

# The Assessment of Statistical Processes used in Published Educational Researches: Dar-Almandumah Database as a Model

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## Abstract

This research aims to study and assess the statistical processes used in the educational researches published in Dar-Almandumah database. Purposive sampling has been used in this study, which consisted of 301 educational researches classified into three categories. To achieve the objective of this research, the approach of Preferred Reporting Items for Systematic and Meta-Analysis Protocols (PRISMA-P2015) has been followed. It consists of three stages; the first covers abstracts, the second covers the statistical methods, and the third discusses verification of the assumptions related to the statistical methods used in the researches. Frequencies and percentages have been used in each of the three stages. The first stage concluded that: most of the educational researches' abstracts did not mention the type of sample used, a few abstracts mentioned the size of sample and target population, most of the researches used the descriptive-analytical approach and qualitative data, and the independent variable was mentioned in the abstracts more than the dependent variable. The results of the second stage indicated that descriptive and simple inferential methods are used the most, whereas, the results of the third stage indicated a lack of verifying assumptions of the statistical methods used in the researches.

**Keywords:** statistical methods, educational research, Dar-Almandumah database

## 1. Introduction

### 1.1 Introduce the Problem

Statistical processes occupy a prominent position in the design and implementation of many scientific researches and graduate theses needed for obtaining a master's or PhD degree. Since statistical methods are an integral part of the statistical process, almost no psychological or educational research is does not use it, whether descriptive or inferential. As a result of recent developments in technological means, it has become possible to use many statistical methods in data analysis that were not available long time ago.

It has become a requirement for good research to use appropriate statistical methods to collect and interpret data, and reach statistical indicators for accepting or rejecting statistical hypotheses, in order to generalize the researcher's findings, some even consider educational research that does not use statistics as impractical (Bahash, 2020). Therefore, the researcher should have the ability to properly understand the different theories and employ them appropriately. He/she also needs to possess logical thinking that helps in analysis, and should have the ability to conclude results through interpretation. The skill of analyzing and interpreting data involves arranging data according to its importance in the occurrence or interpretation of the problem, and this should be done in specific steps (Al-Figah, 2020). The researcher should choose the statistical method after studying his/her theoretical framework, not only in terms of the conditions to use different statistical method but also in terms of their suitability for the research and its hypotheses. In order for the researcher to do so, he/she should consider a set of criteria, namely the objective of the research and the statistical method that suits it (descriptive statistics, inferential statistics), measurement scales, the type of sample and its relation to the population, the nature of variables, and the strength of the statistical test (Rabia & Adaika, 2018).

Statistics have two definitions; the first refers to the way, in which we collect, analyze, and interpret digital facts (data),

and the second is statistics in itself, the primary numerical data obtained by observation and measurement, or the calculation results derived from this data. The term "statistical analysis" is often used and it generally refers to the descriptive statistics that are used to present and summarize data, and it means the way in which these statistics are used to draw statistical conclusions. (Peers, 2006, p.2).

Educational research is one of the various fields of scientific research, and it can be said that it has become one of the most important areas that contribute to the progress of countries. However, it has been observed that educational research is marred by confusion and instability, which results from some errors, made by researchers and affects the credibility of educational research and therefore the reliability of its results. Thus, it is necessary to assess the educational research on continuous basis to identify weaknesses and errors and deal with them, and also to strengthen existing positive aspects. (Al-Sardi, 2012).

Ghanayem (2013) pointed out, through reading many graduate theses and educational researches, that many of them do not use statistical methods accurately. For example, some researchers in the educational field were not able to choose the appropriate statistical methods suitable for their research which exposed them to ethical and scientific liabilities. Common statistical errors that researchers make include errors in statistical test analysis, in sampling, in questionnaire design, in data collection e.g. bias and chance error, and other general methodological errors (which are related to choosing the appropriate approach for comparison).

Thus, the research aims at studying and assessing the statistical processes used in the educational researches published in the journals of the Educational Information Database (Edu Search), a sub-database of Almandumah database, finding out which statistical methods are most used in these researches, and if these researches have tested the assumptions of the used statistical methods. These aims will be achieved by reviewing the graduate theses and educational researches published in the Educational Information Database (Edu Search) included within the Almandumah database.

Many Arab and foreign studies covered various issues related to studying statistical methods used in educational research. The study of Al-Sardi (2012) aimed at assessing the statistical methods used in educational researches and postgraduate studies at the Islamic University of Gaza. The most important findings of this study included the increased use of descriptive statistics methods in master's theses, the decreased use of simple inferential statistics, and the poor use of advanced inferential statistics. The study indicated that most studies correctly used methods to determine the size of the sample representing the population. As for the type of sample, the survey method was used correctly in all studies, 69.86% of the studies used simple random sampling correctly, 77.78% used systematic random sampling correctly, and 96.23% used stratified random sampling correctly.

Al-Nuaimi and Abdullah study (2012) aimed to identify the principles adopted in selecting the research sample and some of the principles adopted in statistical significance tests and their degree of accuracy. The study found that all graduate theses in the College of Physical Education did not use statistical standards and treatments in selecting the sample, and most of them did not use the automated statistical package in evaluating the statistical significance level and interpreting the results. In a similar context, Ghanayem (2013) pointed out that many scientific theses, studies, and educational researches do not use statistical methods accurately, which leads to many errors in the statistical analysis and result in negative outcomes, including bias and lack of objectivity. This caused researches to lose their scientific value and lack of confidence in the researches' results.

The study of Yanushkevichene, Yanushkevichius and Din (2016) drew attention to two aspects regarding the use of mathematical statistics for educational research purposes; the first is the adequacy of applying mathematical statistics in examining phenomena related to the educational process, for example, the use of T-test for statistical hypotheses testing in educational research. The second aspect is clarifying how computer affects the quality of mastering study materials and developing student's personality. The study concluded with two findings; the first is that the use of T. test was not appropriate for the educational data that was analyzed because it did not meet the condition of normal distribution. The second finding was related to two experiments conducted to understand how computers affect the learning process and highlight different topics in statistics, once with two independent variables and the second with an indirect dependency relationship. Despite the positive impact of computer-assisted learning, poor experimental designs can alter the nature of the relationship between random variables.

Wind (2018) discussed statistical models of wireless data and educational reviews thereof. It divided data sources into two main sources: GPS data and Router data. The study concluded that this system has contributed to determining the quality of observations through the so-called feedback and enabling educational reviewers to ensure that all students receive the best possible feedback, and has helped supervisors to automatically identify feedback that needs supervision.

Wali (2018) focused in her study on identifying obstacles to using statistical methods in graduate theses from the perspective of master's first-year students in the Department of Psychology, the University of Mohamed Boudiaf, in three areas (data collection, research procedures, analysis and interpretation of results). The study found that the

obstacles to using statistical methods in graduate theses in the above-mentioned areas are too many from the students' point of view.

Kues (2018) outlined in his study some tips on collecting, presenting, and analyzing data statistically through reviewing strategies to avoid reviewers' criticism in research related to improving education and practice. The study indicated that the statistical problems faced by auditors, reviewers, and journal editors are easy to avoid by having a discussion with a reliable statistician regarding the selection of statistical tests, data analysis and interpretation. The study also indicated that most statisticians prefer to consult experts during the research design stage. Also, a comprehensive review of the literature related to the study question may be very helpful in designing the study, selecting the tool, and choosing statistical tests.

Hallinger and Kovačević (2019) included in his study a review of researches related to educational administration using systematic review (scientific mapping) as a mean of understanding the progress of educational administration research. He reviewed the educational administration researches published in Scopus database between 1960 and 2018. The results indicated a paradigm shift in studies from "school administration" to "school leadership" over the course of six decades, and indicated that school leadership for student learning and development is the basis for the knowledge structure in educational administration.

With regards to comprehending the statistical concept, Susbiyanto et al. (2019) conducted a study on the importance of statistics course in the Department of Physics, Jambi University. The study indicated a decrease in students' ability to comprehend the concept of research statistics. In order to check the student's comprehension of statistical concept, the researchers used problem-based learning as one of the methods to examine scientific progress, using the quantitative approach. The results of the simple regression analysis used in the study in the sixth chapter indicated that problem-based learning (PBL) positively affects comprehension of the statistical concept, as it contributed to comprehending it by 72% of males and 67% of females. Likewise, in the eighth chapter, problem-based learning contributed to comprehending the statistical concept by 68% of males and 70% of females.

Rabia and Adaika (2019) indicated that the process of choosing the appropriate statistical method is strongly recommended for researchers to have more objective and accurate results, and that violating the conditions of applying any statistical method inevitably leads to wrong results.

