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Enhancing the quality and standard of research in Saudi Arabian universities:

**Selection and use of research methods at doctoral level: An investigative study on
the use of research into statistical methods**

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**A thesis submitted in fulfilment of the requirements
for the Degree of Philosophy (PhD)**

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Abstract

This study investigated the selection and use of research methodologies at doctoral level, with particular emphasis on the use of statistical practices in research and with a focus on the Saudi Arabian context. There are misapplications in certain studies when analysing the statistical data, and some of these inaccuracies come from using improper management and suitable statistical methods at the analysis stage, contributing to misleading research conclusions. A key question was ‘How do academics and PhD students from Education departments in a selected university in Saudi Arabia and a university in Scotland/United Kingdom, from different educational backgrounds, view their readiness, selection, and utilization of statistical methods in PhD research?’. The accurate use of Statistics is critical in academic research, Statistics provide a methodical and objective approach to data analysis and interpretation, allowing researchers to make meaningful conclusions and uncover noteworthy patterns. Thus, a study acquires credibility and assures the validity of its findings by using accurate statistics, allowing policymakers and stakeholders to make educated decisions and perform targeted adjustments that enhance every aspect of society.

This study examined PhD students' perceptions of their preparedness for statistical analysis, as well as their statistical and mathematical skills. Currently in Saudi Arabia, a programme of development: *Vision 2030*, is being implemented and so an aim of this study was to show why reforms are needed in Saudi Arabia's education system and why future university students should have sufficient Mathematical understanding to maintain the PhD researcher's basic knowledge base (Mathematics and Statistics). This was accomplished by sending a questionnaire to PhD students in SA and UK and conducting interviews with Statistics lecturers for postgraduate students in Saudi Arabia. The study found there is data analysis problems, such as inaccurate statistical technique application, a lack of pre-existing Mathematical expertise, wrong data processing, and incorrect result analysis. To increase the accuracy of statistical methods employed in PhD research, the study recommends that qualified statisticians, Statistics centres, and quality Mathematics and Statistics material be developed in the KSA. Furthermore, the research showed the significance of developing educational cadres in Statistics, developing the literacy pathway in schools in Mathematics, and making advanced Statistics courses necessary for postgraduate students in order to improve the quality and credibility of research undertaken, and the significance of students having a mathematical foundation in the Kingdom of Saudi Arabia.

Key words: Statistics, Mathematics, Application, Education, Accuracy, Research; Vision 2030.

Abbreviations

| | |
|-----------------|---|
| ASA | American Statistical Association |
| TIMSS | Trend in International Maths and Science Study |
| OLD | Ordinary Least Square regression |
| OECD | Organization for Economic cooperation and Development |
| PISA | Programme for International students Assessment |
| ERIC | Education Resources Information Centre |
| AMOS | Analysis of Moment of Structures |
| SPSS | Statistical Package for Social Science |
| MS EXCEL | Microsoft EXCEL |
| UK | United Kingdom |
| KSA(SA) | Kingdom of Saudi Arabia |

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Author's Declaration

I hereby declare that this thesis has been prepared on the basis of all inputs being my own work unless referenced otherwise, and that such other published and unpublished source materials have been acknowledged.

The thesis is compliant with university of Glasgow's guidance and regulations for doctoral thesis.

Name: Manal Abuhaimed

Signature:

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Definitions:

Accuracy: The use of proper methods, processes, and tools to deal with data in order to obtain accurate scientific measurements that are free of mistakes that may lead to misleading and unreal study conclusions (Ismail, 2020).

Apply: “*Students apply knowledge and skills gained from traditional classroom learning to hands-on and/or real-world settings, creative projects or independent or directed research*” (SUNY, 2018, para. 1).

Quality: Al-Warthan (2008) defines quality as a set of standards and procedures whose implementation aims to improve the scientific product continuously. Blauchow (2009) describes the quality of education as the sum of the characteristics and advantages of the educational system and its ability to provide a distinctive educational product that meets and achieves the current and future needs and strategic aspirations of the beneficiary of the service, the student, the labor market, and society.

Readiness: “*is the physical, motor, socio-emotional, behavioural, linguistic, and cognitive skills indicating preparedness to receive formal educational instruction*” (Millians, 2011:P 17). Meisels (1998) defines readiness as a “*State or condition of an individual that makes it possible for him or her to engage profitably in a given learning activity, learning readiness depends on such factors as past experiences, cognitive development, affective factors, and motivation as well as on the instructional methods and materials to be used*” (Meisels, 1998).

Statistics: The branch of mathematics concerned with statistical methods that include gathering information and numerical data for a phenomenon, tabulating and displaying it, and analysing it in a way that aids in describing or identifying it, before drawing conclusions and making appropriate recommendations (Zaitoun, 1948, p. 13). Nayfa (2002) notes that “Statistics: as defined by the American Statistical Association (ASA) “*is the science of learning from data, and of measuring, controlling and communicating uncertainty, A consequence is that whereas a mathematician prefers an exact answer to an approximate question, an applied statistician prefers an approximate answer to an exact question*”. Researchers usually use one or several methods when collecting the information needed to write scientific research, and statistical methods are one of these necessary methods, as information is extracted and analysed using Statistics, which includes mathematical formulas, and some statistical analytical techniques (Nayfa, 2022).

Chapter 1: Introduction

1.1 Research Background

In educational research using a quantitative method, statistical literacy is vital for the researcher because statistical methods act as pillars to not only uphold but also enhance the reliability and validity of quantitative research. This is true from the initial conceptualization within the study to reaching their conclusion and disseminating the results. Ultimately, statistical literacy within quantitative research enhances the effectiveness of researchers and enables them to apply statistical techniques proficiently (Beavers et al., 2013). Furthermore, the credibility of the research can be negatively affected when the statistical methods used in the quantitative research lack validity and reliability, and this can negatively influence the quality of the research (Mitchell & Alfreh, 2018). The reliability and integrity of study results are compromised by presenting unrealistically elegant results that may be difficult to reproduce without personal involvement in such techniques. Furthermore, questionable research begets more questionable research. (John et al., 2012). Moreover, this is possible with the lack of basic knowledge of the statistical methods and techniques adopted by the researcher. According to Ghanaie (2013), researchers in all fields of scientific research in general, and in the field of educational research in particular, must have appropriate experience in using Statistics in their research, as one of the main problems that most researchers in this field face is the difficulty in determining the appropriate statistics for the nature of the research, its assumptions, and its variables.

To enhance the quality and standard of research at Saudi Arabian universities, this study aimed to identify how statistical techniques were used in education departments to achieve the PhD student's research objectives effectively by identifying the perception of the readiness of PhD students to use statistical methods to conduct research on a specific topic as well as their importance to achieve and advance research objectives. It sought to identify what extent to which PhD students apply the steps of statistical methods before conducting statistical analysis, the accuracy and interpretation of data based on the statistical method depending on students' and academics' perspectives on this, and the possible alternative ways to promote greater accuracy in the use of statistical methods in doctoral research through the point of view of the PhD students and those responsible for teaching Statistics in Saudi Arabia. To show the need for why reforms are needed in Saudi Arabia's education system and why future university students should have sufficient mathematical understanding to maintain the researcher's basic knowledge base (Mathematics and Statistics). As far as the researcher is aware, this study is the first of its kind to focus on PhD students' perceptions of using statistical methods in their thesis in the Kingdom of Saudi Arabia.

Within academic research, researchers often rely heavily on sampling procedures to obtain statistical data concerning human activities and related conditions. Statistical methods have been used for the main purpose of collecting and analysis of data and providing evidence to be used for future planning and making the right decisions when needed. Statistical methods usually are used to facilitate and help the researcher to organise and analyse data, which should be used to answer various questions arising from the research process and validate the obtained result (Abu Haimed, 2013).

Statistical methods are primarily used to obtain logical research conclusions that are asserted from findings, recommendations and proposals. When a researcher manages to select the appropriate statistical methods for data analysis, their findings and recommendations are more likely to be reliable, and most importantly valid (Urdan, 2010). However, where a researcher has obtained results that are inconsistent with the appropriate use of statistical methods, the outcome will likely be misleading (Castellan, 2010). The errors will ultimately invalidate the conclusions, and the researcher's hypothesis may not be accurately addressed. This would cause further implications whereby the research may lack validity and reliability in providing authoritative proposals which can be utilised by relevant stakeholders (Urdan, 2010). These stakeholders can include governments, councils, ministries, educational institutions, and other suitable stakeholders. Essentially, accuracy and reliability in research are required to make the appropriate decisions for community improvements and growth.

McCook (2016) has pointed out that the existence of inaccurate application of statistical methods raised concerns at the American Statistical Association in 2015 (ASA). ASA in turn issued a set of principles and guidance for the usage and interpretation of statistical values. The editors of the Journal of Sociology were frustrated due to the poor application of statistical concepts such as p-value and T-Statistic, as they had been wrongly interpreted (McCook, 2016).

Consequently, the conclusions drawn from such scientific research become null and hold no value. Hence, in terms of education, studying and comprehending Mathematics and learning it provides the students with many vital abilities that will support them in their future life, education and career as well as in various areas of their life (Nasrallah,2019). Thus, it is important to develop the education system in Saudi Arabia and why university students should have enough mathematical knowledge to use Statistics correctly.

According to Ghanaiem (2013), researchers/students should ensure that they have a thorough knowledge of statistical concepts and methodologies and, if required, seek assistance or support from specialists in the field. The requirement to use robust and statistically significant methodology is, unfortunately, a major limitation in the research process, which ultimately invalidate conclusions in many studies (Shankar &

Singh, 2014). Therefore, different research methods, including their strengths and limitations are required to be taught, so that the researcher is in the best position to choose the most suitable research method to address the research aims and objectives.

Khusainova et al. (2016) stated that selecting the suitable statistical approach can lead to correct conclusions and interpretation of research data, resulting in research results with scientific and valuable values.

Social Science and psychology have been influenced by developments in Statistics, social science has benefited from the statistical method in developing the research tools, especially the questionnaire which has enabled social scientists to study a large number of respondents in a short period, improving the reliability and validity of the research (Al-Qassas ,2007). It has allowed the researchers to examine the relationship between what they observe (based on the phenomenon in reality) and what they assume from the assumptions in an attempt to interpret that reality (Saunders et al., 2016). Moreover, it also supports the researcher in broadly providing the specifications regarding scientific accuracy. Al-Qassas (2007) also argued that statistical methods support summarizing the results through graphs and charts, aiding the understanding of relevant stakeholders. Since its inception, sociology has relied on the use of statistical methods to process and analyse data, and these methods have undergone significant developments due to the statistical revolution that took place in the field of data analysis in the twentieth century. Scientists such as Francis Galton, Karl Pearson, and Ronald Fisher greatly impacted the current new sociology, where the quantitative analysis of data became strongly imposed (Faoubar & Zaghar, 2023). Fisher (1970) believes that *“Statistics is essentially a branch of applied Mathematics. Statistical methods are essential for Social studies, and it is mainly through these methods that these studies can be elevated to the rank of sciences.”*

Lang (2004) noted the existence of high rates of statistical errors in large numbers of both medical and non-medical studies published in several journals, from which twenty statistical studies have been identified in biomedical journals, “reporting measurements with unnecessary precision dividing continuous data into ordinal categories without explaining and the use of descriptive Statistics incorrectly” (Lang, 2004, p. 45). Similarly, Ziliak and McCloskey (2008) stated that over the past 80 years, it seems that some of the research and Social Science research papers contained some errors due to the incorrect choice of the most suitable methods and the importance of the correct usage of the selected methods in place. Therefore, with errors undetected at early stages when conducting the research, implications prevail, making conclusions unreliable. Such implications could be avoided when the researcher becomes educated on the various statistical methods, as it would enable the researchers to make informed decisions regarding the application of suitable research methods in the context of their research topic. However, where statistical literacy is not

prioritised, wider implications may prevail due to the quality and integrity of the findings (Marley and Levin, 2011).

1.2 Research Rationale and Motivation

Regarding the application of statistical research methods, some studies Abu Haimad (2013), Al-Ajlan (1990), Al-Maleky (2017), and Al-Rashidi (2004) conducted within Saudi Arabia agree that the issue of the existence of errors committed by researchers using statistical methods at the data analysis stage due to the lack of previous knowledge, leading to a main factor contributing to the misleading research conclusions. Not only this, but it would need to be more reliable to be used by decision-makers. According to Al-Taiti et al. (2015), the student's poor academic performance in interpreting and processing statistical data is mainly due to the student's ability to solve mathematical problems on their own. The infrastructure of secondary schools in Saudi Arabia has been formed in line with the educational system set in most Middle Eastern countries. The secondary education system comprises different forms of learning such as scientific pathway and literacy pathway. In all these forms of learning, the application and teaching of the Statistics only take place in science-related programs, and it is not taught in the literature or religious studies sections (Faraj, 2009). When students reach this level of secondary education, they get to choose between learning either science pathway including Mathematics and Statistics subject or literacy pathway where Mathematics and Statistics are not studied at all. Where students' mathematical foundation in the literacy pathway are poor, it is difficult to understand some of the mathematical calculations they may require while studying Statistics at a doctoral programme in the Kingdom of Saudi Arabia.

As Saudi Arabian students pursue higher (university) education and conduct research as part of their Master and PhD studies, they are required to study and use statistical methods for their research. Saudi universities provide graduate students with a compulsory course in Statistics in all fields. Al-Maleky research suggested that the needed statistical materials offered to postgraduate students be reviewed since they are insufficient, where the study revealed that there is a lack of knowledge and understanding of statistical procedures among Saudi students (Al-Maleky,2017). As part of this, they are taught different statistical methods, including the need to familiarise themselves with statistical software such as Statistical Package for Social Sciences (SPSS). Postgraduate Students accessing SPSS are expected to possess knowledge on the subject in advance. Moreover, some postgraduate students find it hard to learn statistical concepts due to their lack of background knowledge.

According to the researcher's experience as a Mathematics teacher and a researcher in how to use statistical methods in research in the Kingdom of Saudi Arabia, there are several problems in teaching Mathematics,

such as the teaching methods, dealing with issues of thinking and analysis skills, a lack of teaching aids, a large number of students, and a lack of student's passion for learning Mathematics. Some students who graduate from the high school literacy pathway have difficulty in studying and applying Statistics at the graduate level, which was caused by a weakness in the basis of Mathematics for some Saudi students. In contrast, it is easier for graduate students from the high school science pathway to study and apply Statistics in their research. This issue has become prevalent, as important subjects such as Statistics are not taken seriously at an early stage of a student's education which consequently causes greater concern for those that opt to pursue further higher education (Alghamdi et al., 2019). Thus, a prior understanding of Mathematics aids PhD students in learning more effectively. If students do not have valuable previous knowledge of Mathematics, making conclusions based on data obtained from a research project will be very complex without a background in Mathematics and Statistics.

1.3 Misapplication of Statistics in the Arab world research

The issue regarding lack of emphasis on the use of reliable and valid research methods back to the late 20th Century with Al-Najjar (1991) commenting on the significant common error in the way statistical methods were obtained and analysed (Al-Najjar, 1991). Al-Najjar (1991) focused on the reliability of publications within the universities in Saudi Arabia and argued that the proportion of the research papers that included the appropriate use of statistical methods was far less than the proportion of the studies that undertook an inappropriate use of the statistical methods. Al-Najjar's study has paved the way for further developments amongst current research scientists.

Research conducted by Al-Maleky (2017) highlighted that there had been a significant lack of statistical knowledge amongst university students in Saudi Arabia as well as a low awareness level of the importance of the varying statistical methods. It was found that students were at a disadvantage due to the tutors being not academically qualified to provide sufficient knowledge of statistical methods. Ultimately, for these students, this meant that their research data was distorted due to mismanagement and misapplication of appropriate statistical methods used at the analysis stage (Al-Maleky, 2001).

Each research aims to identify specific aspects of some social, economic, and health phenomena or to study a particular problem and develop solutions. Assume that any researcher is inexperienced with statistical methods that are relevant for research. In that case, the researcher will obtain misleading and incorrect results that cannot be relied upon to solve the research problem (Al-Maleky, 2001). Any study may findings reveal the behaviour of the phenomena being examined in the past and what could happen to it in the present and future (Hassan, 2000). If the researcher is not skilled in using Statistics in research, this study will be

useless (Gharib, 1989). The application of statistical methods has become one of the main pillars for finding acceptable answers to many societal challenges and difficulties, such as health, education, agriculture, industry, and commerce. The inappropriate application of Statistics in research has an impact on the correct comprehension of the issue to be examined. It also has an impact on the creation of solid solutions to address, change, or improve the problem, and hence does not assist decision makers in making the best option. If the public or private sectors lack information, data, and statistical indicators, they will be unable to carry out the necessary labour, responsibilities, and obligations (General Authority for Statistics, 2017).

The research findings assist in the formulation of policies, the expansion of knowledge, and the prediction of the future. According to the researcher's 25 years' experience in teaching Mathematics in schools and universities in KSA, 15 years as a teacher in school and 10 years as an educator in university, the researcher experienced that some Saudi students lack fundamental knowledge of Mathematics in both the school and university. Also, postgraduate students, particularly those from the literacy pathway, suffer greatly from using and studying Statistics at this stage; for example, understanding the simple mathematical operations performed when studying one of the statistical methods such as regression, chi-square, and others. Moreover, the PhD student's goal is to memorise for the sake of achievement, and the teacher's target is to facilitate the mandatory Statistics subject in the doctoral programme so that the student can succeed.

Undoubtedly, the Arab world is not immune to the fact that researchers have not utilised reliable and valid statistical methods when conducting the research. This is true not only in Saudi Arabia but also in other Arab countries, as the educational system is often similar amongst Arab countries (Shibl, 2004). A study conducted by college of Education in Mosul university, Iraq, in 2009 found that due to students choosing unsuitable methods of research and the incompetence of being able to use statistical methods such as the t-Test, over 110 articles were classified as not suitable. The study concluded that the misapplication of statistical methods caused greater harm to untrained Master and PhD students as it hindered their research, with their results interpreted in a way inconsistent with the recognised and acknowledged statistical methods (Almurad, 2009). Akin to this, a study conducted by the Al-Fateh university of Sudan showed that the existence of some errors in the selection of statistical methods caused the research to come to a halt due to results being flawed (Abdul Rahman, 2015). Further, in Egypt, Al-Shafei's study showed that there is a variation in the students' use of statistical methods (42.86%) of the total 72 master's degrees in department of Psychology (Al-Shafei, 2010). As these studies were undertaken mainly within social sciences, it clearly illustrates that scientists lacked the knowledge required for these methods; hence the outcome of this situation was discrepancies obtained in the results.

Moreover, various studies in Saudi Arabia highlighted that the advancements within the education sector were constantly hindered due to the researcher's choice to undertake only one specific statistical method, and more interestingly the misapplication of statistical methods being an issue rooted in the mismanagement by educators due to the lack of understanding of the importance of Statistics as a subject. For instance, Al-Najjar's study on the strengths of the statistical tests used by researchers cited that all 46 research studies published by the Institute of Public Administration presented errors in the application and understanding of statistical methods (Al-najjar, 2006). Al-Ajlan (1990) and Al-Rashidi (2004) also confirmed that there had been a great misapplication of statistical methods. They both went further to state that the most common reason for the anomalies was rooted in the statistical methods being unsuitable for the data scales of the research and lack of knowledge.

In relation to such context, a study by Awdah (1993) stated that error arises in many research studies and the main errors appear in the analysis of statistical data (Awdah, 1993). In light of this, Rachid (2007) has mentioned that the main problem is the inexperienced members of staff who usually teach the subject of Statistics and its application upon carrying research. This reflects not only on the students' understanding of this subject but inevitably affect their research. Due to a lack of the appropriate teaching methods, students are not able to implement the statistical methods in the actual research process involving quantitative data analysis (Rachid, 2007). Further, the issues also derive from the lack of teaching facilities available for students to be able to coin a solid understanding of various research methods and lack of resourcing staff deployment decisions by the university in ensuring students are taught by academically specialised tutors/professors.

One of the most important findings for Hammad (1995) in Saudi Arabia is the inappropriate choice of statistical methods by the researcher, whereby mistakes occurred in the process upon applying the analysis of covariance before verifying the availability of its assumptions (Hammad, 1995). Al-Maleky (2001) confirmed this through the findings whereby errors caused by the misapplication of statistical methods in master's and PhDs were shown in two hundred and six out of the four hundred and twenty-three sample used. He noted that the most common errors in quantitative research are due to inappropriate use of statistical methods (Al-Maleky, 2001).

All the above findings reinforce the existence of a common problem in using the statistical methods used to choose the appropriate statistical methods for research data analysis in KSA.

1.4 Aim and Objectives

The study sought to investigate the selection and utilisation of research methods at the doctoral level, with a specific focus on the use of statistical practices in research to enhance the quality and standard of research at Saudi Arabian universities. How do academics and PhD students from Education departments in a selected university in SA and a university in Scotland/UK, from different educational backgrounds, view their readiness, selection, and utilization of statistical methods in PhD research. Al-Dawish (2019) stated that the Saudi student's previous experience in Mathematics in high school is limited and does not assist them in accomplishing the mathematical assignments in further education. Investing mathematical knowledge in other academic subjects represents realising the integration of experience. He also mentioned that developing mathematical abilities helps in the development of the capacity to collect and classify quantitative data, tabulate, and interpret. Moreover, choosing the appropriate statistical method can lead to accurate conclusions and interpretation of research results, leading to results with scientific and informative values for these research results (Khusainova et al, 2016). To show the need for why reforms are needed in Saudi Arabia's education system and why future university students should have sufficient mathematical understanding to maintain the researcher's basic knowledge base (Mathematics and Statistics). This will not only allow the researcher to determine the importance of previous knowledge base for PhD level study but will be useful to identify whether there is a link between misapplication of statistical methods and lack of background knowledge about Mathematics and Statistics as a subject, From the perspective of experienced educators who taught Statistics to PhD students in doctoral programme in university in Saudi Arabia. The researcher chose Saudi Arabia and the United Kingdom as a comparison in this PhD thesis. The decision is based on the UK's strong educational system, which includes mandatory maths education. as contrasted with Saudi Arabia, where Maths is optional in high school and students can join university without it. Furthermore, the researcher's study in the United Kingdom give familiarity with the curriculum as well as simple access to information, making the comparison between those two countries particularly relevant. The British education system is of excellent quality, ranking among the finest in the world in cognitive capabilities and educational achievement (Al-Dakhil,2015). Thus, a comparison between doctoral level students from two different countries, i.e., Saudi Arabia and the UK will be made to observe the similarities and differences to determine the extent to which doctorate students are prepared to select and apply statistical methods in their study. This helps to identify the knowledge gaps within the Saudi education system and helps to recommend ways to enhance the quality and standards of research at Saudi Arabian universities. The following are key objectives of this research.

- i. To investigate the perception of the readiness of PhD students to conduct statistical analysis in PhD research.
- ii. The extent to which PhD students follow certain steps of statistical methods before conducting statistical analysis (for example, applying a pilot study, preliminary data inspection, and choosing the appropriate type and size of the sample before conducting statistical analysis).
- iii. The competence of PhD students in applying statistical methods and data interpretation based on statistical methods.
- iv. To investigate the understanding level of Mathematics and Statistics among PhD students.
- v. To investigate the similarities and differences in the statistical analysis procedures used by PhD students in the Kingdom of Saudi Arabia and the United Kingdom.
- vi. To suggest possible alternative ways to ensure greater accuracy of statistical methods and higher quality of doctoral research in Saudi Arabia, some suggested methods are gathered from PhD students and Statistics faculty members at SA universities.

1.5 Research Questions

“How do academics and PhD students from Education departments in a selected university in SA and a university in Scotland/UK, from different educational backgrounds, view their readiness, selection, and utilization of statistical methods in PhD research?”

As part of addressing this research question, the following sub-questions were addressed:

- What is the perception of the readiness of PhD students to conduct statistical analysis in PhD research?
- To what extent to which PhD students apply the steps of statistical methods before conducting statistical analysis?
- How competent are PhD students in applying statistical methods and data interpretation based on statistical methods?
- What are the possible alternative ways to enhance greater accuracy in the use of statistical methods in PhD research?
- What are the similarities and differences in the statistical analysis procedures used in a university of KSA and university of the UK for PhD research?

1.6 Thesis Structure

Having elaborated on the rationale for the study and the key research question, the rest of the thesis has the following structure. The literature review in chapter two provides an overview and analysis of the education system, including the history of education and the evolution of the education system in the Kingdom of Saudi Arabia. It includes an explanation of the emphasis on education as part of *Vision 2030* and the issues experienced by state education.

Moreover, a critical analysis of the available literature on the subject matter is presented to better understand the issue of misapplication of Statistics, including the various factors that contribute to this and the results in terms of low reliability, validity, generalisability of the findings as well as the ethical issues experienced by the researchers. The literature review also focuses on the importance of correcting statistical misapplication. The chapter begins by providing definitions and explanations of the term "misapplication" of Statistics. Then, different types of statistical misapplication (i.e., manipulation, data mining, and misapplication of data due to a lack of knowledge of statistical techniques and methods) are analysed. The methodology used by different authors including their findings on the occurrence of statistical misapplication practices is evaluated.

After that, it begins by explaining the change in higher education and defines the term change. Moreover, the three different types of change are explained, which include developmental change, transitional change and transformational change. The need for change within the higher education sector in KSA, including the forces contributing to change, is analysed. Finally, the chapter explains four models of change which are discussed in the rest of this section. These models have been selected due to their suitability for use in facilitating some of the change initiatives within higher education institutions, as well as the importance of Statistics, which is part of Mathematics and taking Singapore as a successful example in the change of success of their education due to the distinction of Singaporean students in Mathematics and science.

The third chapter discusses the research methodology, which includes research philosophy, study design, target population, sample, and sampling techniques. It will also discuss collecting data processes, tools, and data analysis methods.

The mixed research approach was used to achieve a better understanding of the research's problem. When quantitative and qualitative methodologies are used in the same study, they complement each other to provide a better knowledge of the research problem (Greene et al., 1989).

The fourth and fifth chapters consisted of an examination of the data gathered via questionnaire and interviews. Followed by chapter six which is the findings of the statistical analysis and interviews were addressed, and some recommendations, limitations, and a conclusion were made in the last chapter.

Chapter 2: Literature Review

2.1 Overview

The purpose of this literature review chapter is to critically analyse the existing literature to provide a critical overview and commentary on literature related to the focus of this thesis, which is Drawing from the literature; the chapter highlights a lack of statistical knowledge amongst students within postgraduate university research (especially in Saudi Arabia) as a basis of research problem including misapplication of Statistics. As the purpose of this study is to investigate the perception of how well prepared doctoral-level students are to do statistical analysis in their research by discovering PhD students' competence and understanding about using statistical methods, as well as the PhD students' perception of the extent of their ability to selecting the appropriate statistical methods for their research accurately to show the need for why reforms are needed in Saudi Arabia's education system and why future university students should have the sufficient mathematical understanding to maintain the researcher's basic knowledge base (Mathematics and Statistics). The findings are complemented by analysing the literature on change within education, including the review of models for change. A sample analysis of the Singaporean education system is provided, including a review of its emphasis on foundational learning, teacher quality, and system characteristics. The main focus would be on the fact that foundational learning in the Singaporean education system carefully devised and introduced Mathematics in the syllabus. As a result, Singapore's educational system is chosen as a sample in terms of the relevance of Mathematics and Statistics. This will help highlight the weaknesses of Saudi Arabia's current education system, particularly the lack of focus on mathematical instruction.

