# Non-parametric Statistical Methods to Predict the Benefits of Switching to E-learning, by Application on Saudi Universities

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**ABSTRACT:** The current research aims to use non-parametric tests to predict the benefits of switching to e-learning. Non-parametric tests (Chi-square goodness of fit, Chi-square independence and Kruskal Wallis) were used. For the empirical analysis, a questionnaire was used as a tool to collect data and distribute it in 8 Saudi public universities. The research questions included: What are the readiness students of switching to e-learning?  What are the most significance indicators of the positive and negative impact of switching to e-learning?  The findings indicated that (67.1%) of the students have a high the readiness. It  had been seen that the most significance of indicators related to the benefits of switching to e-learning are: (e-learning solves the problem of increasing the number of students, e-learning focuses more on knowledge, it reduces time, it is flexible, e-learning has succeeded in developing  programs, e-learning offers topics are well organized, it increases the sharing of experiences between students,  assessment methods are fair;  and it gives me enough time to think). The most significance indicators related to the challenges, are (e-learning prompted students not to underestimate the education, the professor can identify the negative student, the university provides a virtual library, I have get sufficient training , indirect communication does not affect the understanding , virtual laboratories have been activated,  there is no difficulty in submitting exams , the internet is strong in my area,  virtual classes are more effective,  e-learning helps in exchanging assignments, and the university provides technical support). The findings showed that the course content was the decisive factor of switching to e-learning. The findings can benefit for educators and policy makers for the effective implementation of e-learning in Saudi universities, through attention is paid to all indicators that have a negative impact. And adopting the positive indicators to encourage students to continue e-learning in the future.

**Keywords**: e-learning benefits, non-parametric tests, forecasting, traditional education.

## I. INTRODUCTION

The integration of technology into the educational process has become a global trend. The provision of educational materials via mobile devices has become a motivating factor for learning instead of being satisfied with traditional studies, as the student obtains the skills that qualify him to meet the needs of the labor market. Although the notion of online education has been in the agenda of researchers for a long time, however the extraordinary circumstances caused by the COVID-19 pandemic has made distance education compulsory worldwide and Saudi Arabia is no different. Nowadays, forecasting students' readiness to transfer to electronic learning has gained increasing attention from researchers in most countries. There are still raising questions about the possibility of delivering distance education in the future. Since the virtual learning system gets notable importance in Saudi Arabia during and after pandemic, it is pertinent to know the experiences of the students and most importantly predict the benefits of e-learning to obtain to accurately quantify the benefits of e-learning. In most Saudi universities, the technical requirements related to e-learning are available, but their

application is linked to several factors, the most prominent of which is related to the level of readiness of the educational elements to transform into the e-learning system [1]. E-learning has become a highly significant topic. It is considered the main challenge for many higher education institutions during recent years. The Saudi Ministry of Education offered many options for school and university students to study remotely. The first option the launch of "iEN" satellite channels. It is composed of 20 stations at the Prince Sultan bin Abdulaziz Educational Complex in Riyadh.  Students had full access to iEN channels by using the YouTube. The second option launching a platform, which provided synchronized interaction between students and teachers "Madrasti" [2]. The Saudi Arabia's government has thus invested in digital transformation, especially in that of e-learning (Unified National Platform, 2021).  Committed to such plans, significant investment was made in the sector of education during 2021, with 19% of the country's total budget allocated to its educational infrastructure. The Saudi Arabia has thus been ranked between the top ten developed countries globally for its network coverage and robust digital frame-work.  As for universities, e-learning system " Blackboard" has many fantastic features [3].

There is lack of agreement about the factors and critical challenges that shape the optimal usage of e-learning system. The challenges and limitations of accepting and adopting e-learning are: (Lack of tech support, institution readiness, quality course content, awareness, and less information technology skill of student, faculty members, self-efficacy, digital competence, lack of technological infrastructure) [4].  All previous challenges and obstacles have significantly affected the adoption of e-learning in higher education institutions. E-learning can contribute to sustainable development through reducing the need for physical classroom spaces and energy consumption, and it has the potential to reduce the costs, such as maintenance and transportation expenses. But there may be costs associated with implementing and developing e-learning programs. Although there were many studies in the field of e-learning in Saudi Arabia and abroad, accurately predicting the benefits of e-learning was frustrating, as most previous research lacked adequate statistical mechanisms to accurately predict. The choice of analytical method requires theoretical foundations and its use must be justified in the methodology in terms of the criteria for its use.  Therefore, there is a great need to conduct many studies to fill this research gap. Hence the novelty of this study despite the advantages of e-learning, many questions revolve around its effectiveness as a total alternative to traditional methods, and the extent of readiness for that, and what is the benefit of adopting e-learning? Therefore, this research seeks to predict the benefits of switching to e-learning using non-parametric statistical methods, by answering these questions, what is the level of readiness of students in Saudi universities to adopt e-learning applications? Are there statistically significant differences between real observations and expected results (which we want the benefits of e-learning to reach)? What are the most significance indicators that have a positive impact of the shift to e-learning? What are the most significance indicators that have a negative impact on the transition to e-learning? Often, research depends on realistic data in which it is difficult to identify the formula of the probability distribution that it follows. Therefore, statisticians have developed alternative statistical methods and methods (non-parametric methods). These methods do not require many assumptions or knowledge of the probability distribution of the populations from which samples are chosen. Also, one of their attractive features is that they fit data sourced from surveys or questionnaires.