In a relevant context, Ferrão (2020) aimed to identify the statistical methods used in higher education research between 1998 and 2017. To collect data, he relied on Education Resources Information Center (ERIC) and Current Index to Statistics (CIS) and examined the keywords in the abstracts of the studies included in ERIC in terms of: (data, dependent variable, response, result or performance). The statistical methods used in the studies were classified into seven categories (descriptive statistics, hypotheses testing, simple regression models, multiple regression models, factor analysis, survival analysis, errors category). The results showed that until 2010, the majority of researches used, to a limited extent, a set of statistical methods, including descriptive statistics, basic tests, and simple regression. After that, more quantitative methods were used, including factor analysis, multiple regression models, structural equation models, propensity score analysis, stochastic frontier analysis, and survey models. The study also found that most of the researches focused on statistical relationships between variables instead of generating and testing theory-based methods.

Bahash (2020) aimed to present the effect size as a complementary method for testing statistical hypotheses. He indicated that practical as well as statistical significance must be examined to show the proportion of variance of the dependent variable because of the independent variable and not due to other external factors. The study concluded that the most common statistical significance test is (T.test), where the rate of reference to effect size is very poor, and that the effect sizes extracted from these tests are also poor.

Some previous Arab studies covered the issue of assessing statistical methods used in postgraduate theses (master and PhD) in educational specialties, such as (Al-Sardi, 2012). The study of (Al-Nuaimi & Abdullah, 2012) discussed the principles adopted in choosing the sample of educational research and some of the principles adopted in statistical significance tests and their degree of accuracy. The study of (Bahash, 2020) covered the issue of knowing the magnitude of effect in educational research. Some other studies discussed obstacles to using statistical methods in educational research, such as (Wali, 2018).

As for foreign studies, some covered statistical models and their educational reviews, such as (Wind, 2018). Similar to the Arab studies, some foreign studies highlighted the mechanism of collecting, presenting, and analyzing data statistically by reviewing strategies to avoid the reviewers' criticism in research related to improving education and practice, such as (Kues, 2018). Some foreign studies sought to identify the statistical methods used in postgraduate research, such as (Ferrão, 2020), while others aimed to assess the defect in educational research by building a robust statistical model for the outputs of categorical variables, such as (Zhu, 2020).

This study is aimed at assessing the statistical processes in the educational researches (masters and PhD) published in the educational journals included in the Educational Information Database (Edu Search). The study reviews these researches from two perspectives; the first aims at reviewing the statistical methods used in them, while the second aims at verifying assumptions of these methods.

The educational researches covered by this study are published in prominent educational journals; some of them included in the global database Scopus, such as Dirasat Journal issued by the University of Jordan. As for postgraduate theses (masters and PhD), they are issued by many internationally recognized Arab universities. This study is outstanding because it's not limited to a specific educational journal or Arab university, but rather it covers researches from various journals and universities. It is also distinguished because it focuses on studying the abstracts of researches and theses in addition to studying used statistical methods and verifying their assumptions.

### 1.2 Purpose of This Research

It is well known that almost no research, especially educational, does not include and use of statistical processes and methods, whether descriptive or inferential. Therefore, taking a quick look at educational research can be sufficient to provide clear proof of the extent to which educational researchers use appropriate statistical processes. The statistical process has stages that almost all research follow, namely, data collection, organization, mathematical processing, and result analysis in which the data is converted into clear and understandable information. Statistical methods have also conditions and assumptions that must be tested before starting the process of result analysis, interpretation, and generalization, including sample size, nature of data, data independence, randomness, and normal distribution of data. Many researchers face obstacles regarding statistical methods and how to apply statistical processes related to the research subject. Wali (2018) indicated that postgraduate students face many statistical obstacles and problems when writing graduate theses, which leads to difficulty in trusting the obtained results and thus constituting a clear failure in dealing with educational problems.

More specifically, this study seeks to answer the following questions:

1. *What are the percentages of the statistical methods used in the educational researches and theses?*
2. *Were assumptions of the statistical methods used in the educational researches and theses verified?*

### 1.3 Explore Importance of this Research

The theoretical importance of this study is reflected in the results it concluded regarding statistical processes in educational research and theses in terms of the appropriateness of statistical methods to the nature of data and research hypotheses, and verification of their assumptions. As for its practical importance, it is represented in guiding the researcher in the scientific steps he/she should take in the field of research before starting to apply the statistical test, including study population, sample type, sample size, type of variables (categorical or continuous), nature of data (quantitative or qualitative), and scale type (nominal, ordinal, interval, ratio scale).

### 1.4 Research Terms

Table 1, contains definitions of the terms used and included in the research.

Table 1. Research Terms

Term	Definitions
Dar-Almandumah database	A comprehensive database concerned with building and developing scientific information sub-databases in research and academic fields, namely Educational Information Database (Edu Search), Islamic and Legal Sciences Database (Islamic Info), Language and Literature Database (Arabase), Economy and Management Database (Eco link), Humanities Database (Humanindex), and University Theses Database.
Educational research (procedural definition)	Research concerned with studying a specific educational problem or educational field and has been published in one of the educational journals within the Educational Information Database (Edu Search), which is a sub-database of Dar- Almandumah database.
Statistical processes (procedural definition)	The process of collecting, organizing data and conducting mathematical processing using statistical methods to reach numerical results, analyze results, and convert solid data into information.

### 1.5 Research Limitations

This research is limited to the educational researches published in the educational journals included in the Educational Information Database (Edu Search) between 2018 - 2020.

*Statistical Methods, Samples, and Nature of Data in Educational Research:*

Statistical methods used in educational research include the following:

1. *Descriptive Statistics*

Descriptive statistics in educational research include: mean, median, standard deviation, simple linear correlation, Spearman Rank Correlation, and Simple Linear Regression.

2. *Inferential Statistics: Parametric and Non-Parametric Statistics*

Table 2, shows the most important inferential parametric and non-parametric statistical tests in educational research.

Table 2. parametric and non-parametric statistical tests in educational research

Desired Evaluation		Parametric Test	Non-Parametric Test
1.	Comparing one group with the default value	1. One-Sample t-test	1. Wilcoxon signed rank test
2.	Comparing two independent groups	2. Independent Sample t-test	2. Mann-Whitney U test.
3.	Comparing three or more independent groups	3. One-Way ANOVA	3. Kruskal-Wallis test
4.	Comparing two related groups	4. Dependent t-test	4. Wilcoxon signed rank test
5.	Comparing three or more linked groups	5. Repeated Measure Design	5. Friedman test
6.	Correlation between two variables	6. Pearson Correlation	6. Spearman's correlation
7.	Predicting a variable from a set of variables	7. Linear regression	7. Non-parametric regression/Logistic regression

1.6 *Assumptions of Parametric Statistics*

Uttley (2019) pointed out the most important assumptions of parametric statistics, namely:

The data must be at least on the categorical scale. Data Independence, meaning randomly selecting any individual within the sample does not affect another individual in the same sample. Randomization, meaning that every member in the study population has the same opportunity to be chosen as a part of the study sample. Normality, meaning that random data approximate normal distribution, depending on the type of test performed. Homogeneity of Variance: When comparing more than one group, the variance is the same for all groups.

1.7 *Methods of Testing Parametric Assumptions in Educational Research*

Data Independence: Tested by Durbin-Watson coefficient. The parameter value ranges between (2.5-1.5) in order for data to be independent. Randomization: Tested by Run test (Verma & Abdel-salam, 2019). Normality: Tested by Kolmogorov-Smirnov test, and the hypotheses for normal distribution test are as follows:

- o  $H_0$ : Data is normally distributed.
- o  $H_1$ : Data is not normally distributed.

If the p-value is > 0.05, the null hypothesis is not rejected and the data is normally distributed (Verma & Abdel-salam, 2019; Garson, 2012). Homogeneity of Variance: The hypotheses for homogeneity of variance are as follows:

- o  $H_0$ : All groups have the same variance.
- o  $H_1$ : At least two groups have different variance.

The most common tests used to check Homogeneity of Variance are:

Levene's test: If the p-value > 0.05, the null hypothesis is not rejected and the variance is equal for all groups.

Bartlett's test: 
$$\chi^2 = \frac{(N-K) \ln(S_p^2) - \sum_{i=1}^K (n_i - 1) \ln(S_i^2)}{1 + \frac{1}{3(k-1)} (\sum_{i=1}^k (\frac{1}{n_i - 1}) - \frac{1}{N-K})}$$
 (1)

If the calculated value of  $\chi^2 >$  the critical value at a degree of freedom  $df = k-1$ , it means that groups have homogenous variance.

