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STATISTICAL EVALUATION OF E-LEARNING SYSTEMS DURING CORONAVIRUS PANDEMIC: A CASE STUDY

FADHIL A. ABIDI [1] AND ALI A. ALDHALEMI

ABSTRACT. The progress that has taken place in the fields of computers, communications and the Internet has enabled many universities and scientific and training centres to provide educational and training programs to more beneficiaries. E- learning became a possible reality (especially after the Coronavirus (COVID-19) pandemic) representing the most appropriate way to complete the curriculum and conduct assessments and examinations. Using E-learning in Al-Furat Al-Awsat Technical University in Iraq during COVID-19 pandemic needs to be evaluated by the beneficiaries depending on the points of view of teaching staff and students of the university. The research collected perspectives of a sample of 695 teachers and 5466 students and presented their responses on two questionnaire forms. Z test statistical analysis was conducted to assess the significance of the difference in responses of teachers and students. Teachers and students agreed on each of the need for more training workshops, the course material was theoretical only, and the need to enhance the practical side of the e-learning where the differences between the two samples are not effective (acceptance of the hypothesis (p-value> 0.05). Contrary to the students' opinion, 71% of the teachers want e-learning to complement traditional education and 76% of them believed that e-learning will be successful if the basic requirements are met.

[1]*corresponding author*

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1. INTRODUCTION

The methods of teaching are changeable through time, generations and circumstances, and the progress which has taken place in the field of computers, communications and the Internet has made it possible for many universities and scientific and training centres to provide educational and training programs to the beneficiaries. E-learning became a possible reality (especially after the Corona (COVID-19) pandemic) representing the most appropriate way to complete the curriculum and conduct assessments and examinations. COVID-19 pandemic indeed could be considered as a major turning point in the use of e- learning worldwide.

The e-learning term was originated in the mid-1990s when the Internet began to gather the momentum and the application of e-learning includes a computer-based learning as well as web-based learning [1]. E-learning also includes many of the different components that are very familiar with the traditional learning, namely, learner's presentation ideas, group discussions, arguments and other different forms that conveying the information accumulating knowledge [2].

Researchers suggested many definitions of e-learning as follows:

(i) E-learning is a wide set of applications and processes, such as Web-based learning, computer-based learning, virtual classrooms, and digital collaboration. It includes the delivery of content via the internet, intranet/extranet (LAN/WAN), audio and videotapes satellite broadcast, interactive TV, and CD-ROM" (ASTD definition as reported by Derouin [3]).

(ii) E-learning covers a wide set of applications and processes, including multimedia online activities such as the web, Internet video SD-ROM, TV and radio. Students can use these materials to teach themselves" (Hassenburg, 2009 as cited in Titthasiri [4]).

(iii) E-learning refers to the use of computer network technology, primarily over or through the internet, to deliver information and instructions to individuals" [5].

(iv) E-learning is an approach to teaching and learning, representing all or part of the educational model applied, that is based on the use of electronic media and devices as tools for improving access to training, communication and interaction and that facilitates the adoption of new ways of understanding and developing learning [6].

(v) E-learning as the experience dimension of e-learning, which includes such factors as engagement, curiosity, simulation and practice" (Elliott Masie as cited in Behera [7]).

The importance of e-learning is to achieve a set of results, including [8]:

(i) Achieving educational goals with high efficiency, saving in each of time, effort and traditional infrastructure.
(ii) Achieving learning in ways that suit the characteristics of the learner in a fun and interesting way.
(iii) Provide rich sources of information that can be accessed in a short time.
(iv) Stimulates the learner in self-learning and self-repositioning skills in acquiring experience, knowledge and effective learning tools.
(v) Provide 24-hour educational materials by keeping them in different software engines and the student can refer to them at any time to increase learning.
(vi) The student is the centre of the educational process, unlike traditional education, which needs a classroom and a teaching room in which the teacher is the centre.

2. Research Problem

The lack of a clear picture of the level of dealing with e-learning among teachers and students at Al-Furat Al-Awsat Technical University (ATU) during COVID- 19 Pandemic and the future horizons for the development of this experience.

