The Effects of a Case-Based Learning Approach on the Achievement and Attitudes of Students towards an Occupational Health and Safety Course in Turkey

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Abstract **– In this study, the effects of case-based learning (CBL) and learning styles on the achievement and attitude of students towards an occupational health and safety (OHS) course are investigated experimentally. A total of 50 students in their first year at the electrical education department at Kocaeli University participated in this research. The students were split into two equal groups according to their scores in the central university entrance exam conducted every year by the high education consul in Turkey. The students were assigned to the control and experimental groups randomly. The control group students processed the OHS course materials using the traditional methods, while the experimental group students processed them through the CBL method in the environments developed by the authors regarding to their learning styles. According to the results of the analysis, the CBL method based on learning styles applied to the experimental group students is significantly effective in increasing students' success in the OHS course. The findings also show that for OHS training, the CBL method based on learning styles, which has not been applied in previous studies, has a great effect on the students' performance compared to the traditional teaching methods.**

Keywords **–** ***Case-based learning, learning styles, occupational health and safety.***

1. Introduction

Today, occupational health and safety is one of the important issues in work life. According to the International Labour Organization (ILO), despite global efforts to address OHS concerns, an estimated 2.3 million work-related fatalities and 337 million work-related accidents still occur each year [1]. However, the issue might be neglected due to the globalization effects on business and the worries of enterprises about the future [2], [3]. The accidents have mostly occurred in developing countries, where the influences of these factors are more strongly experienced [4].

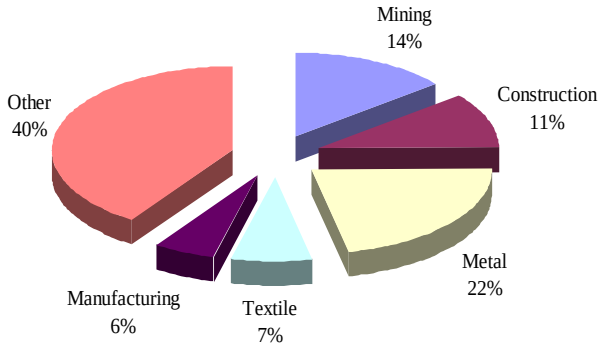

Figure 1. The percentage distribution of injury cases in the industrial sector of employment of Turkey in 2009.

According to data from the Social Security Institution (SSI) in Turkey, 164,316 occupational accidents and 429 professional illnesses occurred, resulting in the death of 1,171 laborers in 2009. The occupational accidents that occurred in the years between 2000 and 2005 in Turkey were assessed. The results show that the accidents were mostly in the metal goods manufacturing, coal mining, construction, textile, and transport vehicle-manufacturing industries. Figure 1 shows the percentage distribution of injury cases in the industrial sector of employment of Turkey in 2009.

However, the occurrences of death and the permanent defection due to occupational accidents were mostly in the construction industry [5]. Injury cases in the constructional sector of employment amounted to thirteen percent of total fatal accidents in Turkey in 2009. The causes of deaths were 30 percent fall from heights, 26 percent accidents while hauling, 19 percent pressing between the machines and pounding, and 18 percent electric shock [6], [7]. Table 1 shows the distribution of the employment injuries by cause in Turkey in 2009. Types of accidents are classified by ILO standards.

Table 1. The distribution of the employment injuries by cause in Turkey in 2009 [8].

Code No	Type of Accident	2009		
		Male	**Female**	**Total**
100-Transportation accidents	Other types of accident, not elsewhere classified	2.472	189	2.661
200- Accidental poisoning		15	0	15
300- Accident caused by falls		7.713	651	8.364
301	Falls from heights (trees, buildings, scaffolds, ladders, machines, vehicles), and into depths (wells, ditches, excavations, holes in the ground)	3.582	165	3.747
302	Drowning, submersion	36	6	42
303	Falls on the same level	4.095	480	4.575
400- Accident caused by machinery		9.122	563	9.685
500- Accident caused by explosion	Firedamp explosion	499	16	515
600- Exposure to or contact with extreme temperatures	Contact with very cold substances or objects	1.084	71	1.155
700- Struck by falling objects		11.110	282	11.392
701	Slides and cave-ins (earth, rocks, stones, snow)	2.805	21	2.826
702	Collapse (buildings, walls, scaffolds, ladders, piles of goods)	92	1	93
703	Struck by falling objects during handling	4.647	151	4.798
704	Struck by falling objects, not elsewhere classified	3.566	109	3.675
800- Stepping on, striking against, or struck by objects excluding falling objects	Accident due to a sharp piercing device	18.112	1.189	19.301
900- Exposure to or contact with electric current		448	10	458
1000- Injuries due to the challenging body		1.151	36	1.187
1100- Contamination of a part of body with a foreign object	Choking due to food material	525	13	538
1200- Biting and kicking by animals or by poisonous insect		40	2	42
1300- Treatment accident and vaccination complications		3	0	3
1400- Late appearance of a problem because of an earlier accident		6	1	7
1500- Accident while welding		196	1	197
1600- Murder and wound	Murder or injury by another person	141	4	145
1700- Trauma due to battle operation		0	0	0
1800- Exposure to or contact with harmful substances or radiations	Exposure to radiations other than ionizing radiations	80	14	94
1900- Other types of accident, not elsewhere classified		8.036	520	8.556
Unknown		1	0	1
TOTAL		60.754	3.562	64.316

*** Types of accidents have been arranged in accordance with ILO standards.**

Figure 2 shows the number of employment injuries by the time at which the injury occurred in Turkey in the years 2008 and 2009. It is seen that the number of employment injuries increases in the beginning and ending hours of the daily shift. That gives rise to the thought that the employees' readiness to work is low in the beginning hours of their daily shift, and they are more vulnerable to injuries in the ending hours of their daily shift because of their decreasing concentrations.