Fmax test (Hartley's Fmax): This test is used in the context of ANOVA.

$$F_{max} = \frac{\text{larger variance}}{\text{smaller variance}} \tag{2}$$

Assuming that the size of the study groups is equal, if the value of F-max equal one, it means that the variances are homogeneous, but if it does not equal one, the value of F-max is compared with F-max critical values at a degree of freedom  $df = k-1$ , while  $k$  means the number of groups. To check homogeneity in case of regression, parallelism tests are used to verify that the slope of regression line is the same for all levels of the variable (Garson, 2012).

### 3. Advanced Statistical Tests

Advanced statistical methods include Factor Analysis, Principal Component Analysis, Discriminant Analysis, ANCOVA Analysis, Survival Analysis, Multiple Regression, and Logistic Regression.

### 4. Indicators of Relationship Strength and Effect Size (Al Kilani & Al-Sharifin, 2017)

The indicators of relationship strength and effect size are used when rejecting the null hypothesis in the T-test of two independent samples and the tests of variance, because the statistical significance is not an appropriate measure of treatment effect, since the statistical significance is related to the sample size. The larger the sample size, the greater the possibility of rejecting the null hypothesis. Among these indicators in educational research are ETA squared  $\eta^2$ , Omega squared  $\omega^2$ , and effect size  $(d)\Delta$ .

### 5. Pre and Post Hoc Multiple Comparison Tests (Al-Kilani & Al-Sharifin, 2016; Al-Hopi, 2017)

These tests are used when F is statistically significant, that is, they are used after the results of variance analysis have shown a statistical significance. They are either pairwise or complex comparisons. Pairwise comparisons include, for example, Tukey's test (HSD), Newman-Keuls test, and Tukey/Kramer (TK) test, while complex comparisons include Scheffe test. Pre-hoc comparisons that can be used regardless of F significance include Dunnett's test.

### 6. Types of Samples in Educational Research (Al-Manizel & Al-Gharaybeh, 2010)

Samples are divided into two types, probability (random) and non-probability (non-random) samples. Random samples are those in which every member of the population has the same opportunity to be within the sample, and they are subdivided into (simple random sample, systematic sample, stratified sample, and cluster sample). As for non-probability samples, there are no equal opportunities for population members to be within the sample, and they are subdivided into (convenience sample, purposive sample, quota sample, and snowball sample).

### 7. Size of Sample Representing Population

Statisticians formulated methods for determining the optimal sample size, as shown in Table 3 and Table 4 (Al-Haddad, 2018).

Table 3. Sample size in some studies

Type of Study	Sample Size
Descriptive studies	Small population size (a few hundred)
	Large population size (a few thousand)
Correlational studies	20% of population
Experimental studies	10% of population
	More than fifteen members
	Number of members in each group should not be less than fifteen members

Table 4. Sample size determination in case of a homogenous or heterogeneous population.

Population	Accuracy	Sample Size Percentage
Almost homogenous	High accuracy	Simple random sample of 23%
	Adequate accuracy	Simple random sample of 10%
Heterogeneous and contain groups of equal size	High accuracy	Simple random sample of 23% and stratified sample of 10%
	Adequate accuracy	Simple random sample of 12%
Heterogeneous and contain groups of unequal size	High accuracy	Stratified sample of 10% and simple random sample of 23%.
	Adequate accuracy	Simple random sample of 23%
Heterogeneous and contain small scattered groups	High accuracy	Stratified sample of 12%
	Adequate accuracy	Stratified sample of 10%

### 8. Nature of Data in Educational Research

The phenomenon under study is denoted by the symbol  $y$  or  $x$ , and each item is denoted by the symbol  $y_i$  or  $x_i$ . The value of  $y_i$  differs from one item to another, thus  $y$  is called variable. A variable can be defined as a phenomenon that can vary from one entity to another and is denoted by the symbol  $y$  or any other symbol. Data is divided into two

groups:

**Qualitative Data:** The variable is expressed in non-numeric data arranged in levels or in the form of numerical categories. It can be nominal or ordinal, such as (eye color, marital status, gender). **Quantitative Data:** The variable is expressed in numerical data representing the actual value of the phenomenon, such as (height, weight, age). It can be either discrete (countable information), or continuous (measurable information that can take an integer and fractional values) (Karsh, Al-Qazzaz & Hammoudi, 2014).

#### 8. *Measurement Scales*

There are four types of scales, each of which represents a specific measure (Dalati, 2018; Matthews, 2017), as shown in Table 5.

Table 5. Measurement scales and characteristics of each

Scale type	Characteristics
Nominal Scale	The simplest type of scales that expresses the phenomenon under study by specific numbers or symbols given to the nominal variables and used instead of names to denote them.
Ordinal Scale	The second level of measurement where the variables are classified based on their degree. They are arranged from lesser to greater or vice versa, and the intensity of difference between these ranks may be equal or not. Inequality of differences between ranks does not require order change.
Interval Scale	A quantitative scale used to express the differences between items in addition to their order, where distances are equal, numbers have a meaning related to the measured property, and the zero value is relative, not absolute. Because the distances are equal on this scale, they can be added and subtracted, while division is not permitted as the zero value is not absolute.
Ratio Scale	The highest level of measurement that has all the features of the previous scales. It deals with various scales, even if they are different in units of measurement. It is distinguished from the interval scale in that zero is true and means the absence of the variable you are measuring. The ratio between any two degrees does not depend on the units used. On this scale, we can do arithmetic processes (addition, subtraction, multiplication, division), and use parametric statistical methods.

## 2. Method

The research follows the descriptive evaluative approach that relies on collecting, analyzing, and interpreting information and facts to reach realistic conclusions that are applicable and developable, due to the appropriateness of this approach to the objectives of the study. The research population consists of the educational researches published in Arab journals included in the Educational Information Database (Edu Search) within Dar-Almandumah database. The size of the target population is huge; therefore, the study sample was chosen from the recently published educational researches within the database

### 2.1 *Sampling Procedure*

After reviewing the educational literature in previous studies related to the research subject and gathering evidence related to the research objectives, the researcher used a checklist consisting of several stages according to the eligibility criteria (Preferred Reporting Items for Systematic and Meta-Analysis Protocols PRISMA-P2015) as a research tool. This protocol or approach is a tool for reviewing and evaluating researches and studies, and it is based on the collection of studies and researches related to a specific topic to reviewing them in stages. After gathering these studies and researches, their abstracts were reviewed, then the statistical methods used, the data and their nature, determinants, recommendations, and results. These stages might increase based on the type of study. This protocol allows identification of the most used and appropriate methods for relevant researches and studies, and serves as a reference that can be referred to in reviewing their results and draw upon them in subsequent studies, and considered an appropriate base regarding inclusion criteria and decision-making (Shamseer et al., 2015).

#### 2.1.1 *Sample Size*

The sample consisted of the educational researches published in educational journals within the period 2018-2019. This period was chosen to ensure the recently of the published researches. The research sample included 301 educational researches and theses that were classified into three categories as follows: (43 graduate theses, 168 educational researches on curricula, teaching methods and educational issues, and 90 educational researches on statistical issues). The focus in this sample was on abstracts, statistical methods used, the procedures for choosing the type of sampling, and the results of applying statistical methods.

#### 2.1.2 *Research Design*

In this research, the review protocol consists of the same stages used in (Ferrão, 2020), in addition to statistical assumptions verification. The stages are as follows:

**First Stage:** Reviewing the abstracts of researches and theses and identifying the following elements: size and type of research sample, nature of data, independent variables, dependent variables, statistical method used, and results.

**Second Stage:** Identifying the methods of statistical analysis in these researches and theses, namely:

1. Descriptive statistics: frequency, mean, median, variance or standard deviation, correlation, simple regression, and graphs.
2. Statistical hypothesis testing: t-tests, z-tests, analysis of variance, chi-square test.
3. Simple regression models.
4. Multiple regression models.
5. Factorial analysis (FA), Principal Component Analysis (PCA), and Discriminant Analysis.
6. Survival analysis.
7. Nonparametric methods
8. Effect size and statistical significance coefficients.
9. Post-hoc comparisons if the test result rejects the null hypothesis.

**Third Stage:** Verifying each assumption of statistical methods used, including sample size, data independence, randomization, and homogeneity of variance.

This three-stage approach aims to determine the appropriateness of sample size for under-study population size in the first stage, the appropriateness of the used statistical methods in the second stage, and evaluation of statistical assumptions testing in the third stage.

