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A Training Program to Develop Concepts and Skills Related to Occupational Health and Safety Issues for Workers in Photovoltaic Power Plants

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Abstract

The fundamental reason for the existence of risks and even the occurrence of most accidents is the factor itself, so it was necessary to train workers to fully adhere to prevention methods, apply precautionary measures for potential risks, spread preventive health awareness, how to manage work risks, and the importance of implementing regulations and legislation for occupational safety and health. So, the current research aims to propose a training program for the development of concepts and skills related to occupational health and safety issues for workers in the installation of photovoltaic power plants. To achieve this goal, the researchers prepared a list of occupational safety and health concepts and skills, identified the general objectives of the program, then designed the general framework of the proposed training program related to occupational safety and health, prepared an achievement test and an Observation card. The training program and tools were applied to the research group, and the results indicated that there were statistically significant differences between the mean scores of the experimental group in the achievement test in the pre and post-measurements in favor of the post-measurement. In addition, there were statistically significant differences between the mean scores of the experimental group in the observation card of skills related to occupational safety and health in the pre and post-measurements in favor of the post-measurement.

Keywords

Occupational safety, occupational health, risks of installing photovoltaic stations, industrial security, training in occupational safety.

Introduction:

The interest in occupational safety and health has increased because it is the real focus of success and the rapid development of various aspects of work resulting from technological progress and modern industries. Laws and regulations have been legislated to protect the human element from the risks fraught with it. Workers' occupational health and safety behaviors and achieving the greatest measure of prevention will lead to reducing injuries and protecting workers and property from danger (Abdul Karim, 2019, 108).

Since the advent of human work, occupational health and safety risks have existed. And in the eighteenth and nineteenth centuries, it was recognized that all types of work are fraught with occupational health and safety risks, as happened in the industrial revolution in Europe. Gradually, the occupational scope of safety and health began to expand from diseases or injuries attributed to work and is determined by the nature of the work itself and the wider work environment. The occupational safety and health is divided into disciplines related to specific problems and applications in physiology, psychology, sociology, ergonomics, medicine and health, work safety, toxicology, epidemiology, and more (Abdul Khaleq, et al., 2019, 322).

Attention to the field of work in occupational safety and health is mandatory to keep pace with modern scientific progress and international laws and legislation, to reach the highest levels of protection. Employers of companies must provide the necessary capabilities to achieve the highest level of safety and prevention for workers, through a system and policy for occupational health and safety management. It helps protect human resources and important assets at work. It thus leads the business towards success and prosperity, by proactively preventing risks and minimizing losses (Zaid, & Zahran, 2019, 84).

Occupational safety and health regulations and policies concern the protection of workers and work property, and what the company produces. Personnel management has a long history of providing a safe working environment for employees. Naturally, work systems can affect competence and commitment and have future risks for individual well-being." There is some evidence to conclude that the design of work systems may affect physical health, mental health, and the longevity of life itself. This certainly increases the importance of occupational health and safety policies, laws, regulations, legislation, and work systems to reduce potential risks for all businesses (Abdallah, 2018; Al-Sayes, & Gogel, 2016).

This has been proven by many researches and studies on the importance of occupational health and safety and the importance of educating and qualifying specialists and workers in occupational health and safety procedures in their various aspects: A study (Tarawneh, 2017, 413) provided that workers and specialists in occupational health and safety are qualified by applying, developing and providing health and safety regulations and laws Occupational diseases due to their importance to the individual and society and the prevention of occupational diseases.

Said, et al. (2019, 8) and Abu Orabi (2019, 27) also recommended encouraging and providing educational and training programs that provide the appropriate scientific background for workers, occupational health and safety practitioners, and professionals to achieve more effective implementation of occupational safety and health regulations and procedures. Here, the role of specialized training programs is highlighted in the necessity of providing trainees with a set of skills, values, behaviors, scientific and professional knowledge, and different trends, in light of the requirements of occupational health and safety.