Figure 3 shows the distribution of the number of employment injury cases of insured persons by age in Turkey in the years 2008 and 2009. The number of injury cases in the age group 25-29 is higher than the number in the other age groups. One of the underlying reasons can be that the number of employees in this age group is more than the number in other age groups. The other reason can be that they participate in work more actively than the other age groups. Consequently, accidents and illnesses cause ineluctable damage on the national economy. They cost the SSI in Turkey 2.5 billion US dollars per year, and based on the data on the gross national income, they amount to a total cost of 20 billion US dollars per year for the national economy [9]. Therefore, the matter is worth

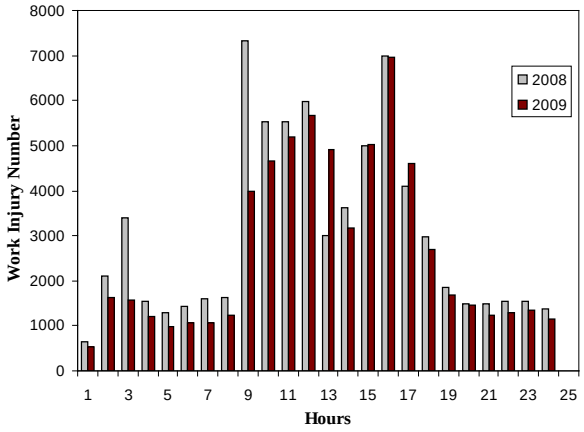

Figure 2. The number of employment injuries by the time at which the injury occurred in Turkey.

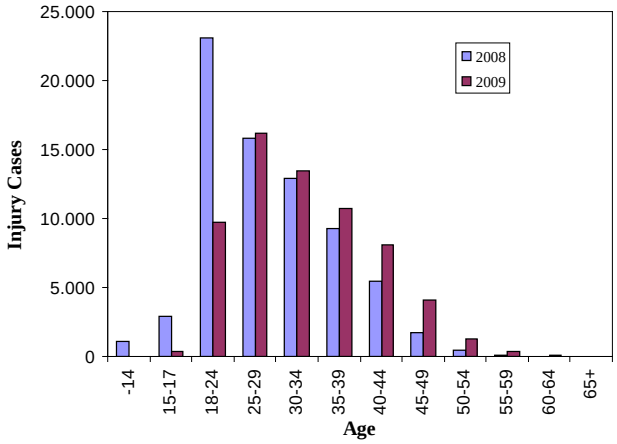

Figure 3. The distribution of the number of employment injury cases of insured persons in Turkey by age group.

studying, especially for this country. It can be said that occupational accidents and work-related illnesses are mostly preventable since they are mainly attributed to human causes. The majority of occupational accidents occur due to the unsafe behaviors of the laborers. The main causes of occupational accidents and professional illnesses are indiscipline, lack of education, inconsistent attitudes, and lack of consciousness about occupational health and safety [10]. Education is the key to prevent these causes [11]. It plays a critical role in solving problems related to OHS. It is a fact that the achievement of precautions related to OHS depends on laborers who are educated about the subject [12-16]. A total of 350 workers from six departments in the printing industry were surveyed in Turkey. The results highlight the importance of training for the prevention of injuries and increasing the workers' adoption of safety procedures [17]. The effects of the occupational health and safety training in the accommodation sector were also examined. The results indicate that the training affects the employees positively [18]. According to the investigation results on the life conditions of oil industry laborers, researched by the Turkish oil business union in 1994, as the education level of the laborers increase, the occurrence of occupational accidents and professional illnesses decrease [19]. This means that educational and behavioral development regarding OHS is decidedly important in minimizing occupational accidents and professional illnesses. Hence, the subject has to be covered at all school and university levels, as well as in the workplaces [20]. There is an increasing interest in degree programs delivered without requiring the students to attend traditional classroom-based courses. Therefore, the program of OHS education should sufficiently include pedagogy, technology, and communication [21-22]. Moreover, OHS training should be sustained not only during the persons' educational life but over the course of their whole life as a lifelong learning process.

The continuity of OHS training is very important in creating perception and consciousness in individuals who take part in the work life. Thus, a great number of institutions all over the world, such as the U.S. Occupational Safety and Health Administration Training Institute, have started to provide the required training and carry out OHS regulations. OHS training is an important issue for all employees that are actively involved in the work life. It is also a significant matter for engineering and technical education students who do not yet participate in work [23]; since they will eventually be responsible for device and equipment designing and maintenance, among others, they should be well versed in design safety [24].

As such, the critical question is how OHS should be taught to engineering and technical education students. This question is answered by this study comprehensively. Hence, this research is believed to be useful for students who are future practitioners of OHS in the workplace and for future studies. The traditional OHS training includes many laws and theoretical expressions that restrict the learning acquisition of students on this matter. Hence, occupational health and safety training requires new approaches to enable the students to acquire permanent behaviors considering their learning styles and abilities. Therefore, the CBL method based on the students' learning styles as a new approach to OHS education is explored in this study.