### 2.1.3 Statistical Methods

The research used the following statistical methods:

1. Percentage.
2. Statistical frequency.
3. Mean and standard deviation.

## 3. Results

To answer the research questions, the data were analyzed along two axes as follows:

### *First Axis*

The first axis covers the results related to the first research question (*What are the percentages of the statistical methods used in the educational researches and theses?*)

In order to answer this question, the data were analyzed in two stages. The first stage covers the analysis of abstracts of the under-study theses and researches in terms of elements covered by these abstracts, while the second stage covers the statistical methods used in each thesis and research.

### *First Stage Results*

The percentage of graduate theses constituted 14.3% of the under-study population, while educational researches on curricula, teaching methods and educational issues constituted 55.8%, and educational researches on statistical issues constituted 29.9%. Thus, the sample is considered reliable in data analysis and realizing the objective of the study, as it reflects well the problem under study, as shown in Table 6.

Table 6. Frequencies and percentages of the graduate theses, the educational researches on curricula, teaching methods and educational issues, and the educational researches on statistical issues

Research Type	Frequency	%
Graduate theses	43	14.3%
Educational researches on curricula, teaching methods and educational issues.	168	55.8%
Educational researches on statistical issues	90	29.9%
Total	301	100%

The means of the abstracts' elements ranged between (2.19 - 1.19). The highest mean was for the nature of the data and the lowest was for the sample type. Whereas, the standard deviations ranged between (1.13 - 0.30). The highest SD was for the sample type and the lowest was for the independent variable. The range of means was 1, and the range of standard deviations was 0.83. This shows the diversity of the educational researches included in the sample and its appropriateness



for the study objectives, as shown in Table 7.

Table 7. Means and standard deviations of the abstracts' elements in the graduate theses, the educational researches on curricula, teaching methods and educational issues, and the educational researches on statistical issues

Abstract Elements	M	SD
Sample type	1.19	1.13
Nature of data	2.19	.99
Independent variable	1.90	0.30
Dependent variable	1.89	0.31
Used approach	1.45	0.49
Results	1.84	0.37

As shown in Table 8, 14% of the graduate theses stated that they used systematic random sampling. Systematic random sampling was also used in 10.7% of the educational researches on curricula, teaching methods and educational issues, and in 7.8% of the educational researches on statistical issues. Whereas, the researches that did not mention the type of sample in their abstracts accounted for the highest percentage; by 67.4% of the graduate theses, 70.2% of the educational researches on curricula, teaching methods and educational issues, and 71.1% of the educational researches on statistical issues.

Table 8. Frequencies and percentages of sample types used in the graduate theses, the educational researches on curricula, teaching methods and educational issues, and the educational researches on statistical issues

Research Type	Sample Type							Total
	Systematic Random	Stratified Random	Purposive	Convenience	Snowball	No Mention	None	
Graduate Theses	6	2	2	1	0	29	3	43
%	14	4.7	4.7	2.3	0	67.4	7	
Researches on Educational Issues	18	2	6	0	0	118	24	168
%	10.7	1.2	3.6	0	0	70.2	14.3	
Researches on Statistical Issues	7	2	1	1	0	64	15	90
%	7.8	2.2	1.1	1.1	0	71.1	16.7	
Total	31	6	9	2	0	211	42	301
%	10.3	2	3	0.7	0	70	14	100

• *None*: Researches that did not mention any of the statistical methods used in analyzing their data.

The results of abstracts analysis related to mentioning sample and population sizes show a fluctuation in sample-to-population sizes. In most of the researches, the sample was not truly representative of the population. Sample sizes ranged from 100% to 2.2% of population, as shown in Table 9.

Table 9. Frequencies and percentages of sample-to-population sizes in the graduate theses, the educational researches on curricula, teaching methods and educational issues, and the educational researches on statistical issues

Research Type	Sample Size	Population Size	%
Graduate Theses	960	960	100
	11	46	24
	50	2260	2.2
Researches on Educational Issues	117	390	30
	299	1235	24
	55	183	30
	29	29	100
	172	500	34
	99	773	13
	53	77	67
	69	144	48
	60	240	25
	38	105	36
Researches on Statistical Issues	56	80	70
	18	206	9
	225	396	57

The results of abstracts analysis indicate that the type of data was qualitative in 41.9% of graduate theses, in 56.5% of the educational researches on curricula, teaching methods and educational issues, and in 56.7% of the educational researches on statistical issues, whereas, 16.3% of the sample did not mention the type of data, as shown in Table 10.

Table 10. Frequencies and percentages of data type in the graduate theses, the educational researches on curricula, teaching methods and educational issues, and the educational researches on statistical issues

Research Type	Data Type					Total
	Quantitative	Qualitative	Mixed	No Mention	None	
Graduate Theses	15	18	9	1	0	43
%	34.9	41.9	20.9	2.3	0	
Researches on Educational Issues	20	95	18	35	0	168
%	11.9	56.5	10.7	20.8	0	
Researches on Statistical Issues	17	51	1	13	8	90
%	18.9	56.7	1.1	14.4	8.9	
Total	52	164	28	49	8	301
%	17.3	54.5	9.3	16.3	2.7	100

• *None*: Researches that did not mention any of the statistical methods used in analyzing their data.

The results of abstracts analysis indicate that 93% of the graduate theses mentioned the independent variable, while 46.5% of them mentioned the dependent variable. 88.1% of the educational researches on curricula, teaching methods, and educational issues mentioned the independent variable, while 48.8% of them mentioned the dependent variable. 88.9% of the educational researches on statistical issues mentioned the independent variable, while 37.8% of them mentioned the dependent variable, as shown in Table 11.

Table 11. Frequencies and percentages of mentioning variables (dependent and independent) in the abstracts of the graduate theses, the educational researches on curricula, teaching methods and educational issues, and the educational researches on statistical issues

Research Type	Independent Variable			Dependent Variable		
	Mention	No Mention	Total	Mention	No Mention	Total
Graduate Theses	40	3	43	20	23	43
%	93	7		46.5	53.5	
Researches on Educational Issues	148	20	168	82	86	168
%	88.1	11.9		48.8	51.2	
Researches on Statistical Issues	80	10	90	34	56	90
%	88.9	11.9		37.8	62.2	
Total	268	33	301	136	165	301
%	89	11	100	45.2	54.8	100

The results of abstracts analysis indicate that more than half of the graduate theses did not mention the research approach used, and the applies for the educational researches on curricula, teaching methods, and educational issues. Whereas, 62.2% of the educational researches on statistical issues did not mention the research approach used, as shown in Table 12.

Table 12. Frequencies and percentages of mentioning research approach in the abstracts of the graduate theses, the educational researches on curricula, teaching methods and educational issues, and the educational researches on statistical issues

Research Type	Research Approach		Total
	Mention	No Mention	
Graduate Theses	20	23	43
%	46.5	53.5	
Researches on Educational Issues	81	87	168
%	48.2	51.8	
Researches on Statistical Issues	34	56	90
%	37.8	62.2	
Total	135	166	301
%	44.9	55.1	100

The analysis results indicate that the descriptive analytical approach is the most used approach in the graduate theses, the educational researches on curricula, teaching methods and educational issues, and the educational researches on statistical

issues by 35%, 23%, and 38%, respectively, as shown in Table 13.

Table 13. Frequencies and percentages of research approaches used in the graduate theses, the educational researches on curricula, teaching methods and educational issues, and the educational researches on statistical issues

Research Type	Used Approach	Frequencies	Total	%
Graduate Theses	Deductive	1	20	5
	Analytical	1		5
	Descriptive analytical	7		35
	Descriptive survey	1		5
	Descriptive	3		15
	Quasi-experimental	3		15
	Experimental	1		5
	Descriptive analytical and experimental	1		5
	Investigative	1		5
	Quantitative and qualitative	1		5
Researches on Educational Issues	Descriptive	18	81	22
	Descriptive analytical	19		23
	Quantitative	2		2
	Experimental	4		5
	Quasi-experimental	4		5
	Analytical	1		1
	Pre-experimental	1		1
	Descriptive quasi-experimental	3		4
	Descriptive Survey	15		19
	Six Sigma	1		1
	Quasi-experimental one-group experimental	1		1
	Descriptive inductive			
	Descriptive experimental	1		1
	Descriptive quasi-experimental	2		2
	Quantitative and qualitative	3		4
	Descriptive and content analysis	1		1
	Exploratory descriptive	3		4
Partial control experimental	1	1		
Researches on Statistical Issues	Qualitative	1	34	3
	Time series	1		3
	Quasi-experimental	1		3
	Descriptive analytical	13		38
	Analytical survey	1		3
	Descriptive survey	2		6
	Descriptive analytical correlational	1		3
	Qualitative	1		3
	Descriptive	9		26
	Mixed	1		3
	Correlational	1		3
	Descriptive correlational	1		3
	Mixed	1		3

The most important results of the researches were mentioned in the abstracts of 93% of the graduate theses, 82.1% of the educational researches on curricula, teaching methods and educational issues, and 82.2% of the educational researches on statistical issues, as shown in Table 14.