3. The Aim of the Research

The research aims to:

(i) Sustain communication with teachers and students to explore their reactions.
(ii) Analyze the experience of E-learning in ATU during COVID-19 pandemic using statistical methods.
(iii) Discover the positive side of the E-learning to strengthen it and identify the problems and obstacles which faced the teachers and the students to suggest solutions and answer the question of the problem of research.

4. Research Hypothesis

To answer the question of the problem of research and achieve its goals, it is necessary to develop a hypothesis that can be tested (proven or denied) about the uniformity of answers between the sample of teachers and the sample of students because of the questionnaire forms contained (11) similar questions. These responses reflect the points of view of teachers and students about the application of e-learning in the university this year and in the future. The suggested hypothesis was as follows: There were no significant (moral) differences between the points of view of teachers and students about the application of E-learning in the university.

5. Previous Studies

Abdullah and Al-Ani (2007) [9] conducted a field study at the Faculty of Education at Qaboos University to identify the positives and disadvantages of e-learning according to perspectives of students, and whether their views varies by gender, specialization, level of study, cumulative rate, place of residence, degree of computer knowledge, courses and average hours of Internet per week. The sample included 175 students representing 17.5% of the total community.

Hussein T. (2012) [10] presented an analytical study on the difficulties of adapting electronic education in Palestinian universities in Gaza according to point of view of teachers and students. The study included (208) teachers and (1028) students for the academic year 2011/2012 based on the statistical method of analysis and comparative tests between the opinions of teachers and students.

AlMulla A. (2016) [11] published a study to evaluate the experience of distance learning at the Malaysian Open University and the Faculty of Education for Girls in Saudi Arabia. She relied on the documentary records and information available on the website of the Malaysian Open University while relying on a random sample of the Faculty of Education for Girls through a random sample (30) survey form. The study showed that the most important quality factors in distance education are: good infrastructure, availability of physical and human expertise, versatility and quality of technology.

According to statistics from the United Nations Educational, Scientific and Cultural Organization (UNESCO, 2020) [12], two-thirds of the world's schools and

universities students have been affected by the total closures imposed by the governments of 143 countries due to the Corona pandemic (COVID-19). The survey conducted by the International Association of Universities (IAU) [13] showed that 59% of the universities surveyed had been closed and all of their activities had been suspended due to the COVID-19 pandemic. To address the impact on the teaching and learning process, two-thirds of these institutions have shifted from traditional (face-to-face) education to distance education (e-learning). A World Bank report [14] also noted that the closure of universities because of COVID- 19 pandemic in many countries of Europe and Central Asia had forced higher education institutions in these countries to quickly switch to distance learning to ensure the continuation of the teaching, learning and minimum examination process. This shift was easy in countries that have already been interested and invested in e-learning and digitization such as (Denmark, Estonia, Finland, France, and Germany) while others have encountered significant difficulties in this shift.

Bao W. (2020) [15] had completed a study of the state of online education at Peking University after it was shut down due to the COVID-19 pandemic. Six specific learning strategies were provided to summarize current online teaching experiences for university teachers who may conduct online education in similar circumstances. The study concluded five high-impact principles of online education: (a) a high link between online educational design and student learning, (b) effective delivery of online educational information, (c) appropriate and adequate support by faculty and teaching assistants to students; (d) high-quality participation to improve the breadth and depth of student learning, and (e) an emergency plan to deal with unexpected incidents of online learning platforms.

Hamad (2020) [16] developed a questionnaire to gather data from a sample of 366 university students in the United Arab Emirates who actively used the E-learning system. He concluded that each of subjective norms, perceived usefulness, perceived ease of use, enjoyment, and accessibility" are the vital predicators behind the intention of students for using E-learning systems.

6. STATISTICAL METHOD

The two forms were distributed through the online sites of the colleges and institutes of Al-Furat Al-Awsat Technical University (case study) and accessed by electronic link during the period from 15/5/2020 to 01/6/2020. The incomplete

answers were excluded. The number of respondents was 695 teachers out of 900 totals, which is a very good percentage (77%). The number of forms received from students with full information was 5466 covering various specializations of the university (medical, technological, administrative, agricultural, and arts) which represents 27% of the total number of students in the university (20245).