2. Background

2.1. Case-Based Learning

Learning is defined as the process of exchanging knowledge and using it under new conditions at various references [25]. The idea of authentic

learning is coordinated by this comprehension. Therefore, the group study is proposed to provide the students with access to real-world problems [26]. For the students to resolve real problems in authentic learning, the main factors are authentic assignments, the framework of instructors, discovery and questioning activities, social discussion opportunities, and the obtainable facilities. Since the students work in groups on real-world problems, they are aware that their learning is significant. The students learn to find out, examine, debate, and significantly build ideas and dealings with substantial consistencies.

As a new context approach, CBL appears to be one of the most interesting instructional strategies [27]. The cases are similar to the stories or story lines about certain activities that the students interactively read or discover, and they are greatly utilized to keep the students interested in samples of real-world practices. Through the cases, the students are guided towards a conclusion or fed with resources, and the contexts are discussed and the issues debated dynamically. The cases lead the callow to esteem the sophistication of the real world by supplying itemized information about specific circumstances, such as an authentic problem, and how professionals handle them. They ensure critical thinking and supplementary reasoning about real-world practices [28].

The cases take place in many teaching and learning styles, such as debates, group discussions, trade-off analysis, summarization, critical analysis, etc., since they are introduced at varying degrees of elaboration and under many conditions [29]. Since the case histories are real-life experiences, the CBL is very valuable, specifically in the electrical field. The case histories of electrical incidents provide numerous benefits, such as aiding the prevention of future accidents, improving electrical safety programs, and creating a reference for companies and organizations [30]. The purpose of a case history is to bring out the facts of an incident via a story. Employees, the management, and students comprehend the idea easily in this context, which is very important for education and raising awareness. A case history is different from an injury report related to an incident investigation. The summary of an incident is given in the case history, which includes the facts of how the incident happened and any resulting injury. An accident is defined as an unexpected happening resulting in loss or an injury that is not due to any fault or misconduct on the part of the person injured. In contrast, an incident, according to Webster's dictionary, is an event that is subordinate to another, which can be related to noncompliance with work practices, deficient equipment design, or lack of proper personal protective equipment. In spite of its advantages, the CBL approach is not common in OHS training because the method and its gains are not sufficiently known. The aim of this study is to attract the attention of academicians and researchers to this point and to enlighten the future works about the subject.

2.2. Learning Styles

Learning styles personalize the learning process by finding clues with regard to the learning of the students. In addition, they establish a ground for whether the learners should study individually or in small groups. It has been pointed out that the determination of the learning styles of the students assists the teachers in developing the teaching process [31]. Thus, the determination of the learning styles of the students is an advantage for teachers. If the students know their learning styles, then they are able see the weaknesses and strengths of their learning process. So that they can easily adapt to the learning environment, and they can learn permanently.

To date, many researches have been done about learning styles, and a large number of models of learning styles have been developed [32].

Dunn first used the concept in 1960 [33]. Thereafter, Kolb developed researches on experiential learning theory; he conducted these assistive researches to support that concept. Keefe explained learning style as signed indicators that the students perceive, interact and response to learning environments [34]. Gregorc stated that learning style consists of distinct behaviors that show how the student acquires knowledge from the environment and adapts this knowledge to himself [35]. Dunn and Dunn defined learning style as the distinct, personalized, and unique ways each student uses in the process of learning and memorizing new knowledge [36]. Ursin described learning style as an unchanged personal process group that guides the students as they acquire knowledge from their environment [37].

Clearly, learning style involves a set of factors that determine how students psychologically perceive, interact with, and respond to their learning environments. The previously mentioned definitions were reviewed, and the common characteristic found in all of them was that the learning speed, the learning form, and the comprehension form for the information differ among individuals. Felder, who conducted researches related to learning styles, noted that learners differ in the way they learn [38]. Afterwards, Felder and Soloman classified learners into four different domains according to their learning styles [39-40].

Table 2 shows Felder-Solomon Index of Learning Styles (ILS). These four domains are active-reflective learners, sensing-intuitive learners, visual-verbal learners, and sequential-global learners.

Table 2. Felder-Soloman Index of Learning Styles (ILS).

Active • proceeds and remembers knowledge best by • discussing it with others • implementing/spreading it in a group	**Reflective** likes better • to think about on his own • figure out something on his own
Sensory • likes to learn facts, • solves problems by well-established methods • good at memorizing facts and doing hands-on work • dislikes complications as well as surprises • resents being tested by the material that is not covered in the class explicitly • does not like the courses that have no apparent connection to the real world	**Intuitive** • prefers to discover the possibilities and relationships • likes innovation • good at grasping new concepts • more comfortable with abstractions and mathematical formulations • dislikes repetition • does not like the courses that involve lots of memorization and routine calculations.
Visual • proceeds and remembers knowledge best by • diagrams, flow charts, time lines, films, and demonstrations that he saw	**Verbal** • gets more out of words from written and spoken explanations
Sequential to find the solution • tends to gain understanding with linear steps • each step must follow the previous one • each step must be in logical stepwise paths	**Global** once he has the big pictures • solves complex problems quickly • put things together in novel ways • may have difficulty explaining how he did it.

Table 3 shows Felder-Silverman corresponding teaching style according to ILS [41]. In the wake of this knowledge, these questions have arisen: What if the OHS course adopted the CBL approach, which would involve determining the learning styles of the students? Would such approach have any advantage in terms of the achievements and behaviors of OHS students?

This paper presents the results from the ongoing feasibility study undertaken on the OHS course. It aims to investigate the possibility and practicability of designing and operating the CBL method by considering learning styles.

