

## STATISTICAL LITERACY AMONG EFL MASTER'S STUDENTS: ACTION RESEARCH

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**Abstract:** *The Social Package for the Social Sciences (SPSS) is among the most common programs used by researchers in language studies to explore, examine, and analyze quantitative data for the sake of drawing valid conclusions. The current action research aims to offer insights into the utilization of SPSS by Master's students in their empirical studies for statistical analysis. Specifically, it attempts to depict the way SPSS is employed in academic pursuits, and discern the inherent challenges faced by students, offering insights into the obstacles that may impede their effective use of SPSS as a tool for statistical exploration and interpretation in academic research. To reach these objectives, ten Master's dissertations written by EFL students at the Department of English at Mouloud Mammeri University in language studies were scrutinized through a qualitative content analysis. Findings indicate that the students limit the scope of their use of SPSS to quantitative variables and descriptive statistics. In addition, it has been found that the most commonly used statistical technique is 'the mean' or 'the average' that could be easily measured without any sophisticated software. Furthermore, no reference to inferential statistics in order to compare among groups or to measure the impact of a variable on another is made. The overall conclusion drawn from the analysis of the corpus is that students exhibit reluctance to the use of inferential statistics in their empirical studies and unconsciously believe that SPSS, inferential statistics, or any other sophisticated software are tightly related to natural sciences and could not be easily applied in social sciences. On the basis of the findings, a number of recommendations are suggested like organizing workshops with computer scientists. In addition, students' self-confidence should be increased in order to change their perception of their potential and abilities to feel more at ease with statistics and technologies while doing academic research in language studies.*

**Keywords:** Inferential statistics, Novice EFL researchers; Social sciences; SPSS, Statistical Literacy.

### 1. Introduction

Endeavoring into scientific research can be both an exciting and a challenging adventure mainly for novice researchers. Scientific research is a rewarding experience when it aims to explain a variety of phenomena around us. According to Dörnyei, "research simply means trying to find answers to questions, an activity every one of us does all the time to learn more about the world around us" (2007:15). However, conducting systematic research can be challenging as it

requires from the researcher to follow a systematic plan and reliable research tools in order to get valid results.

To make of any study a scientific one, a researcher has to make judicious selections of tools to systematically collect and analyze data. Indeed, the choice of specific research tools is one of the basic criteria for classifying research into different categories. There exists three standard ways of conducting research: qualitative, quantitative and mixed-methods research. *“The key distinction between quantitative and qualitative research lies in the types of data collected”* (Paltridge & Phakiti, 2015, p.08). While qualitative research relies on data that can be described or conceptualized in words, quantitative research uses numerical or statistical data to draw conclusions. The latter is the object of the current study.

The use of statistics in quantitative empirical studies has revealed its significant effect to get reliable and more valid results. Proficiency in interpreting statistical information and employing it judiciously in decision-making is pivotal within various professional domains and within a societal framework that progressively leans on quantitative knowledge and evidence (Callingham & Watson, 2017). When applied in social sciences, statistics handle issues related to social phenomena and human behavior. Various areas of research can be explored through social statistics by assigning numbers to different social categories.

The way scientists and researchers conduct their statistical analysis has changed as a result of the development of statistical software in research (Masuadi et al., 2021). As an example, a widely used program for statistical analysis in language studies and education is the SPSS. The use of statistical procedures for data analysis in social sciences is increasingly gaining ground among proficient and novice researchers alike. The ultimate objective of their adoption is to better understand the human behavior and account for the social attitudes prevailing in different contexts through, mainly, survey or experimental methodology. SPSS has significantly revolutionized the landscape of statistical analysis, particularly in the fields of language studies and education. It offers a range of powerful tools and features that have enhanced the efficiency and depth of statistical examinations in these domains. It facilitates the efficient organization, management, and cleaning of large datasets, enabling researchers in language studies and education to handle complex data structures with ease.