This is what was aimed and recommended by many researches through different angles, but all of them agreed in the end that training has a purpose and great importance for continuous

permanent motivation of workers to raise their efficiency and to continue their activity to improve productivity, and reducing accidents and injuries and addressing deficiencies and defects in performance (Na'em, 2022, 203). Abdul Muttalib (2018, 151) explained that training is the planned procedure; It has to raise the technical competence of the workers, which aims to modify the personal attitudes and develop the skills, abilities and knowledge of the workers to enable them to meet the requirements of production. De Wit, et al. (2022, 1064) also recommended the importance of training is evident according to many parties, including the importance of training for the workers, and occupational health professionals, as it is evident in improving the skills, behaviors. Al-Gharabli (2018, 110) explained training is also important for societies by improving the level of societal thought, and finally the importance of training according to its goals designed for each according to its exact specialization.

Research problem and questions:

In the light of the foregoing, the problem of this research is determined by the lack of familiarity of the workers in the installation of photovoltaic power plants with the concepts of occupational safety and health, as well as the lack of their behaviors in the skillful performance related to issues of occupational safety and health in the installation and maintenance of photovoltaic plants, which requires designing a training program in occupational safety and health suitable for those workers in installing photovoltaic power stations.

In light of the research problem, this requires answering the following questions:

1. What are the appropriate occupational safety and health measures that affect the skillful behavior of workers in photovoltaic power plants?

2. What is the proposed scenario for the occupational safety and health training program for workers in photovoltaic power plants?
3. What is the effectiveness of the proposed training program in acquiring the concepts and knowledge of occupational safety and health for workers installing photovoltaic power stations?
4. What is the effectiveness of the proposed training program in developing skills related to occupational safety and health among workers in photovoltaic power plants?

Research Objectives:

The objective of the research is to:

1. Identify the concepts and skills related to the occupational safety and health of PV plant workers.
2. Design a training program related to the occupational safety and health of PV plant workers.
3. Identify the necessary and appropriate occupational safety and health procedures for workers in photovoltaic plants.
4. Investigate the effectiveness of the proposed training program in developing concepts and skills related to the occupational safety and health of PV plant workers.

Research importance:

Occupational safety and health measures in the work environment play an essential role protecting individuals and property. The degree of workers' awareness of occupational safety and health procedures determines how these procedures and laws will be applied thus providing a safe work environment free from injuries, damage or property damage. Therefore, this research seeks:

1. Equipping the workers of photovoltaic power plants with a set of occupational health and safety concepts and skills that are suitable for them, which affects the extent of awareness of occupational safety and health procedures to reduce risks when installing and maintaining photovoltaic power plants.
2. Achieving some goals of occupational safety and health in preserving the elements of the production process represented in people, machines and raw materials, which in turn will reflect positively on photovoltaic power plants to reduce accidents and reduce workplace injuries.
3. To benefit the owners of photovoltaic power plant installation companies interested in reducing risks and work injuries by providing occupational safety training in the exact specialty of their field of work, which is the installation and maintenance of photovoltaic power plants.
4. Provide a standardized tool to measure the level of achievement of workers and another to measure the skills of workers for occupational safety and health, which can be used to measure the level of achievement of workers and their level of performance for other training programs.

Research delimitations:

This research was delimited to:

1. Some safety and occupational health measures required for workers installing photovoltaic power plants.
2. A sample of workers installing photovoltaic power stations at Anfal International Company in Qalyubia Governorate.
3. Measuring the level of workers' achievement of the concepts by the achievement test for procedures related to occupational safety and health at the levels of remembering, understanding, applying, analyzing, constructing, and evaluating.

4. Measuring the dimensions of the observation card for the skills associated with the occupational safety and health procedures, namely: health skills, occupational safety at the work site, safety in installing solar panels, safety in the cable and panel system, safety in installing system devices, safety in operation and maintenance.

Research hypotheses:

1. There are statistically significant differences between the mean scores of the experimental group in the achievement test in the pre and post-measurements in favor of the post-measurement.
2. There are statistically significant differences between the mean scores of the experimental group in the observation card of skills related to occupational safety and health in the pre and post-measurements in favor of the post-measurement.