## II. LITERATURE REVIEW

Prior to the pandemic period, previous studies showed that students did not care in e-learning for a long time and preferred traditional education [5-12]. However, during the pandemic, several studies have shown that students have developed a positive perception of online education and demonstrated a high level of acceptance [13, 14]. E-learning in emergencies is certainly different from a full online education system. There was much new research coming out of the various experiments during the Coved crisis, and most research outcomes are not somewhat near as bleak [15-17]. Blended learning is likely to become increasingly widespread across all educational fields [18]. Many researchers have raised questions about whether higher education decision-makers are prepared for the forthcoming virtual learning era [19,20].  Despite the advantages of e-learning, many questions revolve around its effectiveness as a total alternative to traditional methods, and what is the readiness for that?

There are many studies that reflect students' attitudes, expectations and assessments towards e-learning. In Saudi Arabia, some studies have demonstrated the importance of applying e-learning in graduate programs,

including a Sharidah study [21] conducted at Prince Sattam bin Abdulaziz University. Descriptive statistics and a T-test were used in analyzing the data. Results proven that the availability of devices supporting of e-learning within the college was average. Mansour's study [22] aimed to identify the reality of applying e-learning from the point of view of students at King Saud University. Descriptive statistics were used in the case study. The study reached many results, including the web net is the most used of the e- education. A cross-sectional inferential study of students of higher education institutions in Saudi Arabia and India was conducted by Jayendira et al. [23]. Structural Equation Modeling had been used in data analysis. The results showed that there is a positive correlation between the set of independent factors and the quality of e-learning. Studying Hoshan, et al. [24] based on the Multiple Decision Model in data analysis, by evaluating inputs and outputs from the point of view of students in Saudi universities. They found that the input axis was higher than the output axis. Ja'ashan [25] conducted a study at Bisha University. Descriptive statistics have been used in data analysis. The findings suggest that academic, technical, and administrative challenges are the main problems of distance learning. Karim and Hassan's study [26] aimed to understand the challenges and prospects of the virtual learning system from the point of view of undergraduate students at Prince Sattam bin Abdulaziz University. Descriptive statistics were used in data analysis, and the results showed that the majority of students supported virtual learning. The study of Atheer Ibrahim [27] also aimed to assess the Kingdom's experience in e-learning in light of the Corona pandemic from the point of view of parents in the city of Riyadh. Descriptive statistics were used to obtain the results. The study found that the experience of distance education was a success. A study by Fadi Al-Qudah [28] aimed to assess the quality of distance learning, and its impact on satisfaction of Taibah University students. Structural equation modeling method was used in data analysis. The results showed that overall trends towards e-learning quality were high. The bone study [29] examined the reality of e-learning in Saudi universities. Ten research studies were collected to determine how successful distance learning has been. The researcher used descriptive statistics in data analysis. Many positive results reflected student satisfaction. Two studies of Al-Harbi [30] and Al-Maliki [31] investigated the effectiveness of distance education provided at the University of Jeddah. Descriptive statistics and ANOVA test were used. The results showed that the students' evaluation of the quality of distance education came with a high score in all fields. Chata et al. [32] aimed to highlight student and faculty issues to address technical challenges, at the Prince Sattam Bin Abdulaziz University. Descriptive statistics were used in the case study. The results indicated that the majority of faculty members conducted virtual classes to their satisfaction and expectations of students. A study of Alturki and Aldraiweesh [33], investigated the effects of a many of parameters discovered in the literature on the use of blackboard platform, as a sustainable education using self-efficacy and student problems-solving abilities, at King Saud University. Structural Equation Modeling (SEM) was used in analyze the data. The results of the study provided background information on how colleges can improve student acceptance using Blackboard systems as a model for sustainable education. Almutairi and Al-Saqri study [34] sought to identify the factors affecting the reality of e-learning in Saudi Arabia from the point of view of Twitter hashtag users. Descriptive statistic was used in a case study. The results showed that the social factor leads in influence, followed by the technological factor, then the health factor, and finally the economic factor. According a studies globally, the most pressing problems facing online learning include technological knowledge, a sense of isolation, a lack of support, and personal issues such as discipline and motivation [35-37] . On the other hand, an e-learning system provides many benefits to learners such as easy access to learning materials, flexible learning, more interactions between students, and cost-effectiveness [38]. For example: Syndyani et al. [39] evaluated the effectiveness of distance education on medical students in Jordan. Descriptive statistics were used in the case study. The results indicated that traditional teaching is still preferred. Beltkin [40] examined the efficiency of the distance learning system in Turkey. T-test, F-test and Pearson correlation coefficient were performed. The results indicated that the courses taught in e-learning are not as practical as face-to-face instruction. A study by Siron et al. [41] aimed to examine the factors influencing the use of e-learning in Indonesia. Descriptive statistics and the F test were used in the case study. The results provided an