Therefore, the inverted triangle approach was used to do that. The essential information and causes of the problem were provided since the problem's roots may be traced back to the education system of the Kingdom of Saudi Arabia. Thus, an overview of education in the Kingdom and some of its problems related to this research problem and serious attempts to develop education through *Vision 2030* was presented. The focus then moved to the actual causes of statistical misapplication and the consequence of a lack of fundamental knowledge and comprehension of Statistics and Mathematics. The significance of changing the education system in the Kingdom of Saudi Arabia was then highlighted, and the Singaporean educational system was considered. In terms of accessing resources for reviewing the literature, databases such as Scopus, Science Direct, Research Gate, and ERIC, as well as journals such as Selected ethical issues in the analysis and reporting of research (Poon and Ainuddin, 2011) and Quantitative and qualitative research (Castellan,2010), were heavily used. In this case, the main obstacle was the lack of information

and resources relating to the focus of the thesis and the lack of current literature. Therefore, a number of less recent resources were utilised.

The literature relating to different types of statistical misapplication i.e., manipulation of numerical data and statistical results and misapplication of data due to a lack of statistical knowledge was looked at. The subsequent helped to analyse the fact reasons of statistical misapplication and if these are the result of a lack of knowledge and fundamental understanding of Statistics and Mathematics. Multiple Saudi research showed that the issue of statistical misapplication within Saudi Arabia is mainly due to a lack of knowledge and understanding of the statistical methods (Abu haimed (2013); Al-Ajlan (1990); Al-Maleky (2001); Al-najjar (1991); Al-Rashidi (2004)). This insufficient understanding related to the use of appropriate research methodology contributes to statistical misapplication by negatively impacting the quality of the research and the trust of the public in the academic profession. This suggests the need for change at the school level and within the higher education system in Saudi Arabia to provide the students with the quality education to improve the human capital of the nation considering the forces for change (Abouammoh, 2018).

The literature review also provided an insight into the educational transformation considering its importance within the developing countries where change has become essential. This is particularly the case in an era of significant development of information, globalisation and continuous innovation done by the education sector. The changes in the external environment increase pressure on the education sector to undergo reform to ensure that the industry remains competitive in fulfilling its objective of providing graduates with practically relevant and suitable skills mandatory for companies in the contemporary environment. One such skill is the knowledge and understanding of Statistics so that post-graduates can undertake comprehensive research including the use of robust quantitative/ econometric methodology that is considered reliable and valid. For this, the change in education and explanation of the term change is needed and this is explored in Section 2.10 of this chapter. This followed by the consideration of three different types of change including developmental change, transitional change and transformational change. The need for change within the education sector in KSA, including the forces contributing to change is also considered. The explanation of four models of change would also be discussed in the rest of this section, which has been selected due to their suitability for use in facilitating some of the change initiatives within higher education institutions.

Mathematics is recognised as one of the most essential subjects since it is incorporated in the foundation of all sciences at the current moment, which rely on measurements, quantities, numbers, and equations (Obeid et al., 1948). Nasrallah, 2019, emphasised that Mathematics is the foundation of many sciences, and that it

is considered as one of the most essential, if not the most important, starting point, and that Mathematics works on the growth of the human intellect. Nasrallah mentioned that Mathematics is the science of numbers, and its importance is evident in its use in financial and commercial transactions, as well as in individuals' daily lives, because these transactions are based on the numerology method of subtraction, division, addition, and multiplication, as well as determining quantities, sums, and proportions, so all members of society must understand it. Mathematics should increase students' capacity to think and make informed conclusions based on measurement and analysis. Although some academics see Statistics as a separate discipline from Mathematics, others consider Statistics to be a component of it. According to Nasrallah (2019, p.1-5), Statistics and Probabilities are a branch of Mathematics; having a solid foundation in Mathematics is essential, as studying and comprehending Mathematics provides students with numerous necessary skills that will aid them in their future and career lives and other areas of their daily lives. Thus, a sample education system of the Singaporean education system with regards to the importance of Mathematics and Statistics is chosen because Singapore outperformed all other TIMSS 2019 countries in terms of average achievement (TIMSS & PIRLS International Study Centre at Boston College). With the help of this, the weaknesses of the existing education system in Saudi Arabia including a lack of emphasis on Mathematics education would be highlighted. Based on the review of the literature, some of the influences will be mentioned that would eventually help to explain the superior academic performance of Singaporean students, having foundational learning of Mathematics and Statistics in Singaporean schools and colleges. In Singaporean, Mathematics is a subject that is required from the first grade of primary school through the last year of secondary school. Around 20% of school curriculum time is allocated to Mathematics in the early grades so that pupils can create a strong foundation for further education. Mathematics curriculum from elementary through pre-university are designed using a spiral method. The curriculum comprises a few material threads (such as number, algebra, geometry, measurement, statistics, and probability) at each level, allowing for links and interrelationships between the threads. At the secondary level, pupils can choose between Accelerated, Normal (academic), and Regular (technical) curriculum. The curriculum covers concepts and skills in number, Algebra, Measurement, Geometry, Statistics, and Probability (Cho ,2019). According to TIMSS (Trend in international Math and science study) (2019) Singapore results achieved first place in the exam.

This may be due to the fact that foundational learning in the Singaporean education system was due to how Mathematics was carefully devised and introduced in the syllabus. Additionally, there was great emphasis on the recruitment and selection of teachers, along with their training and continued professional development, as means to enhance the quality of teaching provided to the students. Finally, some other factors such as the system characteristics that have served as an integral part of the Singaporean education

system and contributed to the superior academic performance in maths and other subjects comprising academic standards, measures of accountability, and academic expectations in the society are also relevant.

The analysis of the aforementioned factors including the review of the educational practices in Singapore which may help to provide the recommendations that can be adopted by the Saudi education system. Finally, the chapter highlights the importance of proposed change within the education system in Saudi Arabia as necessary to improve numeracy skills and to best prepare the students from an early age, ensuring that the students at the doctoral level are adequately prepared to undertake statistical analysis in their research studies. Johnson and Kuennen (2006) observed that basic Mathematics skills are important for a student to learn introductory-level Statistics as well implement practical methods of Statistics. Therefore, this chapter discusses peer-reviewed journal articles on relevant subjects such as Mathematics and Statistics, application of statistical knowledge in research, identification of gaps in the education system of KSA, and the importance of addressing these gaps are considered while also examining features of a high-performing system through sampling Singapore's educational system

2.2 Importance of contextual and cultural factors in the evolution of education system in KSA

Education in Saudi Arabia is divided into three stages: pre-primary education, general education, and higher education. Pre-primary education is aimed at children aged up to six-year where attendance is optional. The second stage, general education is mandatory and free. It is divided into three stages: primary education, intermediate education and secondary education.

Primary education: Children aged 6 enter the first grade of primary education (age 6-12).

Intermediate education: Three years (ages 12-15).

Secondary education: This lasts three years and consists of 3 academic stages (ages 15-18).

All three phases namely primary, intermediate and secondary education is administered by the Ministry of Education. According to the Saudi annual yearbook (2023), Saudi Arabia puts great emphasis on early education because of its importance in the individual's development. The education system applicable in Saudi Arabia enables children aged between three and five, to enrol in kindergarten as an optional stage. Formal education consists of three mandatory educational stages (primary, intermediate, and secondary) aimed at 6 to 17 age groups. The three years of secondary education in both its forms (scientific and literacy pathways). Students at the age of secondary school and older students may pursue their studies in technical and vocational colleges. Once they complete their secondary education, students can join state or private universities and vocational training colleges. Older students who have not completed their secondary

education can join evening classes, colleges or industrial secondary colleges. Those who were not allowed to study at primary schools could join an adult education centre (Alhabeeb and Rowley, 2017). This provides these students with an opportunity to obtain an education through measures such as adult education centre (Alhabeeb and Rowley, 2017).

Pariona (2017) indicated that every level of education has a specific set of objectives and goals for the curriculum of its students. At the primary school level, teachers attempt to provide teaching based on Islamic education while developing Maths, Languages and basic physical education skills. At the intermediate school level, the main teaching goals are providing a foundation for rules and processes, guiding students to use their spare time for reading, participation in religious activities and continuing the promotion of the concept of the Social Islamic life. Thus, the curriculum comprises Islamic education along with an emphasis on language, Mathematics and physical education. A secondary school which is the last three years before graduation is a stage where students can take general education courses or specialise their learning in vocational training programmes. These programmes are available in the following fields: commerce, industry and agriculture.

The former Minister of Education Ahmed Al-Essa announced in 2015 that the Government of Saudi Arabia would apply a curriculum system to all the high schools, whereby a consistent curriculum would apply to educational institutions across the country. This programme begins from Grade 10 to Grade 12 and was implemented in 2018/19 (Mitchell and Alfuraih, 2018). This policy aims to develop the personality of students, given the flexibility offered to students to select the subjects they would like to study, albeit with certain conditions to be followed by the students. The conditions take into consideration the desires and existing skill set of students.

The system includes mandatory subjects within the scientific path and other subjects as part of the humanities path. The subjects studied as part of the scientific path include Mathematics, Islamic and Arabic studies whereas the subjects studied as part of the humanities pathway include History, Geography, Islamic Studies, Arabic Studies, Social Sciences and Psychology. Within the humanities pathway, Mathematics is not a mandatory subject and there is no requirement for the students that they must pass Mathematics before progressing to university. All the students need to choose between the scientific pathway and humanities pathway in Grade 11.

Once the pathway has been selected, there is no flexibility for students to change the subjects or the pathway, as it becomes obligatory to take and pass all the subjects (Mitchell and Alfuraih, 2018). This

indicates the relative lack of flexibility within the existing education system, as well as a lack of focus on mathematical and statistical knowledge. This arguably explains a weak base and lack of statistical knowledge amongst most Saudi Arabian students, who have not chosen the scientific path in secondary education. As the students do not have a strong background in statistical concepts and techniques, this is likely to contribute to challenges when it comes to conducting statistical analysis, especially as part of the research projects at the university level. The distinction between the two pathways is illustrated in figure 2-1 and 2-2 below. When students continue their studies at the university and join departments in the College of Education, they will not be taught statistics within these departments. These departments typically do not include mathematical courses in their curriculum, as most students come from the literacy pathway where mathematics is not taught at the secondary level in school. This lack of mathematical background makes it challenging for students to understand statistical and mathematical processes. However, in the Department of Psychology and Social Sciences an exception exists, where there is a statistics curriculum. The curriculum is often limited in scope and does not provide the in-depth mathematical foundation needed for students who lack prior exposure to mathematics, making it difficult for them to fully understand statistical concepts. According to Abuhaimed (2013) and Al-Maleky (2017), postgraduate statistics curricula are insufficient, hence PhD students want further assistance.

However, students from the literacy pathway struggle to understand this curriculum because their previous education did not adequately prepare them for mathematics. The statistics curriculum provided is insufficient for re-establishing a foundational understanding of mathematical and statistical processes, resulting these students at a significant disadvantage.

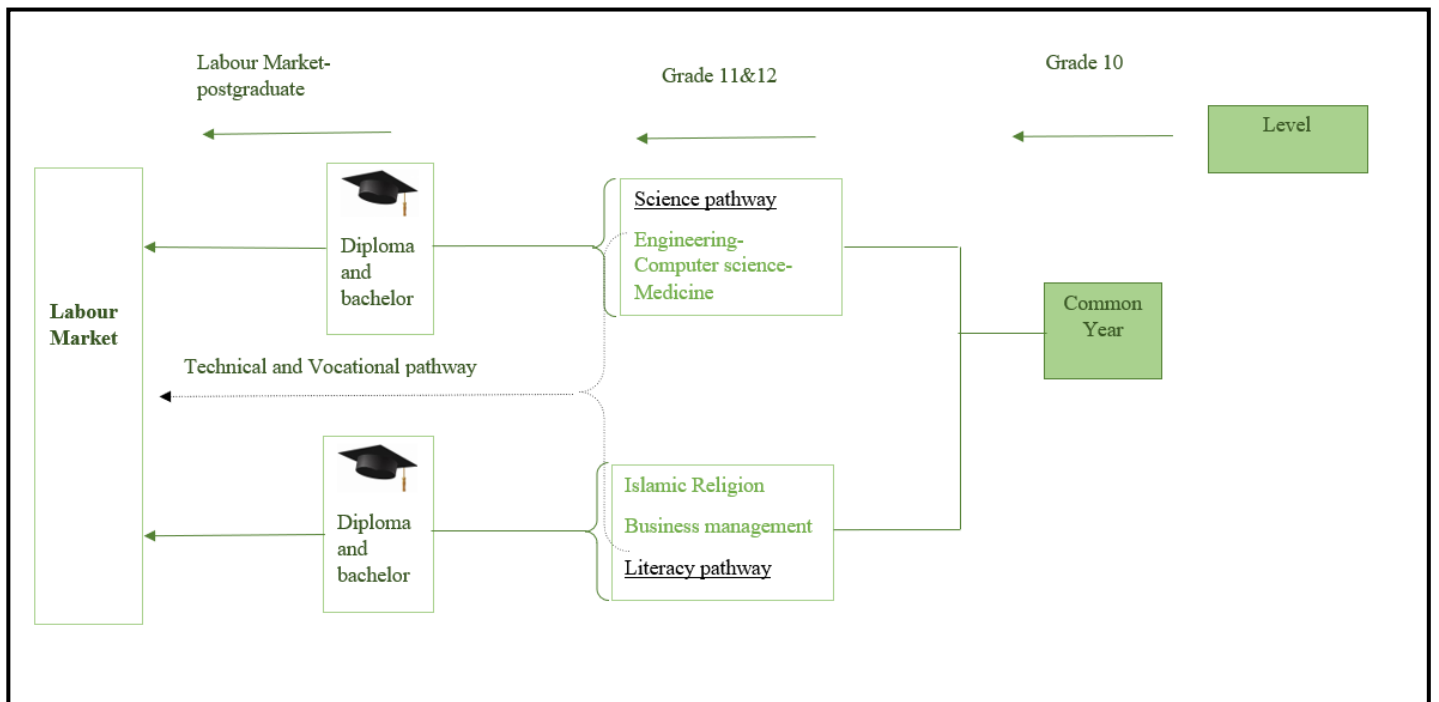


Figure 2-1: The organizational structure of education in the Kingdom of Saudi Arabia current system (Ministry of Education in KSA)

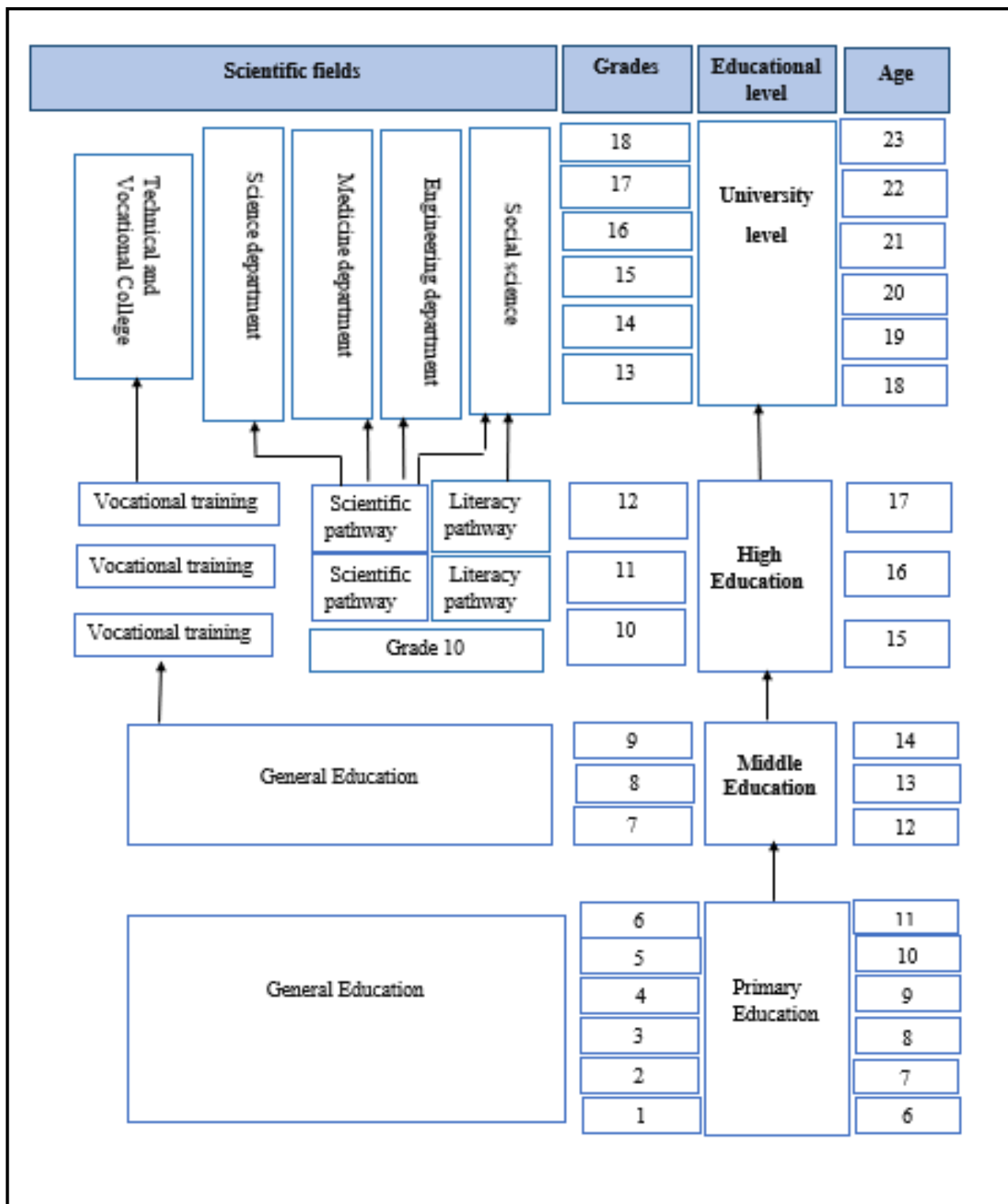


Figure 2-2: The organizational structure of education in the Kingdom of Saudi Arabia old system (Al-Jabri, 2016)

2.3 Importance of Education in *Vision 2030*

Saudi *Vision 2030* is a vision of Saudi Arabia formed by King Salman bin Abdulaziz Al-Saud along with the Crown Prince Mohammad Bin Salman. It comprises 96 strategic objectives that the country is aiming to achieve by 2030 (Vision 2030.gov.sa, 2016) to promote sustainable economic growth and development in the future.

The education and training sector in Saudi Arabia is going through important development phases. The Saudi vision of education in the future and up to 2030 contained several objectives that the Kingdom is attempting to achieve. They include the provision of educational opportunities for all within an appropriate educational environment based on the Kingdom's educational policy, to improve the quality of education outcomes, to increase the effectiveness of scientific research, to encourage innovation and creativity, to upgrade general education, to point students towards suitable employment and professional options and other ambitious goals that require rigorous planning based on comprehensive and precise data to support decision and policymakers in the field of education and training (Vision 2030.gov.sa, 2016).

Education is the cornerstone of the *Vision 2030* agenda of the Kingdom of Saudi Arabia which aims to build a vibrant society. Through educational and academic systems, Saudi Arabia is trying to develop children's character, achieve economic prosperity, promote economic growth, expand and improve technical and vocational training programmes across the kingdom, expand nursery and kindergarten programmes to enhance teaching skills and improve knowledge competence. This specifically includes reforming curricula and improving the educational as well as academic environment to bring about outcomes that are suitable to the requirements of the labour market, having the right experience and equipped with training that keeps abreast with knowledge and modern technologies (General Authority for Statistics, 2019).

Vision 2030 is the driving force behind several educational reforms. The National Transformation Program aims to achieve operational excellence in the public and private sectors including the improved economic enable and standard of living through accelerating the implementation of primary and secondary digital infrastructure projects (Vision 2030.gov.sa, 2016). As part of the National Transformation Program, the focus of the Saudi Government is on the overhaul of an out-of-date educational system that had meant Saudi students lagged in international assessment tests, contributing to a lack of ability of Saudi Arabia to be successfully prepared for the post-oil economy, as oil revenues declined starting in 2015, which negatively affected the state budget and economic growth rates. Thus, finding a different path to achieve

financial stability and economic sustainability has become an urgent matter that requires the discovery of new incentives. (Vision2030.gov.sa, 2016). Education accounts for about 23 per cent of the country's annual budget. The KSA government allocated about SR189 billion (about US\$ 40 billion) to public education, which employs more than 500,000 teachers in 30,000 public schools across the country (KPMG, 2023).

Mosaad (2016) indicated that the educational aspect of *Vision 2030* focuses on three major areas: curriculum development, higher education advancements and building skills needed for the job market. The Vision includes goals such as “to have at least five Saudi universities among the top 200 universities in based on QS World university Rankings; help students achieve results above international averages in global education indicators and work towards developing job specifications of every education field” (Vision2030.gov.sa, 2016).

Without considering the importance of the social benefits of a good education, it will not be possible to introduce meaningful economic and cultural reforms. Implementing the objectives of *Vision 2030* will be a tremendous challenge, because of outdated school curricula, ineffective teaching methods and poor education standards. Education is one aspect of the Vision that requires a comprehensive overhaul (Pavan, 2016). Statistics show that two-thirds of the Saudi population totalling 33 million are under 30 (KPMG, 2019). For *Vision 2030* to succeed, Saudi Arabia must take advantage of the knowledge, skills and experience that this age group could offer.

Given the emphasis on education in *Vision 2030* as a means to improve the quality of the workforce in Saudi Arabia that would help the economy to enhance its human capital and maximise economic development, various issues in the education system must be addressed. In particular, the lack of emphasis on knowledge of statistical methods and statistics in general means the quality, reliability and validity of the research is compromised, negatively impacting the quality of the research published (Mitchell and Alfuraih, 2018).

2.4 State education issues in Saudi Arabia

Addressing an audience of international business and education leaders gathered for the Yidan Prize Summit 2017 in Hong Kong, Dr Ahmad Al-Issa, former Saudi Minister of Education told an audience that “Education is key to the success of *Vision 2030*, our current education system is a product of the past, not an enabler of the future” (Vison 2030.gov.sa, 2018).

Alhammad (2010) pointed out that what is more disappointing is the academic approach promoted at Saudi schools; teachers encourage a system of ineffective memorisation and a superficial understanding of facts for the sole purpose of passing a test. This type of education extends far beyond high school to college and university levels. Students are continuously taught ways to pass an exam rather than critically engaging with the literature to formulate their viewpoint to maximise their learning and cognitive (Tawir, 2018, pp.1-4).

Education reform programmes in Saudi Arabia should be based on criteria of scientific excellence, not least in Sciences, Maths and Languages, which would allow students to excel scientifically and academically. A study conducted by McKinsey and Company (2007) explored how the educational policies achieved their best outcome summed up the key elements that underpin education reform programs in countries that have achieved excellent results in international student assessments. It analysed the achievements of the best-performing schools through interviews with education experts and practitioners and school visits to various countries. The research from McKinsey and Company (2007) concluded that South Korea and Singapore have demonstrated that a school system can go from low performance to high performance within a few decades, considering it is taking a long time to see the impact of the reform, UK and USA have also demonstrated that substantial improvements in the outcomes can be achieved in a short period. A study was concluded that best-performing systems in the world can achieve excellent results if they succeed in attracting more talented people to teaching, develop their skills for the provision of the best teaching and setting the benchmarks that ensure that teachers continue to offer the best standards to all students (Al-Issa, 2009).

The Saudi Minister of Education indicated at the Yidan Prize Summit 2017 in Hong Kong that it is necessary to shift teaching methods from a teacher-centred to a student-centred education and move away from traditional learning and teaching to allow more interaction from students in class and allow them to be independent. He stated that the Ministry is considering a new initiative to improve the quality of education and the calibre of graduates coming from the Faculties of Education of the different Saudi universities. The Ministry recently introduced a new initiative called *Future Gate* to promote digital learning and “change the whole setting” in schools. It is working towards replacing textbooks in schools with digital tools such as iPads (Al-Issa, 2009).

Last updated figures from the Ministry of Education highlight there were 93,000 students from Saudi Arabia studying overseas (Ministry of Education, 2019). The scale in terms of the number of students highlights the need to build an educational infrastructure where students and their families are offered good incentives

to pursue further studies at home so that they do not have to face the sudden change associated with living and studying abroad. It is too early to foresee the fate of *Vision 2030*. Only time will tell how and more importantly if Saudi Arabia's education will exceed expectations and break barriers at international levels (Mosaad, 2016).

According to Karasik (2015), a Gulf analyst, the Saudi education system is plagued by a number of issues, some of which are chronic. Since the establishment of the Ministry of Education in 1954, the emphasis has been on the curriculum. There is ongoing discussion regarding the importance of religion and languages over science and Mathematics. The education system is stagnant, generating graduates that fall well short of worldwide quality requirements.

Karasik (2015) reiterated that Saudi students seem to be frustrated by the current educational system. There is a widespread belief that a shortage of qualified teachers will result in students who do not receive a basic education but continue on to university. Many Saudis think that this will increase the situation since these university students will be employed to work in the education sector and other sectors. Some Saudi students have no analytical skills by applying rigorous methodologies, which can enable them to make significant contributions to a society that values knowledge. Although few Saudi students can learn statistical methods, this does not address the problem of lack of statistical knowledge and application of statistical methods in a real scenario, that is, quantitative research, which leads to statistical misapplication. However, the standard level of quality of research published in Saudi Arabia needs to be improved (Al-harthy, 2011). Thus, it is essential to comprehensively understand the term 'statistical misapplication' and the importance of addressing this, as outlined below.

2.5 Importance of Mathematics and Statistics in Doctoral Research

A strong base in Science and Mathematics fosters and highlights the skills of presenting hypotheses, discovering facts, developing controls and experiments, finding patterns, finding solutions, proof, and conclusions, and extracting absolutes, evaluating results while remaining open to new knowledge. Mathematics is important not only for scientists and engineers but for any student who wants to think and learn critically and creatively, regardless of their specific career fields (Hand, 1998). In terms of terminology, symbols, and representations that communicate its content in the form of equations or graphs, Mathematics is a language of communication. Mathematics is a way of reasoning and proof, and by proof, it means thinking and moving from facts to draw sequential findings, indicating that we have achieved the desired conclusion. (Zohair, 2010). From a theoretical point of view, prior experience or knowledge plays a significant role. Any information that an individual has about mathematical concepts that has been used,

expanded or re-conceptualized during university studies and that has been learned prior (Johnson and Kuennen, 2006). Learners recreate new information learned in school independently, using their current awareness about concepts relevant to the new content, according to constructivist and cognitivist theories about learning. As a result, to get benefit from academic learning experiences, learners would most likely need enough prior knowledge of Mathematics to perform at university (Galagedera et al., 2000). Ramos (2018) stated that the regression results showed that math self-efficacy was a positive predictor of Statistics motivation. According to Al-Dawish (2019), the Saudi student's previous experience in Mathematics in high school is limited and does not assist them to accomplish the mathematical assignments. Investing in mathematical knowledge in other academic subjects represents realizing the integration of experience. He also stated that developing mathematical abilities helps in the development of the capacity to collect and classify quantitative data, tabulate, and interpret (Al-Dawish, 2019, p.112). Due to the lack of previous background in statistical and mathematical knowledge among some PhD students in the Kingdom of Saudi Arabia, as the doctoral program in the Kingdom of Saudi Arabia requires passing a statistical exam, students prefer merely passing the exam without comprehending the subject due to an insufficient background in fundamental mathematical calculations.