Research Terms:

Concepts and skills:

Concepts in this research can be defined operationally as: A set of attributes, or facts common to things, and measured by the grades they obtain in the achievement test prepared for that. The skills in this research can be defined operationally as: The ability of workers in photovoltaic stations to implement occupational safety and health procedures in the installation and maintenance of photovoltaic stations, and it is measured by the grades they obtain in the observation card prepared for that.

Training program:

The training program in occupational safety and health can be defined operationally in this research as a set of specific and organized elements of goals, content, strategies, activities, and evaluation methods for the development of workers in photovoltaic power plants with a set of concepts, skills, knowledge and attitudes related to occupational safety and health to reduce risks and maximize the sustainability of work safety in photovoltaic plants.

Occupational Safety and Health:

Occupational safety and health can be defined operationally in this research as a set of concepts, skills, procedures, values, and behaviors related to occupational safety and health work to help workers to continue working safely without accidents affecting the health of these workers and assisting the employers to continue production without accidents that hinder work mechanisms by achieving the requirements, procedures, and objectives of occupational safety and health in photovoltaic power plants.

Research Methodology:

The current research used the following two approaches:

1. The descriptive analytical approach: to describe and analyze the literature related to the research subject and discuss, analyze and interpret the results.
2. The experimental approach examines the impact of the training program as an independent variable on the development of concepts and skills as dependent variables.

Research tools:

1. An achievement test to measure the employees' achievement of the concepts included in the training program.
2. An observation card for the skills related to occupational safety and health to measure the level of skill performance through the proposed training program.

Research procedures:

The current research proceeds according to the following procedures:

First: Determining a list of occupational safety and health procedures necessary for workers installing photovoltaic power plants, through:

1. Reviewing literature of previous studies, research, journals and periodicals related to the research subject: the components and devices of photovoltaic power stations, the characteristics of installing photovoltaic power stations, the potential risks facing workers in installing and maintaining photovoltaic stations and the characteristics, requirements, objectives and procedures of occupational safety and health.
2. Preparing a list of appropriate behavioral concepts and skills for those working in the installation of photovoltaic stations and presenting it to a group of arbitrators specialized in the educational and technical field to ensure its validity and put it in its final form, which is shown in the following table.

Table 1

Dimensions of the list of skills and concepts related to occupational safety and health for workers in photovoltaic plants

N	Main skills	Number of sub-skills	The relative weight of sub-skills	Number of concepts associated with the main skill	The relative weight of concepts
1	Checks the integrity of the tools used	6	%22.22	7	%22.58
2	Safety requirements are applied at the place of installation	5	%18.51	5	%16.12
3	Safety is applied in the construction of the cable and panel connections system	5	%18.51	7	%22.58
4	The battery bank shall be connected under occupational safety instructions	4	%14.81	5	%16.12
5	Evaluates work risks and procedures for dealing with various accidents	7	%25.92	7	%22.58
	total	27	%100	31	%100

Second: Designing the proposed training program

The researchers designed the proposed training program in occupational safety and health to develop concepts and skill performance of occupational safety and health procedures for workers installing photovoltaic power plants and submitting it to a group of experts and arbitrators to adjust them before implementation (objectives - content - training methods - education and training activities - training aids - evaluation methods).

The content was organized in the form of training courses in a logical manner to achieve the objectives of the training program. The content of the training meetings was distributed and organized in the form of five training courses that covered all the contents of the training program,

taking into account the extent and sequence in distributing the content, according to a specific time plan so that each training meeting is Two sessions, including a break, and the duration of the training meeting is four hours, as shown in the following table:

Table 2

The time plan for applying the research experience for the technician of photovoltaic power station installation companies