Table 14. Frequencies and percentages of mentioning results in the abstracts of the graduate theses, the educational researches on curricula, teaching methods and educational issues, and the educational researches on statistical issues

Research Type	Researches Results		Total
	Mention	No Mention	
Graduate Theses	40	3	34
%	93	7	
Researches on Educational Issues	138	30	168
%	82.1	17.9	
Researches on Statistical Issues	74	16	90
%	82.2	17.8	
Total	252	49	301
%	83.7	16.3	100

*Second Stage Results*

The second stage of the first axis related to the first research question covers the statistical methods used in the under-study theses and researches.

The analysis results indicate that the most used descriptive statistics in the graduate theses are frequency and mean by 69.8%, followed by standard deviation by 63% and finally median by 21%. Whereas in the educational researches on curricula, teaching methods, and educational issues, the most used was frequency by 77%, followed by mean by 68%, then standard deviation by 65%, and finally median by 13%. In educational researches on statistical issues, the most used was frequency by 73%, followed by mean by 53%, standard deviation by 44% and finally median by 9%, as shown in Figure 1.

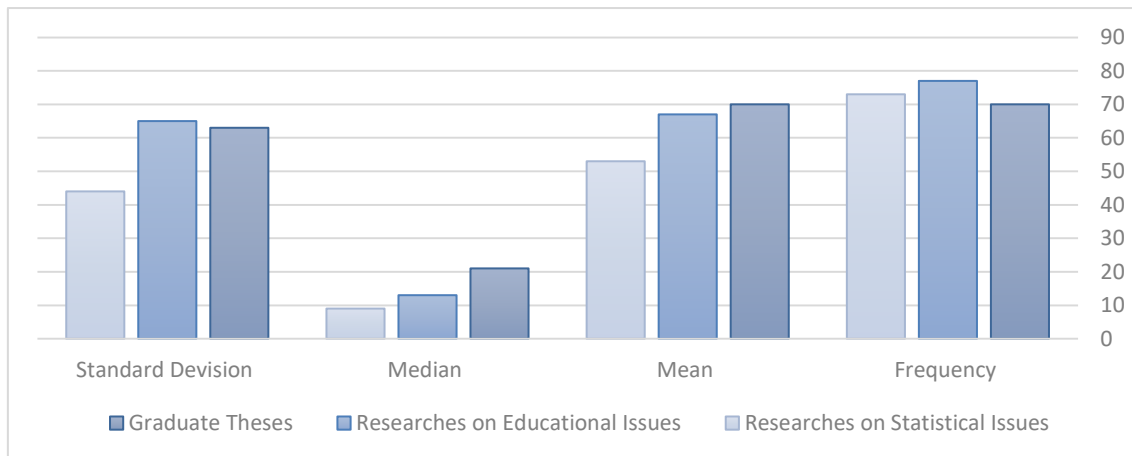


Figure 1. percentages of descriptive statistics used in the graduate theses, the educational researches on curricula, teaching methods and educational issues, and the educational researches on statistical issues

The analysis results indicate that correlation coefficients (Pearson / Spearman) were used in 60% of the graduate theses, in 71% of the educational researches on curricula, teaching methods and educational issues, and half of the educational researches on statistical issues. Simple linear regression was used in only 2% of the graduate theses, in 3% of the educational researches on statistical issues, and none of the educational researches on curricula, teaching methods and educational issues. Regarding graphs, it was used for results presentation in 33% of the graduate theses, in 19% of the educational researches on curricula, teaching methods and educational issues, and in 27% of the educational researches on statistical issues, as shown in Figure 2.

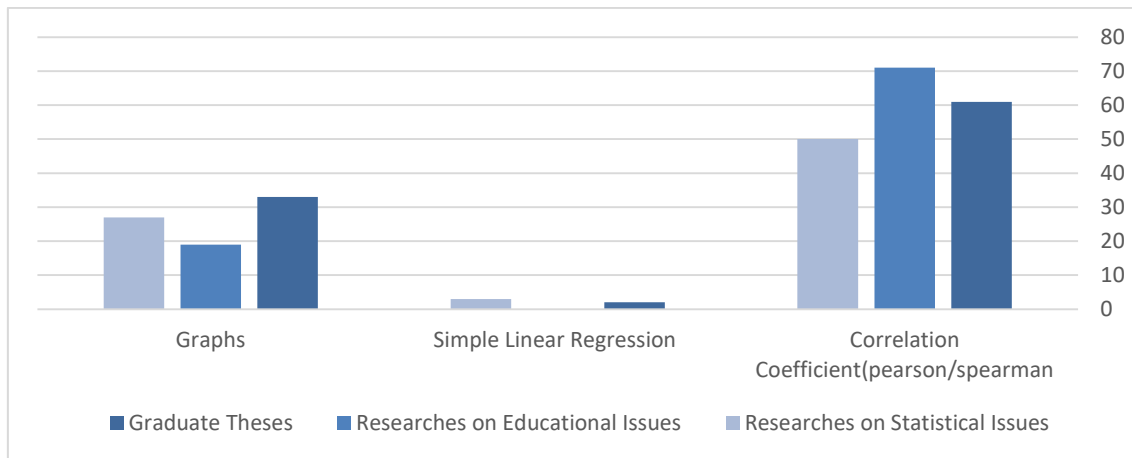


Figure 2. percentages of correlation coefficients (Pearson / Spearman), simple linear regression, and graphs in the graduate theses, the educational researches on curricula, teaching methods and educational issues, and the educational researches on statistical issues

The analysis results indicate that Z-test was used in only 2% of the graduate theses, in 4% of the educational researches on statistical issues, and none of the educational researches on curricula, teaching methods and educational issues. T-test was used in 40% of the graduate theses, in 48% of the educational researches on curricula, teaching methods and educational issues, and in 29% of the educational researches on statistical issues, as shown in Figure 3.

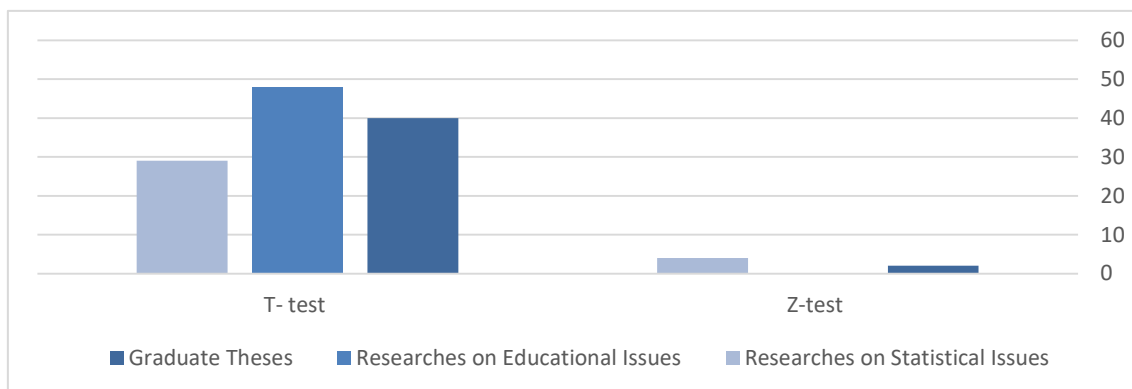


Figure 3. percentages of simple statistical tests (z-test & t-test) used in the graduate theses, the educational researches on curricula, teaching methods and educational issues, and the educational researches on statistical issues

The analysis results indicate that the one-way analysis of variance was used in 86% of the graduate theses, in 16% of the educational researches on curricula, teaching methods and educational issues, and in 21% of the educational researches on statistical issues, Whereas the two-way analysis of variance was used in only 5% of the graduate theses, in 2% of the educational researches on curricula, teaching methods and educational issues, and in 1% of the educational researches on statistical issue, and so three- way anova, as shown in Figure 4.