The fundamental hypothesis of this research was that the integration of the CBL method based on learning styles into the teaching of an OHS course would have a significant effect on the students' success and attitudes towards the course.

From this hypothesis, it follows that:

1. Significant differences were not expected in the pretest achievement scores between the experimental and control groups.

2. Significant differences were expected in the posttest achievement scores between the experimental and control groups.

3. Significant differences were expected between the pretest and the posttest achievement scores of the experimental group.

3. Methodology

3.1. Research Model

In this study, a pretest-posttest design with control group (PPDC) is used as the experimental design since it is a complex pattern that is widely used. In this method, the participants are evaluated through a relevant dependent variable before and after the process.

The PPDC is a relevant pattern because identical participants are measured through the relevant dependent variable twice. The PPDC is also an irrelevant pattern because it compares the measurements of the experimental and control groups, which consists of different participants [42]. Table 4 shows the pattern of PPDC.

Where G_E is the experimental group, G_C is the control group, $O_{E.A1}$ and $O_{E.A2}$ are the pre- and post-achievement test measurements of the experimental group, $O_{E.AT1}$ and $O_{E.AT2}$ are the pre- and post-attitude test measurements of the experimental group, $O_{C.A1}$ and $O_{C.A2}$ are the pre- and post-achievement test measurements of the control group, $O_{C.AT1}$ and $O_{C.AT2}$ are the pre- and post-attitude test measurements of the control group.

R shows that the students are assigned to the groups neutrally, and X shows the experimental variable based on CBL that is applied to the experimental group only.

3.2. Participants

A sample is a group of persons chosen from a universe in a research study for the purpose of representation of the universe. Samples can alter materially. For example, one research might utilize a sample of over a thousand registered electors for symbolizing the population of a major city, and another research might investigate a sample of only ten children in a kindergarten program [42]. Scientifically, a sample should be taken at least 10 percent in figurative researches, while it is needed to

Table 3. Felder-Silverman corresponding teaching style according to ILS.

Active • allows lots of class time for discussion of the problem-solving activities • encourages the students to study in a group where the members take turns to explain different topics to each other • supports the students to work with other students	**Passive** • allows the students to write short summaries of the readings or the class notes in their own words • may take extra time for both students and teachers, but will enable the students to retain the material more effectively
Concrete • provides the students with specific examples of the concepts and procedures • makes the students find out how the concepts can be applicable in practice • creates an atmosphere for student brainstorming sessions	**Abstract** • supplies the students with interpretations and theories that help them link the facts • encourages the students to try finding the connections themselves • gives students the opportunity to take their time to read entire question before they start answering • ensures that the students check their results which may be incorrect due to their impatience with details and dislike of repetition
Visual • gives diagrams, sketches, schematics, photographs, flow charts, and other visual representations of the course material • provides videotapes/CD-ROM that displays of the available course material. • prepares the concept map (lists key points, encloses them in boxes or circles, and draws lines with arrows between the concepts to show the connections) • prepares the color-code course notes with a highlighter	**Auditory** • encourages the students to summarize the course material in their own words. • encourages the students to work in groups • makes them hear their classmates' explanations about the material • makes them realize their learning even more when they do the explaining.
Sequential • fills the skipped steps for the students to remember and follow • provides references for the students to fill them • gives time to the students to outline the lecture material in the logical order.	**Global** • provides the students an overview for the entire chapter in a text before they begin to study • tries to make the students relate the subject to things they already know • helps them see parts of the other disciplines or to consult the other references • does not let them lose faith in themselves

Table 4. The schematic of the research model.

Group	Assig. method	Pretest	The exp.var.	Posttest
GE	R	$O_{E.A1}$ $O_{E.AT1}$	X	$O_{E.A2}$ $O_{E.AT2}$
GC	R	$O_{C.A1}$ $O_{C.AT1}$		$O_{C.A2}$ $O_{C.AT2}$

be 20 percent in small universes. Minimum thirty persons are required for correlation studies, whereas for causative comparisons, at least thirty persons from every group should be included in the research.

Table 5. The distribution of students.

Groups	Branch	Total no.
Experimental	1A	25
Control	1B	25

However, fifteen test subjects from every group are sufficient for validation of the results in experimental researches [43]. Consequently, a sample of fifty students in their first year at the Electrical Education Department of Kocaeli University during the 2010-2011 fall semester are used as research participants. Table 5 shows the distribution of the participants.

Based on the achievement scores of the students in the central university entrance exam, three groups were formed, equivalent to high, medium, and low scores. The experimental and control groups were composed of students randomly taken from the high-, medium-, and low- scoring groups. The Felder-Soloman Index of Learning Styles was applied to the experimental group students. As a result, it was determined that 23 students had a visual learning style, while 2 students had a sensory learning style. Afterwards, the course materials that will later be processed in the experimental group students were revised by considering the corresponding teaching styles based on the CBL and the visual-sensory learning styles.

3.3. Instruments

In this study, the tests on achievement and attitude towards the OHS course, and the ILS adopted to determine the learning styles of the experimental group students were used as data collection instruments.