implicit indication of the importance of e-learning adoption factors. A study by Alipio,[42] focused on descriptive assessment of e-learning readiness in higher education students in less economically developed countries. Logistic model was used to determine the relationship between Demographic characteristics and e-learning readiness. Most respondents answered "no" on all items. Yuan [43] described university student satisfaction with online learning in Malaysia that most students have a positive attitude. The research focused on descriptive analysis. A study by Sambo et al. [44] aimed to assessed the effectiveness of online learning by students at universities in Zimbabwe. The data has been graphically presented. The results indicated that different e-learning platforms should be introduced. Hatthottuwa and Rubasingha [45] focused on determining the feasibility of adapting to e-learning in Sri Lanka. The data was analyzed using regression and logistic regression analysis. The study found that college students were more likely to use smartphones. A high percentage of students would like to use e-learning in the future. Ivana Kovacevic. et al. [46], provided a summary of student satisfaction predictions for e-learning in emergencies. The research was carried out in the faculties of engineering in Serbia. The F test was used. The results showed that the prediction can be achieved based on previous experience and the level of digital competence. As for Zigh et al. [47] focused on four main variables: effectiveness, cost, flexibility, and independent work, by analyzing the impact of e-learning on a sample of Algerian university students. Researchers concluded that e-learning provides students with a great degree of flexibility. According to Al-Shboul et al. [48], most students believe that the Coronavirus pandemic has changed the use of online education more, as perceived by students in Jordanian universities, where the study used t-test and an ANOVA test in data analysis.

## 1. CRITICAL ANALYSIS FOR LITERATURE REVIEW

Looking at previous studies, we were to find very few published papers based on a survey of all Saudi universities. In addition, this is not in line with the great effort made by the Ministry of Education to expand e-learning through many educational platforms such as Blackboard and Madrasati. In this context, the current study focused on all Saudi university students, with the aim of identifying their attitudes towards the benefits of e-learning, and monitoring its pros and cons. In addition, most of the previous research in Saudi Arabia and abroad focused only on conducting surveys and finding results, as it used parametric tests, such as (T test, ANOVA test, F test, Pearson correlation coefficient). In addition to structural equation modeling (SEM), and regression analysis, without attention to the use of appropriate statistical methods for data. To this end, non-parametric methods (Chi-square test for independence, Chi-square goodness of fit test, and kruskal-wallis test) were used to predict the benefits of switching to e-learning. Advantages of the chi-square test include its ease of calculation, robustness in terms of data distribution, flexibility, and detailed information that can be extracted. This richness in details leads to more accurate and simulates reality results. This research is important because it provides policymakers and educators with a fresh perspective on how to properly plan the adoption of an e-learning system, as a long-term approach to distance learning (a preplanned online education).In addition to advising researchers to use non-parametric statistical methods when the source of data is from surveys or questionnaires.

## 2. THEORETICAL BACKGROUND

The chi-square test is a nonparametric test, also called a free distribution statistic. It used to test relationships between groups when the dependent variable is measured at the nominal or categorical level. The purpose of testing is to determine whether the difference between variables is due to chance, or if it is due to a relationship between them. Constraints include relatively small sample size, difficulty in interpreting when there are large categories numbers (more than 20) in the dependent or independent variables, and lack of independence of observations [49-51]. There are two main types of Chi-Square tests:

## 3. CHI-SQUARE TEST OF INDEPENDENCE FORMULA

It is equivalent to Pearson's correlation coefficient (parametric test). The Pearson correlation is used when we have two quantitative variables, while the chi-square test of independence is used to determine whether there is a relationship between two nominal variables. For example, if there are two variables, measured in nominal form, that have only two planes A and B, and the observed values are a, b, c, d, the test statistic is [52, 53].

$$\chi_2^2 = \frac{n\,(ad-bc)^2}{(a+b)(c+d)(a+c)(b+d)} \tag{1}$$

## 4. CHI-SQUARE GOODNESS OF FIT TEST FORMULA

It is equivalent to one-sample t-test. The choice between the two tests will largely depend on the substance of the available research data. The purpose of Chi-square goodness-of-fit test is to determine whether the differences between the observed values and the expected values are due to chance, or whether the differences are likely to come from a particular distribution. Expected values are calculated on the basis that all categories have the same ratio (by default), or categories can have user-defined expected ratios. It allows drawing conclusions about population distribution based on the sample, and examines the hypothesis "are there statistically significant between observed values and expected values". The mathematical formula for the chi-square goodness of fit test is [54, 55].

$$\chi_k^2 = \sum_{i=1}^{k} \frac{(O_i - E_i)^2}{E_i} \tag{2}$$

$\chi^2$ : Formula instruction to sum the entire cell Chi-square test, k: Number of categories, $O_i$: Observed value, $E_i = npi$ = Expected value, or $= \frac{(Row\ Total) \times (Column\ Total)}{Total\ Number\ of\ Observations}$, pi: Expected proportion in category i, n: Sample size, K-1: The degrees of freedom

## 5. KRUSKAL WALLIS TEST FORMULA

It is equivalent to a parametric ANOVA test with the data replaced by the ranks. The Kruskal-Wallis test is used when ANOVA assumptions are not met. The test statistic is given by [56, 57].

$$H = (N-1) \frac{\sum_{i=1}^{k} n_i\,(\bar{r}_i - \bar{r})^2}{\sum_{i=1}^{k} \sum_{j=1}^{n_i} n_i\,(r_{ij} - \bar{r})^2} \tag{3}$$

$$Or\ H = \left(\frac{n-1}{n}\right) \sum_{i=1}^{k} \frac{n_i\,(\bar{R} - \bar{E}_R)^2}{\sigma^2} \tag{4}$$

Where $N$ is the total number of observations in all categories, $K$ is the number of categories, $n_i$ is the number of observations in category $i$, $r_{ij}$ is the rank of observation j from category, $\bar{r}_i = \frac{\sum_{i=1}^{k} r_{ij}}{n_i}$ is the rank means of all observations in- category $i$.