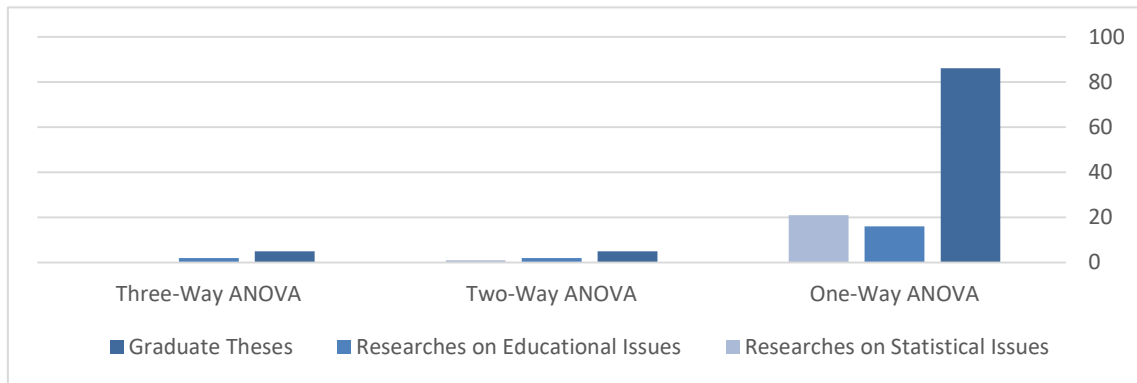


Figure 4. Percentages of ANOVA (one-way, two-way, three-Way) used in the graduate theses, the educational researches on curricula, teaching methods and educational issues, and the educational researches on statistical issues

The analysis results indicate that all of the graduate theses, 91.7% of the educational researches on curricula, teaching methods and educational issues, and 86.7% of the educational researches on statistical issues did not use partial correlation in analyzing their data, With regard to the multivariate analysis of variance (MANOVA), it was used in 7% of the graduate theses, none of the educational researches on curricula, teaching methods and educational issues, and also none of the educational researches on statistical issues. Whereas the analysis of covariance (ANCOVA) was used in 4.7% of the graduate theses, none of the educational researches on curricula, teaching methods and educational issues, and also none of the educational researches on statistical issues.

As for repeated measures design, it was used in 2.3% of the graduate theses, none of the educational researches on curricula, teaching methods and educational issues, and also none of the educational researches on statistical issues, as shown in Table 15.

Table 15. Frequencies and percentages of advanced statistical tests (Partial Correlation, MANOVA, ANCOVA, Repeated Measure Design) used in the graduate theses, the educational researches on curricula, teaching methods and educational issues, and the educational researches on statistical issues

Research Type	Partial Correlation			Total
	None	Used	Not Used	
Graduate Theses	0.0	0.0	43	43
%	0.0	0.0	100	100
Researches on Educational Issues	13	1	154	168
%	7.7	0.6	91.7	100
Researches on Statistical Issues	11	1	78	90
%	12.2	1.1	86.7	100
Total	24	2	275	301
%	8	0.7	91.4	100
MANOVA				
Graduate Theses	0.0	3	40	43
%	0.0	7	93	100
Researches on Educational Issues	13	0	155	168
%	7.7	0.0	92.3	100
Researches on Statistical Issues	11	0	79	90
%	12.2	0.0	87.8	100
Total	24	3	274	301
%	8	1	91	100
ANCOVA				
Graduate Theses	0	2	41	43
%	0.0	4.7	95.3	100
Researches on Educational Issues	13	4	151	168
%	7.7	2.4	89.9	100
Researches on Statistical Issues	11	0	79	90
%	12.2	0.0	87.8	100
Total	24	6	271	301
%	8	2	90	100
Repeated Measure Design				
Graduate Theses	0	1	42	43

%	0.0	2.3	97.7	100
Researches on Educational Issues	13	0	155	168
%	7.7	0.0	92.3	100
Researches on Statistical Issues	11	4	75	90
%	12.2	4.4	83.3	100
Total	24	5	272	301
%	8	1.7	90.4	100

•None: Researches that did not mention any of the statistical methods used in analyzing their data.

The analysis results indicate that factor analysis (FA) was used in 19% of the graduate theses, approximately none of the educational researches on curricula, teaching methods and educational issues, and in 13% of the educational researches on statistical issues. With regard to principal component analysis (PCA), it was used in 9.3% of the graduate theses, in 1% of the educational researches on curricula, teaching methods and educational issues, and in 10% of the educational researches on statistical issues. As for Discriminant Analysis (DA), it was used in 5% of the graduate theses, in 1% of the educational researches on curricula, teaching methods and educational issues, and none of the educational researches on statistical issues, as shown in Figure 5.

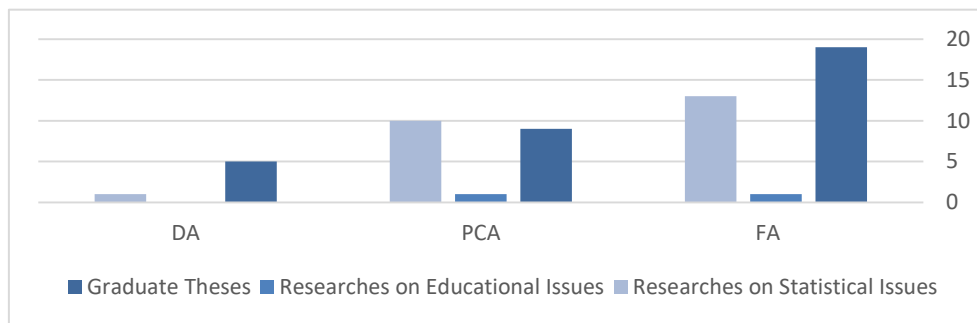


Figure 5. Percentages of FA, PCA, DA used in the graduate theses, the educational researches on curricula, teaching methods and educational issues, and the educational researches on statistical issues

The analysis results indicate that multiple regression was used in 2% of the graduate theses, none of the educational researches on curricula, teaching methods and educational issues, and in 1% of the educational researches on statistical issues. As for logistic regression, it was used in 9% of the graduate theses, in none of the educational researches on curricula, teaching methods and educational issues, and in 13% of the educational researches on statistical issues. Whereas, survival analysis wasn't used in any of the theses and researches, as shown in Figure 6.



Figure 6. Percentages of multiple regression, logistic regression, survival analysis used in the graduate theses, the educational researches on curricula, teaching methods and educational issues, and the educational researches on statistical issues

The analysis results indicate that the Chi-Square test of independence was used in 4.7% of the graduate theses, in 3% of the educational researches on curricula, teaching methods and educational issues, and in 1.1% of the educational researches on statistical issues. As for the Chi-Square Goodness of Fit test, it was used in 20.9% of the graduate theses, in 4.8% of the educational researches on curricula, teaching methods and educational issues, and in 8.9% of the educational researches on statistical issues, as shown in Figure 7.

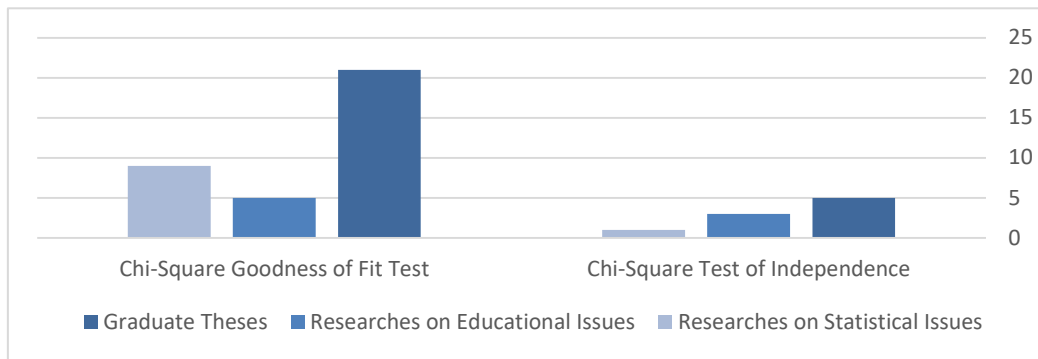


Figure 7. Percentages of Chi-Square test of Independence and Chi-Square Goodness of Fit test used in the graduate theses, the educational researches on curricula, teaching methods and educational issues, and the educational researches on statistical issues

The analysis results indicate that Mann–Whitney test was not used in any of the graduate theses, whereas it was used in 4% of the educational researches on curricula, teaching methods and educational issues, and in 3% of the educational researches on statistical issues. As for Kruskal–Wallis test, it also was not used in any of the graduate theses, yet used in 2% of the educational researches on curricula, teaching methods and educational issues, and in 2% of the educational researches on statistical issues, as shown in Figure 8.