The first form included (22) questions (4) of them contained general information like gender, specialization, scientific rank, and name of college or institute. The other questions covered different aspects of E-learning and the response was either (Yes or No) or multiple choice. The second form included (23) questions (3) of them contained general information like gender, specialization, and name of college or institute. The other questions covered different aspects of E-learning and the student response was either (Yes or No) or multiple choice. The 11 similar questions (mentioned in the research hypothesis) and percentages of their positive responses are summarized in Table 1.

Z test count has been relied upon to test the extent of conformity between the perspectives of the teachers and students through the following mathematical formula Eq. (6.1) [17, 18]:

$$Z_c = \frac{\hat{p}_1 - \hat{p}_2 - Ho}{\sqrt{\hat{p} * (1 - \hat{p})(\frac{1}{n_1} + \frac{1}{n_2})}}. \tag{6.1}$$

The hypothesis is rejected if p-value <0.05. Minitab version 17 is used to analyze the results and computing Z test and P values. The interface of this program is shown in Figure 1 and Figure 2.

7. Results and Discussion

The responses of teachers and students were collected, classified according to general information and type of response for the rest questions, and converted to an EXCEL(.XLSX) file to compute the percentage of different responses. The data was then analyzed by adopting the inference statistical formula (Z test technique) as mentioned earlier.

7.1. **Responses of Teachers.** To facilitate the process of discussing the results, the responses were compiled according to the similarity of information in the questionnaire form as follows:

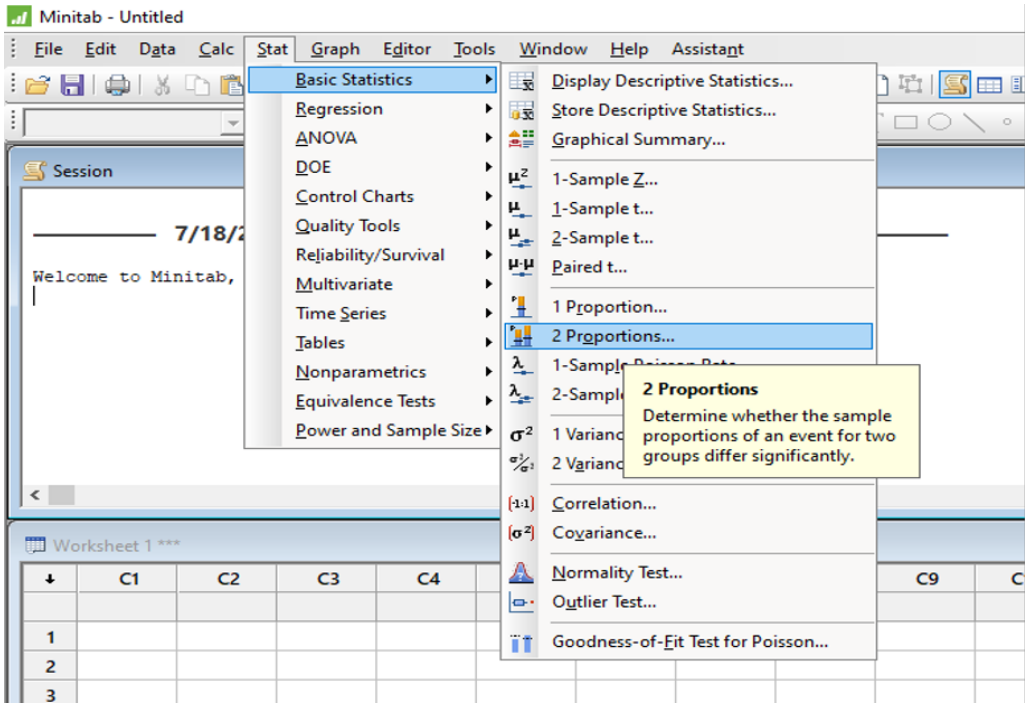

FIGURE 1. Procedure to test two proportions in Minitab

7.1.1. *General information.* The ratio of female teachers who responded to the questionnaire (58%) was higher than that of males (42%) although the total number of male teachers in the university is higher than the total number of female teachers. Among different specializations, the technological specialization (42%) was the highest followed by administrative (27%). In the field of scientific title, the highest percentage of respondents was an assistant lecturer (53%) followed by a lecturer (24%). 6% of the sample were technicians as they are responsible for the practical aspect of the teaching process. At the level of the institutions, the technical institute/Babylon was the institution with the highest ratio of response (19%) followed by the Technical College -Musaib (17%) and the ratios of other institutions varied according to the difference in the numbers of their teaching staff.