Despite these advancements, ambiguity is still surrounding when it comes to selection of statistical software for a specific research design, thereby creating confusion and uncertainty in choosing the right statistical tools among researchers. This is mainly the case of novice researchers who experience the use of statistics for the first time in their empirical studies.

The practitioner-researcher in charge of research methodology course has noticed that Master’s students, when endeavoring into quantitative research for the first time, keep struggling with the way to implement the scientific method in social sciences. Furthermore, they face a serious challenge of using SPSS in an appropriate way to conduct their statistical analysis in quantitative studies. This reveals their limited statistical literacy. Accordingly, the present study is action research meant to provide an overview of how SPSS is used by Master’s students in their empirical studies while conducting statistical analysis. Specifically, it addresses two research questions

- In their empirical studies, how do EFL students in Algeria utilize SPSS for statistical analysis?

- What challenges do Algerian EFL students encounter when performing statistical analysis in their empirical studies?

The purpose of the study is to give insights into the crucial role of statistics in general and inferential statistics in particular when dealing with social issues. In addition, the overall aim of the teacher-practitioner is to depict the students' deficiencies in order to amend the course content or suggest innovative teaching techniques.

## 2. Review of the Literature

### 2.1 Quantitative Research in Social Sciences

Science encompasses two categories of disciplines: natural sciences and social sciences. Disciplines dealing with naturally occurring objects, the human body, or physical objects fall within the scope of natural sciences. On the other hand, "*social science is the science of people or collections of people, such as groups, firms, societies, or economies, and their individual or collective behaviours*" (Bhattacharjee, 2012).

Around the end of the nineteenth century, the scientific method was borrowed from natural sciences to be applied in social sciences resulting in the quantitative method in order to increase the reliability of the research tools, and the validity of the results.

Quantitative methods reflect positivist philosophical assumptions. It perceives knowledge in terms of numerical values that can be empirically measured, and produces hard facts.

The incorporation of numerical values in research methodologies underpins a stronger link between positivist philosophical assumptions and the chosen methodological approach. According to Dörnyei (2007), an important feature of quantitative research is the use of numbers. To be meaningful, each number, unlike natural sciences, should be contextualized or related to a specific category. In addition, the language of statistics has become part of the quantitative research jargon. The links between different variables are stated in tabular and statistical forms.

Conducting quantitative research in social sciences in general and language studies, in particular, is challenging since it is difficult to deal with the extreme variability of the human mind and man-made constructs. Among the challenging key-elements of quantitative studies is the data analysis phase, in other terms statistical analysis.

Quantitative research extensively relies on statistics as the predominant branch of mathematics. Social statistics include the collection and interpretation of numerical data about human behavior and social environment. Quantitative data arising from closed-ended items of questionnaires, surveys, and tests' scores can be analyzed through the statistical method. The latter relates to well-defined mathematical procedures ranging from descriptive statistics to multivariate analysis. The results are, then, converted into frequencies or means and presented in tables or charts. Two types of statistics are used in a complementary way in quantitative studies: descriptive and inferential statistics.

Descriptive statistics describe and summarize the collected data in a meaningful way and could include a simple table of numbers including scores, rates, averages,

or cross-tabulation displaying the distribution of two variables by tabulating their results one against the other. Their aim is to visualize the findings in order to simplify their interpretation. According to Hanneman et al. (2013), the main task of descriptive statistics is to summarize large amounts of information in such a way that can be accurately and quickly communicated.

Inferential statistics go much further. They are employed to compare between the different categories of participants. Their aim is to validate the obtained results, to perform reliability analysis, and to generalize the results from the sample to the whole population. *“Inferential statistics are used when we try to connect individual variables in terms of their relationships. Inferential statistics help us make inferences about population parameters”* (Paltridge & Phakiti, 2015:30)

Questions that inferential statistics might help answer include mainly correlations among a variety of variables. They

- allow researchers to test hypotheses about relationships among the data and to make conclusions based on statistical evidence;
- help to draw conclusions about an entire population by looking at only a sample of the population and to generalize the results from the sample to the whole population;
- compare among different categories of participants;
- validate the obtained results, to perform reliability analysis. In social sciences, a result is typically considered as significant when the probability coefficient (P-value) is smaller than 0.05.