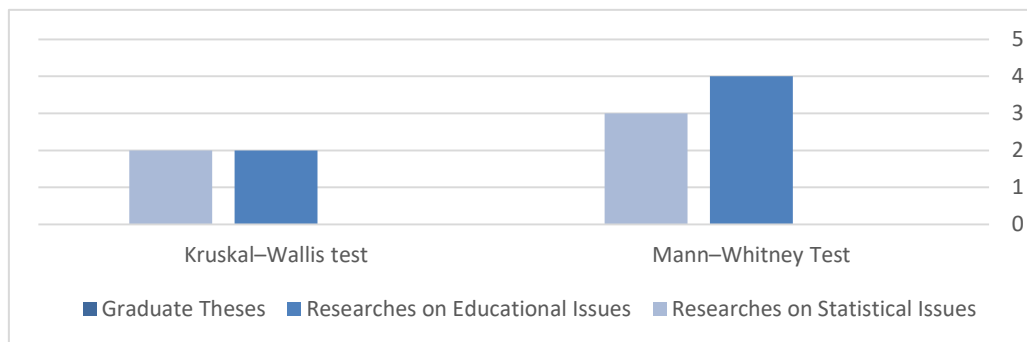


Figure 8. Percentages of Mann–Whitney test and Kruskal–Wallis test used in the graduate theses, the educational researches on curricula, teaching methods and educational issues, and the educational researches on statistical issues

The analysis results indicate that Friedman test was not used in any of the theses and researches. Wilcoxon test was also not used in any of the graduate theses, yet was used in 1.2% of the educational researches on curricula, teaching methods and educational issues, and in 2.2% of the educational researches on statistical issues, as shown in Figure 9.

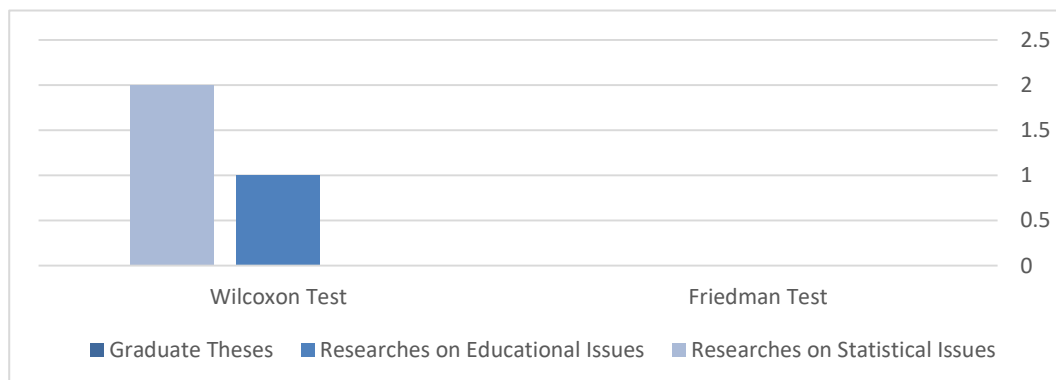




Figure 9. Percentages of Friedman test and Wilcoxon test used in the graduate theses, the educational researches on curricula, teaching methods and educational issues, and the educational researches on statistical issues

The analysis results indicate that statistical significance was used in 72.1% of the graduate theses, in 59.5% of the educational researches on curricula, teaching methods and educational issues, and in 55.6% of the educational researches on statistical issues, as shown in Table 16.

Table 16. Frequencies and percentages of the statistical significance in the graduate theses, the educational researches on curricula, teaching methods and educational issues, and the educational researches on statistical issues

Research Type	Statistical Significance			Total
	None	Used	Not Used	
Graduate Theses	0	31	12	43
%	0	72.1	27.9	100
Researches on Educational Issues	13	100	55	168
%	7.7	59.5	32.7	100
Researches on Statistical Issues	11	50	29	90
%	12.2	55.6	32.2	100
Total	24	181	96	301
%	8	60.1	31.9	100

• *None*: Researches that did not mention any of the statistical methods used in analyzing their data.

As shown in Table 17, the analysis results indicate that Omega for the strength of the relationship was not used in most of the theses and researches, whereas Eta was used in 7% of the graduate theses, in 5.4% of the educational researches on curricula, teaching methods and educational issues, and in 4.3% of the educational researches on statistical issues.

As for the effect size (Eta-Squared), it was used in 14% of the graduate theses, in 20.8% of the educational researches on curricula, teaching methods and educational issues, and in 6.7% of the educational researches on statistical issues.

Table 17. Frequencies and percentages of Omega, Eta, and effect size in the graduate theses, the educational researches on curricula, teaching methods and educational issues, and the educational researches on statistical issues

Research Type	Omega			Total
	None	Used	Not Used	
Graduate Theses	0	0	43	43
%	0	0	100	100
Researches on Educational Issues	13	1	154	168
%	7.7	0.6	91.7	100
Researches on Statistical Issues	11	0	79	90
%	12.2	0	87.8	100
Total	24	1	276	301
%	8	0.3	91.7	100
Eta				
Graduate Theses	0	3	40	43
%	0	7	93	100
Researches on Educational Issues	13	9	146	168
%	7.7	5.4	86.9	100
Researches on Statistical Issues	11	1	78	90
%	12.2	1.1	86.7	100
Total	24	13	264	301
%	8	4.3	87.7	100
Effect Size (Eta-Squared)				
Graduate Theses	0	6	37	43
%	0	14	86	100
Researches on Educational Issues	13	35	120	168
%	7.7	20.8	71.4	100
Researches on Statistical Issues	11	6	73	90
%	12.2	6.7	81.1	100
Total	24	47	230	301
%	8	15.6	76.4	100

- *None*: Researches that did not mention any of the statistical methods used in analyzing their data.

The analysis results indicate that Tukey's and Tukey-Kramer post-hoc tests were not used in any of the graduate theses, yet were used in 3.6% and 0.6% respectively of the educational researches on curricula, teaching methods and educational issues. As for the educational researches on statistical issues, 1.1% of them used Tukey's test and none of them used Tukey-Kramer test. With regard to Scheffe' test, it was used in 11.6% of the graduate theses, in 5.4% of the educational researches on curricula, teaching methods and educational issues, and in 8.9% of the educational researches on statistical issues. It should be noted that Dunnett's test was not used in any of the theses and researches, as shown in Table 18.

Table 18. Frequencies and percentages of post-hoc tests in the graduate theses, the educational researches on curricula, teaching methods and educational issues, and the educational researches on statistical issues

Tukey's Test				
Research Type	None	Used	Not Used	Total
Graduate Theses	0	0	43	43
%	0	0	100	100
Researches on Educational Issues	13	6	149	168
%	7.7	3.6	88.7	100
Researches on Statistical Issues	11	1	78	90
%	12.2	1.1	86.7	100
Total	24	7	270	301
%	8	2.3	89.7	100
Tukey-Kramer Test				
Graduate Theses	0	0	43	43
%	0	0	100	100
Researches on Educational Issues	13	1	154	168
%	7.7	0.6	91.7	100
Researches on Statistical Issues	11	0	79	90
%	12.2	0	87.8	100
Total	24	1	276	301
%	8	0.3	91.7	100
Scheffe' test				
Graduate Theses	0	5	38	43
%	0	11.6	88.4	100
Researches on Educational Issues	13	9	146	168
%	7.7	5.4	86.9	100
Researches on Statistical Issues	11	8	71	90
%	12.2	8.9	78.9	100
Total	24	22	255	301
%	8	7.3	84.7%	100

- *None*: Researches that did not mention any of the statistical methods used in analyzing their data.

### Second Axis

The second axis represents the third stage of analysis, and it covers the results related to the second research question (*Were assumptions of the statistical methods used in the educational researches and theses verified?*).

As shown in table 19, the analysis results indicate that the assumption of independence was verified in 9.3% of the graduate theses, 6.7% of the educational researches on statistical issues, whereas it was not verified in any of the educational researches on curricula, teaching methods and educational issues.

Table 19. Frequencies and percentages of verifying the assumption of independence in the graduate theses, the educational researches on curricula, teaching methods and educational issues, and the educational researches on statistical issues

Research Type	Independence			Total
	None	Used	Not Used	
Graduate Theses	0	4	39	43
%	0	9.3	90.7	100
Researches on Educational Issues	13	0	155	168
%	7.8	0	92.2	100
Researches on Statistical Issues	11	6	73	90
%	12.2	6.7	81.1	100
Total	24	10	267	301
%	8	3.3	88.7	100

• *None*: Researches that did not mention any of the statistical methods used in analyzing their data.