The achievement test: The authors developed the achievement test for the OHS course. In order to generate the experimental multiple choice test, 40 items, each with only one correct answer, were selected from various topics in occupational health and safety, such as safety procedures, the risks caused by the work environment, safety in electrical work, hazardous substances, work accident analysis, and personnel safety, work safety, and fire safety issues. To confirm the construction and appearance validities and the suitability of the measurement assessment principles for the items, the researchers consulted with experts (a professor and an assistant professor in the field of education). Pre-application of the prepared test was performed among 170 second-year students, who had previously taken the OHS course at the Electronics, and Computer Education Departments of Kocaeli University. Later, each item was analyzed statistically according to their difficulty and discrimination indexes. Twenty items with a discrimination index of less than .20 were excluded from the achievement test. The remaining items in the test had a difficulty index of between .26 and .78. Both easy and hard items were included in the achievement test. The difficulty and discrimination indexes of the items are shown in Table 6.

The reliability of the measurement tool (alpha) was calculated by the KR20 formula for the remaining 20 items on the test, resulting in a reliability score of .86. Since the test was highly reliable, it was applied to both the experimental and control groups as a pretest and a posttest.

The literature was searched before the scale was improved. Thus, a pool of 26 equally positive and negative statements was created. Afterwards, the statements corrected by the experts are implemented on total 170 students in their third and fourth years, took OHS course previously in departments of electronics, and computers in Technical Education Faculty, at Kocaeli University.

Table 6. Difficulty and discrimination indexes of the items in the prepared achievement test for the OHS course.

Item no for the pre-ach. test	Difficulty index of the item (p)	Disc.index of the item (r)	Item no for the final test
2	.61	.23	1
4	.43	.32	2
24	.68	.40	3
5	.31	.28	4
7	.32	.34	5
8	.57	.28	6
23	.68	.41	7
11	.59	.32	8
13	.39	.41	9
22	.78	.43	10
21	.36	.30	11
25	.26	.26	12
26	.53	.36	13
27	.40	.28	14
28	.55	.33	15
30	.77	.31	16
31	.36	.39	17
32	.58	.29	18
33	.66	.32	19
20	.53	.34	20

Factor analysis is a technique that provides an empirical basis through combining parameters related to each other at medium or high level, to obtain clusters of few but independent parameters. Thus, downgrading a large number of parameters to few clusters or dimensions is possible. The clusters or dimensions are called "factor" [44]. The aim is to find few factors (hypothetical parameter) via analyses that are difficult to interpret, more relevant, independent of original parameter, and significant cognitively. The higher the variance ratios one finds by means of analysis, the more powerful the factor structures one has [45]. However, between 40 and 60 percent of variance ratio is acceptable in social science analyses as adequate [46].

Factor analysis is especially used in physiology (for determination of personal characteristics such as introvert, extrovert, neurotic, etc.), social sciences, educational sciences, political sciences and international relationships, economy (company enlargement, productivity, profit, and work power), urban development, sociology, biology, geology, medical sciences, management (marketing, especially consumer, and ad researches), etc. [47], [48]. Hence, validity of the attitude scale is tested by factor analysis in this study.

Based on the factor analysis results, statements with a value lower .45 were removed from the prepared scale. Thus 15 statements remained as a measure of the students' attitudes towards the OHS course.

Table 7. The results of the factor analysis of the attitude scale towards the OHS course.

Item no for the pre-ach. test	**Load value of first factor**	**Total correlation of the item**	**Item no for the final test**
17	.832	.738	1
20	.786	.740	2
9	.780	.745	3
26	.636	.747	4
6	.592	.756	5
3	.544	.758	6
21	.787	.750	7
22	.778	.740	8
8	.504	.786	9
13	.718	.764	10
16	.675	.764	11
18	.537	.777	12
25	.780	.786	13
1	.616	.767	14
23	.863	.782	15

The factor loads and correlations of the items are shown in Table 7. The total variance explained in the attitude scale is 62.731%. It is evident that the scale has a general factor since the load values of the first factor of all items are more than .45, and the variance explained by the first factor is quite high. Thus, the scale is accepted to be single-dimensional. The alpha factor of the attitude measurement is .773. Therefore, the prepared attitude scale was shown to have high validity and reliability.

The learning styles scale: Although there are many tools and methodologies for the assessment of learning styles, two similar instruments are dominant in science and engineering education: Kolb's Learning Styles Inventory and the Felder-Soloman Index of Learning Styles (ILS). To determine the learning styles of the experimental group students, this study used the ILS as data collection instrument. The ILS, which is available online, consists of 44 multiple choice questions designed to distinguish the learning style affinities of an individual. Keskin and Samanci concretized the adaptation of ILS to our culture and the study of validity and reliability in 2007 [50].

3.4. Application

The OHS course was processed over 14 weeks at 2 hours per week at the Electrical Education Department of Kocaeli University in Turkey. Thus, there are 28 contact hours per semester. The course content is given in Appendix. The assessment of the OHS course is based on two criteria:

a. Examination – 50% (final examination)
b. Course Work – 50% (quizzes, assignments, and participation)

The course objectives are to develop in the students:

a. the capability to set up occupational health and safety systems and procedures in an organization,
b. the proficiency to implement and monitor an occupational health and safety program, and
c. the responsiveness to address universal health and safety requirements and take the essential preventive measures to avoid injuries and diseases.

Before the process, the attitude scale towards the OHS course and the achievement test on the OHS course were applied to a group of 50 students as a pretest.

Additionally, the ILS were only applied to the experimental group for determination of their learning styles.

Both experimental and control group students received lectures from the same instructor throughout

the process. Figure 4 shows the application and evaluation process of the OHS course. For the control group, the subjects were processed using a textbook, and a blackboard and/or projector was used when needed. PowerPoint presentations were given as plain text. Thereby, the course contents were presented to the control group through the traditional methods.