$\bar{r} = \frac{1}{2}(N+1)$ is the mean of all the $r_{ij}$ (n−1)+(n+1)/12, $\sigma^2 = \left(\frac{N(N+1)}{12} - \frac{\sum_{S=1}^{r} \tau_S^3 - \tau_S}{12(N-1)}\right)\left(\frac{1}{n_A} + \frac{1}{n_B}\right)$ is the rank variance, $\bar{R}$ is the rank mean sum in- category i.

## III. METHODOLOGY

After finalizing the research questions, we restricted the scope of the work to higher education institutions. 8 public universities were selected out of 29, using the cluster random sampling method. In this technique, first groups of clusters are selected and then respondents are selected from these groups. There is no bias into

research because the selection of participants for a study is random. The questionnaire was designed from relevant studies, shared in Arabic and administered using Google Forms [58]. The questionnaire has four domains. The first domain consists of 14 questions related to the course content. The second domain consists of six questions related to assessments. The third domain concerns economic benefits and consists of three questions. The fourth domain is related to the obstacles of e-learning benefits and consists of seven questions. Finally, one variable was added to the questionnaire to assess the overall. As well as a section on the demographic data of the participants. The evaluation criteria were created on three levels, on a 3-answer Likert scale (Disagree, Neutral, Agree) [59, 60]. Reliability and validity of the questionnaire [61-63]. A pilot study was conducted on 251 students, and Table (1) represents the statistic of persistence. The overall Cronbach's alpha reliability coefficient of 0.905, shows that the scale used in this search is internally consistent and reliable.

**Table 1.** Reliability statistics for scale

| Indicators | Cronbach's Alpha Based on Standardized Items | N. of items |
|---|---|---|
| Research domains | .913 | 4 |
| All research variables | .905 | 31 |

As for the validity of the scale, table (2) shows that the correlation coefficient of all indicators with the general average is statistically significant at the level of ($\alpha = 0.01$), except for question No. (3) (e-learning is suitable for teaching theoretical subjects only), so it will be deleted. Arteaga [64] advises such exceptions, stating that indicators that do not agree with the general direction of the scale should be removed, as they are likely to cause statistical results to be erroneous. The results showed that the scale is a reliable and valid measurement tool to measure the benefits of e-learning in Saudi universities. As shown in table (2). Then data analysis was performed using the Chi-square test for independence, the Chi-square goodness of fit test, and the Kruskal-Wallis test (non-parametric tests). For comparison purposes, widely used parametric tests, namely Pearson correlation coefficient, one sample t-test, and (ANOVA) test were used. Finally, the statistical methods are compared based on the details of the information that the chi-square statistic can provide. The analysis was conducted with the help of SPSS version 23.

**Table 2.** Questionnaire and Spearman's rho Correlation Coefficient for test validity for scale

| N. | Indicators | Correl. Coef. | P. value |
|---|---|---|---|
| | Course content | | |
| q1 | E-learning offers topics are well organized and informative learning | .550** | .000 |
| q2 | E-learning is appropriate for teaching practical course | .461** | .000 |
| q3 | E-learning is suitable for teaching theoretical course. | .003 | .919 |
| q3 | In e-learning, I can understand the information | .498** | .000 |
| q4 | E-learning focuses more on knowledge than skills | .320** | .000 |
| q5 | E-learning helps achieve learning outcomes objectives. | .566** | .000 |
| q6 | E-learning helps in exploring new methods of learning. | .466** | .000 |
| q7 | E-learning has succeeded in developing study programs | .562** | .000 |
| q8 | Virtual classes are more effective than real classes. | .624** | .000 |
| q9 | E-learning increases the sharing of experiences between students | .613** | .000 |
| q10 | Indirect communication does not affect understanding of the lesson. | .615** | .000 |
| q11 | The Blackboard platform presents a course in an interesting way | .461** | .000 |
| q12 | Virtual laboratories have been activated. | .430** | .000 |