7.1.2. *The Opinion about e-learning application.* Although 62% of the teachers had prior knowledge of e-learning, 74% of them responded that they need more training workshops (74%). Teachers benefited from the experience of e-learning with a high ratio of 91% and this supports their answer that 96% of them noticed a

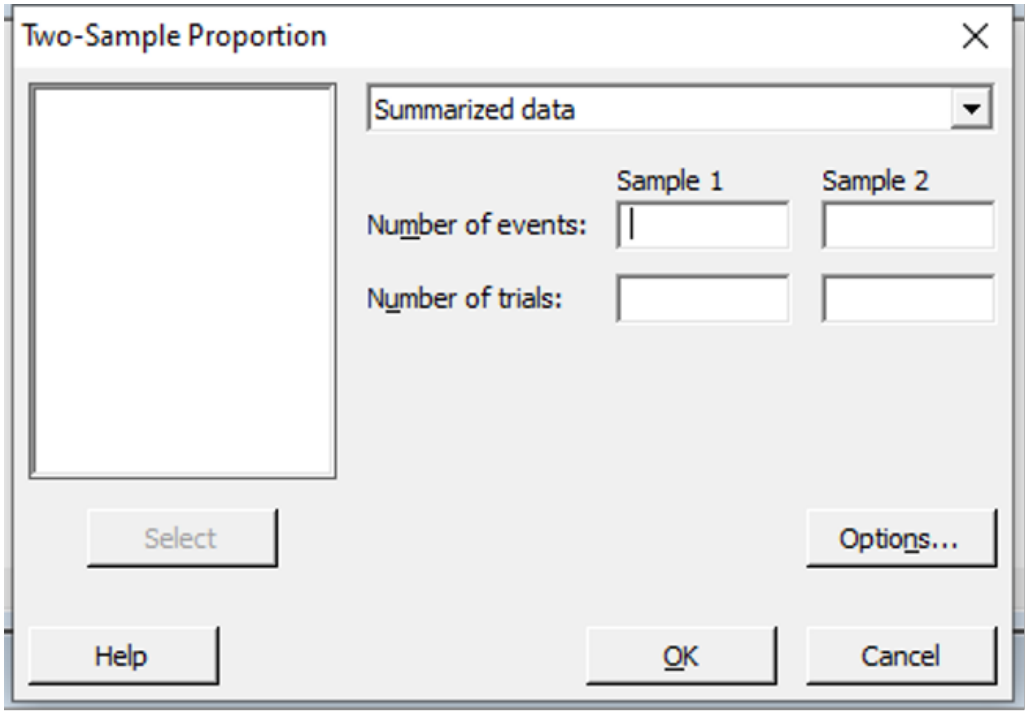

FIGURE 2. Dialogue screen to enter data in a test of two proportions in Minitab

difference between the method of e-learning and traditional (face to face) learning. 71% of teachers wanted e-learning to be a complementary part to traditional learning and 78% of them believed that e-learning will be a successful method when providing the requirements.

7.1.3. *The teachers' method in presenting the course material.* A very high percentage of teachers 88% responded that they explained the course subject with regular schedules and the theoretical materials represented 66% of the total lectures. Accordingly, there is a 34% of practical and applied materials which may include the solving of exercises, or video presentations for workshops, or laboratory experiments. ATU is a technical university interested in teaching skills as well as theoretical knowledge, and so the ratio of practical hours to total hours in the study plan usually ranges from (50-70)%. This meant that there is a shortage in the execution of the practical part of the curriculum when using e-learning which represents the main issue to be taken into consideration, and so 86% of teachers believed that there is a need to enhance the practical aspect of e-learning. 55%

of teachers responded that they showed videos through the lectures while 57% of them added voice to PowerPoint applications and 49% added voice to Word applications. 87% of teachers have dealt with Google Classroom platform while 55% rely in on Telegram in addition to Google Classroom. 39% of teachers believed that night is the best time for teaching while 38% of them preferred morning time.