For the experimental group, the subjects were processed using sample case applications. Sample cases related to occupational health and safety were taken from the Internet database. The materials included video footages of occupational accidents, various animations and comics related to the topic, pictures about the subject, and sample case texts collected from miscellaneous print sources. The materials exhibited using a projector were organized as PowerPoint presentations and written resources. In addition, during the experimental operation, the students were given the chance to prepare posters related to the topic. Sample cases sourced from newspapers and internet news were given to the students, who were then asked to work in small groups to resolve the sample cases. The case studies, both real and hypothetical, were intended to extend the students' understanding of law applications. The aim was for the students to acquire basic knowledge of the key aspects of the current legislation. In addition, the objective was for the students to develop the necessary skills to recognize deviations from the legislation and common law principles and to have the confidence to advise employers and employees of their legal obligations and rights. Importantly, the approach helped the students to recognize those situations in which they should seek additional legal assistance.

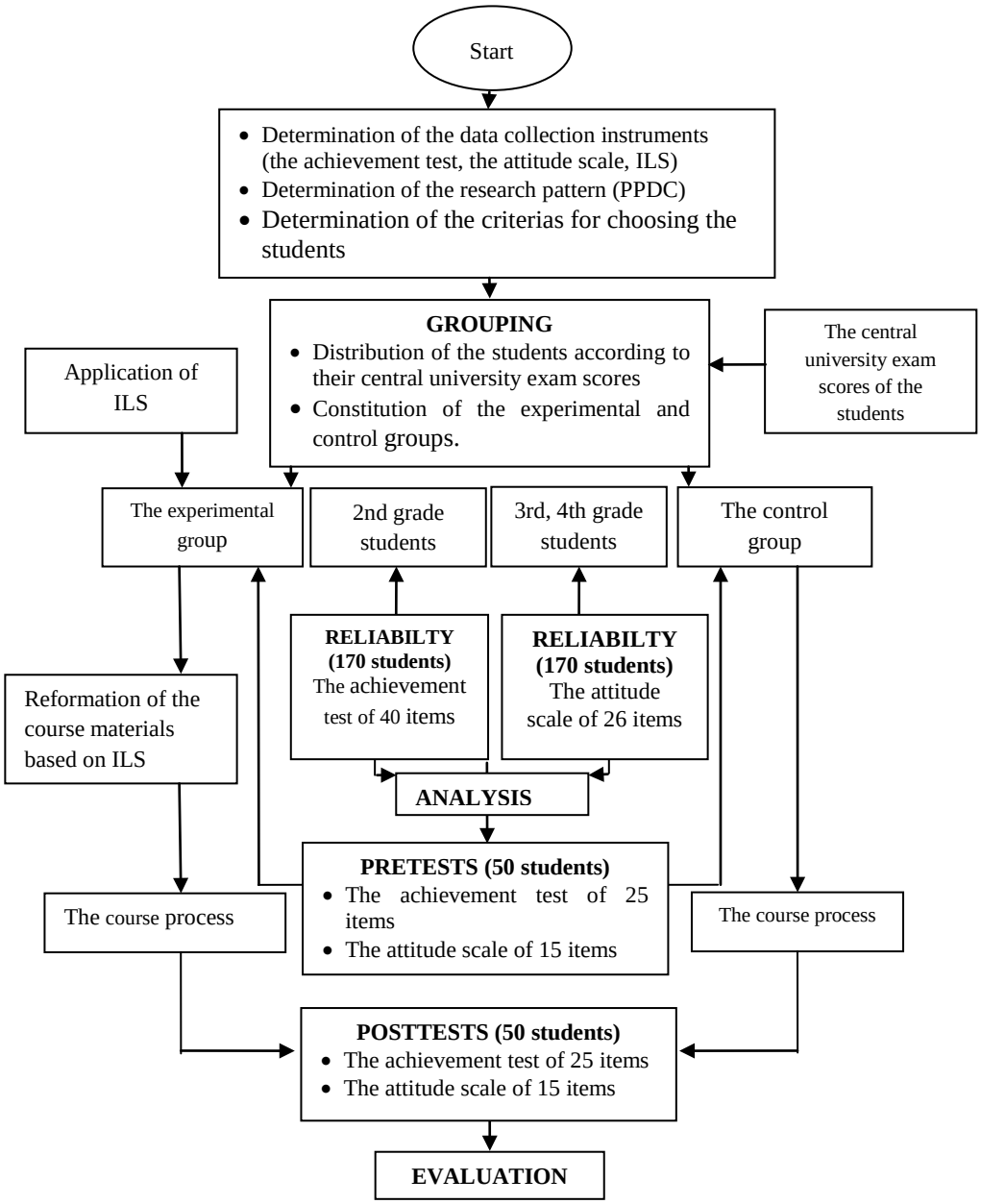

Figure 4. The flowchart of the study.

The experimental group students and the instructor worked together to clarify the problematic issues in the sample cases. Thus, the students shared their opinions about the sample cases within their group. After the group study, the experimental group students discussed their results together. The instructor acted only as an organizer and guide for the students during this time. Consequently, the students answered the questions regarding the sample cases either individually or as a group and then delivered the answers to the instructor. For this research, an example of a case history is given below.

Sample case: Mr. KS is 31 years old and has worked as an operator of a press machine for 2.5 years. On the day of the incident, Mr KS was working for madding colander at the machine, which has a single-hand control button. The incident occurred when, as he moved to take the finished colander in his hand, his body pushed on the button and his right hand was pressed under the headgear of the press machine.