| | | | |
|---|---|---|---|
| q13 | The university provides a virtual library as educational resources | .432** | .000 |
| | Assessments | | |
| q14 | E-learning gives me enough time to think and conclude | .616** | .000 |
| q15 | E-learning does help in exchanging assignments. | .381** | .000 |
| q16 | In e-learning, it is easy to submit assignments on time | .439** | .000 |
| q17 | In e-learning, I can follow up my assessments. | .519** | .000 |
| q18 | In e-learning, assessment methods are fair. | .550** | .000 |
| q19 | In e-learning, there is no difficulty in submitting exams. | .504** | .000 |
| | Economic cost | | |
| q20 | E-learning is flexible, in terms of time and location. | .536** | .000 |
| q21 | E-learning reduces time and effort, compared to traditional education | .465** | .000 |
| q22 | E-learning solves the problem of increasing the number of students. | .509** | .000 |
| | Obstacles | | |
| q23 | E-learning prompted students not to underestimate the importance education. | .576** | .000 |
| q24 | In e-learning, the professor can identify the negative student | .525** | .000 |
| q25 | I can send an email with an attached file easily. | .422** | .000 |
| q26 | The Internet is strong in my area. | .444** | .000 |
| q27 | The university provides technical support for students. | .598** | .000 |
| q28 | Educational topics submit without technical failure. | .637** | .000 |
| q29 | I have gotten sufficient training to use e-learning tools. | .527** | .000 |
| | Overall | | |
| q30 | If I had a choice, I would choose e-learning instead of classroom. | .598** | .000 |

**Correlation is significant at the 0.01 level (2-tailed).

## IV. DATA ANALYSIS

### 1. CHI-SQUARE TEST OF INDEPENDENCE

We The results indicated in table 3. that more than half of Saudi university students have a high level of conversion to e-learning (67.1%). Through the Chi-square test of independence, we have proved beyond any doubt that there is a strong relationship between, if I had a choice; I would opt for e-learning instead of traditional education and demographics characteristics, with the exception of the variable (e-learning tool).

This shows that most demographic variables have a significant influence on the student's choice of type of education, only a variable (e-learning tool) which influence is weak. For comparison, the Pearson correlation coefficient was used. It can be seen that it agrees with the Chi-square test for independence in two variables (university and training), and differs in three variables (gender, specialization, and learning tool). This does not reflect the students' views as found in the real data and does not reflect reality, because gender and specialization have a strong relationship in the student's choice of teaching method.

**Table 3.** Results of the chi-square for independence test and the Pearson correlation coefficient

| Demographic characteristics | (Sample size= 971) | | | | | | Chi-square test | | Pearson corr. | |
|---|---|---|---|---|---|---|---|---|---|---|
| Responses | Disagree | | Neutral | | Agree | | Total | stat. | P- Value. | stat. | P- Value. |
| University | | | | | | | | | | |
| Prince Sattam | 11 | (1.1) | 25 | (2.6) | 119 | (12.3) | 155 | (16.0) | | | |
| Najran | 5 | (0.5) | 18 | (1.9) | 80 | (8.2) | 103 | (10.6) | | | |
| King Khalid | 5 | (0.5) | 20 | (2.1) | 90 | (9.3) | 115 | (11.8) | 300.1 | .000 | -.234 | .000 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| King Saud | 9 | (0.9) | 24 | (2.5) | 98 | (10.1) | 131 | (13.5) | | | | |
| Al Jouf | 11 | (1.1) | 30 | (3.1) | 99 | (10.2) | 140 | (14.4) | | | | |
| Princess Nourah | 7 | (0.7) | 20 | (2.1) | 85 | (8.8) | 112 | (11.5) | | | | |
| Taibah | 6 | (0.6) | 17 | (1.8) | 79 | (8.1) | 102 | (10.5) | | | | |
| Tabuk | 5 | (0.5) | 106 | (10.9) | 2 | (0.2) | 113 | (11.6) | | | | |
| Sex | | | | | | | | | | | | |
| Male | 14 | (1.4) | 120 | (12.4) | 211 | (21.7) | 345 | (35.5) | 19.3 | .000 | .049 | .126 |
| Female | 45 | (4.6) | 140 | (14.4) | 441 | (45.4) | 626 | (64.5) | | | | |
| Specialization | | | | | | | | | | | | |
| Scientific | 35 | (3.6) | 174 | (17.9) | 415 | (42.7) | 624 | (64.3) | 34.5 | .000 | .004 | .904 |
| Human | 24 | (2.5) | 86 | (8.9) | 237 | (24.4) | 347 | (35.7) | | | | |
| Training | | | | | | | | | | | | |
| Yes | 49 | (2.1) | 236 | (15.9) | 526 | (43.7) | 598 | (61.6) | 22.99 | .000 | -.137 | .000 |
| No | 10 | (4.0) | 24 | (10.9) | 126 | (23.5) | 373 | (38.4) | | | | |
| Learning tool | | | | | | | | | | | | |
| Phone | 17 | (1.8) | 75 | (7.7) | 223 | (23.0) | 315 | (32.4) | | | | |
| Laptop | 25 | (2.6) | 111 | (11.4) | 230 | (23.7) | 366 | (37.7) | | | | |
| IPod | 15 | (1.5) | 47 | (4.8) | 181 | (18.6) | 243 | (25.0) | 1.55 | .464 | -.042 | 191 |
| Desktop | 2 | (0.2) | 27 | (2.8) | 18 | (1.9) | 47 | (4.8) | | | | |
| Overall | 59 | (6.0) | 260 | (26.8) | 652 | (67.2) | 971 | (100) | 192 | .000 | 0.597 | .000 |