Several statistical programs have been designed to facilitate the quantitative analysis of data. SPSS is the most common software used in educational research. It was initially created by The SPSS Corporation in the early 1980s and has recently discharged version eleven.

## **2.2 The Use of SPSS for Statistical Analysis**

Several inferential statistical procedures are to be found in the literature depending on the type of the variables investigated and the objective of the analysis. When using SPSS, the researcher has to go through a set of steps to make their analysis systematic and get valid results.

The first step of the analysis is coding the collected data in a data file by defining the various variables and assigning values to each possible response. The coding frame varies according to the question type. The second step consists of selecting specific statistical procedures that fit the purpose of the research. The type of data analysis techniques used by a researcher depends on the design of the study, the type of data being gathered, and the questions being asked. Chi-Square tests, independent-samples T-tests, paired-sample T-tests, and ANOVA are the most used statistical techniques in applied linguistics and language studies. They are mainly used in survey studies and experimental studies.

It is worth noting that researchers need to understand the type of the collected data, the dependent and the independent variables included in the study, and, most importantly, the aim of the statistical tests before starting the data analysis phase.

Understanding the rationale behind statistical tests is essential for researchers as it guides appropriate test selection, promotes accurate result interpretation, helps avoid common pitfalls and assumption violations, supports generalization to populations, aids in effective communication of findings, contributes to

methodological rigor, and facilitates informed decision-making throughout the research process. This comprehension ensures that statistical analyses align with study objectives, leading to more reliable and meaningful scientific conclusions.

### **2.3 Statistical Literacy: Analytical Framework**

Statistical literacy involves the ability to understand, interpret, and critically evaluate statistical information, enabling individuals to make informed decisions and comprehend the implications of data within the context of research. Katherine Walleman defines statistical literacy as “*the ability to understand and critically evaluate statistical results that permeate our daily lives coupled with the ability to appreciate the contributions that statistical thinking can make in public and private, professional and personal decisions.*” (1993, as cited in Watson & Callingham, 2003:06)

Watson (1997) proposed a hierarchical framework for statistical literacy, categorizing it into three levels. The foundational tier encompasses basic numeracy and a grasp of probabilities. The intermediate level involves contextual understanding of statistical language in practical scenarios. The highest tier signifies advanced statistical literacy, characterized by a critical approach to statistical arguments. This conceptual framework provides a structured perspective on the developmental stages of statistical literacy.

In accordance with Watson's (1997) framework, descriptive statistics align with the initial level of statistical literacy, encompassing foundational numeracy and probability comprehension. Conversely, inferential statistics are situated at the pinnacle of statistical literacy, requiring researchers to critically formulate conclusions and inferences. This categorization within the proposed hierarchical structure sheds light on the varying cognitive demands associated with distinct statistical approaches.

### **2.4 Previous Studies about the Students' Statistical Literacy**

A glance at the literature shows the existence of substantial empirical studies dedicated to the examination and exploration of statistical literacy particularly within the realms of Social Sciences. However, a paucity of systematic investigations of the topic was noticed in the Algerian context as no study was reported or published. For illustrative purposes, this article reports findings from two distinct studies.

Marcus Berndt together with a group of scholars conducted a study to explore and investigate the impact of the study domain on the students' statistical literacy at a German University. The participants were enrolled in different courses: medical sciences, social sciences, and economics. Their findings reveal a correlation between study domain and statistical literacy. In addition, the longer students are exposed to statistics the higher are their scores.