Meeting address	**Meeting topics**	**Time**
The pre-application of research tools		4 hours
Occupational health and safety in the workplace	Topic 1: the appropriate procedures for each work Topic 2: Personal protective equipment and how to check it Topic 3: electrical tools and tools and how to check them Topic 4: arranging the workplace in a safe manner Topic 5: Securing electrical connections and switches	4 hours
Safety in solar panel installation	Topic 1: Safety in carrying solar panels Topic 2: safety in the installation of solar panels Topic 3: Toxic internal components of solar panels Topic 4: Safety in the use of stairs and lifts Topic 5: Means of protection from tripping and falling	4 hours
Safety in building cable and panel installation system	Topic 1: Safety in cable laying and welding Topic 2: electrical protection and protection devices Topic 3: Electrical insulation of panels and cable ends Topic 4: Safety instructions and posters Topic 5: Preparing a first aid kit	4 hours
Safety in dealing with system devices	Topic 1: Safety in connecting the battery bank Topic 2: Safety in connecting electrical inverters Topic 3: safety in the network connection of the station Topic 4: Safety in connecting charging regulator devices	4 hours
Safety in operation and maintenance	Topic 1: the grounding network to protect the system and people Topic 2: Lightning arresters to protect the system Topic 3: Risk Assessment and Incident Dealing Procedures. Topic 4: fire prevention. Topic 5: Evacuation plan and how to locate a safe gathering	4 hours
The post-application of research tools		4 hours
total		28 hours

Third: Preparation trainer's manual and a trainee's manual:

- Preparing a book for the trainee's: A trainee's manual has been prepared that includes (an introduction dealing with the definition of training meetings - training objectives for each subject - training concepts and skills for each subject - training steps - training evaluation).
- Preparing a trainer's manual: The trainer's manual has been prepared and contains the planning of the experimental meetings explained in it (an introduction that deals with the definition of each meeting - the topics of each meeting separately - training concepts and skills for the topics of each meeting - the procedural goals to be achieved at the end of each topic - training resources - training aids - Training methods - Description of the training environment - The role of the trainer and the trainee during training according to the stages of the constructivist learning model - evaluation - enrichment activity).

Fourth: Preparing the two research tools and presenting them to experts and arbitrators, to adjust them before application:

1. Preparation of the achievement test:
    - The objective of the achievement test: The achievement test aims to measure the workers' achievement in the construction of the photovoltaic power plant in the concepts related to occupational safety and health. Determining the dimensions of the achievement test: The test included the five dimensions mentioned in the scientific content of the training program.
    - Developing test items: the test items were formulated in a multiple-choice style, and the test included (44) items in its initial form. These items were distributed among the topics of the training program according to their relative weights, so that they measure the levels of teaching and learning, and the test instructions were formulated.

- Validity of the test: By presenting the test to a group of arbitrators, the vocabulary belongs to the level of knowledge, and each vocabulary belongs to the objective associated with it and the validity of the linguistic formulation and the scientific accuracy of the vocabulary.
- Conducting the pilot study for the test: It was conducted on a group of workers at the Zaid Solar Company in the Dakahlia Governorate, consisting of (6) employees of the company, to calculate the following:
    - Calculating the reliability of the achievement test: Resilience refers to the real degree that expresses the individual's performance on a test each time it is tested, whether with the same test or an equivalent form that measures the same characteristic (Farag, 2012, 295). This was done by applying the achievement test to a sample of workers at Zaid Solar Energy Company in Dakahlia Governorate. Then it was re-applied to the same sample of workers after a two-week. The correlation coefficient between the sample scores in the two tests was calculated using the Pearson equation in the SPSS program version 2019, and the result of the correlation coefficient was 92.5. %, which indicates that the direct correlation is high, proving the achievement test's reliability.
    - Test time: The test time was calculated by calculating the time average between the times the workers finished answering the test. The test time was determined as 60 minutes, which is a suitable time for performing the test.
- Grading System: The test scores were determined by giving one point when choosing the correct answer from among the alternatives for each question and zero for anything less than that. Thus, the maximum score for the test becomes (44) degrees.

Thus, the final version of the test was developed, as it became an appropriate degree of validity, stability, and valid for application. The following table specifies the concepts test.