7.1.4. *The extent of commitment and cooperation.* The teachers pointed out that the majority of students (63%) have a medium commitment with a low excellent percentage (14%) and therefore the acceptable commitment rate was 67%. This relatively weak commitment may be attributed to many factors such as poor infrastructure, and the weakness of the Internet signal. However, 87% of teachers themselves suffered from weak Internet signal although 41% of them pointed out that the reason for the lack of interaction of students with electronic learning is due to lack of desire or motivation. In the field of cooperation between teachers and scientific departments,69% of teachers felt good cooperation to solve problems facing them during e-learning operation while a ratio of 59% reported good cooperation with deanships of colleges and institutes. However, when adding the ratios of medium cooperation of each of the scientific departments and deanships, the ratios of cooperation will reach 94% and 89% respectively.

7.2. **Responses of Students.**

7.2.1. *General information.* The results showed that the percentage of female's students who responded to the questionnaire (52%) is higher than that of males, while the percentage of medical and technological specializations was equal (34%). At the level of institutions, the Technical Institute / Babylon had the highest participation rate (19%), then the Technical Institutes of Diwaniyah and Najaf (13% for each institute) and some institutes with very low percentages.

7.2.2. *The Opinion about e-learning application.* 75% of the students did not have prior knowledge about e-learning, and this was confirmed by their response to the need for more training workshops (75%). There is a negative response from the students about the benefit from the e-learning with a ratio of 67%, and this supports their answer of not relying on e-learning to be a complementary part to traditional learning (72%). This weak response may be because students were

not familiar with this type of education as it was the first time they deal with e-learning. Only 59% of students believed that e-learning will be successful when providing the requirements and 94% of them experienced a substantial difference between e-learning and traditional face to face learning.

7.2.3. *The teachers' method in presenting the course material.* Apart from teachers' responses, 51% of the students answered that the material provided by the teachers was condensed and (60%) of them answered that it is not given in regular schedules. This can be attributed to the fact that the application of e-learning in ATU begun after a period of students' stopping attending lectures due to the demonstrations that began at October 2019 and later the Iraqi Government imposed lockdown (totally and partially).To compensate for this long period of stopping study and to complete the curriculum, teachers were forced to intensify the lectures and adding the missing units. Similar to teachers' opinion, students responded that a percentage of 65% was a theoretical subject and 81% of the sample answered that it is needed to enhance the practical side in e-learning. As for lecture broadcasting time, 56% of students received lectures at night, and 21% in the morning and 65% indicated that there were video lectures and 53% of them were transmitted via the Classroom platform and 48% by Telegram.

As for the students' ability to solve exercises and problems, 61% of them answered that they could not, and this response confirmed that 88% of them need more interactive lectures to be able to ask and discuss with their professors. Accordingly, only 50% of students were satisfied with the university decision to choose e- learning method to substitute the traditional method. The students in their responses attributed weak interaction with e-learning to different causes like weak Internet signal (35%), shortage of computers and smart mobiles (31%), lack of students' motivation (14%), as well as low experience of students and teachers in e-learning (15%). This negative response of students may be attributed to the exceptional circumstances which happened this year and the application of e-learning from the beginning of the academic year (in the coming year) will surely provide enough time to improve the ability of students to benefit from e-learning substantially.

7.2.4. *The extent of commitment and cooperation.* The students' opinion about the degree of cooperation of scientific departments in solving the problems facing them was very good through the total ratio of satisfaction (medium and good),

TABLE 1. Test of positive response ratios for the same questions in the two questionnaire forms

No.	Hypothesis	Teachers ratio	Students ratio	p-value	decision
1	Prior knowledge of e-learning	0.62	0.26	<0.001	Reject Ho
2	Do you need more training workshops	0.74	0.75	0.551	Not reject Ho
3	Did you get to benefit from the E-learning experiences	0.91	0.33	<0.001	Reject Ho
4	Do you want e-learning to be a complement to traditional education?	0.71	0.28	<0.001	Reject Ho
5	Do you expect successful e-learning when providing the requirements	0.78	0.59	<0.001	Reject Ho
6	The course material given was theoretical only	0.66	0.65	0.585	Not reject Ho
7	Do you need to enhance the practical side of the e-learning lectures	0.86	0.83	0.057	Not reject Ho
8	Was Google Classroom the most used platform in e-learning?	0.87	0.53	<0.001	Reject Ho
9	Was the weak internet signal the most problem you faced?	0.36	0.82	<0.001	Reject Ho
10	Do you think that some students have no interest in e-learning?	0.41	0.31	<0.001	Reject Ho
11	Was the Deanship of the institute or college cooperating well with you?	0.59	0.36	<0.001	Reject Ho

which amounted to 81%. The degree of cooperation and support from institutions' deanships was 83% as students responded. The high degree of cooperation of each of scientific departments and deanships reflects exceptional efforts conducted by all the staff of the university to overcome repercussions of COVID-19 pandemic and its impact on the education process.