Another study was conducted by Bromage et al. and published in 2022. It explored the array of challenges encountered by both educators and students engaged in the instruction and acquisition of statistical concepts within disciplines outside the realm of mathematics. The outcomes of their investigation indicate that a considerable portion of the primary challenges emanates from the students' negative attitudes towards statistics, together with poor motivation to engage with the subject, factors further intensified by the presence of statistics anxiety.

### **3. The Empirical Study**

#### **3.1 Research Design**

In this study, two research questions are explored, focusing on the way Master's students at the Department of English, MMUTO use SPSS for their statistical analysis. The first question examines how these students incorporate SPSS into their research endeavors, shedding light on their approach and utilization of the statistical software. The second question explores the challenges faced by these students when employing SPSS.

The present study is part of an action research; its overall objective is to depict the students' deficiencies in terms of quantitative research methodology, then suggest some guidelines to improve current teaching practices and help students get increasingly better results. Parsons and Brown (2002) define action research as

a form of investigation designed for use by teachers to attempt to solve problems and improve professional practices in their own classrooms. It involves systematic observations and data collection which can be then used by the practitioner-researcher in reflection, decision-making and the development of more effective classroom strategies.

Action research is an umbrella term for a set of studies that can be conducted by practitioners and teachers with their learners or inside their classrooms. It consists of continually observing learners in order to depict their daily challenges. In addition, it is a systematic way for teachers and educational leaders to reflect upon their practices and observe their classroom practices. Its purpose is to guide teachers towards improving the quality of their instruction to help learners become better. In this context, Burns (2015) lists some of the advantages of conducting action research for multiple purposes: educational, social or critical as follows

- Facilitate positive transformation and improvement in the social circumstances of participants.
- Generate both theoretical insights and practical knowledge pertaining to the given situation.
- Foster collegiality, collaboration, and active involvement of participants who are integral actors in the situation and are highly likely to be impacted by any ensuing changes.
- Cultivate an attitudinal disposition characterized by a commitment to ongoing change, self-development, and personal growth.

To achieve the study's goals and address the research questions, Master's dissertations that employed quantitative research methods were chosen for examination using a qualitative approach. Consequently, the research design adopted for this study is exploratory in nature.

#### **3.2 Corpus of the Study**

The study's corpus comprises ten (10) dissertations sourced from the online database "D-space," dedicated to dissertations and theses within the Department of English at Mouloud Mammeri University of Tizi-Ouzou. These chosen dissertations involve quantitative analyses through SPSS, carried out by Master's students specializing in language studies. To uphold ethical standards, both the students' names and the precise titles of the dissertations remain confidential.

### **3.3 Data Analysis: Qualitative Content Analysis**

The corpus is examined through qualitative content analysis. The latter is a versatile technique widely employed to analyze text data with the aim of interpreting meaning. At its core, it involves the qualitative interpretive act of assigning categories to text passages (Mayring, 2014:10). This method encompasses three main categories of data analysis: conventional, directed, and summative analysis. In the context of this research, the directed content analysis category is particularly relevant.

Directed content analysis is a systematic approach wherein researchers identify predetermined coding categories based on an existing theoretical background. The primary objective of this approach is to either validate or extend a theoretical framework or theory (Hsieh & Shannon, 2005: 1281). In the present study, the analytical categories include the types of variables students analyze through SPSS, the utilization of inferential statistics for group comparisons or to validate quantitative results, and the various inferential statistical procedures employed. This structured analysis aims to provide a deeper understanding of the researched phenomena within the established theoretical framework.

## **4. Findings & Discussion**

The selected corpus has been thoroughly scrutinized in order to bring answers to the research questions raised at the outset of the investigation and advanced in the introduction.

