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Effect of Practical Training on Engineering Education

Abstract *The laboratory training is one of the most important methods of the distinctive and fundamental role that stimulate the skills of creative scientific thinking and develop deductive and critical thinking to cope with the scientific developments and technological progress in the world. Therefore, it has been found that many researchers conducted at different levels of learners pointed to the importance of the inclusion of this type of teaching methods, Which makes the learner in direct contact with the artificial environment simulates what is happening in the laboratories and factories and areas of work related to their competence after graduation, which leads the student to be able to link the theoretical information received in the theoretical lesson with the information in the scientific laboratory. In this statistical work has been conducted for two categories of students, the first category was subjected to the experiment of scientific laboratories) scientific laboratories (to support the theoretical approach, and the second category is students who have been absent or not attended scientific laboratories so they did not acquire the skills of applied scientific work .it was found that clear differences between the two categories, where the first group responded positively to the theoretical test and a higher success rate compared to the second category. This study was conducted to evaluate the effect of the scientific laboratory (specifically the experimental laboratory) on the academic performance of under graduate students (junior and senior) of the Chemical Engineering Department at the University of Technology in Baghdad, For the academic year 2017-2018. The number of students Ranged from 24 to 26 students.*

Keywords-*: experimental training, engineering education, theoretical learning, academic performance.*

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1. Introduction

The basis of the success students is not the planning of the subjects of study, but the learning of a normal intellectual thought that makes them think of any problem of scientific thinking seriously and address the problem objectively addressed so the improvement of thinking desirable and desired by both the individual and the community because it is indispensable operations especially when faced with a problem that cannot be resolved by its usual behavior [1]. The virtual laboratories represent one of the technological innovations that have emerged in the recent years. [2].

The Science teaching aims to achieve the following objectives: [3]

-Obtain appropriate technical information.

-Developing the scientific thinking of the trainee students and problem solving abilities

-Enhancing the appropriate job positions for the trainee.

-Developing some functional scientific skills.

-Promoting scientific career trends.

-Enhancing appreciation of scientific attitudes.

These goals cannot be achieved properly without the effective use of the laboratories through the willingness of trainers to use the laboratory effectively.

Scientific laboratory equipment's allow students to interact directly with the data collected. Laboratory equipment's and supplies make teaching easier for trainers as well as for students. There are many theories and scientific concepts that are difficult to explain directly from text books. For example, physics and chemistry subjects have easy to understand, complex and accurate science theories, where laboratory training is frequently used to develop the skills required for more advanced research.

It has been noted that laboratory teaching enables students to acquire technical skills and apply concepts and theories presented in the theoretical lecture [4]. Some educators believe that the science subjects cannot be taught effectively without experimental work. Therefore, modern educational trends confirm the adoption of laboratory activities and experimental work, because the laboratory is physically linked to the scientific subjects required by practical laboratory experiments, and the achievement of the goals of education on the other [5].

The importance of laboratories in the engineering educational process has been noticed since 1987 when the first conference on educational development was held. It focused on the role of the laboratory in the educational process and examined the reasons for the unwillingness of trainers to use the experimental curriculum in teaching science.Emphasis was placed on the need to strengthen the role of the laboratory in the educational process, so that the ministries concerned in many countries of the world prepared plans and methodologies for this purpose. As a result, the curriculum was enriched by laboratory activities requiring the implementation of the pilot curriculum in education [6, 7].

2. The Interaction between the Theoretical and Practical Concept

Experiments help students to understand the chemical theories and principles that are difficult. Experiments also offer many opportunities for students, such as: safely and confidently handling chemicals, gaining practical experience in using tools and devices, developing scientific thinking and enthusiasm for chemistry, developing Basic skills for problem solving, development of investigative skills, identification of chemical hazards and learning to assess and monitor risks associated with them [8, 9].

The specialists in the scientific education and teaching science distinguished between two types of the laboratory in terms of performance and implementation as follows.

I. The Demonstration Laboratory

Emphasizes the implementation of scientific activities and laboratory experiments in an explanatory manner to scientific information previously learned or known by the student. This type of laboratory activity is based on the principle of closed-ended scientific experiments, in which the student implements the instructions given by teachers, and complies with the literal text.