The analysis results indicate that the assumption of randomness was verified in only 2.3% of the graduate theses and 1.1% of the educational researches on statistical issues, whereas it was not verified in any of the educational researches on curricula, teaching methods and educational issues, as shown in Table 20.

Table 20. Frequencies and percentages of verifying the assumption of randomness in the graduate theses, the educational researches on curricula, teaching methods and educational issues, and the educational researches on statistical issues

Research Type	Randomness			Total
	None	Used	Not Used	
Graduate Theses	0	1	42	43
%	0	2.3	97.7	100
Researches on Educational Issues	13	0	155	168
%	7.8	0	92.2	100
Researches on Statistical Issues	11	1	78	90
%	12.2	1.1	86.7	100
Total	24	2	275	301
%	8	0.7	91.3	100

• *None*: Researches that did not mention any of the statistical methods used in analyzing their data.

The analysis results indicate that the assumption of normal distribution of data was verified in 2.3% of the graduate theses, 0.6 % of the educational researches on curricula, teaching methods and educational issue, and 2.2% of the educational statistical issues, as shown in Table 21.

Table 21. Frequencies and percentages of verifying the assumption of normal distribution in the graduate theses, the educational researches on curricula, teaching methods and educational issues, and the educational researches on statistical issues

Research Type	Normal Distribution			Total
	None	Used	Not Used	
Graduate Theses	0	1	42	43
%	0	2.3	97.7	100
Researches on Educational Issues	13	1	154	168
%	7.8	0.6	91.7	100
Researches on Statistical Issues	11	2	77	90
%	12.2	2.2	85.6	100
Total	24	4	273	301
%	8	1.3	90.7	100

The analysis results indicate that the assumption of homogeneity of variance was verified in 7% of the graduate theses, of which 2.3% used Bartlett's test and 4.7% used Levene's test. Homogeneity of variance was verified in 1.8 % of the educational researches on curricula, teaching methods and educational issues, all of which used Levene's test. As for the educational researches on statistical issues, 7.8% of them verified homogeneity of variance, of which 5.6% used Bartlett's test, 1.1% used Levene's test, and 1.1% used F max test, As shown in Table22.

Table 22. Frequencies and percentages of verifying the assumption of homogeneity of variance in the graduate theses, the educational researches on curricula, teaching methods and educational issues, and the educational researches on statistical issues

Research Type	Homogeneity of Variance					Total
	None	Used			Not Used	
		Fmax	Bartlett	Levene		
Graduate Theses	0	0	1	2	40	43
%	0	0	2.3	4.7	93	100
Researches on Educational Issues	13	0	0	3	152	168
%	7.7	0	0	1.8	90.5	100
Researches on Statistical Issues	11	1	5	1	72	90
%	12.2	1.1	5.6	1.1	80	100
Total	24	1	6	6	264	301
%	8	0.3	2	2	87.7	100

#### 4. Discussion

The result of the first research question (*What are the percentages of the statistical methods used in the educational researches and theses?*) are as follows:

In the first stage that covered the elements of the abstracts of the graduate theses, the educational researches on curricula, teaching methods and educational issues, and the educational researches on statistical issues - the study concluded that a small number of the under-study educational researches mentioned the type of sample used, and the most used sample was systematic random sample. A small number of abstracts mentioned the sizes of sample and population yet they did not mention the basis on which they relied in choosing the sample size. There was a fluctuation in sample-to-population sizes; sometimes the whole population were taken as a sample, sometimes the sample size approximated the population size, and sometimes the sample size was very small in relation to the population size. This indicates that the under-study theses researches did not use statistical standards and treatments in selecting the sample size in order for it to be truly representative of the population. This result agrees with the result of study (Al-Nuaimi & Abdullah, 2012) which found that all graduate theses in the College of Physical Education did not use statistical standards and treatments in selecting the sample.

With regard to the type of data, nearly half of the under-study educational researches stated in their abstracts that the type of data used in them is qualitative.

As for mentioning the independent and dependent variables, the study found most of the under-study educational researches mentioned the independent variable in their abstracts, yet most of them did not mention the dependent variable, which indicates that educational researchers focus on mentioning the independent variable yet they give a lesser degree of interest on mentioning the dependent variable.

With regard to the research approach, nearly half of the under-study educational researches did not mention it, and the most used approach was the descriptive-analytical approach. This indicates the researcher's negligence to mention the used approach in the abstracts of their educational researches.

The second stage covered the statistical methods used in the under-study educational researches, and most of them used descriptive statistical methods represented in (frequency, mean, standard deviation, Pearson/Spearman correlation coefficients). Pearson/Spearman correlation coefficients were used to examine the stability of the study tools and to reveal the correlation between items of the study tool used or the so-called internal consistency. This indicates that the majority of the under-study theses and research used descriptive statistics extensively, which agrees with (Al-Sardi, 2012) and this indicated increase in use of descriptive statistics methods in master's theses, the decreased use of simple inferential statistics, and the poor use of advanced inferential statistics.

As for T-test and Z-test, the study found, nearly half of the under-study educational researches used T-test. Through a review of the statistical methods used, it was observed that these tests were used mostly for the purpose of verifying the parity of the study groups. The study found that the use of T-test was not appropriate to the analyzed educational data, as it did not fulfil the condition of normal distribution. This result agrees with the result of (Yanushkevichene, Yanushkevichius & Din, 2016)

The results related to the analysis of variance indicated that the one-way ANOVA is the most used in the under-study educational researches. As for advanced statistical methods, the results indicated that the factor analysis (FA) was the most used compared to other methods. The reason for using this method is that some educational researches dealt with

statistical issues related to test item analysis or item response theory. This indicates a decrease in the use of advanced statistical methods in the under-study educational researches.

With regard to non-parametric statistical methods, the most used non-parametric test in the under-study educational researches was the chi-square test of independence, yet the criteria and reasons for using this test were not clarified.

The study found that most of the under-study educational researches used statistical significance due to the use of statistical hypotheses in which acceptance or rejection of the hypothesis depends on the value of the statistical significance.

The study found that the under-study educational researches did not use pre-hoc comparisons that are used to select the most appropriate statistical hypotheses based on the statistical hypotheses that were used in previous studies. This type of comparison requires referring to relevant previous studies and a comprehensive review of the literature related to the study question, which is very useful in designing the study and selecting its tools and statistical tests.

As for post-hoc comparisons, the study found that Scheffe test was the most used post-hoc test, which is used after rejecting the null hypothesis to verify the significance of differences. However, the use of this test was limited as many of the under-study educational researches neglected this aspect of the analysis despite its importance in revealing the significance of differences.

The result of the second research question (*Were assumptions of the statistical methods used in the educational researches and theses verified?*) found that there was:

Lack of verifying the assumptions of statistical methods in the under-study educational researches. The assumption that has been verified the most in the under-study educational researches is the homogeneity of variance.

The under-study educational researches used statistical methods, especially inferential, without verifying the assumptions of these methods, which is important for the robustness of using these methods and the credibility, realistics of the research results. The under-study educational researches that verified the assumptions of the statistical methods are the ones in which the subject of research revolves around item response theory, the use of which requires verification of assumptions, including the assumption of independence. Poor verification of statistical assumptions leads to a breach of the conditions for applying any statistical method, resulting in erroneous results and negative effects. The process of choosing the appropriate statistical method has become a strong necessity for researchers for more objective and accurate results, as violating the conditions of applying any statistical method inevitably leads to wrong results (Rabia & Adaika, 2019).

Based on the study's findings regarding assessing statistical methods in the under-study educational researches, the study recommends:

Educational research abstract needs to include the most important elements of the research, so that other researchers can benefit and refer to in their future studies. There is also a need to diversify the study tools, which should not be limited only to questionnaires in studies and researches, and to use quantitative data represented in tests as study tools in addition to other tools.

Researches must follow new approaches of statistical methods; especially that recent research's trends refer to using advanced research methods and not to be limited to simple statistical methods and descriptive statistics. The justifications for the use of non-parametric statistical methods should be mentioned, as they are no less important than parametric statistical methods. They are important for many researchers when the assumptions of the parametric statistical methods, especially normal distribution, the size and type of sample, and the nature of data are all verified. It is important to use pre-hoc comparisons before embarking on studies and researches for the robustness of this study or research. There is also a need to focus on required post-hoc comparisons in the statistical methods, in order to reveal the significance of differences, which would achieve the intended benefit of the research.

Failure to verify the assumptions of statistical methods is an indication that the educational research is weak and that its results are unrealistic. Therefore, the assumptions must be verified before embarking on the use of statistical methods in order for the results to be realistic and to be used in the educational decision-making process.

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