### **4.1 Answer to Research Question # One: Novice EFL Researchers and the Use of Statistics**

The first research question examined the way Algerian EFL students use SPSS in their statistical analysis. Findings reveal negative attitudes towards the use of statistics in their quantitative studies reflecting statistics anxiety. These findings align coherently with existing scholarly works, notably those conducted by Bromage et al. (2022) and Berndt et al. (2021). These prior studies have consistently documented and reported unfavorable attitudes exhibited by students in the social sciences concerning both the theoretical comprehension and practical application of statistical techniques. The convergence of our results with established research underscores the persistence of negative perceptions toward statistics among students within similar academic domains.

After taking a five-year course in English studies, EFL students at the department of English, and as part of the partial fulfilment of the requirements for the Master's degree, are asked to do scientific research in order to write a fifty-page dissertation. To help them succeed in their task, a course in research methodology is offered to them. The latter introduces the students to descriptive and inferential statistics and describes them as a compulsory component of quantitative research methodology. Indeed, a bulk of studies are reported in the literature relating to the teaching of introductory statistics courses for novice researchers (e.g. Hogg, 1999; Moore 2001).

As a teacher in charge of this course, I have noticed that students show reluctance towards the use of inferential statistics in their empirical studies. In addition, whenever they are asked to use SPSS, their anxiety increases; a feeling which is shared among proficient and less proficient students alike. Indeed, this result is in

line with other empirical studies revealing the ambivalent attitudes of students towards statistics, mainly in social sciences. Sue Gordon (2004) reported in her article about students' experiences of statistics, that "*Seventy three percent of the students surveyed reported that they would not have studied statistics, if they had been given a choice*".

It is worth noting that during the different research methodology classes, students showed enthusiasm when studying statistics which is a new field for them. They are used to having courses in literature, civilization, linguistics or other disciplines related to social sciences, but they discover the use of numbers in social contexts for the first time. So, it is a new experience that they enjoy in research methodology classes, but when it comes to practice, they show an opposite attitude. Williams and colleagues (2008) contend that the influence of attitudes toward statistics on statistical literacy may surpass the impact of declarative knowledge about statistics. Indeed, EFL student tend to perceive statistics as less relevant for their subsequent professional practice.

#### **4.2 Answer to Research Question # Two: Participants' Challenges while using SPSS**

The second research inquiry delved into an examination of the distinct challenges confronted by students in the process of conducting statistical analyses of data. The analysis of the corpus consisting of Master's dissertations written by Master's students has revealed some weaknesses, as well as some difficulties encountered by the students when doing their empirical studies. These difficulties are mainly related to the use of SPSS to conduct inferential statistical analysis.

The first challenge of the students is the use of statistics with nominal or categorical variables. Indeed, they have limited the scope of their use of SPSS to quantitative variables. A variable is a quantifiable characteristic or attribute that can take on various values through measurement. It may be quantitative like the level of the participants, age, height, population size etc. or categorical/ nominal like gender, marital status, level of education, work experience, geographical area etc. both types of variables are useful to reach reliable results. However, the analysis of the corpus revealed that the categorical or nominal variables are not considered, while much focus is put on quantitative variables. By doing so, the participants reveal either their limited knowledge of the use of the software and the various statistical tests, or their fear and anxiety towards the use of inferential statistics. This result discloses that the participants in the study exhibit a limited level of statistical literacy, aligning with the initial hierarchical level proposed by Watson in 1997.

Another result that emerged from the analysis of the corpus is that the students have limited the scope of their use of SPSS to descriptive statistics. It has been observed that the most frequently employed statistical technique is 'the mean' or 'the average', a measure that can be readily calculated without the need for sophisticated software. This result confirms the previous claim about students' negative attitudes towards statistics and mathematics since they are enrolled in literature and language studies courses.