It is widely acknowledged that an appropriate and proper use of statistical knowledge and information is a critical component of research integrity (Currie, 2009; Gardenier and Resnik, 2002). To better understand what the misapplication of Statistics means, it is important to gain a detailed understanding of and explain the role of Statistics within the context of scientific research. Gardenier and Resnik (2002, p.66) argued that the misapplication of statistical knowledge and information can be characterised as either misconduct or misapplication as a result of a deficit of competence and negligence on the part of the student/ researcher.

Statistical knowledge has a critical role in scientific research, Statistical methods are crucial to numerous steps of the scientific method, including the analysis and interpretation of data (See Figure 2-3). Any research begins with a clearly defined research problem which helps to formulate a viable research question to be answered by the researcher. This includes a review of the literature to develop the research hypotheses. The literature review provides an understanding of the research methodology including the design experiment that should be a basis to collect primary and secondary data as well as analyse the findings (Loewen and Gass, 2009). The statistical methods and measurement tools are critical at different stages of the research including the literature review and hypotheses development, the methodology and data analysis stages, as well as the peer review stage.

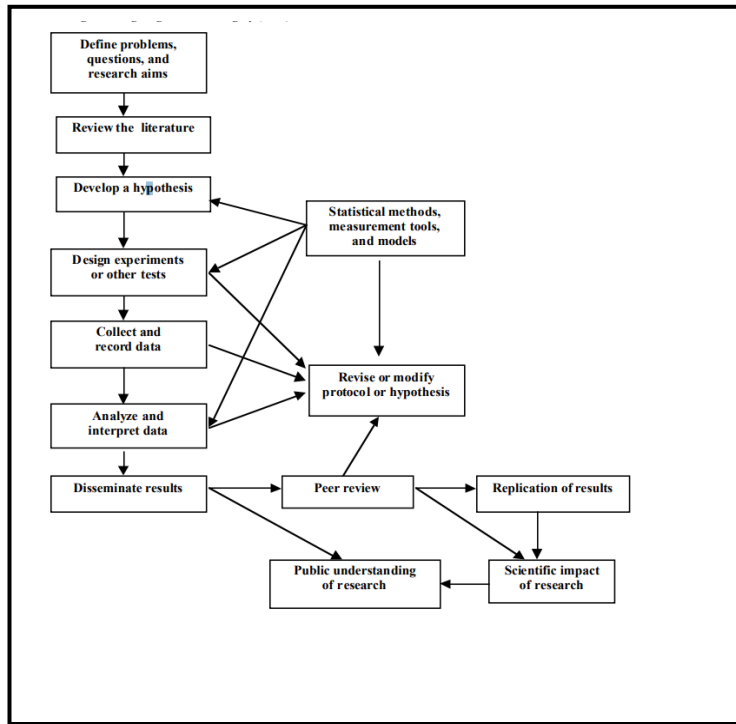


Figure 2-3: The Role of Statistics in the Scientific Method by Gardenier and Resnik (2002, p. 265)

Gardenier and Resnik (2002, p. 67) defined the term “misuse” of Statistics in empirical research as “an incorrect use, i.e., use of Statistics that is not appropriate given the research question, the experimental design, and the methods being used. For example, it may be appropriate to exclude outliers if there is credible evidence that such points are not part of the statistical population represented by the sample. It may also be appropriate to use statistical methods to fill in (or impute) missing data for statistical analysis. It is important to clarify within this definition provided by Gardenier and Resnik (2002) that a distinction between an appropriate and inappropriate exclusion of outliers and imputation of data, this is based on the fact that an appropriate exclusion of outliers reduces the noise within the data deprived of influencing the signal that explains the effect of one variable on another, which is being investigated in the study.

Resnik (2003) stated that an individual commits scientific misconduct when they engage in a serious violation of existing scientific research practices, regulations, and ethical norms during the research process. It is possible for ethical issues and statistical misconduct to arise at any stage of the research undertaken, including the collection, analysis, or reporting of the statistical findings in the research (Aguinis and Henle, 2002). A researcher who commits several errors due to quickness, ignorance, or sloppiness may be considered to be negligent or lacking the necessary level of competence (Grinnell, 1992).

Poon and Ainuddin (2011, p. 309) used the arguments presented by Cossette (2004) and defined research misapplication as “any intentional conduct that violates the ethical rules which a community of researchers

has agreed on at a specific point in time regarding how to behave when preparing or publishing the results of the research.” Based on this definition, irresponsible behaviour from the students, either intentionally or unintentionally, due to a lack of relevant statistical knowledge, constitutes statistical misconduct.

The misrepresentation of data and statistical misapplication can occur in different ways. The first form of research misconduct is intentional data misrepresentation, also referred to as fabrication of data i.e., the tendency of students/researchers to make up data that did not exist in the first place (Resnik, 2000). Another form of misrepresenting the data is a manipulation of data, which is where the researcher may input the missing information and data or excluding the data (e.g., outliers) that significantly influences the results and findings based on secondary and primary data. The motivation behind such an action undertaken by the researcher is to increase the likelihood that results would reinforce the research hypothesis being tested (Poon and Ainuddin, 2011).

Each researcher has an ethical duty to act with integrity and honesty when applying the statistical methods, as not undertaking an ethical approach to data collection and analysis is construed as misconduct, which is especially true when a researcher undertakes intentional deception (Resnik, 2000). Such as, the negative use of data mining is another form of statistical misapplication. It involves a collection of a large volume of diverse data, whereby the emphasis of the researcher is on mining the results with the publishing potential e.g., by only analysing the dataset that leads to statistically significant findings through the statistical analysis, which can be through running and reporting the regression results where the p-value is below 0.05 (Resnik, 2000).

The misapplication of statistical techniques may not necessarily be intentional and could be attributed to insufficient knowledge and understanding of the research methods used by the researcher (Gardenier and Resnik, 2002). This unintentional statistical misapplication largely originates as a result of the use of incorrect and inappropriate research design, research methods and research questions being used in the study (Gardenier and Resnik, 2002). Researchers have a responsibility to avoid statistical misapplication to maintain the integrity, credibility and reliability of the research (Cokley and Awad, 2013).

However, if a researcher/student has not completed a detailed study and gained an in-depth understanding of statistics, it increases the likelihood of misapplication of statistical methods based on the lack of knowledge on the part of the researcher. Some of the examples of statistical misapplication due to a lack of statistical knowledge include the use of correlation analysis to analyse the causal relationships, the use of structural equation modelling to test and address the research hypotheses based on a very small number of

observations in the dataset and the use of regression to test the relationship between the independent and dependent variable that is not related linearly (Poon and Ainuddin, 2011).

Borkowski and Welsh (2000) concluded that there is a need for a formal ethics code to administer the behaviour of researcher towards statistical misapplication. They stated that the code of ethics is important amongst the researchers, reviewers and editors which would reduce the occurrence of statistical misapplication, intentional or unintentional during the process of research and subsequent publication of the research material. From the standpoint of statistical misapplication, Borkowski and Welsh (2000) found that respondents considered it unethical to omit results due to the lack of statistical significance because it does not serve the principal objective. However, this practice takes place often in research unintentionally due to a lack of background knowledge. This finding is relevant in the context of Saudi Arabia too, as the reformation of the education system at school, college and university level should promote quality of education by putting greater emphasis on mathematics and statistical knowledge.

If the researcher lacks a strong statistical background and knowledge, this increases the possibility of misapplication of collected statistical techniques and data. Where the results of Pan & Tang (2005) showed a statistically significant negative correlation between the Anxiety of statistics and the number of Mathematics subjects and Statistics courses studied by the students, as well as experience in statistical programs. The misapplication can occur due to the incorrect application of statistical methods due to an insufficient understanding of the methods and techniques used. Moreover, the misapplication can also be attributed to the failure of the researcher to provide the research participants with relevant and important information relating to the methods used as part of the research design (Sakaluk, 2016). Not having suitable statistical knowledge and background means the researchers are unlikely to use the essential research practices, which influence the quality of the data analysis and conclusions/findings from the study.

As argued by Sharpe (2013), statistical knowledge is critical to developing a robust methodology and experimental design. This is because statistical knowledge enables a researcher to devise a methodology and subsequently collect the data that helps to test the research hypotheses and analyse the findings based on statistical techniques to provide evidence either in favour of or against the research hypotheses.

Von Roten and De Roten (2013) stated that the knowledge of Statistics and the problem of statistical misapplication (whether on purpose or due to a lack of knowledge) becomes even more problematic in quantitative studies. If a study is testing a quantitative statement and a research hypothesis, it means that the conclusion reached by the researcher should be premised upon the statistically significant findings. As

part of the knowledge and understanding of Statistics, a researcher possesses appropriate knowledge regarding the sample size, statistical and econometric techniques and tools available to the researcher to arrive at statistically significant findings (Cokley and Awad, 2013). An example to explain the statistical misapplication in this context is provided by Gardenier and Resnik (2002), who stated that a quantitative study to understand the impact and effectiveness of a particular drug on eight to ten patients is unlikely to help to conclude with statistical significance. In addition to this, the study will also suffer from the issues of limited generalisability and reliability problem due to limited sample size, implying that the study conducted by using eight to ten research participants cannot be generalised and applied to a wider population.

Furthermore, the appropriateness of research participants selected as part of the research is another important issue that is influenced by the extent to which researchers possess the knowledge and understanding of Statistics. In relation to the context of the above example, if all or some of the research participants experience certain health issues, therefore, this would introduce bias in the results whilst contribute to two ethical problems (Gardenier and Resnik, 2002). The ethical problem relates to exposing a human research participant to an unnecessary research-related experimental risk, without due consideration to the fact that the benefits as a result of the research may not exceed the costs and risks associated with exposing a human research participant to an unnecessary research-related experimental risk. In case the research experiment is not appropriately designed and suffers from methodological issues which limit the reliability and mean that no meaningful and reliable conclusions can be drawn from the study, this would imply that the potential benefits of the study do not outweigh the risks that the research participants are exposed to (Gardenier and Resnik, 2002).

The above-mentioned arguments, including the discussion of ethical issues, clearly indicates the importance of having knowledge and understanding of Statistics and Econometrics, so that a researcher can address the statistical and related ethical issues when undertaking and conducting the experiment. The importance of statistical knowledge is also reinforced by Brown et al. (2018), Statistical analysis errors involve methods that do not provide reliable evidence for the results. For instance, statistical methodologies are mis specified, or a statistical test result needs to be more accurate. Insufficient data can be defined as information obtained by incorrect or insufficiently low-quality collecting methods, study designs, or sample techniques. Indeed, the fact that many mistakes seen may be attributed to ignorance, Brown et al. (2018) suggested that education is a viable remedy. For example, adding classes in research design, logical inference, data management, and statistical analysis.

The misapplication of Statistics also indicates that researchers are unable to adequately interpret and analyse the results. There is a range of statistical tools in use when it comes to data analysis, ranging from simple econometric techniques such as (OLS) regression, t-test, correlation testing, to more advanced co-variance, chi-square, autoregressive distributed lag and panel data regression analyses. Thomas and Pencina (2016) stated that it is relatively easy for researchers to misapply the available statistical techniques while analysing data that has been collected, especially if the researchers do not have an adequate understanding and knowledge of these methods. It highlights the importance of having a detailed understanding and background knowledge of Statistics in avoiding engaging in statistical misapplication, which would eventually lower the reliability and validity of the research.

To apply any statistical technique and method in the context of an empirical study, the researcher must possess information about the variables that are being used across the different statistical methods (e.g. discrete or continuous variable, bimodal or Gaussian distribution) as well as detailed information about the sampling process in use (e.g. randomness of the sample, extent to which the sample is free from bias and misrepresentation) and the detailed understanding of the underlying assumptions and theory of the statistical technique and methods employed (Schjoedt and Bird, 2014).

If a researcher has not had a comprehensive training and educational background in Statistics in the past, it is simple for statistical misapplication to occur (Poon and Ainuddin, 2011). This is consistent with the conclusion of Gibbs et al. (2015) that the inability of a researcher to correctly use the relevant research methods means the analysis conducted and the conclusions drawn from the study are unlikely to be accurate, as the findings can either overestimate or underestimate the extent to which two variables are linked to each other. Moreover, as Statistics includes tools that help to differentiate the noise from the real signals within the data, it implies that a researcher with insufficient knowledge of Statistics is ill-equipped to accurately analyse the data using statistical and econometric techniques and consequently may produce the findings that are distorted and lack academic/ statistical rigour (Thomas and Pencina, 2016).

As with the benefits and use of robust methodology by the studies analysed in this chapter, there are several shortcomings and caveats associated with these studies that should be highlighted. Bedeian et al. (2010) argued that given the nature of the topic of statistical misapplication including unethical practices such as, manipulation of research materials, instruments, or approaches, as well as modifying or deleting data or outcomes, such that the study is not accurately reflected in the research record.

2.6 Statistical and Mathematics Anxiety

Increased number of social science students in colleges worldwide are presently being enrolled in Statistics courses as a necessary and basic requirement as part of their educational curriculum (Dombrowski et al., 2019). Statistics is argued to be a highly demanding, rigorous and anxiety evoking courses that Social Science students ever take as part of their college education (Benson et al., 2018). The adverse emotional and cognitive response of a number of students while undertaking Statistics in college may lead to a deterioration in their academic performance not only within Statistics but also other subjects (Faber et al., 2018), which also explains why a number of college students prefer to avoid taking Statistics.

Zeidner (1991, p. 319) defined Statistics anxiety as “a particular form of performance anxiety characterised by extensive worry, intrusive thoughts, mental disorganisation, tension and psychological arousal”. When students with limited background knowledge in Mathematics and Statistics are exposed to Statistics problems, content, evaluative contexts and instructional situations, it translates into statistical anxiety (Ordoni et al., 2017). Statistical anxiety is relevant when it comes to maintaining reliability and validity of the research undertaken by postgraduate researchers because it has a negative impact on a wide range of academic situations through interference with the manipulation of Statistics data, as well as solution of statistical problems/issues (Faber et al., 2018). Onwuegbuzie and Wilson (2001) added that statistical anxiety is a phenomenon that impedes performance and negatively affects the student's ability to understand and discuss research articles, analyse and interpret statistical results, and despite that, statistical anxiety may facilitate performance and may prompt the student to prepare themselves for the use of Statistics. Empirical evidence confirms statistical anxiety as distinct from test-anxiety (Benson and Bandalos, 1989; Ordoni et al., 2017), which indicated that limited knowledge of Statistics and Mathematics at the school and college level are important contributors to statistical anxiety.

Past research in the areas of statistical and mathematical anxiety confirms that they are likely to result from a developmental history of failures experienced in circumstances involving Mathematics (Benson and Bandalos, 1989; Ordoni et al., 2017). A low level of mathematical reasoning ability at the school level translates into the concomitant feeling of despair and helplessness experienced by students when it comes to solving Mathematics and statistical problems (Aydin, 2019). These issues also result in a reduction in self-confidence and development of a perception of low likelihood of success in Statistics (Buckley et al., 2016). A lack of foundation in Mathematics leads to lower knowledge of Statistics (Richardson and Woolfolk, 1980), as well as a decrease in self-esteem (Maloney et al., 2011), which eventually reinforce statistical and Mathematics anxiety of students at the undergraduate and post-graduate level. Research on Statistics anxiety is very rare, especially Arabic research. Research on Statistics anxiety is very rare, especially in Arabic research. Hence, the originality of this research. As some researchers consider that

Statistics anxiety is part of Mathematics anxiety, and others see that Statistics anxiety is separate and different from Mathematics anxiety, but high levels of Mathematics anxiety led to negative experiences when facing Statistics, as statistical anxiety is positively related to the level of Mathematics anxiety and is an important and risky factor in its impact on the level of academic achievement among students (Onwuegbuzie,1997). Moreover, Al-titi et al. (2015) stressed that statistical anxiety causes the inability to make the appropriate statistical decision and the inability to interpret the statistical results. Al-titi et al. (2015) also stressed that the student's weak academic abilities related to understanding and processing statistical data are due to the student's ability and self-confidence while solving mathematical problems.

Furthermore, the results of the one mentioned in the paragraph above showed a negative correlation between statistical anxiety and academic achievement in Statistics, and the emergence of a high level of statistical anxiety among students studying Statistics for the first time compared to their colleagues who studied Statistics more than once (Toto,1992). This was also confirmed by Sutarso (1992) that there is a statistically significant correlation between students' anxiety in statistics and previous knowledge and specialization. Additionally, Onwuegbuzie and Wilson (2003) argued that factors related with statistics academics, poor teaching methods, and the amount of time provided for training are among the reasons creating statistical anxiety for PhD candidates.

Previous research supports the need for greater emphasis on Mathematics as part of education. Pizzie and Kraemer (2017) found that the level of statistical and Mathematics anxiety amongst students reduced through the quality and number of past courses in Mathematics, their degree of success achieved in elementary and high school Mathematics. The empirical evidence presents a strong case for initiating changes within education system in Saudi Arabia, if the knowledge of Statistics is to be improved amongst students from the early age so that statistical and Mathematics anxiety can be minimised amongst Saudi students later on in their academic and professional careers.

2.7 Importance of Addressing Statistical Misapplication and Anxiety

In the contemporary educational sector, statistical knowledge is considered vital. Even though Statistics have been criticised at times as biased and distrusted (Schjoedt and Bird, 2014), nevertheless a large majority of researchers continue to employ statistical techniques to arrive at conclusions and use the findings as to the basis for their recommendations (Benjamin et al., 2018; Breaugh, 2008).

The results of statistical analyses are integral to the research conducted in Social Sciences including economics and policymaking, as well as biomedical research and medical diagnosis which influence the

extent of advancement in the standard of living (Schjoedt and Bird, 2014). This argument is supported by Baker (2016), who stated that appropriate epistemological research and studies based on sound statistical techniques and knowledge is the basis of detection as well as control of the existing and new infectious disease. Thus, it is clear that appropriate application of statistical techniques is critical, as social and mental health and wellbeing of citizens are directly impacted by the quality of the research and statistical analysis, along with the resultant recommendations provided based on the statistical analysis.

Moreover, a lack of suitable teaching of Statistics provided to the students (or no knowledge of Statistics provided to students going through certain pathways) means students are ill-equipped to successfully undertaking the research through the use of robust methodology (Sterba, 2006). This can result in detrimental outcomes for the community based on inefficient and wasteful use of available resources, managerial interventions that are misguided and the potential for the research to contaminate the scientific knowledge base (Sterba, 2006).

At the company level, the profitability of each organisation is dependent upon the market research and the extent to which researchers and managers can analyse the information, which is usually through the use of statistical methods (Schneider, 2013). At the macro level, the ability of the economy to function effectively is dependent upon the availability of information that is credible, reliable and based on the use of suitable and robust statistical methods (Savitz, 1993). Furthermore, the policies of the governments and central banks are devised through the use of the findings of the empirical analysis and research conducted across a range of disciplines including the economic environment, education, social equity, criminal justice and public health (Adler et al., 2009).

McAlevey and Sullivan (2010) conducted a study on statistical literacy and criticised the existing statistical education in most countries as maintaining a narrow focus on the statistical techniques themselves without providing the students with sufficient understanding and experience of the practical application of these techniques, which means the students are not well-equipped in their ability to appropriately reason and think from a statistical standpoint. Given the increased volume of data that needs to be processed in the current environment, numeracy skills in general and statistical numeracy, in particular, have become vital (McAlevey and Sullivan, 2010), so that students and researchers employ statistical techniques properly when they conduct the research. In the absence of statistical literacy, suitable policies and decisions are unlikely, especially considering the increased volume of data and uncertainty experienced in the rapidly changing environment.

McAlevey and Sullivan (2010) argued that uncertainty and risk as concepts are not well understood by the researchers/students, which is relevant in the context of statistical studies. Students and researchers should be aware of the issues faced by researchers when conducting the research (whether through primary or secondary data), which will help in selecting a suitable sample size, design the research methodology including the selection of suitable research methods to address the research questions and hypotheses.

2.8 Role of learning Mathematics in Statistical Data Analysis

Mathematical and statistical approaches and theories are crucial in many fields of current research and interest (Rossman et al., 2006). In most cases, Statistics is included in the mathematical curriculum which suggests this is part of Mathematics, but both subjects provide different knowledge bases. However, they overlap in some areas such as arithmetic and numerical skills are taught in both important in both cases. Furthermore, the key emphasis is placed on computation and calculation of information while teaching statistics rather than enabling students to learn an analytical approach (Cobb and Bowers, 1999). According to Moore and Cobb (2000), Mathematics is very important in the field of statistical data analysis, as the concepts within Mathematics help to recognize patterns and assist in interpreting results. The comprehension of different conceptions of Mathematics is fundamental for the execution of mathematical data analysis techniques in statistics. Mathematics was initially developed to confront everyday problems i.e., numbers are used in comparisons, tables, magnitude orders, averaging, measuring, prices and other numerical messages in daily life. A review of some of the school textbooks and experiment reports uncover that Statistics include most of the Mathematics used in the elementary curriculum and a part of the high-school curriculum (Dunkel, 1986).

Gal (2002) observed there is an integral role of mathematical capability in understanding statistical concepts and attaining statistical literacy. As observed in past literature, there is a positive association between mathematical competence and the performance of students in statistical courses (Galagedera and Woodward, 2000; Johnson and Kuennen, 2006; Wisenbaker et al. 2000). Similarly, there is also a link between Mathematics anxiety and statistical performance, such as students who have Mathematics anxiety do not perform well in Statistics (Wisenbaker et al., 2000). Moreover, students who have higher capability and knowledge base of Mathematics are less likely to experience Statistics anxiety (Onwuegbuzie and Wilson, 2003). In order to support this argument, a study conducted by Galli et al., (2008) is important. They found that student with poor mathematical background has a negative attitude towards introductory Statistics course and there is a high possibility that they may fail the course because they experience statistical anxiety. Therefore, it is important to have a Mathematics background to learn Statistics effectively.

In particular, according to previous results (Harlow, et al., 2002; Nasser, 2004; Tremblay, et al., 2000), mathematical background (high school achievement) and maths competence played the major role in performance in introductory statistics course.

In another study, Hand (1998) also argued that statisticians are highly relying on, and concerned with, the Mathematics undergraduate program in a Statistics degree. This suggests the importance of learning maths for statistical students, and it can be presumed that if the Statistics students cannot learn basic concepts of Statistics without math, how data analyst could perform reliable statistical data analysis without prior knowledge of Mathematics (Rossman et al., 2006). The relationship between Mathematics skills of undergraduate students and their educational performance in Statistics was also observed by Tanner et al. (2009) in their research and they found that Mathematics knowledge has a greater impact on student grades in Statistics. Such as, students scoring high marks in Statistics course have a higher level of competence in Mathematics.

According to Gattuso (2006), Mathematics is rooted in Statistics, and Statistics is a perfect field for the learning of numerous mathematical concepts to grant a concrete context. Furthermore, students not only increase their knowledge of Mathematics by doing so, but they too get in contact with another discipline that possesses an increasingly important position in their everyday life. They also get to know another point of view where the responses are relative or not direct, but the contentions are based on the quantitative results (Gattuso, 2006). Students' projects should be an essential component of any statistical work. Statistics should be the instrument to make connection in Mathematics. (Burrill, 1990). Moreover, Abaneh et al. (2007) observed that an essential element for improving the academic educational and academic environment is the interest in mathematical analysis and that it includes topics in Statistics, probability and hypothesis testing so that students learn the different methods of collecting and presenting statistical data.

Even though Mathematics lies at its core, as argued by present scholars, Statistics as a discipline includes many fundamental components beyond Mathematics. Firisa (2014) argued that while an integral part of the scientific method is to carefully test the results of the presumed knowledge and its major purpose is, of course, the exploration of new knowledge, so on this basis, Statistics should be considered as a branch of science rather than Mathematics. Excessive dependency on its mathematical foundation, however, is harmful to the statistical discipline as it leads to limitations on its perceived value such that statisticians and others who could otherwise get an advantage from its methods lose out (Firisa, 2014).

Either we agree or not that statistic is a methodology for solving real-world problems, we should certainly accept that it has Mathematics as its foundation. But it is necessary to realize that Mathematics is just one

component and other components include a great understanding of the area being examined and recognition with the vital computational tools. Therefore, without any of these components, statistical practice cannot be successful (Darling-Hammond et al., 2020). Furthermore, the field of Statistics in recent decades has properly experienced a revolution, basically as a result of the introduction of the computer. Powerful software tools have detached the capacity to manage a statistical analysis from the necessity of understanding the Mathematics underlying that analysis (Hand, 1998).

Similarly, Mathematics plays an important role in analysing data and interpreting its properties, as well as extracting and recognizing the massive amount of knowledge obtained through. Such as Mathematics play a key role in understanding the climate and the environment is a significant subject of modern scientific research. Mathematicians use differential equations to model processes like atmosphere and ocean's movement, resulting in models that can be used to predict and analyse the behaviour of weather and sea, as well as examine the use of tide and wind control. Statistics can be used to check for correlations in the massive quantity of data we have on these processes (Kaper and Engler, 2013). Statistics and Mathematics approaches have found their way into the Social Sciences as well, such as the use of modelling and framework in social research. These techniques are now being used to analyse possible election events, find evidence of any violation of human rights, propose new election processes, study how electoral ridings can be designed, and even solve crimes (Rach and Ufer, 2020).

2.9 Importance of Mathematics Education in the Middle East

The education investment in the Middle East has increased significantly in the past two decades. However, Middle East continues to face a wide educational gap as compared to the rest of the world, as also reflected in low secondary school enrolment and resultant low labour productivity (World Bank, 2021). With a few exceptions, Middle Eastern countries have achieved maximum enrolment in primary education and since 1970, almost tripled the enrolment in secondary schools, along with the five-fold increase at higher education level (Gaad, 2010).

Despite these improvements, the educational achievements of the Middle East continue to lag those of other countries at similar levels of economic development, particularly in Science and Mathematics (Mina, 2001). International test results show that educational outcomes remain drastically below the results achieved by Organisation for economic Cooperation and Development (OECD) countries. None of the 12 participating Middle Eastern countries exceeded the average scale Trend in International Math and Science Study (TIMSS) test on 8th-grade math and science competencies (Mullis et al., 2016). Surprisingly, most Middle Eastern countries do not have national criteria for learning achievement, and those who have criteria do not

utilize them to foster accountability. About two-thirds of secondary students in more than half of the Middle Eastern countries major in the fields of social science and humanities instead of science and Mathematics (World Bank, 2009).

Most countries have reconsidered their educational systems in general, and the system of preparation and training teachers being responsible for the success or failure of any educational system, the existence of a deficit in learning and teaching Mathematics, and that there are a large number of students in many Arab countries who do not have the ability to perform simple arithmetic operations in writing or mentally (Jasim et al. 2018). Moreover, this was confirmed by Al-Rose (2004) the results of the Arab countries in TIMSS, and the international tests PISA revealed that students' performance in Mathematics was generally below average. The Arab attendance remained weak in the higher levels of the scale of international standards (Samidah and Najwa 2014).