II. Exploration laboratory – exploratory

Emphasizes the implementation of student's scientific activities and laboratory experiments in a survey - exploratory. Learning science and studying the investigation and discovery to solve problems. Thus, the student practices the methods of science and his operations, and reaches (under the guidance of the teacher) to scientific results did not know before. As for scientific information, it is a means and an end to the practice of science processes, skills and methods. Thus, science is taught as matter and not as material only [10, 11].

3. Modern Laboratory Components

The training in laboratories is an important and fundamental element in the success of the educational process in any educational institution. Therefore, the international universities have attached great importance to the integrated establishment of modern and advanced quality laboratories that contain all the devices, machines and equipment that establish a promising career (Smart Board) in each lab.

The universities have a large variety of laboratories, general and specialized laboratories, such as medical, engineering labs and computer labs, these labs contain the latest equipment and advanced machines that enable the student to apply scientific and practical and equip him with modern and advanced skills that enable him to join the labor market and compete strongly at the local and international levels. It has a specialized technical staff in all fields to work in these laboratories and provide services to students and researchers.

All laboratories are subjected to periodic reviews which include operational procedures, equipment and materials by the department of Laboratories at regular intervals. The model laboratory has high safety and security measures which supplied with fire alarm system. In addition to the traditional firefighting tools available at the university, the general symbols of security are available from the instructions of prevention, instructions, information, chemical hazard marks and warning marks. The students receive practical training on laboratory safety procedures and the code of conduct and binding instructions that must be respected and complied with. Safe for students in applied laboratories.

The laboratories and workshops are characterized by the use of multimedia electronics, which

provide an interactive learning environment. The laboratories are characterized by accuracy and speed, and a group of specialized laboratories covers the practical aspect of the theoretical materials given to students in various stages.

4. The Importance of Training Programs

The evaluation of the effectiveness of the training comes primarily to determine the extent to which the training program achieves its objectives and within the specified cost of training by measuring the training return of the program. However, some training officials in some organizations make the evaluation process sometimes limited to evaluating the trainers or evaluating the satisfaction of the trainees. The training program aims at promoting the commercial training programs and attracting the largest number of trainees to the training organization. In order to evaluate the effectiveness of the training programs objectively and comprehensively, the evaluation should aim to determine the extent to which these programs contribute to achieving the organizational goals and solving the problems for which the training programs were designed in an effective manne .[12].

The overall evaluation is not limited to the emphasis on the comfort of the trainer or the efficiency of the trainer, nor the cost of the program or the number of trainees, but should include in addition to all these aspects an integrated loop begins by analyzing the training needs and training objectives and ends with the process of measuring the results of training.

Training evaluation is a continuous activity and is an integral part of the training process. Therefore, training should be evaluated throughout all stages of the planning stage, which includes identifying training needs, designing training programs, evaluating the training during the implementation of the training programs and finally evaluating the training after the end of the training program.

The training evaluation should focus on the training programs and the methods used to implement them, the trainers and students, and the economics of the training. Finally, the results of the training should be based on the level of performance and the extent of its contribution to problem solving and the description of suitable solutions according to the following Figure 1 [13].

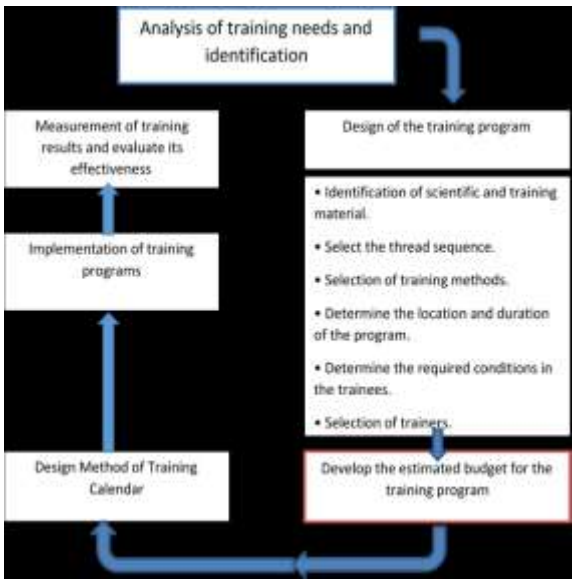

Figure 1: Shows the training programs from their inception to their implementation