Moreover, there is an absence of reference to inferential statistics, which are essential for making comparisons between groups or assessing the influence of one variable on another. Their statistical analysis was limited to univariate analysis aiming to analyze one variable at a time. As an illustration, in one of the analyzed



dissertations, in order to compare participants' practices in social media with focus on gender differences, the students use the descriptive statistics. In this example, the students are supposed to conduct a bivariate analysis by examining the impact of a nominal variable (gender) on another (the use of social forums) by applying a Chi-square test. However, the students limited their analysis to descriptive statistics by calculating the mean or the frequency by using the rule of three. Using descriptive statistics in such situation is likely to mislead the researcher and get invalid results. Descriptive statistics cannot be used to compare among groups. Last but not least, the students have not made any reference to inferential statistics in order to check the validity and reliability of their results. All of their quantitative findings were obtained from a univariate analysis, and presented as facts. All in all, the obtained result indicates that the participants in our study possess a restricted level of statistical literacy, consistent with the foundational hierarchical level as proposed by Watson in 1997. This implies a basic proficiency in statistical understanding among the study participants, highlighting a potential area for targeted intervention or educational enhancement in statistical literacy.

## 5. Recommendations

Building upon the findings presented earlier and drawing from my personal experience as a teacher in charge of a research methodology course, several recommendations for improvement are proposed:

- **Organizing Workshops with Computer Scientists:** Initiate workshops in collaboration with computer scientists to elucidate the procedural steps and the selection criteria for statistical techniques in the context of social sciences. This collaborative effort aims to enhance students' practical understanding of statistical applications.
- **Enhancing Comfort with Statistics and Technologies:** Foster a conducive environment where students can develop a greater sense of ease with both statistical methodologies and technological tools during their academic research endeavors. This may involve incorporating hands-on activities or interactive sessions to demystify statistical processes.
- **Promoting Awareness of Statistics' Role in Social Sciences:** Heighten students' awareness regarding the pivotal role of statistics in social sciences. Emphasize its significance as a tool for measuring social constructs and investigating pertinent social issues, thereby underscoring its practical relevance and applicability.
- **Cultivating Awareness of the Scientific Method in Social Sciences:** Raise students' awareness about the scientific method as it pertains specifically to social sciences. This entails elucidating the systematic and empirical approach employed in social scientific inquiry, fostering a deeper appreciation for the rigor inherent in such methodologies.
- **Highlighting the Unity of Natural and Social Sciences:** Increase students' awareness of the interconnectedness between natural and social sciences, presenting them as complementary facets of a shared pursuit of knowledge. Framing both disciplines as integral components of the broader scientific landscape reinforces the overarching concept of science as a unified and comprehensive endeavor.

## 6. Conclusion

Applying SPSS for statistical analysis in social sciences is crucial for the success of quantitative research, particularly in Master's dissertations. The study focuses on challenges faced by students at the Department of English, Mouloud Mammeri University of Tizi-Ouzou, revealing an ambivalent attitude towards statistics. The researcher suggests that teachers should refine their teaching practices based on insights from the study, aiming to improve students' involvement in scientific research and, consequently, their academic achievement.

The broader implications of the research extend to educational institutions and curriculum design. The findings can guide the enhancement of research methodology courses, especially in addressing challenges related to statistical analysis. There is a need to improve the integration of statistical analysis tools, such as SPSS, in language studies programs. Educators should ensure that courses provide practical exercises and hands-on experiences, promoting proficiency in using these tools for research purposes.

Moreover, the study emphasizes the importance of raising students' awareness regarding the crucial role of statistics in social sciences. Institutions can consider awareness campaigns or workshops to foster a better understanding of statistical methods among students. Additionally, fostering confidence in students to apply new techniques and encouraging intellectual risk-taking is essential. Institutions should create an environment that supports experimentation and exploration, empowering students to use statistical analysis as a valuable tool in their academic pursuits.

In conclusion, the research contributes insights that can lead to improvements in research methodology courses and the integration of statistical analysis tools in language studies programs. By addressing students' challenges with statistical tests, educators and institutions can play a pivotal role in enhancing the quality of research in the social sciences and preparing students for successful Master's dissertations.

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