According to TIMSS (2019), *“The TIMSS 2019 eighth grade Mathematics assessment was based on a comprehensive assessment framework developed collaboratively with the participating countries to reflect their curricular goals. The eighth-grade Mathematics assessment included four content areas—number (30%), algebra (30%), geometry (20%), and data and probability (20%). In accordance with the framework, the majority of TIMSS 2019 Mathematics items assess students’ applying and reasoning skills. To cover the framework at the eighth grade, the TIMSS 2019 Mathematics assessment comprised 211 assessment items”*. This shows that statistics is important and takes part of Mathematics as the students tested the data and probability. As illustrated in table 2-1 the results of the 12 participating Middle Eastern countries.

The key measures of Mathematics and Science performance in TIMSS are the average scores. These are calculated for each country participating in the research based on the scores attained by students taking the TIMSS assessment (Kibriya et al., 2017). The complete distribution of TIMSS average score is centred at 500 (referred to as Centrepoint) which corresponds to the average of overall achievement distribution, whereby 100 points on the scale illustrate one standard deviation (Kibriya et al., 2017).

Table 2-1: Grade 8 TIMSS Scale Centrepoint Mathematics achievement scores in the Middle Eastern Countries. Source: (Countries' Mathematics and Science Achievement – TIMSS 2019 International Reports)

| Country | Average Scale Score |
|----------------------|---------------------|
| Turkey | 496 ↓ |
| Bahrain | 481 ↓ |
| United Arab Emirates | 473 ↓ |
| Iran | 446 ↓ |
| Qatar | 443 ↓ |
| Lebanon | 429 ↓ |
| Jordan | 420 ↓ |
| Egypt | 413 ↓ |
| Oman | 411 ↓ |
| Kuwait | 403 ↓ |
| Saudi Arabia | 394 ↓ |
| Morocco | 388 ↓ |

Recently, Saudi Arabia's Ministry of Education made a decision to establish Mathematics curriculum based on international experiences that have proved successful in enhancing education. Decision-makers selected the McGraw-Hill Education Company and its representative in KSA, Al-Obekan Education Company has been assigned the role of designing Mathematics curriculum for primary, secondary, and higher (university) education based on the requirements and principles of the US National Council of Mathematics Teachers (Khormi and Woolner, 2019). This suggests the efforts made by Saudi Arabia to improve the educational standards of Mathematics. The decision illustrates the attempt from the Ministry of Education to increase the emphasis on Mathematics with a view to improving numeracy skills of Saudi students while addressing the statistical and Mathematics anxiety. A stronger foundation in Mathematics will enhance the statistical

knowledge of students (Richardson and Woolfolk, 1980), improve their self-esteem (Maloney et al., 2011). And eventually reduce the statistical and Mathematics anxiety of Saudi students at the undergraduate and post-graduate level.

2.10 Change in the Education system

The changing nature of higher education globally including massification is an important trend in the external environment (Morace et al., 2017). Change is a continuous aspect of public and private sector organisations globally. Over time, privatisation has meant that public sector organisations have turned into private enterprises, some of the large firms have lost market share to the new entrants as a result of the changes in the external environment and the competition it poses (Ismail & Al-Haisha, 2011). Even though the education industry is fundamentally different from the organisations in the other industries, especially those in the private sector, the knowledge and research conducted on change management within the private sector is also applicable to the education industry to enable the education industry to be able to support and facilitate change (Nielsen and Nielsen, 2013).

It is not straightforward to ascertain the meaning of the term ‘change’, as change encapsulates a variety of terms associated with reforms, development, innovation, improvement and enhancement (Zhang and Rajagopalan, 2010). A definition of change as provided by Sengupta et al. (2006) is considered relevant in this research. Sengupta et al. (2006, p. 2) defined change as “a method of altering an existing institution to enhance its effectiveness in terms of achieving its objectives through organisational change that aims to make modifications to the institutional structure, methods and processes, or introduce new notions and behaviours”. This definition is considered appropriate in the context of this research, as the definition focuses on the relevance of the structure, processes and methods of the organisations that need to change, including the need to develop new practices, behaviours and notions.

The above definition of change as provided by Sengupta et al. (2006) is used by Calegari et al. (2015) including the application of Kotter’s organisational change model to argue that change involves taking into consideration the new possibilities (i.e., new behaviours, patterns, methodologies, markets and ideas) based on the changes in the internal and external environment. While changing, it involves uncovering new patterns to increase the productivity and effectiveness of the organisation in the context of the environment within which the organisation operates, so it could fulfil its objectives in a more effective manner (Calegari et al., 2015). This argument of Calegari et al. (2015) is relevant in the context of the need for higher education institutions in KSA to change, as the students need to become more familiar and proficient in the knowledge and application of statistics so that the quality of research undertaken by the Saudi Arabian

students improves. Change is not considered a rational activity that can be easily mandated or can contribute to measurable consequences (Law and Glover, 2000). This viewpoint of Law and Glover (2000) was the basis of their criticism of the earlier arguments that change can be easily measured.

Three types of change frequently mentioned in the literature include developmental change, transitional change and transformational change (Prabhu, 2018). Developmental change concentrates on improving the existing methods, skills and performance criteria, which may no longer be relevant and compatible with the existing and future organisational requirements. Secondly, transitional change is where the existing stakeholders in the organisations (e.g. employees, management) recognise the need to change to address the existing issues. With regards to transitional change, the changes in the external environment mean that the organisation needs to change to better serve the mutable needs of its customers (Lundberg, 1990). Thirdly, transformational change is another type of change. This involves a significant shift from one condition to another. To successfully introduce transformational change demands a considerable change in the organisational behaviour, culture and structure (Seel, 2000).

Change within higher education is essential because the effectiveness of higher education translates into an improvement in the human capital of a country (Alnahdi, 2014). This argument is supported by Aldabas (2015), who stated that higher education is the most important source of developing human resources, as an investment in higher education translates into an increase in productivity of workers and the ability of the workers to maximise the output for a given unit of input. This explains the positive impact of investment in education on the international competitiveness of firms in a country, as superior productivity of workers results in higher international competitiveness and the ability of firms from the country to increase their export market share (Robertson and Al-Zahrani, 2012).

These arguments further signify the importance of the higher education industry for KSA, as an important objective of KSA as part of *Vision 2030* is to successfully diversify its economic base and reduce its existing reliance on oil and gas resources. To achieve this economic diversification, investment in education and the resultant improvement in productivity and international competitiveness is critical in promoting the human capital and exports of other industries in KSA (Alnahdi, 2014). Thus, with the changes in the external political, economic, socio-cultural and technological environments in the KSA, it is clear that there is a need for the higher education industry to embracing change. This change includes investment in education with a viewpoint to address the issue of statistical misapplication, including the development of the knowledge base and technical understanding of the students when it comes to statistical knowledge and its

application in the research papers to improve the reliability, validity and credibility of the research published by the Saudi Arabian researchers.

2.11 Forces for Change

The considerable changes in the economic, social, technological and political environments mainly as a result of the trends such as rapid technological advancements, globalisation and increased interconnectedness of the global economy have meant that firms across the globe must adapt to the changing environment and change their strategies, objectives and goals accordingly if they are to survive and successfully navigate in the contemporary environment (Al Gamdi and Samarji, 2016; Elyas and Picard, 2013).

The above-mentioned forces for change are also applicable to the higher education industry. The Government of KSA has recognised the important role of the higher education industry and particularly the universities in preparing the future workforce. As the oil price has remained low in the last five years, this has negatively impacted the revenue of the government, contributing to a budget deficit instead of a surplus. This change in the economic environment, along with the rising youth unemployment (due to population growth as a social environmental factor) are the important changes that have led to the greater emphasis of the Government of KSA on the need for the higher education industry to change (Tayan, 2017). Higher youth unemployment is an important social challenge, as increased youth unemployment can cause social unrest and a lack of social cohesion (Dewey et al., 2012). This signifies the importance for the Saudi Government of focusing on the education industry to improve the human capital.

To respond to these economic and social changes, it is vital that the Saudi students graduating possess the relevant skill set required to successfully enter and operate in the current environment, enabling the businesses to meet the challenges of the 21st century (Abed and Alrawajfh, 2017). It means that foundational level learning practices in Saudi Arabia required to undergo the change to focus upon improving the numeracy knowledge of the students (Tayan, 2017). Greater attention paid to improving the statistical knowledge will help to minimise the instances of statistical misapplication, as researchers/ students will be better equipped to use the suitable methodological techniques required to address the research questions and research hypotheses.

Saiti et al. (2018) investigated the impact of the economic environment on the education industry. They argued that the economic environment has an impact on the government budget (surplus or deficit) and consequently the amount of budget the government allocates to the education sector. If a government

undertakes austerity measures (as has been the case in Saudi Arabia since 2016 due to a reduction in revenues from the proceeds of oil) (Samargandi et al., 2019), this has a knock-on impact on the education sector because the government funding for education industry tends to reduce (Pavan, 2016). The potential reduction in the funding available for the education sector can negatively impact the quality standards of the universities and higher education institutions in KSA, which further adds to the challenge of addressing the issue of statistical misapplication in KSA (Samargandi et al., 2019).

The analysis in this section reinforces the changes in the external political, economic, socio-cultural and technological environments in Saudi Arabia and the resultant need for the higher education industry to embracing change. This change should comprise of greater investment in education to overcome the statistical misapplication, including the development of technical understanding and the knowledge base of the students. It will assist in developing statistical knowledge and its application in the research process to improve the research validity and credibility.

2.12 Change Management Models

There are several change management models in use that enable the leaders to successfully promote and manage change, in both the public and private sector organisations. A leader must be able to select an appropriate change management model to undertake and drive change in the organisation to help survive and achieve further growth (Cummings et al., 2016). Kezar (2011) suggested a list of features that should be considered by the leaders in the higher education industry when undertaking change. These include the need to undertake self-discovery of the organisation, achieving greater awareness and understanding of the organisation itself and the changes posed in the external environment, acknowledge these changes including political, economic, social and technological changes, concentrate on adapting to the change, achieve a better balance between the internal and external environment, appreciate the disorderly nature of change and consider the possibility of incorporating and merging the different approaches and models of change.

The four models of change are discussed in the rest of this section. These models have been selected due to their suitability for use in facilitating some of the change initiatives within higher education institutions. The steps of these models are illustrated in table 2-2.

Three-step model

Lewin (1947) proposed three steps of achieving change: unfreeze, achieve the change in the organisation and finally, re-freeze. As part of the unfreeze, the requirement includes defining the existing situation, removing prejudice and resistance to change from the organisation whilst identifying and understanding the desired objectives. The change stage includes the actual implementation of change. This is followed by a re-freeze, which is once the change has been achieved, a new situation is introduced (Lewin, 1947). The three-step model is premised upon the argument that once the organisation has undertaken change, it is important to act upon and re-freeze the change as otherwise, the change will be short-lived.

Eight phases model

Kotter (2012) conducted a comprehensive analysis of a large number of organisations that underwent a change and identified eight phases as part of the change that can be undertaken by the organisations to facilitate change. These steps to change are illustrated in table 2-2. The existence of different phases in change indicates that the process of change undergoes different stages, which should be clearly understood by the change leader (Kotter, 2012).

Seven steps model

Garvin et al.'s (2008) seven-step change model is based on the concept of Lewin's (1947) three-step model. Garvin et al.'s (2008) seven-step change model concentrates on the important role of change drivers in facilitating and implementing change through leading change, creating a shared need and shaping the vision, mobilising commitment, making the change happen, monitoring the progress and finally, changing the structure and existing systems as part of the change process (see table 2-2).

Twelve steps model

Mento et al. (2002) combined the previous change models (e.g. Lewin's model and Kotter's model) to devise a comprehensive 12-step change model. Each of the 12 steps as part of the change model suggested by Mento et al. (2002) are provided in table 2-2.

Table 2-2: Change management models

| Steps | Three steps model (Lewin, 1947) | Kotter's eight-phase model (Kotter, 2012) | Seven steps change model (Garvin et al., 2008) | 12 step model of change (Mento et al., 2002) |
|--------------|--|--|--|--|
| 1 | Unfreeze | Establish a sense of urgency | Lead change | Focus on the change idea and its context |
| 2 | Change | Create a guiding coalition | Create a shared need | Clearly define the change initiative |
| 3 | Re-freeze | Develop a change vision | Shape a vision | Evaluate the environment within which change is taking place |
| 4 | | Communication the change vision | Mobilise commitment | Develop the plan for change |
| 5 | | Empower the action | Make change happen fast | Find a sponsor who will facilitate change |
| 6 | | Create quick wins | Monitor the progress to change | Prepare the target audience for change |
| 7 | | Build on the change | Change the systems and structure as part of the change process | Create the culture suited to the change |
| 8 | | Institutionalise the new approaches | | Select a change leader |
| 9 | | | | Create small wins to motivate the staff to facilitate and embrace change |

| | | | | |
|----|--|--|--|--|
| 10 | | | | Achieve change continuously and strategically |
| 11 | | | | Regularly measure the change effort |
| 12 | | | | Integrate the different lessons learnt to change |

The brief review of the relevant change management models helps to understand how leaders can successfully promote and manage change, in both the public and private sector organisations. These models of change have been selected due to their suitability for use in facilitating some of the change initiatives within higher education institutions. The above-mentioned models are useful for leaders in the education industry in KSA to change, by increasingly focusing on statistical education to minimise the occurrence of statistical misapplication; improving the quality of the workforce in Saudi Arabia that would help the economy to enhance its human capital and maximise economic development, various issues in the education system must be addressed. Change management models are crucial to Saudi Arabia's goals and aims for educational reform, especially Vision 2030, by providing structured frameworks to navigate and implement changes successfully. Educational institutions can plan interventions, manage the transition process more easily and smoothly, and identify areas for improvement with the use of these models. Change management models support Vision 2030 by supporting in the improvement of learning outcomes, innovation, teaching approaches, and the alignment of educational goals with the larger national objectives. The work on researching the 'statistics readiness of PhD students' fits within the change models by aligning with the stages and principles these models' support. For instance, Lewin's Change Model: Unfreezing: Identifying the current state of statistics readiness among PhD students and recognizing the need for improvement. Change: Implementing interventions to improve students' statistical skills, such as additional training or curriculum changes. Refreezing: Ensuring the changes are integrated into the educational system and become part of the standard practice. Another example is Kotter's Change Model, creating a sense of urgency the work done in this PhD informs this aspect of Kotter's change model, Highlighting the importance of statistical readiness and the main reason for insufficient mathematical understanding of the statistical methods of SA PhD students and the implications for their research quality.

Forming a Powerful Coalition: Engaging educational leaders, faculty, and stakeholders to support initiatives aimed at improving statistical readiness. Developing a Vision and Strategy: Creating a clear plan to enhance

statistics education and support for PhD students. Communicating the Vision: Sharing the importance and benefits of improved statistical readiness with all stakeholders. Empowering Broad-Based Action: Providing resources and removing barriers to facilitate the enhancement of statistical skills among students. Generating Short-Term Wins: Presenting early successes from interventions to build momentum. Consolidating Gains and Producing More Change: Building on initial successes to apply broader changes. Anchoring New Approaches in the Culture: Guaranteeing that improved statistical readiness becomes a permanent part of the educational culture.

Learning about change models significantly formed the approach to assessing and improving the 'statistics readiness of PhD students' in various ways. Understanding these models provided a structured framework for identifying gaps in statistical readiness, planning targeted interventions, and implementing effective changes. This structured approach helped in systematically addressing the challenges faced by PhD students and enhancing their preparedness in using statistical methods. Moreover, the models highlighted the importance of planning and strategizing, ensuring that the research addressed essential elements such as identifying gaps, setting goals, and developing an actionable plan. Furthermore, the significance of leadership and communication in change models showcased the need to include educational leaders, faculty, and students in the research and improvement process. Finally, the focus on inserting changes into the culture underscored the importance of making lasting improvements in statistical education past temporary fixes.

By applying principles from change models, this research aimed to evaluate the current state of statistical readiness and create a foundation for future efforts to improve and maintain higher levels of statistical competence among PhD students.

The similarities between the change models proposed by Kurt Lewin, John Kotter, George Garvin, and Mento are as follows: Firstly, the significance of leadership in promoting change within an organization is emphasized by all four models. Secondly, effective leadership is an essential element in motivating and assisting people through change. Furthermore, each model describes a sequence of phases or actions that organizations typically follow during a time of change, including aspects like planning, implementation, and consolidation. Lastly, all models highlight that communication is a crucial component. Effective communication ensures that stakeholders are informed about the change, comprehend its goal, and feel included at every stage of the process.

However, the differences in the change models include the following: Kotter's model addresses eight distinct processes, including establishing urgency, forming a guiding coalition, and securing the change in

the culture, whereas Lewin's model focuses on three stages of change: unfreezing, changing, and refreezing. In contrast, Garvin's approach proposes a methodical procedure for diagnosis, planning, implementation, and stabilisation. Mento's methodology centralizes on the twelve essential components of a successful change, such as system alignment, leadership support, and a well-defined vision. Furthermore, the significance of addressing organisational culture during change attempts is emphasised by both Kotter's and Garvin's models. While Garvin highlights how culture affects processes and behaviours, Kotter stresses the need of encouraging a sense of urgency and integrate change into the culture. Mento's and Lewin's models place more emphasis on the practical steps of implementing change. Additionally, Mento's model emphasises behaviour and attitudes towards change heavily. It illustrates how crucial it is to address concerns and offer resources and support in order to enable the effective adoption of change.

These change models differ in how they handle the implementation of change and time, the significance of organisational culture, and the importance on human behaviour, even if they all share basic ideas like the value of communication and leadership. Organisations may choose a model according to their culture, level of change preparedness, and unique demands.

Furthermore, the most suitable change management model will rely on a number of variables, such as the type and extent of the reform, organisational culture, degree of change preparedness, and available resources.

Various strategies for organisational change are provided by every model. Garvin's approach features the significance of learning and adapting, whereas Kotter's model aims on establishing urgency, creating a guiding coalition, and anchoring change. Lewin's model highlights unfreezing, altering, and refreezing. However, the success of implementing these change models, particularly in the context of educational reform, faces significant obstacles. The lack of emphasis on knowledge of statistical methods and statistics in general means the quality, reliability, and validity of the research are compromised, negatively impacting the quality of the research published. Therefore, it will be impossible to implement real economic and cultural reforms without taking into account the societal advantages of an excellent education. Implementing the objectives of Vision 2030 will be a tremendous challenge due to outdated school curricula, ineffective teaching methods, and poor education standards. Education is one aspect of the Vision that requires a comprehensive overhaul, according to Pavan, (2016) For *Vision 2030* to succeed, Saudi Arabia must take advantage of the knowledge, skills and experience that for its citizens could offer. Moreover, the research question is concerned with the fact that how well prepared are doctoral-level students to undertake statistical analysis in their research studies, which can only be analysed through

gaining an understanding of the significance of Mathematics in the education system because it is a part of applied mathematics.

For this, a sample education system, Singapore's education system, as a high-performing system, was studied to gain a detailed understanding of the key factors that have contributed to its success in a relatively short period.

2.13 Singaporean Education System and the Importance of Mathematics

Singapore is widely acknowledged as one of the highest performing education systems and has become the object of study for several countries in an attempt to replicate the success achieved by Singapore (e.g., Barber and Mourshed, 2007; Lumpe et al., 2012). The country continues to achieve the highest ranking in primary and secondary education within international education tests in maths and science subjects (Coughlan, 2016). The Programme for International Student Assessment (PISA) provides a ranking based on the international tests taken by 15-year olds in science, reading and maths. The tests are considered reliable because they are organised and managed by an independent body set up by the Organisation for Economic Cooperation and Development (OECD) (Hogan et al., 2013). Besides the Programme for International Student Assessment ranking, another international ranking Trends in International Mathematics and Science Study includes the tests taken by over 600,000 students worldwide, which has also rated Singaporean students as number one in mathematics (Coughlan, 2016).

Through identification of the education systems that are performing the best, Programme for International Student Assessment creates “reference societies” (Sellar and Lingard, 2013, p. 712), which form the basis for the policymakers and politicians globally to use to formulate their educational policies to enhance the educational achievement of their countries. Understanding the education system of Singapore and its superior academic performance helps to understand the key factors to the success of their education system, helping to devise academic policies including how the curriculum, programmes and pedagogical practices can be shaped to develop the knowledge and the skillset required for Saudi Arabian citizens in the 21st century (Lewis, 2017).

As Singapore only gained independence in 1965 and comprised of a mostly unskilled workforce with low literacy, the analysis of the Singaporean education system is interesting as it helps to provide an insight into how a country has transformed its education system as a means to develop its economy and improve the standard of living of its citizens, achieving the desired change in a relatively shorter period (Sidhu et al., 2011). The section that follows will concentrate on three factors that have been identified to explain the

superior performance of the education system in Singapore: (1) foundational learning, (2) teacher quality and (3) system characteristics. These factors have been illustrated in the form of a theoretical framework, as shown in figure 2-4 below.

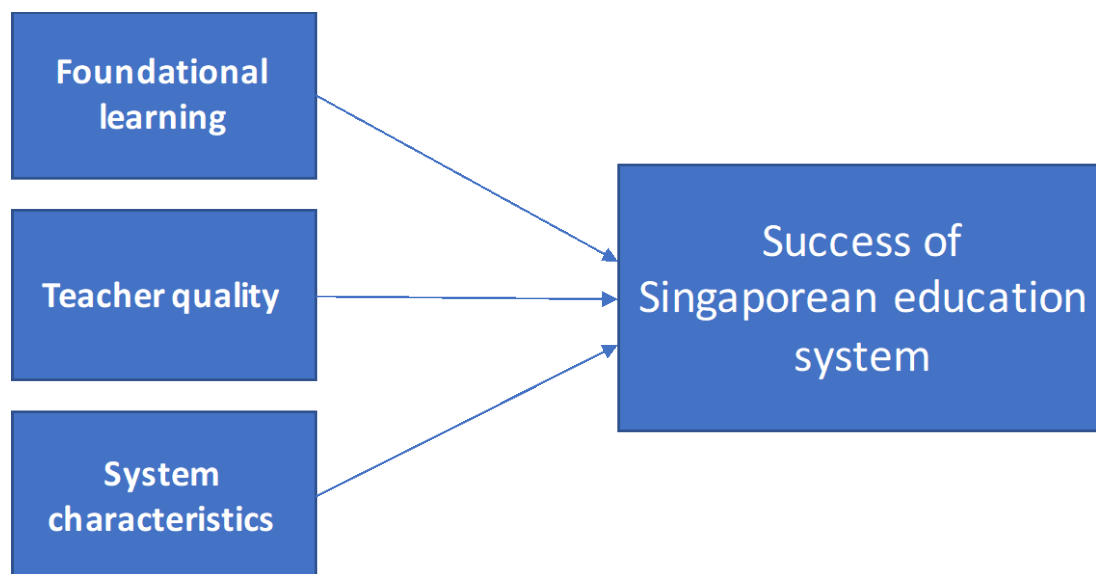


Figure 2-4: Summary of the factors explaining the success of the Singaporean education system

2.13.1 Foundational learning

The curriculum in Singapore is such that it focuses on achieving a comprehensive mastery of the subjects such as Mathematics through the foundational learning that is carefully devised and introduced in the syllabus (Choy et al., 2009). Foundational learning refers to the concept whereby the education curriculum of students is carefully devised. The learning in each year develops on the prior year's learning to strengthen the foundation knowledge and key concepts of students (Ng, 2010). A study conducted by Kumar and Natarajan (2007) examined different components of a theoretical problem-based learning framework adopted by tertiary education institutions in Singapore with a focus on achieving reforms and improvement. Kumar and Natarajan (2007) concluded that the objective of the educational framework and syllabus under the Singaporean education system is on improving how students think and enhance their development of knowledge within a problem-solving context. In the Singaporean curriculum, Mathematics is a required subject from primary school through secondary school. In the early grades, approximately 20% of the school curriculum time is given to mathematics so that pupils can create a strong foundation for future study. The Mathematics curriculum is evaluated every six years, with important stakeholders and partners consulted, to ensure that it matches the needs of the nation. (Kaur et al., 2015). Nevertheless, the

effectiveness of the foundational learning model applicable in Singapore is reinforced by Fogarty and Pete (2010) who concluded that the objective of the education system in Singapore is on developing the foundational learning of the students in such a manner that each grade/ year of school is considered a building block. This highlights the importance of devising the syllabus in such a manner that the students can maximise the learning of the suitable concepts in their year group, building on this learning to maximise their technical knowledge, including an emphasis on problem-solving skills as a means to strengthen their overall knowledge and development (Tan, 2011).

The emphasis on foundational learning and the resultant success of the Singaporean education system has been made possible through the significant investment in education. It is made possible through the persistently high fiscal budget (almost 23% of total government spending) allocated to education by the Singaporean government (Alrabeyi, 2023). Investment in education provides appropriate resources (such as human resources, technological and physical resources) necessary for the educational institutions to conduct suitable research to better understand the student needs. The knowledge and information gained from this help to improve the quality of their decision-making when it comes to devising the curriculum.

Tan (2011) explained how high-quality foundational learning is made possible in Singapore: viewing education as a priority coupled with the use of socio-cultural values focusing on utilitarianism and strong support for education within the community are cited as key factors contributing to exceptional academic standards of Singapore (Tan, 2011). Ultimately, the emphasis on ensuring that students in Singapore understand the material taught at the deeper level instead of only concentrating on doing well in the upcoming tests (Yeo and Li, 2014). Such an approach helps the students to exceed the memorisation and truly understand the relevant material in the curriculum, reducing the likelihood that they would forget the concepts as they progress to the next grade.

2.13.2 Teacher quality

The analysis of the results of countries performing well on PISA particularly Singapore reveals that the quality of teachers (and the resultant quality of teaching provided to the students) is another relevant variable that influences the development of the education system (Luo et al., 2011; Ng, 2010).

A study conducted by Barber and Mourshed (2007) of McKinsey and Company investigated the factors that help to explain the superior educational performance of Singapore and Finland. In the comparative analysis, Barber and Mourshed (2007) emphasised the mechanism involved in selecting the teachers as an important factor in the success of the Singaporean education system. In Singapore, it is acknowledged that

a poor selection decision when it comes to recruiting teachers could negatively impact the standard and quality of teaching for the subsequent four decades (Barber and Mourshed, 2007), highlighting the extent to which recruitment of teachers is an area of focus.