## 2. CHI-SQUARE GOODNESS OF FIT TEST

It is a reliable and scalable method, helps to achieve the research goal (Predict the Benefits of Switching to E-learning) . And it detects indicators affecting the benefits of e-learning. The following hypothesis will be tested: "There is a difference between the observed values and the expected values." In the current research, the overall indicator q30 (If I had a choice, I would choose e-learning instead of classroom.) was used to determine the expected values. (See table 4) . That is, we have a observed values that have been collected in advance, and an expected values that we hope to reach. Then it is the role of the test to determine if there is a significant difference between the observed values and the expected values. As for the research variables, they are an indicators of e-learning benefits, with three levels (disagree, neutral, and agree). The important assumption of the Chi-square fit test has been verified (the expected value for each category should be greater than to 5).

$$E_1 = np_1 = 971 (0.061) \approx 59 > 5, \textit{ so the model is appropriate} \tag{5}$$

**Table 4.** The expected values according to (If I had a choice, I would choose e-learning instead of classroom).

| Response | Disagree | Neutral | Agree | Total |
|---|---|---|---|---|
| Expected value | 59.2 | 260.2 | 651.6 | 971 |
| Expected proportion | 6.1% | 26.8% | 67.1 | 100 % |

$$H_0: P_1 = 0.061 \quad , P_2 = 0.268 \quad , P_3 = 0.671 \tag{6}$$

Where $H_A$, at least one $p_i$ is different about H.

**Table 5.** Chi-square goodness of fit and one-sample t- test to predict the benefits of the shift to e-learning

| | | Chi-square goodness of fit test | | | | | One-Sample t- test | |
|---|---|---|---|---|---|---|---|---|
| | Response | Disagree | Neutral | Agree | Chi-square | P- | The virtual value =2.5652 | |
| | Expected | 59.2 | 260.2 | 651.6 | statistic | Value | t statistic | P- Value |
| | | | | Course content | | | | |
| q1 | Residual | -49.3- | -48.2- | 97.5 | 34.988 | .000 | 13.474 | .000 |
| q2 | Residual | 377.7 | 263.8 | -641.5- | 4324.02 | .000 | -60.537 | .000 |
| q3 | Residual | -16.3- | -62.2- | 78.5 | .968 | .616 | 8.037 | .000 |
| q4 | Residual | -33.3- | 54.8 | -21.5- | 99.552 | .000 | 3.150 | .002 |
| q5 | Residual | -30.3- | -44.2- | 74.5 | 11.148 | .004 | 9.166 | .000 |
| q6 | Residual | -18.3- | -79.2- | 97.5 | 3.053 | .217 | 9.506 | . 000 |
| q7 | Residual | -48.3- | -98.2- | 146.5 | 42.822 | .000 | 18.168 | .000 |
| q8 | Residual | 24.7 | 29.8 | -54.5- | 94.999 | .000 | -1.904- | .057 |
| q9 | Residual | 24.7 | 29.8 | -54.5- | 33.627 | .000 | 12.786 | .000 |
| q10 | Residual | -48.3- | -43.2- | 91.5 | 178.254 | .000 | -4.538- | .000 |
| q11 | Residual | -33.3- | -50.2- | 83.5 | 12.791 | .002 | 10.155 | .000 |
| q12 | Residual | 75.7 | -52.2- | -23.5- | 164.903 | .000 | -2.586 | .010 |
| q13 | Residual | 108.7 | -41.2- | -67.5- | 320.334 | .000 | -5.661 | .000 |
| | | | | Assessments | | | | |
| q14 | Residual | -25.3- | -83.2- | 108.5 | 7.977 | .019 | 11.073 | .000 |
| q15 | Residual | -25.3- | -16.2- | 41.5 | 19.362 | .000 | 6.457 | .000 |
| q16 | Residual | -16.3- | -71.2- | 87.5 | 1.212 | .515 | 8.629 | .000 |
| q17 | Residual | -40.3- | -122.2- | 162.5 | 45.821 | .000 | 18.202 | .000 |
| q18 | Residual | -36.3- | -110.2- | 146.5 | 31.452 | .000 | 15.828 | .000 |
| q19 | Residual | 61.7 | -108.2- | 46.5 | 115.496 | .000 | 1.172 | .241 |
| | | | | Economic cost | | | | |
| q20 | Residual | -50.3- | -134.2- | 184.5 | 74.059 | .000 | 23.508 | .000 |
| q21 | Residual | -48.3- | -144.2- | 192.5 | 80.816 | .000 | 24.045 | .000 |
| q22 | Residual | -54.3- | -154.2- | 208.5 | 105.136 | .000 | 29.109 | .000 |
| | | | | Obstacles | | | | |
| q23 | Residual | 128.7 | 27.8 | -156.5- | 508.134 | .000 | -10.105 | .000 |
| q24 | Residual | 88.7 | 82.8 | -171.5- | 394.24 | .000 | -9.684- | .000 |
| q25 | Residual | -38.3- | -180.2- | 218.5 | 112.242 | .000 | 24.681 | .000 |
| q26 | Residual | -31.3- | -117.2- | 148.5 | 112.50 | .000 | 15.173 | .000 |
| q27 | Residual | 2.7 | 5.8 | -8.5- | 39.353 | .000 | 1.567 | .118 |
| q28 | Residual | -11.3- | 4.8 | 6.5 | 32.606 | .000 | 3.269 | .001 |
| q29 | Residual | 86.7 | 32.8 | -119.5- | 290.83 | .000 | -7.232- | .000 |

Under the null hypothesis, we hope that students' choice of e-learning proportions will be close to the expected proportions, in all the indicators. Table 5 shows that there is a statistically significant difference between the observed values and the expected values of all the indicators related to the course content, with the exception indicators q3 (In e-learning, I can understand the information , and q6 (E-learning helps in exploring new methods of learning) .Table (5) also shows that the indicators that negatively affect are arranged according to the level of statistical significance: q2 (e-learning is suitable for teaching practical courses), q13 (the university provides a virtual library), q10 (indirect communication does not affect the understanding of the lesson), q12 (virtual laboratories have been activated to explain materials that require laboratories), q4 (e-learning focuses on knowledge more than skills), and q8 (virtual classes are more effective than real classes), and indicator q5 (e-learning helps to achieve learning objectives and the quality of learning outcomes).