Discussion questions:

What was the main cause of the incident?
What were the factors that caused the accident?
What are the unsuitabilities according to the labour law?
Who held the primary and secondary responsibility for the incident?
If you were the worker, what kind of behaviour would you display to prevent the injury?
If you were the manager, what would your recommendations be to avoid similar accidents?

The application lasted for five weeks, for a total of 20 course hours, at 45 minutes per session. After the process, the achievement test on the OHS course and the attitude scale towards the OHS course were applied to a group of 50 students as a posttest.

3.5. Data Analysis

The analysis of the research results was done using SPSS 14.0. A t-test was applied to the independent groups and an anova test with two factors was used for the repetitive measurements in the analysis.

4. Results and Discussion

The findings pertaining to significant differences in the achievements and attitudes towards the OHS course between the experimental group with CBL method based on learning styles, and the control group with traditional methods, are given, and the research results are discussed in this section.

Table 8 displays the mean, standard error, and standard deviation, as well as the mode, median, and minimum and maximum scores on the pretest and posttest of the experimental and control groups.

Table 8. Statistical analysis of the achievement test results for the experimental and control group students.

Groups	**Exp. group (N=25)**		**Control group (N=25)**	
	Pretest	**Posttest**	**Pretest**	**Posttest**
Mean	31.20	60.80	34.00	51.40
Stand.Err.	01.30	02.17	02.21	01.69
Median	30.00	65.00	35.00	50.00
Mode	35.00	65.00	35.00	50.00
Stand.Dev.	06.50	10.86	11.08	08.48
Variance	42.25	118.08	122.91	71.91
Range	25.00	45.00	50.00	35.00
Minimum	20.00	30.00	20.00	30.00
Maximum	45.00	75.00	70.00	65.00

4. 1. The findings regarding the 1st subproblem

Hypothesis: Significant differences were not expected between the pretest achievement scores of the experimental and control groups.

Table 9 presents the pretest achievement scores of the experimental and control group students. It is seen that there is a difference (2.8 points in favor of the control group) between the average scores of the experimental and control group. In order to examine if the difference is significant, t-test is applied to the average scores of the groups and it is found 1.089. This value is below 2.009 at 48-degree of freedom and .05-significance level.

Consequently, the results of the independent samples t-test suggest that the difference between the groups is not significant ($t_{(48)}$=1.089, p>.05), verifying the hypothesis that significant differences are not to be expected in the pretest achievement scores between the experimental and control group students.

4. 2. The findings regarding the 2nd subproblem:

Hypothesis: Significant differences were expected between the posttest achievement scores of the experimental and control groups.

In order to test the effectiveness of the experiment, the posttest achievement scores of the experimental and control group students are examined. Table 10 presents the results of the paired t-test on the posttest scores of the experimental and control group students. It is seen that there is a difference (9.4 points in favor of the experimental group) between the average scores of the experimental and control group. In order to examine if the difference is significant, t-test is applied to the average scores of the groups and it is found 3.41. This value is over 2.009 at 48-degree of freedom and .05-significance level. These show a statistically significant difference in the average posttest scores between the experimental and control group students ($t_{(48)}$=3.41, p<0.001). According to the results, the hypothesis that significant differences are expected in the posttest achievement scores between the experimental and control group students was verified.

Table 9. The pre- and post-achievement test results for the control group students.

Group	Test	N	$\overline{X}$	Ss	Sd	t	p
Experimental	Pre	25	31.20	6.50	48	1.089	.281
Control	Pre	25	34.00	11.08			

Table 9. The pre-achievement test results for the experimental and control group students.

Group	Test	N	$\overline{X}$	Ss	Sd	t	p
Experimental	Post	25	60.80	10.86	48	3.41	.001
Control	Post	25	51.40	8.48			

Table 10. The post-achievement test results for the experimental and control group students.

Group	Test	N	$\overline{X}$	Ss	Sd	t	p
Experimental	Pre	25	31.20	6.50	24	11.76	.000
Experimental	Post	25	60.80	10.86			

Table 11. The pre- and post-achievement test results for the experimental group students.

Group	Test	N	$\overline{X}$	Ss	Sd	t	p
Control	Pre	25	34.00	11.08	24	6.05	.000
Control	Post	25	51.40	8.48			

4. 3. The findings regarding the 3rd subproblem:

Hypothesis: Significant differences were expected between the pretest and posttest achievement scores of the experimental group.

The results of the paired t-test performed on the pretest-posttest achievement score averages of the experimental group students were found to be statistically significant ($t_{(24)}$=11.76, p<0.001), as shown in Table 11. Therefore, the hypothesis that significant differences are expected between the pretest and posttest scores of the experimental group students was verified.

4. 4. The findings regarding the 4th subproblem:

Hypothesis: Significant differences were expected between the pretest and posttest achievement scores of the control group.

Table 12 shows the results of the independent samples t-test on the pretest-posttest achievement score averages of the control group students. According to these results, there is a significant statistical difference between the pretest and posttest scores of the control group ($t_{(24)}$=6.05, p<0.001). Therefore, the hypothesis that significant differences are expected in the pretest-posttest scores of the control group students was verified.

4. 5. The findings regarding the 5th subproblem

Hypothesis: Significant differences were expected between the pretest and posttest attitude scores of both the experimental and control groups with their attitudes towards OHS course.