The Singaporean education system acknowledges that for an individual to become an effective teacher, they should possess particular characteristics and competencies before they enter the teaching profession. These characteristics and competencies include strong overall numeracy skills and literacy, communication and interpersonal skills, motivation to teach, and the willingness to engage in continuous learning and development (Allington and Johnston, 2000; Glatthorn et al., 2018; Ng, 2017). The selection procedure of teachers in Singapore is designed in such a way that the focus remains on testing whether the potential candidates possess these competencies. The state-wide selection process used in Singapore when it comes to recruiting the teachers, managed jointly by the Ministry of Education and the National Institute for Education is illustrated in the table below:

Table 1-3: Selection procedure used to recruit teachers in Singapore (Barber and Mourshed, 2007)

| Recruitment stage | Details |
|-------------------|--|
| Screen the CV | <p>Ensure that the candidate possesses minimum qualifications, such as:</p> <ul style="list-style-type: none"> • The candidate should be in the top 30% of their cohort in terms of their academic performance • The candidate should have completed the education to the university level <p>There must be evidence of interest in education and teaching children</p> |
| Assessment test | <p>The focus of this stage is on checking the literacy skills of the candidates through ensuring that:</p> <ul style="list-style-type: none"> • Candidates possess a high level of literacy • Conduct the numeracy, logical and verbal reasoning tests |
| Interviews | <p>The focus of this stage is on checking the attitude, personality and aptitude of the candidates.</p> <ul style="list-style-type: none"> • The interview is conducted with the prospective candidates by the panel of three experienced headmasters to ascertain the qualifications, skillset and motivation of the candidates • The interview could also include practical activities and tests |

| | |
|------------|---|
| Monitoring | <ul style="list-style-type: none"> • Teachers recruited by the schools/ colleges are subsequently monitored during their initial teacher training period • A proportion of the candidates that do not exhibit the skillset and competencies in practice during the training period are removed from their positions |
|------------|---|

As illustrated in the table above, the recruitment process used to recruit the teachers is comprehensive and designed to ensure that only qualified and motivated individuals are selected to teach. The various stages including the CV screening stage, assessment tests, interviews, and monitoring stage are all devised to ensure that the candidates not deemed suitable for teaching are not recruited, thereby maximising the likelihood that the most appropriate candidates are offered the teaching roles. This way, the quality of the selection and subsequently the quality of the teaching is improved (Barber and Mourshed, 2007).

The focus on improving teacher quality is not restricted only to the recruitment stage. Teacher quality in Singapore is enhanced by providing comprehensive teacher preparation programmes and continued professional development (Darling-Hammond and Rothman, 2011). As part of the continued professional development of teaching staff, the emphasis remains on investment in leadership skills of teachers, providing them with the necessary support to develop and improve the existing curriculum, as well as the related investment in necessary resources and support infrastructure such as books and information technology (Lin et al., 2015). The combination of recruitment and investment in training and development help to maintain the excellent quality of the teaching staff in Singapore, which benefits students because of the superior teaching style and the ability of teachers to effectively discharge the knowledge to students (Reyes and Gopinathan, 2015).

2.13.3 System characteristics

The system characteristics refer to the key features of the academic system within Singapore that influence the quality of education and academic standards in the country (Thaver and Lim, 2014). The characteristics of the educational system in Singapore include the academic standards, measures of accountability and academic expectations in the society. These characteristics have served as an integral part of the Singaporean education system and contributed to the superior academic performance in Maths, Science and other subjects (Thaver and Lim, 2014). Koh (2014) argued that high-performing nations such as Singapore set high academic standards for students and subsequently monitor the performance of students and teachers based on these standards and expectations.

The accountability mechanisms in use in the Singaporean education system is a relevant aspect of the educational system that contributes to superior academic standards. The accountability mechanism includes the evaluation of teachers, school reviews as well as teacher appraisal to sustain and enhance the performance of the teachers (Jayanthi et al., 2014). Furthermore, the education system is such that there is a commitment from the Ministry of Education in Singapore to promote a high degree of coherence within the curriculum taught to the students, the instructions and training provided to the teachers (You and Morris, 2016). This coherence within the curriculum taught to the students promotes equity amongst students in terms of providing them with an opportunity to learn the same knowledge and academic skills, as there is an underlying assumption that all the students are capable of maximising their learning to achieve and exceed the standard academic performance criteria (Jayanthi et al., 2014).

As part of the coherence within the curriculum taught to students in Singapore, which is an important aspect of system characteristics, there is a strong focus on visual learning in Singapore which has proved highly effective. When it comes to word problems, the way mathematics is taught in Singapore, the word problems rely upon visual learning and drawing to highlight a word problem (Leland, 2015). This enables students from an early age to begin to visualise what is being communicated by the word problem, so they are in a position to better understand the meaning and consequently solve the problem without the need to memorise how to solve the problem.

When examined on the challenging arithmetic concepts, Wong (2016) found that word problem is an area that students tend to find the most challenging. However, Singapore students can routinely successfully tackle the word problems, as also reflected by the superior academic performance of Singaporean students in the assessments undertaken by the Programme for International Student Assessment and Trends in International Mathematics and Science Study. The underlying rationale for the superior maths performance of Singaporean students is that when it comes to the word problems, rather than focusing on the meaning of words contained in the problems, the students in Singapore can turn these words into a visual learning tool. This technique helps them to change the words into recognisable images from an early age, thereby successfully solving the word problems (Waldow et al., 2014).

Over time, children become more competent and confident in their ability to successfully solve the arithmetic concepts, which not only increases their skill set but also their interest in using the arithmetic skills as part of their university education and career in the future (Ng, 2010). The characteristics of the Singaporean education system with an emphasis on academic standards, measures of accountability, academic expectations, and use of techniques such as visual learning tools clearly illustrate the effectiveness

of these methods in preparing qualified and competent students (Deng and Gopinathan, 2016). These characteristics also provide lessons for the Saudi education system as to how the overall educational system could be reformed to improve the quality of students and human capital in the future (Poon et al., 2016).

2.14: Implications of Singapore's Education System for the Saudi Education System

To improve the skills such as numeracy, logical thinking and problem-solving of Saudi students from an early age, the Singaporean education system, and its success in a relatively short period serves as a relevant benchmark. Several lessons can be learnt by Saudi Arabia from the success achieved by Singapore.

Firstly, the existing curriculum in Saudi Arabia at the primary and secondary school level needs to be reformulated. Foundational learning as an approach is considered suitable within the education system, where the emphasis should be on improving how students think and enhance their development of knowledge within a problem-solving context. The foundational learning of the students can be achieved in a manner that each grade/ year of school is considered a building block. Drawing from the lessons of Singaporean experience and the role of the government, the desired change, and educational reform in Saudi Arabia would require financial and human resources from the government.

Secondly, when it comes to the quality of teachers including their recruitment and selection mechanism in Saudi Arabia, this also requires reformulation. A competency-based approach should be introduced in Saudi Arabia, where a teacher should be required to possess a minimum skillset and competencies such as numeracy and literacy skills, communication and interpersonal skills, motivation to teach, and the willingness to engage in continuous learning and development. This should be complemented with the introduction of consistent recruitment criteria across the public and private sector educational institutions in Saudi Arabia whereby the recruitment and selection process should include the CV screening stage, assessment tests, interviews, and monitoring stage. The combination of these stages would help to ensure that the candidates not deemed suitable for teaching are not recruited, which would maximise the likelihood that the most suitable candidates are offered the teaching roles.

Improved quality of teachers and resultant increase in the quality of Mathematics education is a relevant factor that will help to address statistical and Mathematics anxiety amongst Saudi students. Previous research supports the need for greater emphasis on Mathematics as part of primary education: Pizzie and Kraemer (2017) found that the level of statistical and Mathematics anxiety amongst students reduced through the quality and number of past courses in Mathematics, their degree of success achieved in elementary and high school Mathematics. Therefore, if the Saudi education system improves the quality of

teaching staff and consequently increases the quality of education in Mathematics provided to students, it will equip Saudi students with the suitable knowledge of Mathematics and relevant statistical concepts. The empirical evidence presents a strong case for initiating changes within education system in Saudi Arabia, if the knowledge of statistics is to be improved amongst students from the early age so that statistical and Mathematics anxiety can be minimised amongst Saudi students later on in their academic and professional careers.

Thirdly, academic standards and measures of accountability as part of the education system is another area that requires changes within the Saudi education system. As part of the accountability of the schools and teaching staff, the evaluation of teachers, school reviews, and teacher appraisal should be given greater importance due to their role in improving the performance of the teachers and consequently, the performance of the students.

In the context of change in higher education, the change towards the proposed education system based on the analysis of the Singaporean education system highlights that increased attention needs to be given to the change process, which encapsulates the development of the new practices, behaviours and notions as part of the Saudi education system. The proposed change within the higher education system in Saudi Arabia is necessary, as the effectiveness of the highest education system in terms of improving the arithmetic and mathematical knowledge and skills of the Saudi students from an early age would not only improve the academic performance and develop the human capital of the country (Alnahdi, 2014). Also this ensure that the PhD students are adequately equipped with the knowledge and skillset when conducting their research as part of the doctoral studies.

2.15 Higher Educational Standards in Saudi Arabia

Saudi Arabia is well established as a centre of science and scholarship because of its natural wealth and trade strength (OPEC, 2019). The rapid growth of the Saudi university network between 2009 and 2017 with a growth of 50 per cent has made the country a more desirable option for doctoral studies. The government administration of Saudi Arabia is also spending significantly on its schools and colleges, as almost 23% of its budget is allocated to education (KPMG, 2023). According to Pariona (2017), the educational framework of KSA has established a certain collection of priorities and objectives in the course of the students' curriculum as an example, the Saudi *vision 2030* in which education plays a major role.

Alhammad (2010) supported the preceding argument and pointed out that it is quite misleading to embolden the teacher for providing inadequate memorisation programs and limited knowledge of facts primarily to

crack an exam, which is generally encouraged in Saudi schools as an educational or academic approach. Alharthi et al. (2019) have contended that students are constantly being instructed on how to perform in an exam instead of utilising the literature objectively to articulate their opinions with a view to optimising their academic or cognitive abilities. Furthermore, Saudi Arabia's educational reform programs are required to be focused on standards of academic competence particularly in physics, mathematics and languages that allow students to succeed theoretically and scholastically. Karasik (2015) has determined that high-performing programs around the world will produce outstanding outcomes because they would attract more qualified people to improve their ability to deliver the best education and build a framework to ensure that teachers are always giving the same quality to all students.

Karasik (2015) added that there is a gap between two ideologies namely school and university culture, where Saudi students were disappointed by the existing education system and headed to the institutions of America and Europe to experience a better educational system. Taking into account the opinions of Mossad (2016), one may determine that this would further provide a helping hand in developing restrictive statistical techniques but would not resolve the problem of insufficient statistical information and awareness together with the subsequent statistical misconduct, which is very predominant in the case of Saudi Arabia. The review of the present literature has supported the research problem of statistical misapplication and analysed the need to enhance the quality as well as standard of research at Saudi Arabian universities.

2.16 Need for Change in Saudi Education System

In any nation or state, regardless of it being developing or developed; the improvement and change in the education sector are important because it helps to ensure the fact that the sector would remain competitive (Arlett et al., 2010). The educational sector varies widely from that of other sectors however the global higher education and massification developments are relevant in external contexts owing to the development. Studies carried out on the significance of change implementation within the private sector should be considered by the education sector of KSA for the advancement and promoting the transition (Morace et al., 2017; Nielsen and Nielsen, 2013). In addition to this, Kotter's organisational change model can be considered as an essential element for the KSA institutions of higher education, which would help to bring change ensuring that the students comprehend awareness, implementation and consistency of work carried out by them with regards to statistical analysis (Calegari et al., 2015).

In the Kingdom of Saudi Arabia, there are several obstacles identified in the way of progress including the application of online study (e-learning) and the behaviour of professors towards such implementation. The aforementioned fact needs to be followed with regards to different practices and priorities for survival in

contemporary environments (Al Gamdi and Samarji 2016; Kezar, 2011; Sengupta et al., 2006). Therefore, specific models for implementing and managing change should be considered by the universities and schools of KSA such as Kotter's and Lewin's change management model (Cummings et al., 2016; Dewey et al., 2012). Moreover, a twelve-step model of the change introduced by Mento et al. (2002) can also be considered and applied within the education sector of KSA. Because it provides a clear road map, emphasizes strong leadership, encourages stakeholder participation, places a high value on good communication, and guarantees long-term sustainability, from the researcher's point of view, Kotter's model might be suitable for bringing about change in Saudi education system. It provides a thorough framework for handling challenging transformations and raising the standard of education.

The main forces behind the change can be deliberated as reducing oil prices and budget deficits associated with the education sector, which generates a need for improvement and implementing change within the education industry of KSA considering the fact that quality education would provide quality human resources to the nation for dealing with the crisis (Alnahdi, 2014; Aldabas, 2014; Samargandi et al., 2019). However, possible reductions in the educational fund have a huge potential to adversely impact educational institutes and the quality provided by it in Saudi Arabia, which could further be an obstruction to address the problem of data mismanagement (statistical misapplication) in KSA (Pavan, 2016). The recommended change to Saudi Arabia's university education framework is crucial for establishing that PhD students are adequately prepared for research as part of their doctoral studies. This change aligns well with Kotter's change model, particularly in the steps of creating a sense of urgency and developing a strategic vision. Fundamental education in school and university standards must be strategically planned and implemented to provide a solid foundation and framework for students, helping them avoid statistical misapplication while undertaking their doctoral theses (Alnahdi, 2014). Such as, Saudi Arabia can consider adopting elements of the Singaporean education system, which is renowned for providing high-quality education in Mathematics and Sciences. This strategic overhaul will support Kotter's steps of empowering broad-based action and generating short-term wins by producing well-prepared doctoral candidates capable of high-quality research.

2.17 Conclusion

The literature review chapter has helped to provide an insight into the existing literature to better understand the educational system of Saudi Arabia and why it lags the educational system of leading countries such as Singapore. The chapter began by providing the analysis of the educational system of KSA and the importance of education in the context of the fulfilment of the future objectives of KSA as stated in *Vision 2030* and analysed the state educational issues experienced in KSA. Furthermore, the research problem of statistical misapplication has been explained and analysed through the review of the extant literature and findings of different authors. In contrast, the issue of statistical misapplication is more a consequence of inadequate background knowledge and understanding of the statistical methods within KSA.

Consequently, it can be stated that if the researchers in Saudi Arabia are to gain the trust of the public within the academic profession; it is vital to address the statistical misapplication. This is because enhanced quality, reliability and validity of the research increases the likelihood of suitable findings and aid in an efficient allocation of limited available resources to maximise the efficiency and effectiveness related to the functional ways of organisations as well as the nation. If researchers are ill-equipped in their ability to utilise the different statistical techniques such as descriptive Statistics, correlation, (OLS) ordinary least square regression etc. then this would have a detrimental impact on society because of the poor quality of research and a lack of reliability of the findings.

From the aforementioned analysis, it has been evaluated that the inappropriate educational policies and resource allocation for arithmetic skills are key reasons for the incorrect application of statistical techniques by PhD students. Therefore, it is important to consider that the educational system is improved in Saudi Arabia with a view to increased importance given to the statistical education, ensuring that all the students who would become future researchers have an in-depth understanding of the statistical methods along with the underlying assumptions associated with these methods.

Moreover, the explanation of the change in education, the definition of term change is and three different types of change including developmental change, transitional change and transformational change are provided. The need for change within the education sector in KSA including the forces contributing to change is thoroughly analysed through illuminating four models of change. These models have been selected due to their suitability for use in facilitating some of the change initiatives within education institutions. The four models are useful for leaders to implement change within the education industry of KSA by increasingly focusing on statistical education to minimise the occurrence of statistical

misapplication. The change management in organisations with an emphasis on the education sector is determined, which provide insight into the need for and importance of change in the education industry within KSA. The reviewed literature has also included the discussion of changing political, economic, socio-cultural and technological environments in Saudi Arabia and the consequent need for the education industry to respond to embrace change. It has been stated that the change should comprise of greater investment in education to overcome the statistical misapplication including the development of technical understanding and the knowledge that makes the base for the students with regards to statistical knowledge and its application in the research process that can improve research validity and credibility.

The literature review also included an analysis of a sample education system, in this case, the Singaporean education system and uncovered three factors that have contributed to the success of the Singaporean education system. This was measured through the student performance in Programme for International Student Assessment and Trends in International Mathematics and Science Study. Additionally, it can be stated that Singapore has always been referred to as a reference society, which has achieved a considerable improvement in the education system with relatively few resources since its independence in 1965 when the workforce of Singapore comprised mostly unskilled workforce with low literacy. Thus, Singapore's education system provided an ideal sample education system to draw upon for this research. Some of the factors explained with regards to the sample education system are the superior academic performance of Singaporean students especially in Mathematics including the focus of Singaporean schools and colleges on foundational learning. The change towards the proposed education system based on the analysis of the Singaporean education system has highlighted that increased attention is required to be given to the change process, which would encapsulate the development of new practices, behaviours and notions as part of the Saudi education system.

The proposed changes within the education system in Saudi Arabia is necessary for increasing the effectiveness of the education system in terms of arithmetic and mathematical knowledge along with numeracy skills of Saudi students. It could provide an assurance that students who are adequately equipped with the requisite knowledge and skill set can perform better at the doctoral level. Such as, they would be able to select a viable research method as well as able to implement the numeracy skills while using statistical tools in their research.

Finally, a review of the extensive literature on the education system has uncovered an important gap in the literature: there are few studies that have attempted to assess the relationship between Mathematics and Statistics taught in the primary/ secondary school and the impact this has on the ability of PhD students to

be confident in their ability to research with confidence. The next chapter details the research methodology adopted in this study to address how well prepared doctoral-level students are to undertake statistical analysis in their research studies, to show the need for why reforms are needed in Saudi Arabia's education system and why future university students should have sufficient mathematical understanding to maintain the researcher's basic knowledge base (Mathematics and Statistics).

Chapter 3: Research Methodology

3.1 Introduction

Social research is defined by Sekaran and Bougie (2016) as a systematic, critical, organized, objective, data-based scientific investigation or inquiry into a particular issue, conducted with the purpose to achieve a solution or answer. It is suggested by Cooper and Schindler (2003) that reporting, descriptive, predictive, or explanatory studies are covered in social research. According to Saunders et al. (2009), research is a procedure by which people try to systematically learn things so they can enhance their knowledge. Though not agreed by all, the methodology is perceived as a knowledge body that permits scholars to analyse and describe methods while conducting systematic research (Bryman, 2016). Therefore, research methodology is an important part of a dissertation, as it involves the procedure or means for collecting and analysing the requisite data. Research methodology tackles different kinds of questions established under research aim and helps to answer these questions with gathered evidence (Saunders et al., 2009). The major of this doctoral thesis was to investigate how well prepared doctoral-level students are to undertake statistical analysis in their research studies. To do so, this chapter talks about the research methodology employed in this thesis, involving research philosophy, research design, target population, sample and the sampling processes. It also described data collection processes, data collection instruments and data analysis techniques.

3.2 Research Design

Research design is very important as it critically connects the arguments and theories that enlighten the study and the collected empirical data (Bryman, 2016). Similarly, it was believed by Churchill Jr. (1979) that the research design gives directions for gathering and evaluating data in any particular study. Saunders et al. (2009) maintained that one can represent a research process as the onion. Different layers and perspectives are accessible, which are continuously employed while carrying out this study. In a research onion, deliberations on various issues must be accounted for before the core of the onion or central point is addressed, which is the data analysis and data collection (Saunders et al., 2009). Therefore, the research methodology of this doctoral thesis was developed keeping in view the research onion of Saunders et al. (2009) as research design, where all layers of the onion are discussed one by one in detail.

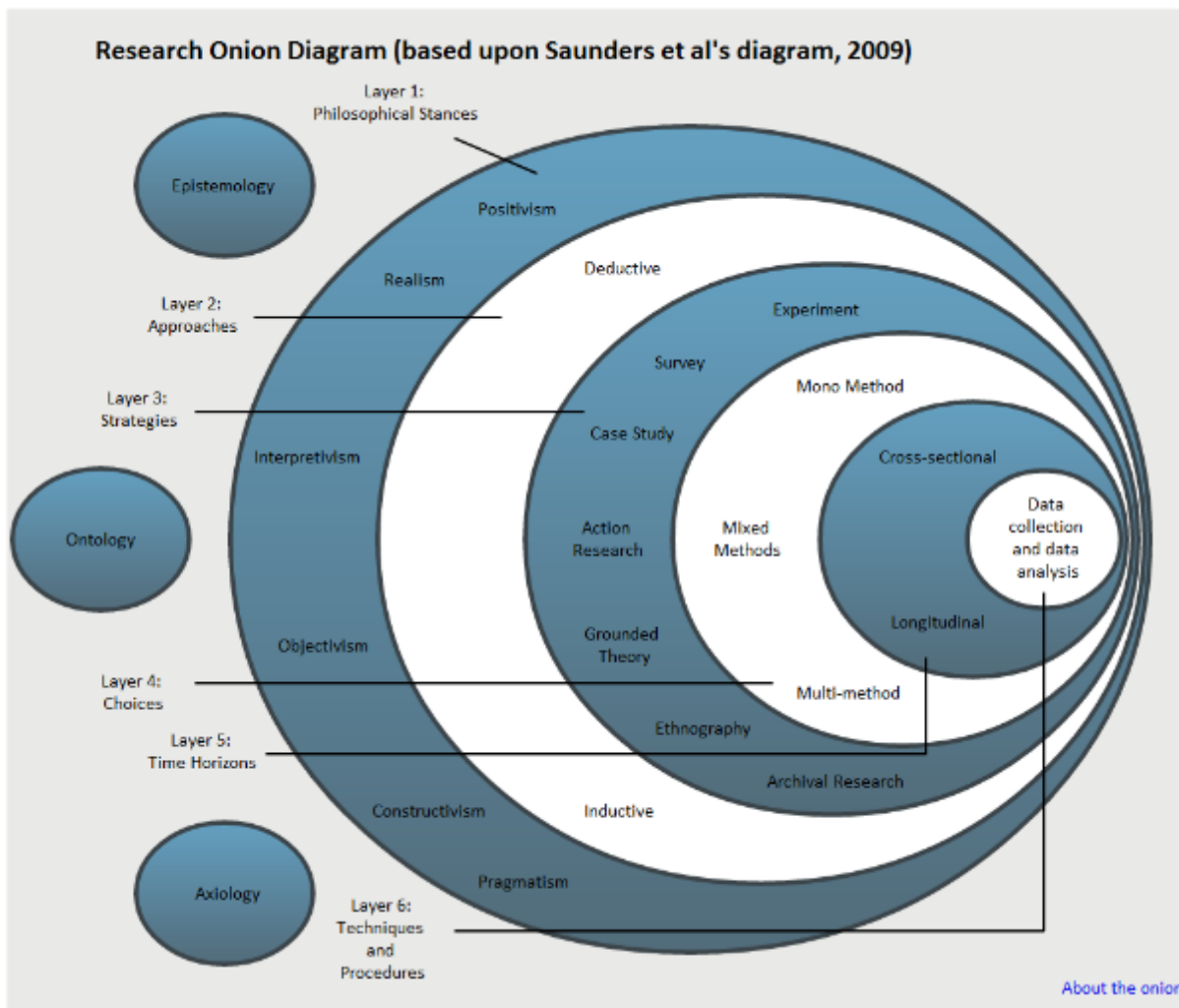


Figure 3-1: Research Onion by Saunders et al. (2009)

3.2.1 Philosophical Position

Research philosophy is the first and important step in developing an effective research strategy. An idea or a belief about collection, implementation and evaluation of collected data can be referred to as the research philosophy (Kleinberg-Levin, 1988). Research philosophy is mainly concerned with developing knowledge in any specific field. This step is adopted by the researcher in a particular study to contemplate significant assumptions regarding his/her views and opinions and how the world is understood by him/her (Simpson, 2009). This will affect the strategy of the researcher in regard to the adopted research method or research plan. Certainly, the specific opinion and view of the researcher regarding the relationship between knowledge and procedure responsible for the development are among the major considerations impacting the selection of a particular philosophy (Saunders, et al., 2009).

Although there are many different philosophies, major – the most crucial ones are realism, pragmatism, interpretivism and positivism that impact how the research process is perceived by the researcher (Saunders et al., 2009). Positivism identifies with the philosophical position of the common researcher and involves working with an apparent social reality to create generalized information. It guarantees unequivocal and exact information. Interpretivism accentuates that people are not quite the same as actual marvels since they make implications. Interpretivists study these implications from a subjectivist point of view. Pragmatism that ideas are just pertinent where they support activity (Kelemen and Rumens, 2008). It endeavours to accommodate both objectivism and subjectivism, realities and values, precise and thorough information and distinctive contextualized encounters. It does this by thinking about speculations, ideas, thoughts, theories and exploration discoveries not in a theoretical structure, but rather as far as the jobs they play as instruments of suspected and activity, and as far as their reasonable outcomes in explicit setting (Saunders et al., 2015-2019).

This study utilized a pragmatist approach to discover how students in Saudi Arabian universities may sometimes misapply statistical analysis techniques to manipulate data. Lohse (2017) discussed that pragmatism is a constituent of the history of the social sciences and aims to deal with the lived experience. It is argued by the pragmatism theorists that the adopted research question is the most significant determinant of research approach. This depicts that research objectives and questions are the essential factors in the research philosophy; although one might be increasingly appropriate as compared to the other one for responding to specific problem (Saunders et al., 2009). Hence, it is arguable that the mixed method, a combination of quantitative and qualitative approach, is possible and would be highly suitable in a study. That is why, it is proclaimed by Creswell (2017) that researchers should focus on research problems, while using all available approaches to comprehend the research problem, instead of emphasizing a single method.

Moreover, a pragmatic approach depends on a description of the abductive reasoning that moves to and from between deduction and induction to connect theory and data. It can transform observations into theories and evaluate them with the help of action (Morgan, 2007). This abductive reasoning is adopted in this research because both quantitative and qualitative methods are sequentially combined to address the research questions. In this scenario, the inductive results of the qualitative method are established on the grounds of deductive outcomes gained from the quantitative approach and the other way round (Ivankova, Creswell and Stick, 2006). Pragmatism also enables the researcher to work to and from qualitative and quantitative data, which is seen as incompatible sometimes at individual level. It provides researchers with the chance to look for helpful points regarding the connection between these two kinds of data (Morgan, 2007). Hence, an appropriate framework is offered by pragmatism to understand the quality and standard

of research at Saudi Arabian universities. So, pragmatism philosophy is used as a base while developing a systematic methodology for this thesis with a mixed methods approach. Quantitative data helps to understand the problem in hand i.e., misapplication of statistical methods by students in doctoral research, whereas qualitative data attained from academics helps to identify the main reasons behind this scenario and allows to make viable recommendations in this regard.

3.2.2 Research Approach

Trochim (2006) considered deductive and inductive approaches as two broad reasoning methods that come under the research approach. He explains induction as shifting from particular towards general, whereas deduction starts from general and then ends with particular. According to Creswell and Plano Clark (2007), a deductive researcher goes from the top towards the bottom, from theory towards hypothesis towards data so they can contradict or add to the theory. The focus of the deductive approach is upon literature to recognize ideas and theories that will be tested by the researcher with the help of data. Contrarily, they said that an inductive researcher works from the bottom-up, utilizing the views of the participants to construct wider themes and establish a theory uniting the themes. As such, the inductive approach collects data and develops a theory using analysis results (Saunders et al., 2009). So, arguments formed on the ground of observations or experiences are best manifested inductively, while those arguments which are based on rules, laws or different other generally approved principles are fittingly expressed in a deductive manner.

This thesis pays attention to testing theory because the theory was initially accepted as a framework for creating a hypothesis and testing it in a particular research context. This research study is deductively oriented, as the thesis aims to follow the path of logic more closely rather than relying on the theoretical perspective of a phenomenon. Abductive reasoning also seems a suitable approach at first keeping in view pragmatist philosophy and mixed-method research, however, abductive reasoning only yields a reasonable conclusion but does not have produce enough evidence to positively verify it (Collis and Hussey, 2013). Therefore, the adoption of deductive reasoning is the most suitable decision as it seems a logical way to establish a sound conclusion and meet the research aim effectively i.e., how to enhance the quality and standard of research at Saudi Arabia's universities.