As for the indicators that have a positive impact are ranked according to the level of statistical significance: q7 (e-learning succeeded in changing programs according to the needs of the future),q1 (e-learning provides

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well-structured topics), q9 (e-learning increases the sharing of experiences between students), and q11 (The Blackboard platform presents a course in an interesting way ). This shows that the course content has not yet reached the percentage we hope for most variables. In some variables, the observed values were much lower than the expected values as q2 (E-learning is appropriate for teaching practical course), and in some variables, the percentage was higher than the expected value as q7 (E-learning has succeeded in developing study programs). As for the e-learning benefits related to assessments, there are statistically significant differences between the observed values and the expected values for all indicators except indicator q16 (in e-learning, it is easy to submit assignments on time). We also note that the indicators that negatively affect are, q19 (in e-learning there is no difficulty in taking exams), q15 (e-learning does not help in the exchange of tasks between students). As for the indicators that have a positive impact, are q17 (in e-learning, I can follow up on my evaluations, they are well organized), q18 (in e-learning, evaluation methods are fair), and q14 (e-learning gives me enough time to think and conclude). As for the indicators related to the economic benefits. It can be seen from table (5) that all indicators have a positive impact. As for the indicators related of the obstacles were mostly of negative statistical significance, except for indicator that had a positive impact q25 (I can easily send an email with an attached file). For comparison, one-sample t-test parametric was used , as an alternative for the Chi-square goodness of fit test non-parametric. The t-test measures the difference between the true average versus the overall means of all the indicators. *First:* the indicators related to the content of the course, we note that similarities exist only in the most negative indicator, q2 (e-learning is suitable for teaching practical subjects). As for the differences between the two tests. For example, it can be seen that q8 (virtual categories are more effective than real categories), was not statistically significant in the t-test, whereas this variable in the chi-square test was statistically significant. Also, q3 (in e-learning, I can understand the information), and q6 (e-learning helps to explore new ways of learning) were not statistically significant in the Chi-square test, while in the t-test they were statistically significant. *Second:* the indicators related to assessments. Table (5) shows that q19 (in e-learning there is no difficulty in submitting examinations) was a non-significant in the t-test, while it was significant in the chi-square test. Also, q16 (in e-learning, it is easy to submit assignments on time) was a significant in the t-test, while it was non-significant in the chi-square test. *Third:* Economic Benefits it can be seen from table (5) that, there is a great similarity between the two tests. Fuorth: the obstacles of the benefits of e-learning, it can be seen from table (5) that q27 (the university provides technical support to distance learning students) is a non-significant in the t-test, while it was a significant in chi-square test.

### 3. KRUSKAL WALLIS TEST

The hypothesis was tested: "There are statistically significant differences between e-learning benefit Indicators, due to the fact that if I had a choice I would opt for online learning". It is shown from table (6) that there are differences  all the indicators, exception q4 (e-learning focuses more on knowledge than skills). That is, all students agree in their views on this indicator. The highest differences were for q8 (virtual classes are more effective than real classes), and the lowest differences were for q15 (e-learning does not help in the exchange of tasks between students). For comparison, the alternative ANOVA test was used for the Kruskal-Wallis test. A complete correspondence was found between the two tests. The reason may be that a large sample size was used.

**Table 5.** Kruskal-Wallis test and ANOVA to test statistically significant differences between the e-learning benefits indicators, attributed to (If I had a choice, I would choose e-learning)

| Indicator | Kruskal-Wallis Test | | ANOVA-Test | |
|---|---|---|---|---|
| | Test statistic | P- Value | F- statistic | P- Value |
| Course content | | | | |
| q1 | 119.51 | .000 | 79.504 | .000 |
| q2 | 32.397 | .000 | 15.765 | .000 |