Table 13 shows the results of the independent samples t-test on the pretest attitude score averages of the experimental and control group students. It is seen that there is a difference (1.08 points in favor of

the experimental group) between the average scores of the experimental and control group. In order to examine if the difference is significant, t-test is applied to the average scores of the groups and it is found .784. This value is below 2.009 at 48-degree of freedom and .05-significance level.

These indicate that there are no significant differences in the pretest attitude scores between the experimental and control students ($t_{(48)}$=0.784, p>.05). Thus, the hypothesis that significant differences are not to be expected in the pretest attitude scores of the experimental and control group students was verified.

In order to test the effectiveness of the experiment, the posttest attitude scores of the experimental and control group students are examined. The results of the independent samples t-test on the average posttest attitude scores of the experimental and control group students are presented in Table 14. It is seen that there is a difference (2.56 points in favor of the experimental group) between the average scores of the experimental and control group. In order to determine if the difference is significant, t-test is applied to the average scores of the groups and it is found 1.242. This value is below 2.009 at 48-degree of freedom and .05-significance level.

Table 10. The posttest results of the experimental and control group students on attitudes towards the OHS course.

Group	Test	N	$\overline{X}$	Ss	Sd	t	p
Experimental	Pre	25	62.36	5.16	48	0.784	0.437
Control	Pre	25	61.28	4.56			

Table 11. The pretest results of the experimental and control group students on attitudes towards the OHS course.

Group	Test	N	$\overline{X}$	Ss	Sd	t	p
Experimental	Post	25	62.36	7.59	48	1.242	0.220
Control	Post	25	59.80	6.97			

These suggest that the difference between the groups is not significant ($t_{(48)}$ = 1,242, p> .001). The hypothesis that significant differences are expected in the posttest attitude scores between the experimental and control group students was therefore not verified. The research results show that CBL method based on learning styles is more effective on individuals compared to traditional methods. The method might offer successful outcomes in many professions that includes upper levels of cognitive area (analysis, synthesis, assessment, etc.), and based on application and skill. If the importance of human factor is considered in occupational accidents, the application of the method on employees who work in the professions which are application oriented, and have high vital risk ratio, might contribute to reducing the risk. Moreover, the social skills of a person can develop, such as his motivation with regard to his job, his self-confidence, his collaboration with group, etc, since the method is individual centered. The method can be used for the pre-service and in-service education of the personnel.

In order to implement the method, the related sample case scenarios should be generated after the learning styles of persons are determined. The scenarios and education context should be arranged according to the targets that need to be earned. For example, a distinct type of case that has often occurred in Turkey can be given as a sample to the candidates who will work in the construction industry or to the existing personnel in the business. Role-shared scenarios, related to a person who died falling from heights during a constructional work can be produced. The scenarios should include the legal parts of the responsibility, expose the failures, and study the experienced incidents before and after the accident. For the areas of engineering, health, law, etc., the various scenarios can be generated.

5. Conclusion

Education has a key role in decreasing occupational accidents and professional illnesses. The OHS course is a very important issue for both employees and engineering students. Therefore, from the primary school to the university, OHS has to be taught as a primary subject in all the educational institutions. In addition, various projects should be produced to develop and embrace the OHS culture in the society. For this purpose, the goals of OHS education for the middle and long term should be determined, and the realization of these aims should be pursued.

The traditional methods include so much laws and theoretical expressions, restricting the learners' acquisition of knowledge on this matter. OHS training requires new approaches for students to gain permanent behaviors, taking into consideration their

learning styles and abilities. The CBL method, which is one of the new approaches to OHS education, should therefore be explored by researchers. Thus, instructors who may want to integrate this method into their course would have a good database to turn to. This study serves as a helpful reference for researches related to the subject.

The effects of the CBL method based on learning styles and of the traditional learning method on students' achievement are investigated in this paper. The obtained results show a significant difference between the pretest and posttest achievement scores of the experimental and control groups in favor of the experimental group, while there is no significant difference between the pretest and posttest attitude scores of the experimental and control groups. However, since no studies on the subject are found in the literature, the obtained results could not be associated with related works. Consequently, this research proves that using the CBL method based on learning styles in OHS training is more effective and useful than applying traditional methods. Hence, the CBL method is proposed as an efficient approach to OHS education.

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APPENDIX

ELK 135 OCCUPATIONAL HEALTH AND SAFETY

Program/Department:	Electrical Education	Type:	Must
Level:	Undergraduate	Semester:	2
Credits:	2	ECTS credits (workload based):	2
Course hours (weekly):	2	Practical contact (weekly):	-
Internship work:	-	Examination hours:	2
Lecturer:	Prof. Dr. F. ARAS	Language of Instruction:	Turkish

Objective:
The aim of this course is to provide students with background information on the Occupational Health and Safety.
Learning Outcomes:
At the end of the course, students should understand the following:
The basic concepts connected with health and safety
Health and safety problems and their solutions
Occupational accidents and diseases: definition, causes and prevention methods
Health and safety signs
Personal protective equipments
Contents
1-Introduction
2-The basic concepts connected with OHS.
2-OHS legislation in Turkey.
3-ILO convention and recommendations, EU directives and application
4- Occupational accidents: definition, causes, and prevention methods.
6- Occupational diseases: definition, classification, causes, medical treatment, and protection.
7- Exam
8--Personal protective equipments.
9-Health and safety signs
10-Potential hazards and possible harmful effects on workers.
11-Risk assessment methods
12-Risk assessment studies
13-Technical inspection, expertise on claims about occupational diseases and accidents.
14-Reporting all hazards, near misses, incidents, and injuries
15-Final exam