3.2.3 Research Strategy

The research strategy considers the question of whether the present dissertation should be categorized as explanatory, descriptive or exploratory, after having to adopt deductive theory as the current research approach. Research strategy also considers the intention behind gathering enormous data through a large population in a highly efficient and economic manner. In order to select an appropriate research strategy, it

is vital to understand the major characteristics of the available options identified above. Flexibility is the main characteristic of exploratory research. This type of research is used in this research as an initial step when the research problem is not particularly defined and has a broad scope. Exploratory studies assist in analysing the concerning situation, ask questions, seek new perceptions and evaluates it from a different viewpoint (Yin, 1994). The goal of exploratory research is to formulate problems more accurately, clarifies concepts, gathering explanations, gains insight, eliminates unrealistic ideas and form hypotheses (Van Wyk, 2012).

On the other hand, descriptive research presents a precise profile of events, situations or people. Such as the survey questions, potential respondents and the analysis method are clearly specified before initiating the data collection process. By doing so, it gives an individual the chance to make the required changes before beginning the data collection process (Van Wyk, 2012). Finally, while focusing on the cause-effect relation, explanatory research explains which effects are produced by which causes. In a casual analysis, the main concern is how a variable directly or indirectly influences another variable. Causation can be strictly interpreted as a process where an external factor generates changes in a dependent variable. Explanatory research is based on theory and theory is formulated to answer how and why questions (Creswell and Plano Clark, 2007).

Exploratory research seems a more suitable approach for this doctoral thesis as it is linked with the deductive approach. In social sciences research, it is a common and popular strategy and is mostly utilized to answer what, where, who, how many and how much (Van Wyk, 2012). In a research problem, where only a few studies or no previous data for reference is available, exploratory research design was adopted in this research. The case is similar for the underlying study, as there is not any preceding evidence about the misapplication of statistical analysis techniques by PhD students in KSA and this study aims to unearth this phenomenon. Further, exploratory research tends to be unstructured and informal sometimes, where it acts as an instrument for primary research that gives a theoretical or hypothetical idea of a research problem. The purpose of conducting this research is to define the problem's nature and assist in understanding the problem better.

According to Saunders et al. (2012), exploratory research tends to be flexible and imparts the initial foundation for future research. Although, it demands that the researcher should investigate various sources for instance data collected from different surveys, different stakeholders' opinions, and observation of the research items and published secondary information. Therefore, exploratory research is adopted in the underlying study to investigate the quality and standard of research at Saudi Arabia's universities while focusing on the use of statistical techniques by PhD students.

3.3 Research Method

Research methods are categorized by the literature into mixed, qualitative or quantitative methods. There are different aspects responsible for deciding which one of the research methods would be most suitable, these aspects are research questions, topics and objectives (Saunders et al., 2009). It is suggested that all research studies are different from each other and comprise their dissimilar objectives that are tackled appropriately. Hence, it is important to utilize the best-suited methods to acquire the goals and objectives of the research (Punch, 2003). Previously, researchers used to chiefly focus upon adopting the quantitative or qualitative methodology. Nowadays, more advanced techniques are required for analysing data and inspecting research problems that have become more intricate and complex over time (Jogulu and Pansiri, 2011).

3.3.1 Mixed Method Research

The utilization of both qualitative and quantitative methods to gather and analyse data in any particular study is called mixed method research (Creswell, 2017). Sandelowski et al. (2009) say that one can technically define mixed approach design as the mixture of probability and purposeful sampling, close-ended and open-ended techniques of data collection and multivariable and narrative analyses which can contain anything. Usually, the main objective of qualitative research is to describe and explore, whereas the main objective of quantitative research is to describe and explain (Johnson & Christensen, 2019). Researchers have claimed that a mixed research method aims to achieve an increasingly comprehensive understanding regarding the research model and also complements the limitations of a quantitative approach (Tashakkori & Teddlie, 2008). That is why, based on the objectives and research questions for this doctoral thesis, using a mixed research design is the best-suited approach.

The reason behind adopting this research method is the perception that the qualitative and quantitative method permits researchers to draw out results with more confidence. It also stimulates the development of creative methods, new manners of tackling an issue and balancing it with conventional methods of data collection and also assists in exploring unexpected aspects of a scenario (Jick, 1979). In this thesis, quantitative research was firstly conducted to gather quantifiable facts and figure about the readiness of PhD students to apply statistical methods in their research, then the interviews were conducted from academics as the qualitative aspect of research to support the quantifiable information with a valid argument and ascertain that how lack of background knowledge in Statistics is causing common errors in research implications. Previously, many researchers have utilized quantitative design to gather research data, although, all variables are not controlled or ruled out by the quantitative research, it might exclude significant human experience (Cooper and Schindler, 2003). Hence, the mixed-method study design is an

appropriate tool to evaluate the misapplication of statistical analysis by students in Saudi Arabian universities, which helps to decrease the weaknesses of purely quantitative or qualitative studies and also to integrate the advantages of quantitative theory assessment with qualitative theory construction (Freeborough, 2012). Mixed research is a crucial tool in studies where existing tool is insufficient. It is especially valuable when information about the phenomenon under investigation is lacking or when previous studies on the problem are unavailable.

Robson (2002) declared that when a relationship among variables has to be measured, quantitative research happens to be particularly appropriate. It is suggested by Cooper and Schindler (2006) that quantitative methods do not influence the research outcomes because the responses of participants are categorized, reduced and coded into numbers, so they can be exploited for the statistical analysis. Bryman (2016) defined quantitative research as a systematic investigation of a research issue by collecting quantifiable information and performing numerical, statistical and computational procedures to analyse the collected information. Quantitative research can be conducted by using several methods, like survey, observations and experiments keeping in view the nature of research. Hence, the quantitative research approach is adopted here to examine the relationship between statistical literacy of PhD students and how well prepared doctoral-level students are to undertake statistical analysis in their research studies competently. Further, the quantitative method is also used to quantify the similarities and differences in the statistical analysis procedures used in the analysis of doctoral theses data in the KSA and the UK research programmes.

Additionally, this doctoral thesis aims to examine how well prepared doctoral-level students are to undertake statistical analysis in their research studies, as well as to investigate the level of Mathematics and Statistics understanding among Saudi PhD students, as well as the impact of statistical and Mathematics literacy on the appropriate selection and application of statistical methods in doctoral-level research. For this, Creswell (2017) argued that the appropriate method to assess a national phenomenon, i.e., the level of preparation, is qualitative research. On many occasions, qualitative research proves to be confirmatory. Olds et al. (2005) said that qualitative research aims to gather and test the textual data, for example, focus groups, observation, conversational analysis and interviews. Similarly, it is also stated by Creswell (2017) that the qualitative method of research is utilized to evaluate an issue associated with the interviewee's work by learning about their attitudes, perceptions, and views. It is suggested by DiCicco- Bloom and Crabtree (2006) that qualitative research makes its contribution by analysing what meaning life experiences have for the interviewees. Therefore, a qualitative method is used here to obtain a detailed explanation from interviewees based on their teaching and supervision experience of PhD student during the process of data analysis using statistical techniques.

Moreover, the quantitative data helps in addressing research questions regarding how prepared PhD students are to undertake statistical analysis, whilst the qualitative data examines into supervisors' viewpoints regarding the reasons behind students' struggles with statistical methods. By integrating both methods, this research achieves a fuller understanding of the problem—one that neither qualitative nor quantitative methods alone could provide. There are obvious advantages to using mixed methods, since they enable the researcher to collect more thorough and consistent data. Because the quantitative data promotes generalisability and the qualitative interviews may add context to the figures, this strategy also lessens the drawbacks of employing either quantitative or qualitative approaches. However, mixed methods can also pose challenges. It might be difficult and resource-intensive to integrate qualitative and quantitative findings, which means that data gathering, and analysis will take longer. It could also be challenging to reconcile discrepancies in the results between the two methods. With these difficulties, the benefits of using mixed methods in this research to provide a comprehensive and multidimensional knowledge exceed the drawbacks. In conclusion, the mixed methods technique fits this study the best as it enables a comprehensive analysis of PhD students' statistical readiness. The integration of numerical data with qualitative insights guarantees the capture of both broad patterns and individual experiences, culminating in a more complete and practically applicable set of conclusions.

3.4 Population and Sampling

A research sample is explained as a large collection of objects or individuals having common characteristics and act as the focus of scientific research (Parahoo, 2006). As this study involved mixed-method research, consisting of both qualitative and quantitative research, similarly the sample of the research was also divided into two major parts.

- Firstly, the sample for quantitative research was randomly selected to involve 100 PhD students currently enrolled in postgraduate programs in Education, with 50 students from one of the participating universities in the UK and 50 students from one of the participating universities in SA. Ultimately, only 46 students opted to participate from the Saudi university and 32 PhD students from the Scotland/UK university.
- Secondly, the sample target for qualitative research was eight, involving those who are responsible for teaching Statistics in Education Schools or faculties at the participating KSA university. However, only five agreed to participate in interviews. The purpose of involving these participants was because they could help to understand how well prepared doctoral-level students are to undertake statistical analysis in their research studies and to assess the efficiency of statistical

methods used in PhD research at Saudi universities, to enhance the quality and standard of research at Saudi Arabia's universities.

Nonetheless, a researcher will encounter difficulties while seeking to observe everyone in the research population, no matter what the chosen research design is. That is why it is emphasized that researchers must consider selecting a study sample and generalize the outcomes to the entire population later (Miles and Huberman, 1994). Choosing a particular subset from all unit cases to represent general results about the whole body of the units is called sampling (Parasuraman, Grewal and Krishnan, 2006). An appropriate sampling method is chosen by the researchers to generalize outcomes, particularly when there is a large population because it is impossible in any research to conduct a complete population survey due to financial and time constraints. That is why, Saunders et al. (2009) suggested that a conclusion regarding the sample from the target population should be made by the researcher, to acquire the objectives of the research.

3.4.1 Sampling Methods

Gratton and Jones (2014) noted that there are two categories into which the design of sampling is divided: non-probability and probability sampling. The major difference between probability and non-probability sampling is the use of the random selection method for sample selection, as probability sampling promotes that every unit of population has an equal and known chance of being selected. On the other hand, non-probability sampling mainly relies on the subjective judgement of the research while increasing the threat of selection bias (Saunders et al., 2009). According to Singleton and Straits (2012), a random selection process always involves probability sampling at some phase. It is most usually associated with strategies of surveys and seems a useable approach for quantitative research. Non-probability sampling methods like purposeful sampling are helpful when there is a smaller sample size, such as in qualitative research. Therefore, a probability and purposeful sampling method were adopted in this doctoral thesis as a mixed-method approach. According to Creswell (2014), sample sizes for quantitative research typically vary from 15 to 30 people per group, depending on the statistical techniques used and the research design. He highlighted that many statistical analyses, including regression analysis, t-tests, and ANOVAs, usually yield valid findings within this range. This reference supports the recommendations made by Cohen et al. (2007) this is used to identify an appropriate sample size for this study. Researchers recommends that around 30 participants per group are frequently sufficient for quantitative research to provide valid statistical analysis (Cohen, Manion, and Morrison, 2007). The target sample of the quantitative and qualitative research are given as follows,

- The target sample for Survey:*** PhD students enrolled in the postgraduate programmes of the two participating universities (Scotland / UK and KSA), as they were selected randomly, having certain characteristics such as students in the department of Education and had almost completed two years of their PhD programs. All the PhD students having the above-mentioned characteristics were selected randomly while using random selection, probability sampling methods. The target sample size was 100 PhD students in the education and social science department, at least 50 students from each participating university in the UK and the KSA. Ultimately, only 46 students opted to participate from one Saudi university in KSA and 32 PhD students from one Scottish/UK university. Moreover, in the questionnaire, the background of the participants was that in the UK, 63% responded that they hold a scientific degree, and 28% answered that they have a humanities degree. In Saudi Arabia, PhD students responded with 30% scientific degrees and 63% humanity certification in education department.
- Target Sample for Interview:*** For selecting the sample of the interview, purposeful sampling a non-probability sampling method, was used. Under this method, the researcher relies on his/her judgment while selecting the individuals from the population to participate in the research study (Saunders et al., 2009). The process involves the selection and identification of specific individuals who are highly experienced and knowledgeable in the phenomenon of interest (Cresswell and Plano Clark, 2007). Therefore, the target sample for interview was eight individuals who are teaching statistics for post-graduate students with a background experience not less than five years in the field were targeted as a sample of qualitative research but got only five participants. Moreover, the participants' expertise ranged from 8 to 20 years of teaching statistics to SA PhD students in education department.

3.5 Development of Research Instrument

After the identification of the target sample, the next step was to develop appropriate research instruments for the collection of both qualitative and quantitative information. For quantitative data collection, a structured questionnaire was used as a research instrument whereas qualitative data was collected through a semi-structured interview questionnaire.

A survey questionnaire comprised of two sections, the first section was about the gathering of demographic information i.e., gender, educational background and current research interest. In the second section, Likert-scale-type questions were used to collect the information about how PhD students from different

educational backgrounds view the selection and utilisation of statistical methods for PhD research in Saudi Arabia, the questionnaire also included a number of open-end questions (parts 2- 5 in the questionnaire see appendix B). The second section of the questionnaire was further divided into the following four categories mainly taken from the research questions of the thesis:

- i. The perception of the readiness of PhD students to conduct statistical analysis in their research studies.
- ii. To what extent to which PhD students apply the steps of statistical methods before conducting statistical analysis
- iii. The competent of PhD students in applying statistical methods and data interpretation based on statistical methods and the implications of that.
- iv. The possible alternative ways to enhance greater accuracy in the use of statistical methods in doctoral research.

In order to collect the qualitative information through interview, open-ended questions were developed while using the semi-structured approach. These questions were only used as a questioning guide during the interview to extract more relevant information.

3.5.1 Instrument Translation

The research instruments were mainly written in the English language at first. However, the translation of instrument from English to Arabic was crucial keeping in view the importance of the Arabic language in the KSA. For this purpose, a three-stage protocol given by Blaschko and Burlingame (2002) was implemented, which was quite helpful to translate the instrument into a suitable version of Arabic. Firstly, a certified and qualified one translator with appropriate translation experience translated the instrument into Arabic. Secondly, another translator expert in both Arabic and English skills translated the previously translated version back into the English language. Lastly, one specialized scholar, fluent in Arabic and English both, verified the validity and accuracy of the translation by comparing and evaluating the re-translated version with the original one. As for the interview, the same steps were taken as all the participants spoke Arabic and were from one university in KSA.

3.5.2 Reliability and Validity of the Instrument

To assess the reliability and validity of a questionnaire, it is necessary to conduct a pilot on a student-based sample with the essential knowledge regarding this research. Ten PhD students from the 2021 year's PhD program were randomly selected from different universities of the UK and KSA, to participate in pilot testing by filling the questionnaire. They were requested to impart their viewpoint regarding the substance of questions examining the readiness of PhD students to conduct statistical analysis, how PhD

students apply the steps of statistical methods before conducting statistical analysis, accuracy in the data interpreted through statistical method and quality of statistical analysis in doctoral research.

Participants were questioned if there is any uncomfortable or unclear phrasing in the concerned questions, so it can be estimated how much time it would take to fill the questionnaire and redesign it following their feedback and comments. It was discovered that the legitimacy of quantitative data relied on the questions' structure in questionnaires and how precisely they are associated with the area of research (Collis and Hussey, 2013). Some alterations were made after the review, such as changing three words to make it more formal in the questionnaire such as, having changed to establishing, agree changed to correspond, and sophisticated changed to complexity. Finally, the bilingual questionnaire was adopted for survey, enabling the respondents to answer in English for students in one university in Scotland/UK and in Arabic for one university in KSA student.

Making sure that the items within a scale are consistent and measure the same underlying concept is crucial for the validity of the research findings. Therefore, Cronbach alpha was used. Cronbach's alpha is used to examine a questionnaire's internal consistency, ensuring that the instrument reliably evaluate a concept. Moreover, using Cronbach's alpha, researchers can ensure that their scales are accurate and that the results derived from them can be trusted. A high Cronbach's alpha (typically above 0.7) indicates that the items measure the same underlying construct and that the scale is reliable. If Cronbach's alpha is low, it can suggest that some items on the scale do not correlate well with others. This helps in identifying items that may be problematic and could potentially be removed or revised to improve the scale's reliability. Three statements were removed from the questionnaire as described in chapter 4.

High internal consistency, as indicated by Cronbach's alpha, enhances the overall quality and credibility of the research. Reliable tools ensure that the data collected is stable and consistent, providing a solid foundation for analysis and interpretation. As well, reliable measures maximize the probability that findings can be generalized to broader populations or different contexts.

Furthermore, Pearson correlation was used as it is important in research because it allows researchers to quantify the strength and direction of the linear relationship between two continuous variables. By calculating the Pearson correlation coefficient, researchers can determine the extent to which changes in one variable are associated with changes in another variable. This information is crucial for identifying patterns, making predictions, and drawing conclusions in a wide range of disciplines. Additionally, the Pearson correlation coefficient is easy to interpret and widely used in statistical analysis, making it a valuable tool for researchers seeking to understand and analyse relationships between variables.

In order to examine the validity of the questionnaire, the Pearson correlation between key variables was calculated. The perception of readiness of UK and SA PhD Students to conduct statistical Analysis in PhD research with how accurate PhD students are when applying statistical methods and data interpretation, the relationship between the greater readiness of UK PhD Students, the more accurate PhD students are to apply statistical methods and data interpretation, and vice versa.

Moreover, the relationship between the extent to which UK PhD students apply the steps of statistical methods before conducting statistical analysis with how accurate PhD students are when applying statistical methods and data interpretation, and vice versa.

In addition, a pilot test run was also done while establishing the semi-structured questionnaire for interview purpose. This technique was adopted to make certain that more insightful and sharper questions regarding the topic are formulated; then the results would surely support the results gained from quantitative research. Firstly, a pilot test was conducted to find out if the questions are comprehensible and appropriate for addressing the propositions of the research. For example, in all the four interviews' interviewees were asked to explain whether they believed the statistical techniques are misapplied by doctoral thesis and whether there is a need to enhance the quality of research in the post-graduate programme. Moreover, the respondents were asked to give their view about possible alternative ways to promote greater accuracy in the use of statistical methods for doctoral research. The interview questionnaire has improved keeping in view the responses of pilot testing. Some alteration was made after the review, such as changing two words to make it more clear in the interviews such as, use changed to utilization and clarification changed to interpretation.

3.6 Data Collection

In a research project, analysis and collection of data are two very significant tasks. A good collection of data means collecting relevant and fitting data that enhances the already available information. Data collection can be described as a process of information collected through different sources to respond to research questions (Creswell, 2002). Quantitative and qualitative data both can be collected from various collection channels however the research methods used by the researcher determine the overall success of a research purpose. In this research, the primary method of data collection is selected, which comprises the first time collecting original data via respondents while utilizing different instruments of data collection and it includes first-hand human interaction. The collection of quantitative data is done through surveys, open or close-ended questionnaires. This is in contrast to case studies where human observation, focus groups and individual extensive interviews are used to collect qualitative data (Dillman, 2011). As the research involve both qualitative and quantitative research, a mixed method consisting of both survey and

interview was adopted in this thesis. Initially, the questions for both the interview and questionnaire were written and organized following the pilot study. Subsequently, the questionnaire was distributed to the students. Afterward, the interview questions were reviewed once more and there were no changes after the pilot study, and then the interviews were conducted.

3.6.1 Quantitative Data Collection

According to Mason (2017), it is significant to recognize the data collection method which is suitable and valid according to a particular research objective. In this research, a structured questionnaire was used to collect data through a research survey. Reliability tends to be higher in survey research (Babbie, 2004), so the survey method is quite beneficial here to produce reliable results. For smooth data collection, an online questionnaire tool i.e. Microsoft Forms was used and the link was shared with the targeted sample for PhD students in Saudi Arabia as the chairman of the subcommittee on human and social research ethics was contacted and all forms were completed and got the ethics approval from them and lastly, the responsible for publishing the questionnaire was contacted three times to send the questionnaire to Saudi PhD students, and the students at the Scottish /UK university got the survey link via the university's survey tool via campus postmaster's email after getting the ethical approval from the ethical committee in Glasgow university. The questionnaire was first sent out on 15/06/2021, followed by a second reminder 10 days later. The final reminder was sent on 23/08/2021 due to the challenges posed by COVID-19 at the time for one Scottish/UK university. For the SA participants, contacting them was very difficult due to travel restrictions, and the questionnaire was sent out on 26/09/2021. The first reminder was sent a month later, followed by the second and third reminder after another month, in accordance with their regulations.

During the management of ethical consideration, the Scottish /UK university was first be asked to send an email to university PhD students that include a plain language explaining the field of research and the general objective of the research, instructions regarding the survey and emphasizing the importance of cooperating to facilitate matters in conducting the study and were received 32 respondents. To consider confidentiality, Participants were told that they are voluntarily participating and can withdraw whenever they like with no prejudice. Further, they were notified that all the collected data through this study must remain strictly confidential, a consent form was sent to all participants before participating. Furthermore, SA university also was asked to send e-mails to university PhD students, exact to those sent to Scottish /UK university students, but in Arabic and got 46 respondents.

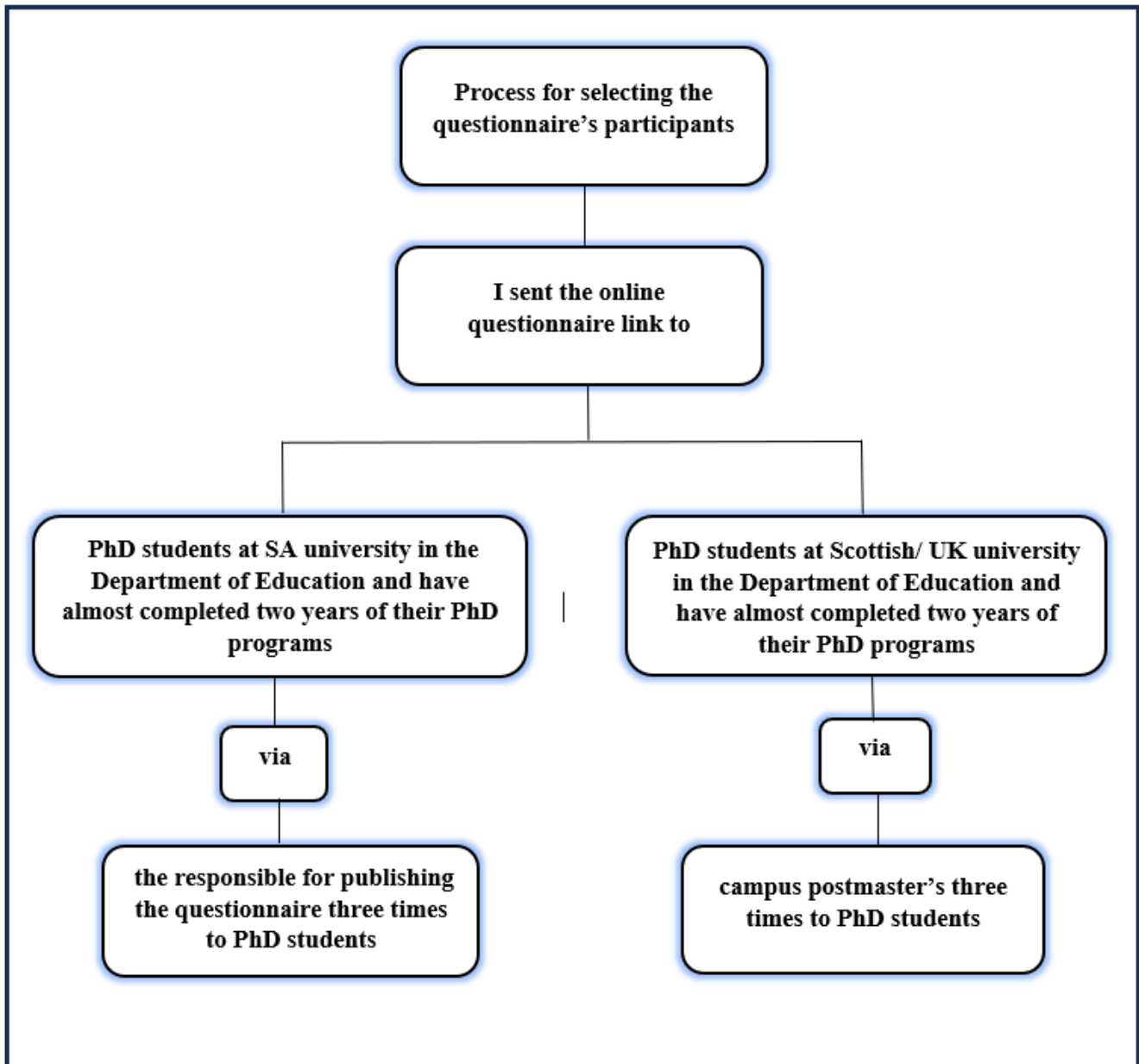


Figure 3-2: Process for issuing the questionnaire to participants

3.6.2 Qualitative Data Collection

For the qualitative data collection process, the interview method was adopted. The interview is an instrument that not only provides the viewpoint regarding human subjects as the data, but it has been created to be such an instrument type that is external to people and also act as a knowledge generator by interacting with people, mostly via making conversations (Singleton and Straits, 2012). Though, it would be right to perceive an interview as a conversation, an interview is a proper encounter for a particular purpose, and it is known by both parties (DiCicco-Bloom and Crabtree, 2006). The instrument of the interview is inter-subjective in nature and is utilized to allow all participants to explain their beliefs, experiences, knowledge and other aspects of everyday life (Singleton and Straits, 2012). The purpose of using interviews in this

doctoral thesis was to achieve richer responses to research questions and also to extract detailed information from all interviewees. This research conducted 30-45 minutes interviews while connecting with the targeted participants through Zoom. This interview method was chosen due to ongoing travel restrictions in both KSA and the UK amid the health pandemic.

Moreover, an interview technique was used to obtain extra information and knowledge from the interviewees. Semi-structured interviews were conducted personally through Zoom communication. Using this format to encourage participants to have conversations and also to enable them to flexibly elaborate important information that is considered to be relevant to the study. It is believed by Firmin and Gilson (2007) that researchers also comprise some freedom to take control during such interviews, they can drift away from the written questions, which allows the respondents to drive the interviews in accordance with their constructs and interests.

There are various advantages of conducting interviews that involve extended answers to the open-ended questions. Additional data regarding the theme might be gained by the researcher as the interviewee and the interviewer directly communicate (Hung-Wen, 2007). However, the biggest disadvantage of the interview is insufficient privacy, which can be considered as an ethical problem in this study. In some scenarios, the participant may not feel comfortable answering particular questions due to several personal reasons, such as fearing that some responses may be critical of the rules of the institution or governmental authority (Singleton and Straits, 2012). However, the confidentiality and privacy concerns are overcome to some extent with the help of participant information sheets and informed consent forms. The interviewees were contacted through WhatsApp and email, the approval was sent to them and got the date and time to meet with them, five interviews were done, who is responsible for statistics teaching from the academic staff at SA university and there was a code for each interviewee to provide confidentiality and privacy. After writing the interviews, they were requested to be reviewed by the participants in order to improve the quality if one of them wanted to add or delete any part of the interview. Thomas (2017) agreed that Research guides and texts on the quality, validity, and credibility of qualitative research frequently recommend member checks, such as sending respondents their transcripts for review, as one of the recommended procedures to confirm or enhance credibility in qualitative research. Contacting the lecturers was a significant challenge due to COVID-19, as there was no one on campus and they did not respond to my emails. The first interview took place on 04/01/2022, and I completed all the interviews by 28/02/2022.