7.3. **Statistical testing of the research hypothesis.** To test the research hypothesis according to the Z test method (Eq. (6.1)), Table 1 was prepared to show the ratios of positive responses of teachers and students on the same questions in the two questionnaire forms. The computed P-Values are also shown in this table.

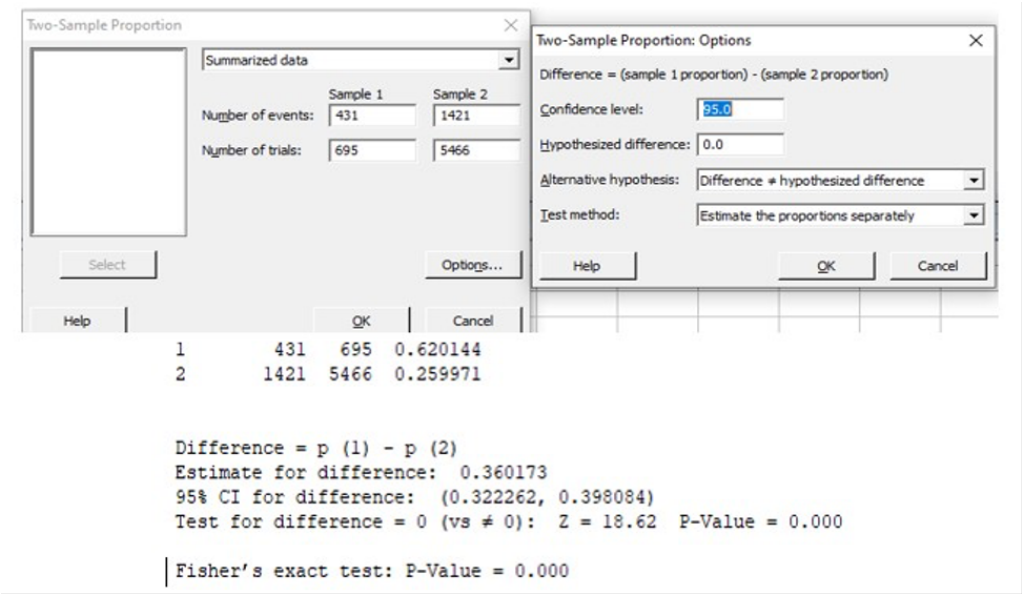

FIGURE 3. An example of a method for entering data and presenting results in a (two-proportions test)

From the above table, we notice that all the differences are significant (rejecting the hypothesis p-value <0.05), which means that it is influential and indicates a mismatch of opinion between the sample of teachers and the sample of students in all answers except for three cases only. These cases are the need for more training workshops, the subject was theoretical only, and the need to enhance the practical side of the e-learning where the differences between the two samples are not effective (acceptance of the hypothesis (p-value>0.05). These differences are illustrated in Figure 4.

8. CONCLUSIONS AND RECOMMENDATIONS

According to the results of the research and taking into consideration that because of COVID-19 pandemic, the application of e-learning in ATU came sudden and late and not from the beginning of the academic year. The results indicate that the percentage of females who responded to the questionnaire (teachers and students) is higher than the percentage of males. Although the teachers have prior knowledge of e-learning, (74%) of them indicated their need for more training workshops, and the students also agreed on the need for training. Contrary to the