| | | | | |
|---|---|---|---|---|
| q3 | 228.05 | .000 | 233.772 | .000 |
| q4 | 5.748 | .056 | 1.736 | .177 |
| q5 | 119.08 | .000 | 73.704 | .000 |
| q6 | 219.52 | .000 | 226.232 | .000 |
| q7 | 62.477 | .000 | 39.574 | .000 |
| q8 | 412.53 | .000 | 325.061 | .000 |
| q9 | 107.20 | .000 | 63.597 | .000 |
| q10 | 314.15 | .000 | 222.250 | .000 |
| q11 | 85.813 | .000 | 35.844 | .000 |
| q12 | 20.479 | .000 | 4.565 | .011 |
| q13 | 194.07 | .000 | 90.934 | .000 |
| mean | 337.149 | .000 | 255.808 | .000 |
| Assessments | | | | |
| q14 | 116.455 | .000 | 48.156 | .000 |
| q15 | 14.772 | .001 | 6.710 | .001 |
| q16 | 21.059 | .000 | 16.954 | .000 |
| q17 | 90.432 | .000 | 57.494 | .000 |
| q18 | 111.921 | .000 | 81.823 | .000 |
| q19 | 61.831 | .000 | 24.454 | .000 |
| mean | 87.899 | .000 | 67.668 | .000 |
| Economic cost | | | | |
| q20 | 57.482 | .000 | 33.989 | .000 |
| q21 | 27.834 | .000 | 28.174 | .000 |
| q22 | 60.202 | .000 | 33.939 | .000 |
| mean | 89.594 | .000 | 44.418 | .000 |
| Obstacles | | | | |
| q23 | 150.297 | .000 | 65.909 | .000 |
| q24 | 157.177 | .000 | 83.005 | .000 |
| q25 | 30.459 | .000 | 9.925 | .000 |
| q26 | 99.000 | .000 | 38.005 | .000 |
| q27 | 45.567 | .000 | 29.146 | .000 |
| q28 | 199.244 | .000 | 114.621 | .000 |
| q29 | 164.975 | .000 | 92.141 | .000 |
| mean | 268.997 | .000 | 177.950 | .000 |

## V. DISCUSSION

In general, the e-learning system has its advantages and disadvantages. This can be seen through the indicators, that have a positive impact, arranged according to statistical significance: (I can send an email with an attached file easily, e-learning solves the problem of increasing the number of students, e-learning focuses more on knowledge than skills, it reduces time and effort, e-learning is flexible, in terms of time and space, in e-learning, I can follow my evaluations, e-learning has succeeded in developing study programs, e-learning offers topics are well organized and informative learning, e-learning increases the sharing of experiences between students, in e-learning, assessment methods are fair, the Blackboard platform presents a course in an interesting way , and e-learning gives me enough time to think and conclude). These positive results are consistent with the research indicating the flexibility of the learning environment, the autonomy of space and time, and the opportunities to repeat lectures asynchronously [64-67]. As for the disadvantages discovered by the students of the current study were in the negative indicators, arranged according to the statistical

significance: (e-learning prompted students not to underestimate the importance education, in e-learning, the professor can identify the negative student, the university provides a virtual library, I have get sufficient training to use e-learning tools, indirect communication does not affect understanding of the lesson, virtual laboratories have been activated, in e-learning, there is no difficulty in submitting exams , the Internet is strong in my area,  virtual classes are more effective than real classes, e-learning focuses more on knowledge than skills, e-learning does  help in exchanging assignments, e-learning helps achieve learning outcomes objectives, the university provides technical support for students, and educational topics submit without technical failure). Similar results were also found in other studies [68-69]. The results of the Kruskal Wallis test and the ANOVA test showed agreement in the results (The reason may be that a large sample size was used). Among the four dimensions, the course content mean was the deciding factor that determines the differences between the indicators of the benefits of e-learning, followed by the obstacles, then the economic benefits, and finally the assessments.

For comparison, it can be noted that the indicators (virtual classes are more effective than real classes, in e-learning, there is no difficulty in submitting exams, the university pro-vides technical support for students) were not statistically significant in the t test, while they were statistically significant in the chi-square test. There are also two indicators (in e-learning, I can understand the information, and e-learning helps in exploring new methods of learning), that were not statistically significant in the chi-square test, while they were statistically significant in the t-test. This expresses students' opinions, as they exist in real data. This is confirmed by another study [70-75].

## VI. CONCLUSION

The findings of the current study showed that most Saudi university students have a high level of Switching to e-learning, and the course content was the decisive factor of switching to e-learning. The findings showed that the most significance of indicators related to the benefits of switching to e-learning are: (e-learning solves the problem of increasing the number of students, it focuses more on knowledge, it reduces time, it is flexible, e-learning  has been succeeded in developing  programs, it offers topics are well organized, it increases the sharing of experiences between students,  assessment methods are fair;  and it gives me enough time to think).  The most significance indicators related to the challenges, are (e-learning prompted students not to underestimate the education, the professor can identify the negative student, the university provides a virtual library, I have get sufficient training , indirect communication does not affect the understanding , virtual laboratories have been activated,  there is no difficulty in submitting exams , the internet is strong in my area,  virtual classes are more effective,  e-learning helps in exchanging assignments, and the university provides technical support).  E-learning continues to provide better learning options for students who prefer greater convenience and flexibility.  It can be concluded that the adoption of e-learning is practical if attention is paid to all indicators that have a negative impact. Universities that want to switch to e-learning should weigh the pros and cons to determine if it is a good option. The study recommended the necessity of continuing to adopt e-learning as a strategic option. Encouraging researchers to use non-parametric statistical methods when the source of data is from surveys or questionnaires. In practice, the current study provides insightful data as it offers policymakers a fresh perspective on the proper preparation for adopting e-learning while ensuring student satisfaction. Further studies should determine the effectiveness of e-learning benefits in universities that were not included in the study. The researchers are required to make their future research more creative by employing more fit n statistical methods to it.

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