3.7 Data Analysis Process

A procedure of gathering, transforming, organizing and representing data to discover the needed information is data analysis. Creswell and Clark (2007) claimed that in a mixed research method, data

analysis consists of an evaluation of qualitative data by qualitative methods and quantitative data by quantitative methods. As doctoral research involves a huge amount of data, so a three-step process (data processing, data cleaning and data analysing) is adopted to analyse the data in an effective manner (Miles and Huberman, 1994).

Firstly, data processing involves arranging the collected data in accordance with the Analysis Tools. For instance, the data is placed in columns and rows of a table inside MS Excel to create a comprehensive data model. Secondly, the data cleaning process was used as the organized and processed data might contain errors, duplicates or may be incomplete. The procedure of correcting and preventing these errors is data cleaning. There are various kinds of data cleaning procedures that rely on the data type, such as statistical analysis can be utilized for outlier observation that subsequently would be excluded (Saunders et al., 2015). After processing, organizing and cleaning data, it becomes ready for analysis. There are various techniques available for data analysis to comprehend, interpret and extract conclusions based on requirements.

3.7.1 Quantitative Data Analysis

In this research, SPSS.28 (the Statistical Package for Social Sciences) was used to analyse gathered data and also to test research questions and objectives. Nachmias (2008) argued that statistical tactics are the main instrument for analysing data, particularly in research in social sciences. The aims of this research are to use a set of statistical tools for different research objectives and questions, such as frequency analysis, correlational matrix and other visualization techniques to analyse and interpret the quantitative information.

Moreover, to link the research methodology to the theories on change discussed in Chapter 2, it is crucial to comprehend how statistical methods can lead to improvements and adaptations in educational research, particularly in Saudi Arabia. Theories of change often illustrate evidence-based decision making, and this is where the quantitative approaches used in this research come into focus. Descriptive statistics, frequency analysis, and t-tests were employed as initial tools to assess current conditions highlighting gaps and making cross-cultural comparisons between PhD students in Saudi Arabia and the UK. These methods allow for the systematic evaluation of educational outcomes and preparedness, which are key to informing change and reform in the educational systems.

Descriptive analysis was used to obtain a whole picture of the data and understand the aspects of the quantitative data. Frequency analysis was used to analyse variables and present key findings in the form of

tables and charts, while means were used to compare UK and SA PhD students. Frequency analysis is critical for understanding the distribution and prevalence of variables by showing how often different categories occur within the dataset. It compresses data into more digestible information, helping identify patterns, trends, and variations. Frequency tables provide a clear and brief way to display data, making it easier to interpret and compare categories. Bar charts visually represent frequency distributions, enhance the communication of findings by making the data more accessible and understandable. This helps in determining the student's readiness to use appropriate statistical methods and interpret their data analysis in the right way. Thus, frequency analysis helps in making informed decisions by illustrating the most and least common categories, identifying target groups or areas needing attention and recognizing the misapplication of statistical methods in Saudi Arabia, ultimately helping solve these issues.

In addition, mean comparison plays a huge role in analysing continuous variables and understanding differences between groups, such as PhD students from Saudi Arabia and the UK. Means offer a central point for comparison, indicating whether there are crucial differences between groups. The simplicity and accessibility of calculating and interpreting mean values make them a popular tool for comparing two groups and facilitating a broader audience understanding of the differences. Frequency analysis provides an overview, while mean comparison offers a numerical evaluation of the differences between groups. These methods aid in constructing a full comprehension of the dataset, assisting better interpretation and decision making.

Afterwards, Inferential Statistics, such as independent t-test analysis was used to contrast and compare two variables, for instance a comparison between UK and SA PhD student's readiness of using statistical methods. The shape of the sample distribution changes with the sample size. The central limit theorem states that when the sample size is large enough, the sample distribution begins to approximate the normal distribution. Most statisticians agree that a sample size of thirty is appropriate for most distributions (Frost, 2022). This is sufficient to consider the distribution normal. Then (Parametric) t- test was used.

The decision to use independent t-tests is grounded in the nature of the research questions, which focus on comparing the statistical knowledge and readiness of PhD students across two different education systems. The t-test is a fundamental statistical method used to compare the means of UK PhD students and SA PhD students to see if they are significantly different. Determining statistical significance, and making inferences about populations, is an essential tool for hypothesis testing. While t-tests are accordingly simple, they are appropriate for comparing two independent groups, such as PhD students in Saudi Arabia and the UK, on key variables like statistical knowledge. Moreover, to assess relationships between variables such as

academic background and preparedness Pearson's correlation was used, These methods were chosen as they are well-suited to the data and provide clear insights into the research questions.

Regarding the sample size, statistical theory proposes that a minimum of 30 participants per group is often sufficient for many basic statistical tests, including t-tests. This size enables a logical estimates of population parameters and ensures reliable statistical inferences. The sample size in this study was based on quantitative research guidelines and supported by literature such as Cohen et al. (2007), which asserts that such sizes are adequate for drawing meaningful comparisons in educational research. In this research, 78 responds were received, 32 from UK PhD students and 46 SA PhD students. This authenticates that the findings and outcome are statistically valid while remaining attainable within the scope of this research.

The use of t-tests, Although it is beneficial for being straightforward to perform and interpret, is limited to comparing only two groups. Other methods, such as ANOVA, are required for comparisons involving more than two groups. T-tests can also be sensitive to outliers which may misrepresent results and lead to misleading conclusions. Proper data cleaning and analysis are necessary to avoid this issue. Despite these limitations, the statistical methods used, including descriptive statistics, t-tests, and Pearson's correlation, provide a solid foundation for the study, ensuring comprehensive and reliable research results that support the broader discussion on improving statistical education and enabling change through evidence-driven analysis.

For the open-ended questions, the Arabic responses were in Arabic, thus, they required to be translated to English.

3.7.2 Qualitative Data Analysis

Data collected from the interviews was analysed qualitatively i.e., in the shape of descriptions and comments, to provide main evidence of the research that can be synchronized with the collected quantitative data from methodology phase one. Though it is argued by some people that there is no sole standardized process for analysis in the qualitative data (Saunders et al, 2012).

In this section, there was four phases. Firstly, (1) preparing the data for analysis as the participants' native language is Arabic, the interview questions were translated from English into Arabic and linguistically checked numerous times. After completing all the interviews, transcripts were reviewed several times. After that, the data was translated from Arabic to English and checked three times to ensure that the words did not change and that the meaning remained the same. (2) Organizing the data: the interview data was coded to keep the participants anonymous; for example, "I1" was used for the first interview. The most relevant responses were then extracted from each interviewee to support the study. (3) Choosing the method of

analysis: Thematic analysis, which is a qualitative data analysis technique, was selected. It entails organising data into categories or themes to make the data useful (Braun & Clarke, 2006), Thematic analysis is preferred in qualitative research for its flexibility, depth, and ease of use. It identifies and explores patterns across data, offering nuanced insights into participant experiences. Unlike qualitative content analysis, which focuses on frequency, and narrative analysis, which emphasizes storytelling, thematic analysis provides a comprehensive approach that ensures participant voices are central while being practical and resource efficient. Additionally, Vaismoradi et al. (2013) compared content and thematic analysis in this paper, emphasising the benefits of thematic analysis in qualitative research. They underline that by locating and analysing patterns and themes in the data, thematic analysis enables researchers to acquire rich, nuanced information. The approach is commended for being adaptable and appropriate for a range of study topics and data sorts. The authors explain how theme analysis is useful for producing rich, in-depth insights in qualitative research because it allows a better knowledge of participant experiences and views.

Lastly, (4) putting the data analysis together and structuring it. There were six phases considered while selecting the thematic analysis approach, which were provided by (Braun & Clarke, 2006) (see Figure 3-3):

Step 1: Immerse in the data until it becomes familiar. At this stage, re-reading the written data and listen to the audio recordings multiple times. Then, while reading or listening, take notes on the data.

Step 2: The interviews were carefully read several times as a large set of codes from all interviews were collected. The first step in coding is to split qualitative data into distinct parts, examine them thoroughly, and compare them for similarities and differences (Strauss & Corbin, 1998, p. 102). And then summarised in one or two words and represented by codes that are the basis of thematic analysis, as shown in Appendix A.

The descriptive code method was employed, which was to summarize each paragraph or sentence in one or two words, keeping in mind that a single sentence may include more than one coding sometimes. Coding is suitable for analysing almost any type of data, including interviews, observations, documents, blogs, photos, and videos using the descriptive code method, which is the summarization of each sentence in one or two words (Saldaña,2016). The codes were then checked multiple times, with some being eliminated and others being integrated, until finally got to the final vision, which was in figures in the interview analysis chapter. The inductive approach involves deriving meaning and creating themes from data without any preconceptions. In other words, you'd dive into your analysis without any idea of what codes and themes will emerge, and thus allow these to emerge from the data (Jansen,

2023). As a result, the inductive approach was utilised in this study since it was the most appropriate approach.

Step 3: searching for themes, thinking of each code and its relationships to other codes or transferring codes from one theme to another and thinking about how to connect them under different themes. According to Saldaña (2016), the first codes were reviewed and converted into themes. Afterward, a mind map of the coding and themes was created from the beginning of the analysis since it greatly assisted in writing the results, as seen in (Appendix A) for the first coding cycle and in the analysis chapter of the interviews the final cycle of coding. In order to extract the codes and themes, inductive reasoning was applied from particular to general.

Step 4: Reviewing themes; the specific themes have been thoroughly reviewed multiple times to ensure that they have a purpose and accomplish the objectives of this research.

Step 5: Defining and naming themes, continuing analysis to refine the specifics for each theme generation of exact names for each theme (Braun & Clarke, 2006). The themes and sub-themes were described to guarantee that they are linked to the code and to aid in the writing of the analysis.

Step 6: Producing the report; finally, it was converted into a piece of writing for interpretation using topics related to the research question in Chapter Five.

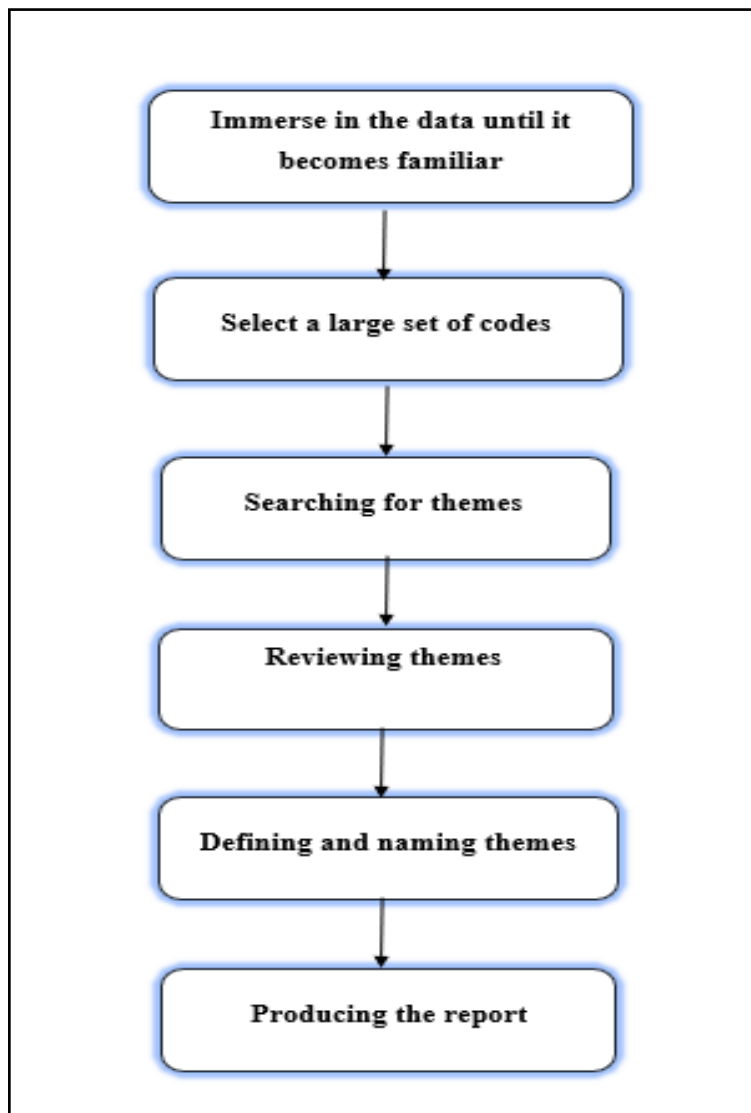


Figure 3-3: Process for qualitative data analysis

3.8 Ethical Considerations

Ethical consideration is a vital aspect of all research as every component of the research must provide maximum benefit and entail minimum risk. Hence, it is impossible to conduct this research in the absence of ethical considerations (Bryman, 2016). In academic research, ethical issues exist to protect both the researcher and the participant. Participants are not just a data source, but every one of them is an essential aspect of the research procedure (Robson, 2002). Research ethics do not only concentrate on which protocols and procedures should be followed for legal safety, but they also secure the position of the researcher regarding his/her devotion towards the reliability of the research (Blaikie and Priest, 2019). Ethics are crucial considerations, that is why they must be addressed prior, during and post data collection. Ethical considerations involve the impact of the research problem, and they will also influence research design, involving samples, outcomes, and procedures. In social science research, the topic of ethics is a

wide-ranging and challenging one that needs vivid information about the participation type, accessibility to required data, risk of damage and informed consent (Blaikie and Priest, 2019).

A considerable ethical issue faced in experimental situations is deception. In deception, the researcher deliberately hides the true conditions and purpose of the study; knowingly misinforms the participants or makes them go through unduly stressful, embarrassing or painful experiences without them being aware of it (Cohen et al., 2000). It is about partially concealing the truth or only representing that part which is beneficial for the research. A deceptive researcher might encourage an individual to take part in the research or lead a person to select a favourable response for himself/herself. Deception is very dangerous because it resides on the thin line separating wrong and right. There is not a single indicator that relies on the beliefs, values, and cultural background of the researcher.

Cohen et al. (2000) explained that some researchers believe the discovering truth is sometimes only possible by deception. Hence, it has been debated if it is correct to extract truth with the help of lies during the research, specifically if no damage is done in the procedure. Still, it is important to ponder the perfect balance between the scientific interests and the humane and thoughtful treatment of individuals who innocently and willingly impart data (Robson, 2002). All the above-mentioned ethical concerns are greatly be taken care of in this research and is free from any deception while opting for the strategies like informed consent, ability to withdraw and participant information sheet. The participants are ensured that the collected data will only be used for academic purpose, and all the information has been treated anonymously. Further, the participants are allowed to question the nature and implementation of research to lower the threat of deception and misinformation.

Ethical guidelines are essential to be followed in this research to carry any investigation systematically. Each ethical component may raise benefits for the study and its ignorance may create risk for the researcher. university PhD students were involved as participants in this study. hence, it has taken care of their safety. An individual has ensured not to harm any respondent psychologically, financially, or socially (Kiani & et.al. 2018). All the participants were given respect and has not offered anything to participate in this investigation. All the participants details are kept confidential. It was ensured to protect the dignity of participants so that they feel comfortable and share their opinions in the interview easily. This helped in gaining in-depth answers on the quality of research.

The ethical approval was granted by university of Glasgow on 05/03/2021 . The questionnaire was sent through the postmaster at a Scottish university in the UK, and there was no direct contact between the researcher and the students who answered the questionnaire. The same procedure was followed for PhD students at a Saudi university, where the questionnaire was sent to the person responsible for distributing

it. 78 PhD students, 32 students from Scottish /UK university and 46 from SA university, were involved as a sample in this study, before involving them it was ensured to get their full consent. The consent form and plain language were sent to the participants and were provided in Arabic for the participants at SA university and English for the participants at Scottish /UK university. The plain language included information about the purpose of the study, reasons for the participants to volunteer. Both forms have all the details of the aim of the study and their rights. After reading the form participants have found it perfect to get involved in the research and they have completed the questionnaire. The privacy of research participants was maintained, as the participant is anonymous.

Furthermore, as there was no previous acquaintance with the interviewees, the interviewees agreed to participate in the study after looking at the plain language statement. The researcher ensured that participants fully understood the information provided and consented to participate without any form of pressure or coercive influence, considering participant bias. Providing adequate information and transparency to participants without guiding them toward specific responses is essential to maintaining data integrity and ethical standards. Moreover, responsible reporting requires that findings be reported honestly and transparently.

Carefully considered wording was used to ensure that neither the interview nor the questionnaire contained any biased or leading information that might influence participants' responses in any way. In order to have a secure atmosphere for transparent and uninhibited criticism, also guaranteed participants' anonymity and the confidentiality of their answers. To improve the validity and reliability of the data that was gathered, following the ethical research guidelines and being consistent in methodology reduced the possibility of participant bias.

Statistical Lecturers were interviewed from SA university; before interviewing them, it was ensured to get their full consent. The consent was obtained by sending a consent form and plain language in Arabic for more information about the study. This form has all the details of the aim of the research and their rights. The form has helped the participants to ensure the voluntary participation of the respondents (Ubi & et.al. 2020). After reading the form participants have found it perfect to get involved in the research and they have signed this form and sent it back to the researcher. The privacy of research participants was maintained, their confidential details were not being shared with any third person, the job position has been shared in the thesis. The entire sample was allowed to share their views and if they are uncomfortable with any question then they may skip that question. Participants' names were not recorded. Codes and numbers were used to identify individuals so that the researcher is the only one that can identify the identity of the participant. All responses were sent to the interviewees to allow them to add or delete anything, avoiding

misrepresentation or exaggeration of results. The data has been protected and stored on a personal computer drive. On completion of the study, and after the required time by the university, all data will be destroyed.

An adequate level of confidentiality was maintained that raised the confidence of participants. Any kind of exaggeration about aim or objective was avoided. It was open and clear communication with its participants and honesty is maintained. This helped in gaining the trust of all respondents and maintains transparency. In this way, participants felt great, and they have taken interest in the research and have shared their great knowledge with the researcher to find the best answers to the research problems and reaching the results (Schamp & et.al. 019).

Data protection is the most important element of ethical consideration in research. In this research the data protection requirements were carefully fulfilled. The data was kept in a secure place that personal computer is protected by a password. It was ensured not to share its password with any third person. In this way, trust was maintained of ethics approval committee. No third person has knowledge about this study and after completing this, it will be deleted and destroyed. (Gelinas & et.al. 2017).

It was avoided using any form of inappropriate words. Objectivity is maintained and no information has been copied in this research as all the details are searched from reliable sources and have translated such details into own language of scholars hence the study does not have an issue related to plagiarism.

To conclude, this chapter discussed the appropriate methods for this research to achieve the research's aims and what is best to collect and analyse the research data. It also discussed the research design, research method, population and sampling, development of research instrument, Data collection, Data analysis process and the ethical considerations that were involved in this research for both the interview and questionnaire. The study analysis for the interview and questionnaire is presented in the following chapter.

Chapter 4: Quantitative analysis

4.1 Introduction

The section presented how PhD students from various educational backgrounds view the selection and application of statistical methods for doctoral research in Saudi Arabia. The purpose of this study is to investigate the perception of how well-prepared doctoral-level students are to do statistical analysis in their research by discovering PhD students' competence and understanding of using statistical methods, as well

as the PhD students' perception of the extent of their ability to selecting the appropriate statistical methods for their research accurately to show the need for why reforms are needed in Saudi Arabia's education system and why future university students should have the sufficient mathematical understanding to maintain the researcher's basic knowledge base (Mathematics and Statistics). Hence, the quantitative research approach is adopted here to examine the relationship between the statistical literacy of PhD students and the perception of how well-prepared doctoral-level students are to undertake statistical analysis in their research studies. Further, the quantitative method was also used to quantify the similarities and differences between the statistical methods used in the analysis of doctoral theses data in the KSA and the UK research programs. After sending the questionnaire to PhD students at SA university in Saudi Arabia and Scottish /UK university in the United Kingdom, 46 out of 50 responses from SA PhD students and 32 responses from UK PhD students were received (questionnaire in appendix B). The questionnaire contained multiple-choice questions(M), open-ended questions (O), and its analysis was done at the end of this chapter and six-point Likert-scale statements (L) (Not applicable, Strongly Disagree, Disagree, Neither Agree nor Disagree, Agree, Strongly Agree). The questionnaire also collected PhD students' educational backgrounds.

The data features, such as the participants' biographical information and educational background, were compiled using descriptive statistics. To fully comprehend the sample, crucial metrics including frequencies, means, and percentages were calculated. For instance, mean values were used to summarise key patterns, and bar charts were utilised to graphically show the distribution of respondents with different educational backgrounds. To comprehend the data's variability, standard deviations were computed. By giving crucial context and enabling the confirmation of presumptions such variance homogeneity and normalcy that are necessary for ensuing inferential tests, these descriptive statistics act as the cornerstone for inferential analysis.

To determine if there were statistically significant differences between PhD students in Saudi Arabia and the UK, inferential statistics were used after the descriptive analysis. In particular, the means of these two separate groups were compared using an independent t-test. To determine if there were statistically significant variations in their statistical preparation, the t-test used descriptive statistics (means and standard deviations). Descriptive statistics were used to confirm the t-test assumptions, such as normality and equal variances, guaranteeing the validity and reliability of the inferential analysis.

It is evident from separating the descriptive and inferential analyses that descriptive statistics are essential in establishing the conditions necessary for an appropriate t-test to be conducted. They offer the background and baseline parameters required for the t-test. When combined, they provide a comprehensive data

analysis, including everything from identifying noteworthy group differences to summarising participant characteristics.

4.2 Reliability and Validity of the Questionnaire

The Likert-scale responses were coded from 0 to 5 (0 -not applicable,1-strongly disagree,2-disagree,3- neither agree nor disagree,4- agree,5 strongly agree). Moreover, in the reverse statements (S18, S111) in part 2 and (S31) in part 4 of the questionnaire (see appendix B List of questions and statements), Likert scale responses were coded from 0 to 5 (0 -not applicable,1-strongly agree,2, agree,3- neither agree nor disagree,4- disagree,5 strongly disagree). Moreover, the last part of the questionnaire was coded from 0 to 5(0-not sure, 1- not at all important, 2- slightly important,3- moderately important, 4- important, 5- extremely important).

Lee Cronbach constructed Alpha in 1951 to offer a measure of a test's or scale's internal consistency; it is represented as a number between 0 and 1. Internal consistency specifies the extent to which all the items in a test assess the same idea or construct (Tavakol & Dennick, 2011). According to Cortina (1993), values of 0.80 or above for coefficient alpha were considered good, while values between 0.70 and 0.80 were considered acceptable and adequate. However, a value lower than 0.70 was not considered much appropriate for a questionnaire. In order to measure the internal consistency of the questionnaire, Cronbach's Alpha was calculated; the result of Alpha Cronbach for each part in the table below, for UK PhD students Alpha Cronbach between (0.74-0.90) was an acceptable percentage for each part, and for SA PhD students Alpha Cronbach between (0.72-0.77) was an acceptable percentage for each part after deleting three statements (see Table 4-1) (parts of the questionnaire in Appendix B).

To explain the above, the result of Cronbach's Alpha for Part 2 for Saudi PhD students was 0.63, which was an insufficient percentage. Nunnally (1978) states alpha should be at least 0.7 in exploratory research. As a result, statement S115 (If you answered yes to question 15, how strongly do you agree/disagree with this statement: "The statistics course I was offered/required to attend was very useful") in part 2 was deleted, and the result was 0.69. Then the statement S113 (If you answered yes to question 13, how strongly do you agree/disagree with this statement: "The statistics course I was offered/required to attend was very useful" was deleted, and the result was 0.76, which was an acceptable percentage. Moreover, in part 3, the result of Cronbach's Alpha was 0.67, which was an insufficient percentage. After deleting the statement S22 (I prefer to use simple statistical methods in my research), the result was 0.77, which was an acceptable percentage.

Table 4-1: Cronbach's Alpha for UK and SA PhD students

| Part | | Cronbach's Alpha | |
|------|---|------------------|------|
| | | SA | UK |
| 2 | Perception of Readiness of Ph.D. Students to conduct Statistical Analysis in PhD research | 0.76 | 0.90 |
| 3 | The extent to which PhD students apply the steps of statistical methods before conducting statistical analysis. | 0.77 | 0.74 |
| 4 | How accurate are PhD students apply statistical methods and data interpretation based on statistical methods selected? What are the implications of that? | 0.74 | 0.85 |
| 5 | The possible alternative ways to enhance greater accuracy in the use of statistical methods in doctoral research | 0.72 | 0.80 |

In order to assess the validity of the questionnaire, the Pearson correlation between key variables was calculated, and the findings were shown in (Appendix C) for UK PhD students. The relationship between the perception of readiness of UK PhD Students to conduct statistical Analysis in PhD research with how accurate PhD students are when applying statistical methods and data interpretation ($R=0.46$, $P<0.01$), there was a statistically significant moderate positive relationship between the greater readiness of UK PhD Students, the more accurate PhD students are to apply statistical methods and data interpretation, and vice versa.

Moreover, the relationship between the extent to which UK PhD students apply the steps of statistical methods before conducting statistical analysis with how accurate are PhD students when applying statistical methods and data interpretation ($R=0.44$, $P<0.05$) there was a statistically significant moderate positive relationship between the greater the extent to which PhD students apply the steps of statistical methods before conducting statistical analysis, the more accurate are PhD students to apply statistical methods and data interpretation, and vice versa (Appendix C).

In addition, for SA PhD students to assess the validity of the questionnaire, the Pearson correlation between key variables was calculated, and the findings are shown in (Appendix C). The relationship between Readiness of PhD Students to conduct Statistical Analysis in PhD research with how accurate are SA PhD

students when applying statistical methods and data interpretation ($R=0.33, P<0.05$) there was a statistically significant weak positive relationship between the greater readiness of SA PhD Students to conduct Statistical Analysis in PhD research, the more accurate are PhD students to apply statistical methods and data interpretation, and vice versa.

Furthermore, the relationship between the extent to which SA PhD students apply the steps of statistical methods before conducting statistical analysis with how accurate are SA PhD students when applying statistical methods and data interpretation ($R=0.48, P<0.01$) there was a statistically significant moderate positive relationship between the greater extent to which PhD students apply the steps of statistical methods before conducting statistical analysis, the more accurate are PhD students to apply statistical methods and data interpretation, and vice versa (Appendix C). positive and significant correlations are found among key measures in each part of the questionnaire indicating the validity of the questionnaire (Schober et al., 2018).

4.3 Personal information

The first part of the questionnaire contains information about the UK and SA PhD student’s educational background (Appendix D).

PhD students in the UK were asked about the country in which they finished university (see Figure 4-1); they answered 16% completed their studies in the UK, 34% of them in Saudi Arabia and, 50 % in different countries other than SA and the UK. While PhD students in Saudi Arabia answered 94% finished their studies in Saudi Arabia and 7% in other countries other than SA and UK (Appendix D).