5. Study the Effect of Laboratory Training on Engineering Education

In this study, junior and senior students of chemical engineering department were considered. These students have two labs which include heat and mass transfer lab. The students were divided in four groups as follows:

1. First group of the third stage chemical operations branch for heat transfer 24 students.
2. Second group of the fourth stage of oil and gas refining for heat transfer 25 students.
3. Third group of the third stage chemical operations branch for the mass movement of 25 students.
4. Fourth group of the fourth stage oil and gas refining branch for the mass movement of 25 students.

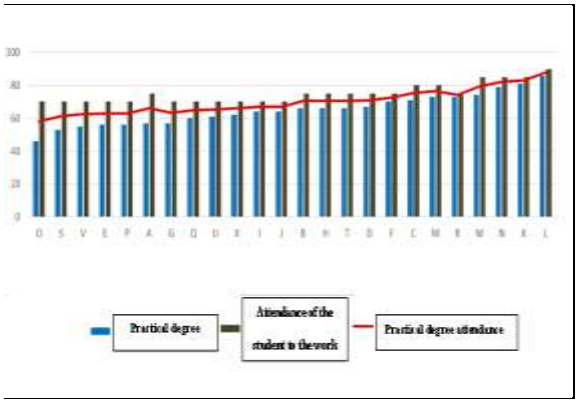

Figure 2: The relationship between the student grades and the number of attendance hours for students of the third stage – mass transfer / chemical processes branch

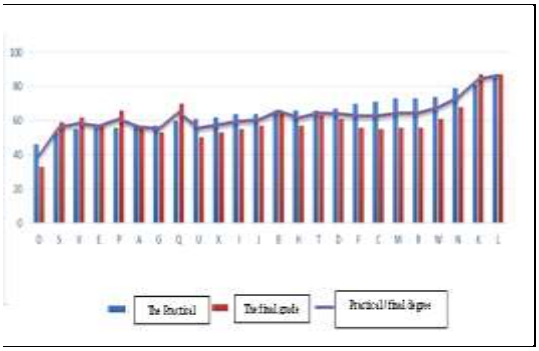

Figure 3: The relationship between the student grades and the final grade for students of the third stage – mass transfer, oil and gas refining branch

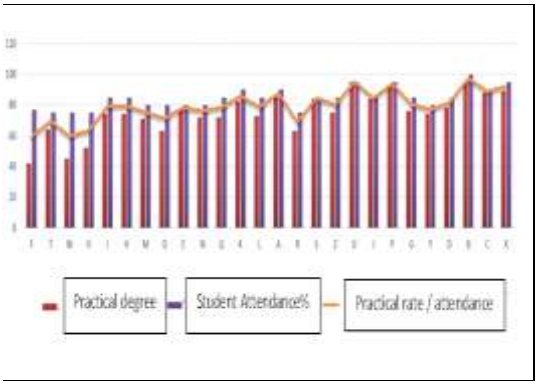

Figure 4: The relationship between the student grades and the number of hours of attendance for students of the fourth stage – mass transfer /chemical processes branch

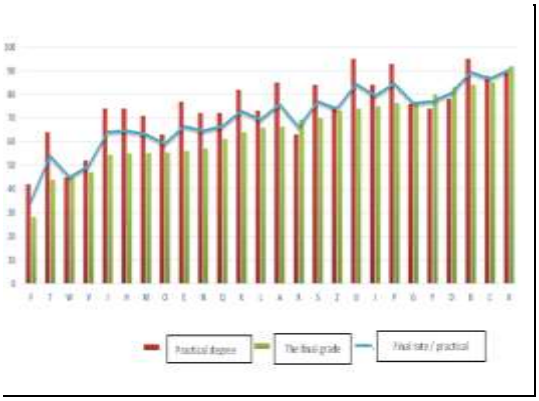

Figure 5: The relationship between the student grades and the final grade for students of the fourth stage – mass transfer subject, oil and gas refining branch

6. Results

According to the Figures 2 and 4, the relationship between the numbers of students, the attendance rate and the same segment of the laboratory over half a year. It was found that the attendance rate is directly proportional to the laboratory grade. This indicates that the practical training enhancing understanding and comprehension of the training program and consequently leading to good scientific outcomes.