Table 3

Occupational Health and Safety Test Specifications for Photovoltaic Plant Workers

N	learning level / Experimental Meetings	Remember	comprehension	Application	Analysis	Installation	evaluation	Number of questions	Relative Weights
1	Occupational Safety at Work Site	3	4	3	1	-	-	11	25%
2	Safety in solar panel installation	4	2	1	-	1	-	8	18.2%
3	Safety in building cable and panel installation system	3	4	2	1	2	-	12	27.3%
4	Safety in dealing with system devices	-	2	-	1	1	1	5	11.3%
5	Safety in operation and maintenance	5	1	1	1	-	-	8	18.2%
	Total Number of questions	15	13	7	4	4	1	44	%100
	Relative Weights	34 %	%29.5	16 %	9.1 %	9.1 %	2.3 %	100 %	

2. Preparing the observation card:

- Determining the objective of the observation card: The observation card aimed to measure the performance of the employees of the photovoltaic power plant construction company when implementing the skills included in the training program.
- Determining the dimensions of the observation card: the elements of the card were formulated in the light of the objectives of the experimental program, which are occupational health and safety at the work site, safety in the installation of solar panels, safety in the system of cables and panels, safety in the installation of system devices, safety in operation and maintenance.

- Drafting of the items of the observation card: It was formulated in phrases arranged in a logical order, describing the trainee's behavior in performance so that it can be observed.
- Estimating the scores of the card: Thus, the estimate for the maximum score for each card was (90) scores, the average score was (60) degrees, and the score for the minimum end was (30) degrees.
- Formulation of card instructions: Card instructions were formulated to be clear and specific and not subject to multiple interpretations or interpretations. The researcher developed instructions for using the card, including: clarifying how to use the card and calculating the performance ratings for each skill according to the rating scale, the high-end score of the card, the total time of the card, and recording the data for each trainee.
- Validity of the observation card: This is part of the observation card on a group of arbitrators to judge the validity of the linguistic and scientific formulation of the phrases and make the necessary modifications, deletions and additions. In light of the arbitrators' opinions, the required amendments have been made, and the card is in its final form.
- Conducting a pilot experiment: it was conducted on six workers at the Zaid Solar Company in the Dakahlia governorate, to calculate the following:
    - Calculating the reliability of the card: by establishing the extent of agreement between the results of the observation reached by inter-rater reliability: the researcher to observe and score the participants in the skill test, and the results of the observation reached by another observer. The results showed that the value of the coefficient of agreement between the observers (researcher - observer) amounted to (83.3%), which is a high value indicating good stability of the observation card.

- Determining the time of the observation card: The time of the card was calculated by calculating the average of the times the workers finished implementing the skill, and the time of the card was determined (120) minute.
- Ensuring that card instructions and phrases, and skills are clear.

Thus, the observation card was characterized by high validity and stability and is applicable to the final form. The following table shows the dimensions of the observation card.

Table 4

Dimensions of the observation card for occupational safety and health skills in the installation of photovoltaic stations

Dimension	Main skills	Number of sub-skills	Relative Weights
First	Checks the integrity of the tools used	5	%16.66
Second	Safety requirements are applied at the place of installation	6	%20.00
Third	Safety is applied in the construction of the cable and panel connections system	8	%26.66
Fourth	The battery bank shall be connected under occupational safety instructions	4	%13.33
Fifth	Evaluates work risks and procedures for dealing with various accidents	7	%23.33
Total		30	%100

Fifth: The experimental study:

The steps of the experimental study are as follows:

1. Selection of a research sample of (6) technicians working for the Anfal International Company for the installation of photovoltaic power stations.
2. The pre-application of the achievement test and the observation card.

3. Teaching the proposed training program in occupational safety and health.
4. Post-application of the achievement test and the observation card.

Research results and interpretation

The present research aimed to develop the concepts and skills associated with occupational safety and health and the knowledge acquisition of photovoltaic power plant installers. To achieve this objective, the research hypotheses were formulated and to verify the validity of the assumptions, the researcher has undertaken several actions, as follows:

1. Result of the first hypothesis:

The first hypothesis reads as follows: *There is a statistically significant difference between the mean scores ranks of the experimental group in the achievement test in the pre and post-measurements in favor of the post measurement.*

To test the validity of this hypothesis, the achievement test was applied before and after teaching the training program Due to the small size of the sample, the non-parametric statistics represented by the Wilcoxon Test for related groups (Al-Sayed, 1978, 355) were used to calculate the value of (Z) for small samples, to verify the significance. The differences between the mean scores ranks of the pre and post-applications using the (SPSS) program, and the results were as follows:

Table 5

Results of the pre-post application of the achievement test on the research group and the effect size

Application	Ranks	N	The mean ranks	Total ranks	Z Values	Significance level	r Values	Effect size
Achievement test	Positive	0	-	-	2.214	0.05	1	High
	Negative	6	3.5	21				
	Equal	0	-	-				
	Total	6	-	-				

It is clear from the previous table:

- The value of Z is statistically significant at the level (0.05), which indicates that there is a difference between the mean scores ranks of the experimental group trainees in the pre and post-applications of the achievement test in favor of the post-application, which means the acceptance of the first research hypothesis.
- The value of r was (1.00), which is the binary correlation coefficient for the ranks of related pairs (Hassan, 2011, 280), which indicates the size of the effect of the independent variable "training program" on the dependent variable "achievement test," meaning that the size of the impact is significant.

Hence, the research answered the third question of the research questions, which is measuring the effectiveness of the proposed training program in acquiring the concepts and knowledge related to the occupational safety and health issues in the photovoltaic stations, for the workers installing the photovoltaic power stations.

2. Result of the second hypothesis:

The second hypothesis reads as follows: *There is a statistically significant differences between the mean scores ranks of the experimental group in the observation card of skills related to occupational safety and health in the pre and post-measurements in favor of the post-measurement.*

To verify the validity of the second hypothesis of the research, the observation card of the skills related to occupational health and safety issues was applied before and after teaching the training program. It was treated statistically using the Wilcoxon Text test for paired groups to calculate the value of (Z) for small samples to verify the significance of the differences between the mean ranks of the pre and post-applications. using the (SPSS) program and the results were as follows:

Table 6

Results of the pre-post application of the observation card on the research group and the effect size

Application	**Ranks**	**N**	**The mean ranks**	**Total ranks**	**Z Values**	**Significance level**	**r Values**	**Effect size**
the observation card	Positive	0	-	-	2.264	0.05	1	High
	Negative	6	3.5	21				
	Equal	0	-	-				
	Total	6	-	-				

It is clear from the previous table that:

- The value of (z) is statistically significant at the level (0.05), which indicates that there is a difference between the mean scores ranks of the experimental group trainees in the pre

and post applications of the skill performance observation card related to occupational safety and health in favor of the post-application, which means the acceptance of the second hypothesis of the research.

- The value of r was (1.00), which is the binary correlation coefficient for the ranks of related pairs (Hassan, 2011, 280), which indicates the size of the effect of the independent variable "training program" on the dependent variable "observation card", meaning that the size of the impact is considerable.

Thus, the current research answered the fourth question of the proposed training program's effectiveness in developing skills related to occupational safety and health among workers in photovoltaic power plants.

To interpret and discuss the previous results, the following can be concluded:

The proposed occupational safety and health program for the development of knowledge, concepts, and skills necessary for workers in photovoltaic power plants proved its effectiveness, and this was demonstrated through its application to the research sample, where the degrees of the post-application of the experimental group was higher than the degrees of the pre-application of the same experimental group.

- There was a statistically significant difference at the level (0.05) between the mean scores of the pre-test achievement test for the experimental group and the post-test for the same group in favor of the post-achievement test.
- There was a statistically significant difference at the level (0.05) between the mean scores of the observation card for the pre-application of the experimental group trainees and the

post-application for the same group in favor of the observation card for the post-application.

Achieving these results may be due to:

- The proposed training program is based on objectives identified in light of the characteristics and nature of work in the installation and maintenance of photovoltaic power stations.
- The proposed training program is based on the objectives, values and dimensions of occupational safety and health associated with installing and maintaining photovoltaic power plants.
- Including the content of the proposed training program for occupational safety and health procedures necessary for workers in installing photovoltaic power stations, which workers need in all construction works of the station.
- The training program in occupational safety and health has been prepared so that the share of each trainee is to understand and comprehend all occupational safety and health procedures included in the proposed training program.
- Using training methods that raised the trainees' motivation to learn and acquire concepts, knowledge, and skills related to occupational safety and health, as it relied on practical presentations, problem-solving and role-playing methods.
- Providing opportunities for experimentation, practice, and practical training for the trainees in the company's workshops and the construction site of one of the stations, which helped in forming concepts and acquiring skills for the trainees in a constructive way, and helped them to show their capabilities and acquire new behaviors that enhance occupational safety and health measures.