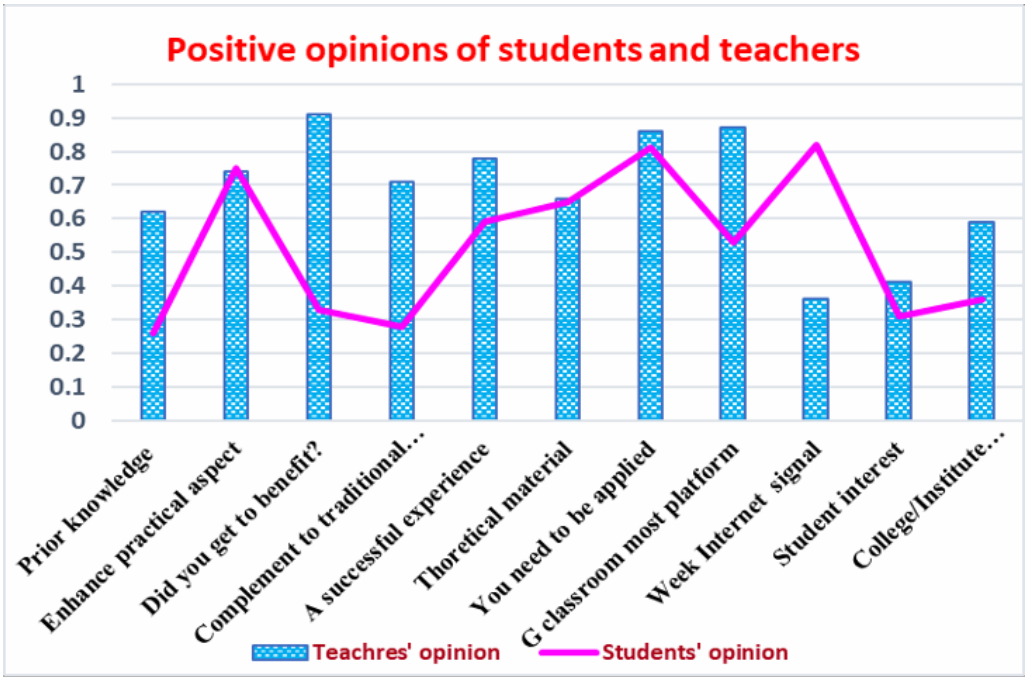

FIGURE 4. Comparison between positive opinions of the teacher's sample and the student's sample

students' opinion, 71% of the teachers want e-learning to complement traditional education and 76% of them believed that e-learning will be successful if the basic requirements are met. The teachers and students agreed about the need for more training workshops, the subject was theoretical only, and the need to enhance the practical side of the e-learning Teachers and students emphasized the weakness of the infrastructure for e-learning and the need for a strong internet signal. For these reasons, the students' response was weak to the e-learning method, and their satisfaction rate was 50%. Google Classroom was the most used platform for e-learning activities followed by Telegram platform. The scientific departments and deanships have made satisfactory efforts to cooperate with the teachers and support students to solve the problems they faced during the application of e-learning. The necessity of providing all the infrastructure requirements for electronic education such as electrical energy, the required equipment, strengthening the Internet signal, and reducing its cost for students and professors. The coming final examinations need more efforts for training workshops for each of professors and

students on the method of constructing questions, sending them to students, receiving the responses, evaluating answers, and the system of the examining committees. This may be implemented Via Google Classroom as it is the most used platform by teachers and students. Take all possible measures to prevent cheating in electronic exams and by the currently available methods to achieve scientific justice and integrity, including using oral exams as much as possible. Directing the colleges and institutes of the university to assess the students' conditions and their suffering due to the incomplete infrastructure of e-learning and to reduce their impacts on the student's score in the exam and on the graduate's rank and entitlements following the laws and instructions in force. We suggest that there be no reduction in the second attempt's degree. Adding new tasks to the departments of quality assurance and university performance to include performance standards regarding e-learning for universities and at the level of (scientific departments, training, academic courses of the college/institute, technicians and instructors, teaching content, evaluation and assessment). Adopting blended learning (traditional learning together with e-learning) in the coming academic year to get the advantage of each of the two types of education and to solve the issue of practical aspect and building skills especially in technical universities.

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MANAGEMENT TECHNICAL COLLEGE OF KUFA
AL-FURAT AL-AWSAT TECHNICAL UNIVERSITY (ATU)
NAJAF, IRAQ
Email address: abidy_fadhil@atu.edu.iq

ENGINEERING TECHNICAL COLLEGE OF AL-NAJAF
AL-FURAT AL-AWSAT TECHNICAL UNIVERSITY (ATU)
NAJAF, IRAQ
Email address: alialdhalemi@atu.edu.iq