Figures 3 and 5 presented the relationship between the students and the grades of the laboratory compared to the final grades of theoretical material, it was observed that the final grade increases when the hours of laboratory training is greater and this leads us to the conclusion of the first is to increase the degree of practical laboratory increases the degree The second conclusion is to expand the learner's perception whether he is a student or any other person for the future benefit of training. For example, the student is the subject of our research. The effect of training is:

1. Increase the final grade of the lesson.
2. The growing opportunity for innovation and creativity through the concrete work of the studied material and linking it to the reality experienced by the trainee.
3. It was found that effect on accompanying things such as linking science and creating creative energies to deal with modern machines and mechanization.
4. Learn patience in getting good results through continuous monitoring and evaluation
5. Raise the morale of students in scientific research through the success of training and obtain tangible results, raising the ceiling of the trainee to get higher grades or completion of graduate studies.
6. It was remarked that there was a big difference between the students who worked on modern devices and their peers who did not have the opportunity to work on the same equipment.

7. Economic Calendar for Training in Workshops and Laboratories

If the evaluation of the training program concludes that, the training is effective and correct. by coming to the economic evaluation of the training, which is to examine the suitability of the value or interest returned to the Ministry resulting from the training with the exercise of this effort of human and material carried by the Ministry to complete this training to determine the extent of achievement of the principle of economics of training or economic feasibility of training. The real results of the training can be evaluated by monitoring the change in performance for the trainees after the end of the training programs according to the type of program as follows:

•Use of time: Timely meetings scheduling and timely reporting are the result of training in a time-consuming program.

•Adhering to health and safety practices providing greater support to subordinates, increasing production and reducing waste,

resulting from programs aimed at effective supervisory or management practices, and project management programs.

•Working as a team instead of a group of individuals and harmony with each other is the result of collective development programs and personal skills and relationships people.

•Individuals provide themselves and better demonstrate their potential as a result of programs aimed at increasing creative capacities.

In order to achieve objective measurement of the aspects being monitored, these aspects should be compared to the pre-training position.

8. Conclusions

It is conclude that training and laboratory work is of great importance, especially with its positive impact on student achievement, development of skills, and building of scientific knowledge. Therefore, laboratory development, provision of materials for conducting experiments, encouraging teachers to take their students to laboratories, and trying to overcome obstacles that may be encountered and lead to their frustration and failure to do so should be undertaken.

9. Recommendations

In light of the previous presentation, and in order to ensure an objective evaluation of the effectiveness of the training, through which to know the extent of economic feasibility, the following recommendations can be listed:

1. It is necessary to use laboratory training in the teaching of science in general, and to coincide laboratory experiments with theoretical lectures in the same week because it supports the achievement of students at several levels.

2. Pay attention to the methods of identifying laboratories and training workshops, and try to design accurate and comprehensive models for this purpose, and be prepared in clear scientific methods, commensurate with the theoretical science taught.

3. Evaluation plan: Prepare a clear and clear plan for evaluation through grades at the near level and through the skills enjoyed by the graduate after training.

4. Objectives of Training: The objectives of the training programs are to provide logical training for the student in the labor market, in addition to its compatibility with what he studies.

5. Attempting to give students the opportunity to apply what they have learned through graduation projects or small research that assesses the student's ability in this aspect.

6. Emphasize the need to define the competencies and competencies of the trainers and not to leave them loose so that students can apply the training they have acquired for their specific work, and thus can determine the results of training seriously.

7. In the Western countries that the student studies binding scientific research without giving the utmost importance to the theoretical lessons that may have been adopted during the previous study and this is another evidence on the importance of the training side, giving us another reason to increase training hours to obtain a human product qualified for work and creativity..

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