- The sample members' motivation, enthusiasm, and activity resulted from the exercises that the trainees implemented themselves, which the researcher felt from their interaction and interest in the program.
- The variety of teaching methods used in the program made the trainees feel renewed and effective, breaking the barrier of boredom that prevailed in traditional teaching methods.
- Practical application of the concept, where the concept was clarified theoretically and then applied in practice, helped acquire concepts and skills together to a large extent.
- The emotional bonds that linked the trainees with the researcher - as an electricity trainer - as he provided them with a suitable training environment through which the trainees felt love for the training topics.
- The speed of the trainees' response to the training, as they felt the improvement of their occupational health and safety behaviors in each training meeting and were able to implement some exercises according to the conditions and procedures of occupational health and safety, and to feel the importance of these procedures to preserve their safety, and to maintain the continuity of work performed at the specified time without interruption and the occurrence of work accidents.
- The use of methods of moral reinforcement during training, and the formation of human bonds between the trainer and the trainees based on acceptance and friendship and not domination and submission helped confirm the trainees' confidence in themselves and their abilities to continue working under occupational safety and health measures.
- Using the method of continuous evaluation throughout the training period, with attention to the quality of the questions that emphasize the trainees' acquisition of concepts and skills

related to occupational safety and health necessary in their field of specialization, which is the installation and maintenance of photovoltaic power plants.

The results showed a lack of knowledge of the workers in the photovoltaic power plants of the necessary occupational safety and health procedures for them, and the continuation of their work without awareness of the safety requirements, which exposes them to potentially work risks. Damage to property, equipment and the health of their workers.

Recommendations:

Based on the findings of the current research, the following recommendations can be suggested:

- Raising interest in designing training packages in occupational safety and health for specializations in the field of new and renewable energy to maximize and sustain the cleanliness of this type of station and be free of any risks.
- Providing material and moral support to the worker who adheres to occupational safety procedures while performing his work by the company's management.
- Activating strict regulations for fines and penalties for workers who do not comply with occupational health and safety procedures by the company's management.
- Activation of a policy of occupational safety and health, and interest from the management of photovoltaic energy installation companies by placing safety instructions and warning posters at work sites and internal workshops to avoid potential risks.
- The participation of the media, with its various devices, in raising awareness and guidance for all workers, technicians, and members of society about the importance of the role of

occupational safety and health towards themselves and returning to their families safely without injuries or accidents.

- Attention to the supplies and tools of personal protection in all workplaces and installation sites so that the worker can wear them before performing the work.
- Providing a first aid bag inside the companies' workshops and photovoltaic power stations installation sites, and paying attention to training workers using the bag's medicines and first aid work in the event of an accident.
- Attention to the means of extinguishing fires and the necessity of having fire extinguishers in the workplace, and the type of fire extinguisher must be compatible with the kind of potential fire.
- Developing a system for preparing and responding to emergencies.
- Measure and monitor OSH performance regularly.
- Establishing a system for investigating accidents, identifying their root causes, and developing corrective and preventive measures to prevent their occurrence again.

Proposed research and studies: The researcher suggests conducting the following research and studies:

- A proposed curriculum in occupational safety and health for students of industrial technical institutes and its impact on developing their scientific and skill concepts.
- The effectiveness of a program based on constructivist learning on risk assessment and management in developing the skillful behaviors, industrial secondary school students in occupational safety and health.
- The role of the occupational health and safety system in improving human performance in industrial establishments.

- Designing a proposed program to develop concepts and skills related to occupational health and safety issues for workers installing wind power plants.
- The effectiveness of a proposed occupational safety and health management program in light of the international standard OHSHAS 18001/2007.

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