupational accidents and diseases and precautions to be taken against them.
- learn the architect's responsibilities in terms of occupational safety.
- adopt safety culture.
- be equipped with occupational health and safety culture.
- be aware of the risks and hazards in offices and construction sites.
- realize the hazards encountered in the construction sector, eliminate the hazards or take measures to keep them under control.
- identify, analyze and evaluate the risks in the workplace.
- be aware of the occupational health and safety legislation and legal responsibilities.

The results prove that increasing the interest of faculty of architecture students by giving them tasks including a design, turn out a productive process with creative outputs which increase the awareness of the OSH in the working environment for the future architects. This output also promotes the “vision zero” decisions in parallel to this study’s main objective.

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