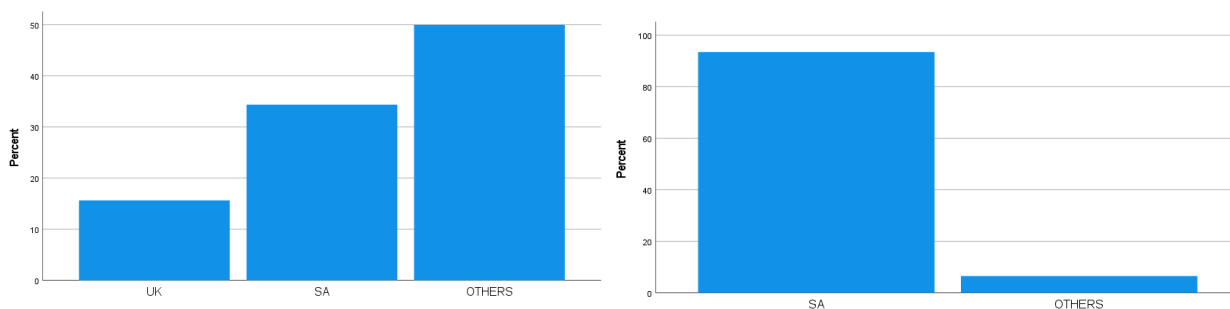


Figure 4-1: Country where students did their undergraduate degree at UK

Country where students did their undergraduate degree at SA

When PhD students in the UK were asked about the undergraduate degree they hold (see figure 4-2), 63% responded that they hold a scientific degree and 28% responded that they hold a humanity degree. In Saudi

Arabia, PhD students responded with 30% scientific degrees and 63% humanity certifications, ‘Others’ in this question indicates either PhD or master’s without specifying in what (Appendix D).

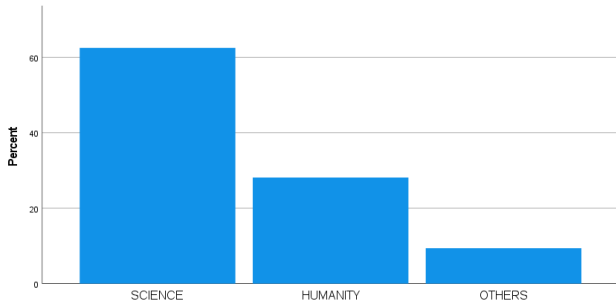
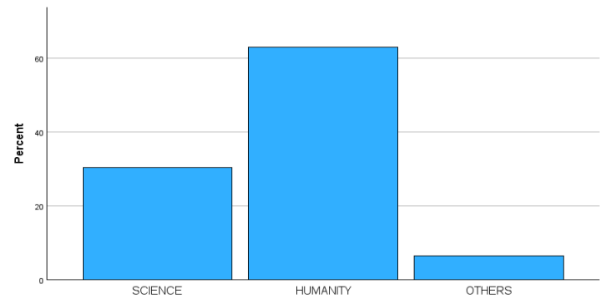


Figure 4-2: Undergraduate degree that PhD students hold in UK



Undergraduate degree that PhD students hold in SA

In figure 4-3, PhD students in the UK were asked about the types of their research 31% were qualitative, 22% were quantitative, and 47% were mixed. Furthermore, for the PhD students in SA, they answered 4% qualitative, 44 % quantitative, 50% mixed research, and 2% chose others, as ‘others’ means ‘not yet’ (Appendix D).

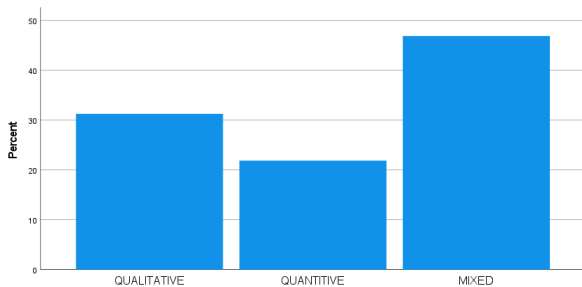
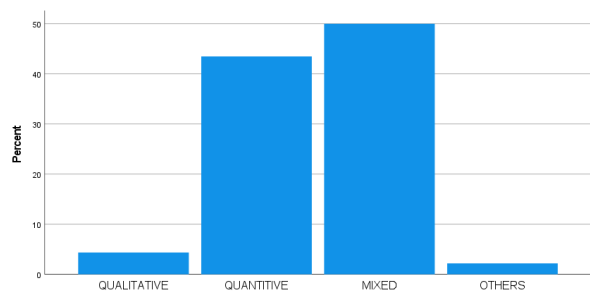


Figure 4-3: Types of the research of UK PhD students



Types of the research of SA PhD students

They were also questioned about the last year they studied mathematics at school, the UK PhD students responded 31% finished in Senior year and 22% in grade 10. In Saudi Arabia, there were 44% finished in Senior year and 33% in grade 10. Others indicate that some students in both countries provided the year that they finished studied maths, for example, 1995 (see Figure 4-4) (Appendix D).

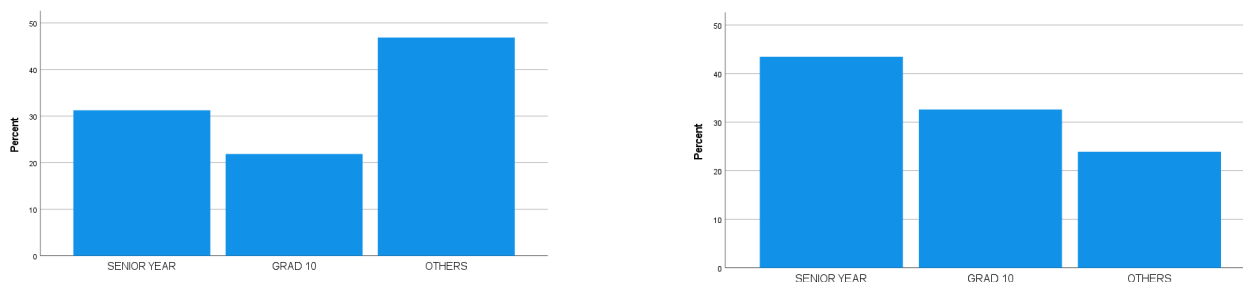


Figure 4-4: Year that UK PhD students finished their Maths at school

Year that SA PhD students finished their Maths at school

In this study, 34% of PhD students in the UK sample completed their university education in Saudi Arabia, 50% in other countries, and only 16% in the UK. This indicated that many UK-based PhD students are international students, many of whom were initially educated outside the UK. A significant finding is that 63% of these UK-based students hold scientific degrees, enhancing their ability to understand and apply statistical methods in their research correctly.

The higher level of preparedness among PhD students in the UK can be largely attributed to the robust UK education system, particularly in institutions such as a university in Scotland/UK. The university is known for its strong academic reputation, professional staff, and thorough support structures, significantly contributing to students' academic readiness. It provides students with resources and guidance, regardless of their country of origin, thus, enhancing their preparedness for research.

In disparity, most Saudi Arabia PhD students (94%) completed their university education in Saudi Arabia, and 63% hold degrees in the humanities. This affects their preparedness in statistics, as their exposure to scientific and quantitative methods is generally more limited than that of their UK counterparts. Compared to UK universities, the need for more solid support systems in Saudi Arabian universities also plays a huge role in this contrast.

The disparity in support systems between the UK and Saudi Arabia is a key factor that significantly impacts the preparedness of PhD students. In the UK, students benefit from strong support systems, including academic resources, mentoring, counselling services, and access to professional statisticians. These services

play a huge role in helping students navigate the challenges of research, thereby enhancing their preparedness. On the other hand, Saudi Arabia universities often provide less comprehensive support, which can inhibit students' ability to accurately apply statistical methods in their research.

The differences in educational systems and support structures between the UK and Saudi Arabia are vital factors that explain the variations in preparedness between the two groups of PhD students. By describing these aspects, the comparison between Saudi and international students studying in the UK becomes clearer, emphasizing how support systems and academic backgrounds contribute to their research readiness.

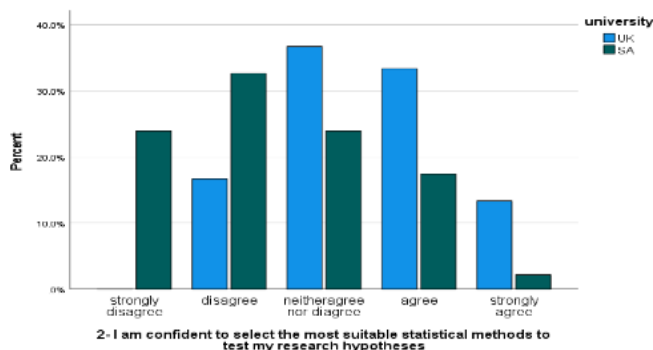
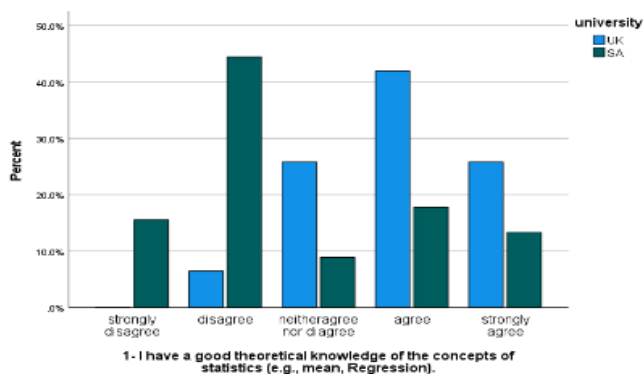
There are suggestions to increase the number of Likert scale points to bring it more in line with continuous scales and normality (Wu & Leung, 2017). Knapp (1990) proposed an early hypothesis " *that increasing the number of points to continues ordinal scales towards interval scales*". According to Leung (2011), it may be considered as a continuous measure, allowing mathematical operations to be employed. Since the data are interval data, it was considered that providing their mean and standard deviation would be an appropriate approach to describe each of them, the perception of the readiness of PhD Students to conduct Statistical Analysis, The extent to which PhD students applying the steps of statistical methods before conducting statistical analysis, how accurate are PhD students' apply statistical methods and data interpretation selected based on statistical methods and lastly, The possible alternative ways to enhance greater accuracy in the use of statistical methods in doctoral research. The two sample groups also had different and similar responses in some statements; the bar chart was used to demonstrate this. In addition, the frequency was utilised. While summarising data, descriptive statistics and graphics are utilised to present information concisely. Data presentation is essential for identifying data pattern changes and properly presenting project findings. (Nick, 2007). To compare between UK PhD students and SA PhD students the t-test for summed Likert scales was used to understand the similarities and differences between the two groups. T-test was used to facilitate the comparison of the mean values of two data sets (Limentani et al., 2005). Furthermore, as recommended by Choudhary (2018), the independent t-test is used to determine the significance of a difference in the means of two independent samples.

4.4 Perception of readiness of PhD Students to conduct Statistical Analysis

In order to assess the perception of readiness of PhD students, a descriptive analysis of all questionnaire items was conducted mainly emphasizing mean and standard deviation. The findings presented in (Appendix E-1) indicate that the majority of UK PhD students neither agree nor disagree (UK mean=3.1), While SA PhD students disagree (SA mean=2.5) to have the necessary skills to conduct statistical analysis. Moreover, UK students outperform SA students in their perception of their readiness to conduct statistical

analysis; SA students have a lower mean in some statements. (1,7,9,10,11,12,13 Reverse S) (Appendix E-2).

Figure 4-5 shows the bar charts for statements (1, 7, 11) in the table of the perception of readiness of PhD Students to conduct Statistical Analysis in PhD research appendix E-2. The UK PhD students have a good theoretical knowledge of the concepts of statistics with a percent of 41.9 % (agreed) and 25.8 % (strongly agreed). However, the percentage of SA PhD students in the statement have a good theoretical knowledge of the concepts of statistics was 44.4% (disagreed) and 15.6% (strongly disagreed) (Figure 4-5, no.1). While the statement I am confident to select the most suitable statistical methods to assess my research hypotheses, the UK PhD students were more confident with 33.3%(agreed) and 13% (strongly agreed) than SA PhD students with 32.6% (disagree) and 23.9% (strongly disagree) (Figure 4-5 no.2). Moreover, the UK PhD students were more confident they can learn statistical methods with 46.7%(agreed) and 33.3% (strongly agree), the percentage of Saudis 30.4% (disagree) and 21.7% (strongly disagree) (Figure 4-5 no.3) (see Appendix E-2).



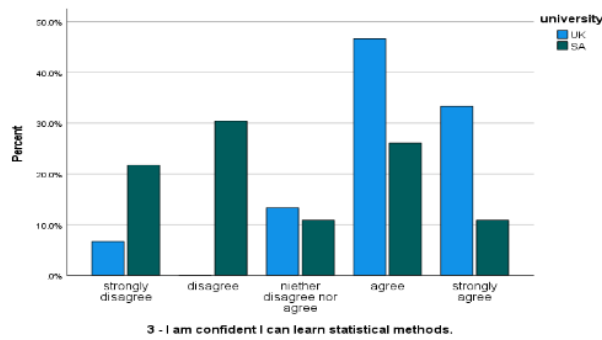


Figure 4-5: Comparison between UK and SA responses for the perceptions of the readiness of PhD Students to conduct Statistical Analysis

According to the visual inspection of the bar charts above, the perception of UK PhD students' readiness to do statistical analysis appeared to outperform the perception of SA PhD students' readiness to conduct statistical analysis.

Although UK students seemed to outperform SA students in readiness to conduct statistical analysis and in the statements for example, (1, 7, 11) in the table of the perception of readiness of PhD Students to conduct Statistical Analysis in PhD research appendix E-2. However, further analysis is required to confirm the statistical significance of the difference between two different samples i.e., SA and UK students. For this purpose, inferential statistics independent- samples t-test for summed Likert scales was conducted in the SPSS while taking both samples as grouping variables. A t-test is a statistical test that compares the means of two groups (Kim, 2015). A comparison of the two variables can be seen in the table below, which shows the value mean and standard deviation. There was a difference between mean values and difference can be seen in standard deviation. Therefore, a t-test is conducted to test this assumption correctly.

The results of the independent-samples t-test presented below (Table 4-2), indicating that equal variances did not assume it can be observed that there was a statistically significant difference between the two samples of the PhD SA students and PhD UK students in scores for PhD SA ($M = 2.5$, $SD = .42$) and PhD UK ($M = 3.1$, $SD = .75$; $t(42.9) = 3.96$, $p = .00$). The perception of readiness of these PhD students in both countries was not equal and there was difference has been found in the case of both tests i.e. Levene's Test for Equality of Variances and the t-test for Equality of Means. The difference in favour of UK PhD students; this means UK students have more perception of the readiness than SA PhD to conduct statistical analysis related to their research (Appendix E2-1).

Table 4-2: Independent-samples t-test for Readiness of PhD Students

| University of PhD students in | N | Mean | Std. Deviation | t | df | P-value |
|-------------------------------|----|------|----------------|------|------|---------|
| UK | 32 | 3.1 | .75 | 3.96 | 42.9 | 0.00 |
| SA | 46 | 2.5 | .42 | | | |

4.5 The extent to which PhD students apply the steps of statistical methods before conducting statistical analysis

A brief analysis of questionnaire items is conducted, and the findings of descriptive analysis can be seen in Appendix E-3. From the results, it can be interpreted that most of UK PhD students agreed (mean=3.7) that they prefer to use qualitative methods. However, SA PhD students agreed that they prefer to use quantitative (mean=3.6) and mixed methods (mean=3.7). Moreover, UK PhD students agreed (mean=4.2) that they determine the statistical techniques of their data analysis by reviewing the techniques used in previous studies, and that they define the type of their research variables by reviewing previous studies (mean=4). However, SA PhD students disagreed with two of the above statements (mean=2.5) (mean=2.6) (Appendix E-3).

Figure 4-6 shows the bar charts for statements (4, 7, 10) in the table of the extent to which PhD students apply the steps of statistical methods before conducting statistical analysis appendix E-3. According to the bar chart below, the majority of UK PhD students (50%) agreed that they define the type of their research variables by reviewing previous studies. Whereas SA PhD students' responses differed, some agreed (34.8%), disagreed (26.1%) and strongly disagreed (23.9%) (Figure 4-6 no.1). Bar chart no. 2 illustrates most of the UK PhD students determined the statistical techniques of their data analysis by reviewing the techniques used in previous studies. However, SA PhD students fluctuated between agree and strongly disagree. Clearly, in the last bar chart SA PhD students agreed (32.6%) and strongly agreed (26%) that they prefer quantitative. Whilst UK PhD students neither agree nor disagree (41.9%) (Figure 4-6 no.3) (see Appendix E-3).

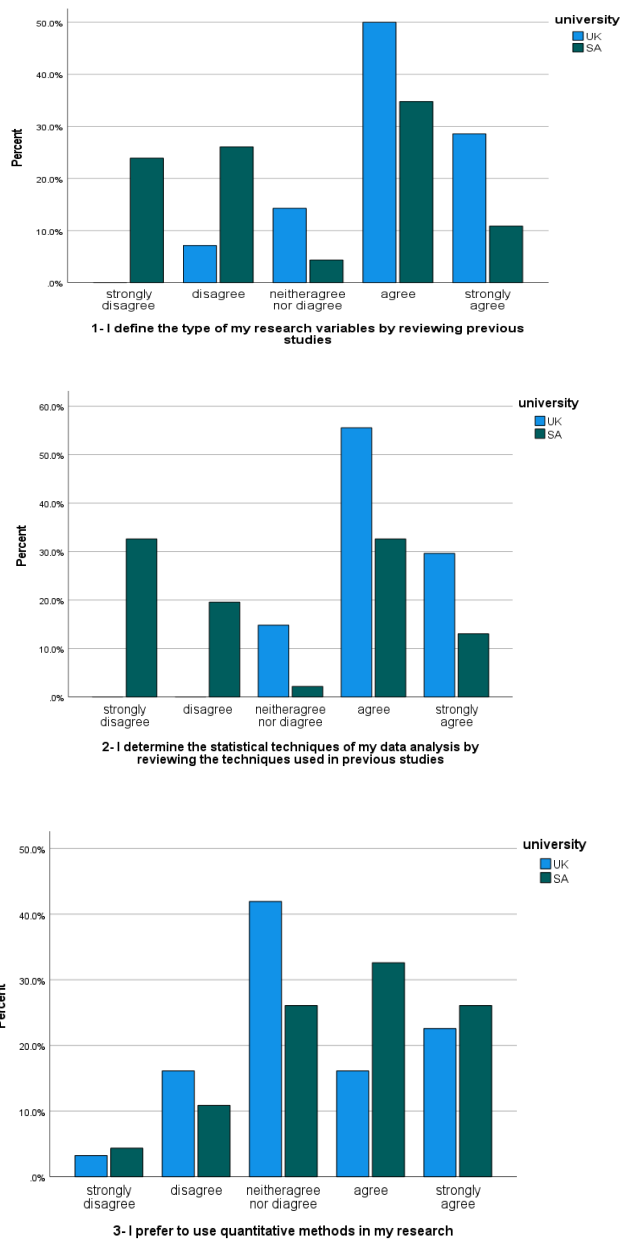


Figure 4- 6: Comparison between UK and SA responses for the extent to which PhD students apply the steps of statistical methods before conducting statistical analysis

In the above statements, most PhD students in the UK can define the type of their research variables by reviewing previous studies and determining the statistical techniques of their data analysis by reviewing the techniques used in previous studies more than SA PhD students. SA PhD students prefer quantitative research more than SA PhD.

However, the actual differences can be assessed based on the inferential statistics independent-samples t-test for summed Likert scales results, indicating that equal variances not assumed it can be observed that there was no statistically significant difference between the two samples of the Saudi Arabian students and UK students as the p-value >0.05 and the scores for PhD SA (M = 3.75, SD = .38) and PhD UK (M = 3.69, SD = .86; $t(39.3) = .36, p = .71$). The extent of PhD students applying the steps of the statistical methods before conducting statistical analysis in both countries was quite equal and no differences have been found (Table 4-3) (Appendix E 3-1).

Table 4-3: Independent-samples t-test for the extent to which PhD students apply the steps of statistical methods before conducting statistical analysis

| PhD students | N | Mean | Std. Deviation | t | df | P-value |
|--------------|----|------|----------------|-----|------|---------|
| UK | 32 | 3.69 | .86 | .36 | 39.3 | .71 |
| SA | 46 | 3.75 | .38 | | | |

4-6 competence in application of statistical methods and data interpretation based on statistical methods selected and implications

Participants agreed (UK mean=3.7, SA mean=3.8) about how accurate PhD students in applying statistical methods and data interpretation selected based on statistical methods. The mixed responses were received from both sample groups (appendix E-4). Such as, the mean value of responses attained from UK PhD students was higher in many statements except 3,5,7. Regarding the statement I have good skills of analysing and interpreting statistical data where UK PhD students agreed (mean=3.60) while PhD SA students neither agreed nor disagreed (mean=3.0).

As shown in Figure 4-7 below for statements (2, 7) in the table of how accurate PhD students apply statistical methods and data interpretation selected based on statistical methods selected in Appendix E-4. In the statement having good skills of analyzing and interpreting statistical data, around 40% of UK PhD students agreed and 20% strongly agreed, however, 28.3% of SA PhD students agreed and 10% strongly

agreed (Figure 4-7 no.1). Moreover, PhD students in both SA and UK know the impact of using statistical methods that is inappropriate to the research leads to inaccuracy results, UK PhD students agreed 42.9% and strongly agreed 39.3% in this statement, SA PhD students agreed 34.8% and strongly agreed 58.7% (Figure 4-7 no.2) (See Appendix E part 4 for Tables).

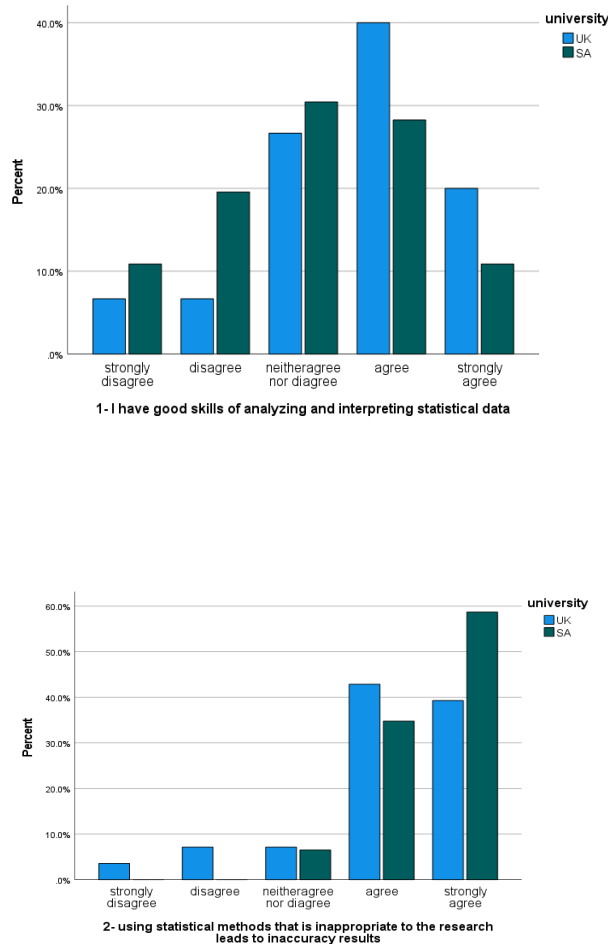


Figure 4-7: Comparison between UK and SA responses for the competence in application of statistical methods and data interpretation based on statistical methods selected and implications

After descriptive analysis, both UK and SA PhD students demonstrated proficiency in the majority of the statements, although the UK PhD was higher in (I have good skills of analysing and interpreting statistical data) than SA PhD students. The differences between both groups are examined using an inferential statistics independent- sample t-test for summed Likert scale results. The table presented below shows the group Statistics for both SA and UK students, indicating that equal variance is assumed, it was a statistically significant difference between the two samples of the PhD SA students and PhD UK students as the p-value < 0.05 and a significant difference in scores for SA PhD (M = 3.51, SD = .44) and UK PhD (M = 3.94, SD

= .42; $t(76) = 3.73$, $p = .00$). The competence of PhD students applying statistical methods and data interpretation selected based on statistical methods was not equal and differences have been found. The difference in favour of UK PhD students, that means UK students were more accurate in applying statistical methods and data interpretation selected based on statistical methods (Table4-4) (Appendix E 4-1).

Table 4-4: Independent-sample t-test for the competence in application of statistical methods and data interpretation based on statistical methods selected and implications

| PhD students | N | Mean | Std. Deviation | t | df | P-value |
|--------------|----|------|----------------|------|----|---------|
| UK | 32 | 3.94 | .42 | 3.73 | 76 | 0.00 |
| SA | 46 | 3.51 | .44 | | | |

4.7 The possible alternative ways to enhance greater accuracy in the use of statistical methods in doctoral research

This section assesses the responses of UK and SA students about the viable alternative ways to enhance greater accuracy in the use of statistical methods in doctoral research. A descriptive analysis of relevant questions is presented in Appendix E-5, which shows both UK PhD students (mean=3.58) and PhD SA students (mean=3.95) agreed (Appendix E-4). Both sample groups provided different responses; for example, considered the mean value of preparing educational cadres in the subject of Statistics capable of overcoming the difficulties of studying Statistics for UK PhD students was 4.04 (respondents agreed) and for SA PhD students 4.5 (respondents strongly agree). Moreover, SA PhD students strongly agreed with the statement (make advanced Statistics courses mandatory for postgraduate students) (mean=4.24) and agreed with the other statement, Teaching Statistics as part of the compulsory Mathematics curriculum in primary and secondary school (mean=3.72), while UK PhD students agreed (mean=3.46) in the first statement and also agreed (mean=3.82) with the second statement. Furthermore, SA PhD students strongly agreed (mean= 4.64) with the statement (Develop methods of evaluating and teaching statistics material in PhD program) and UK PhD students agreed (mean= 4.04) (Appendix E-5).

Figure 4-8 represent some of the possible alternative ways to enhance greater accuracy in the use of statistical methods in doctoral research for statements (6, 7, 8) in the table of the possible alternative ways to enhance greater accuracy in the use of statistical methods in doctoral research in Appendix E-5. PhD

students emphasize that teaching Statistics as part of the compulsory Mathematics curriculum in primary and secondary school is extremely important 42.9% of the UK PhD students and 37% of SA PhD students (Figure 4-8 no.1). The UK PhD students think that it is important to prepare educational cadres in the subject of Statistics capable of overcoming the difficulties of studying Statistics, by 58.3%, but the Saudis consider it as extremely important by 56.5% (Figure 4-8 no.2) (See Appendix E, part 5 for Tables). PhD students responded that developing methods of evaluating and teaching Statistics material in PhD programme is important 60.7% of the UK PhD students and extremely important 73.3% of SA PhD students (Figure 4-8 no.3) (see Appendix E part 5 for Tables).

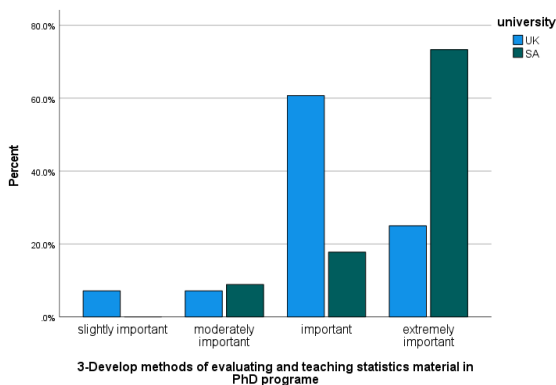
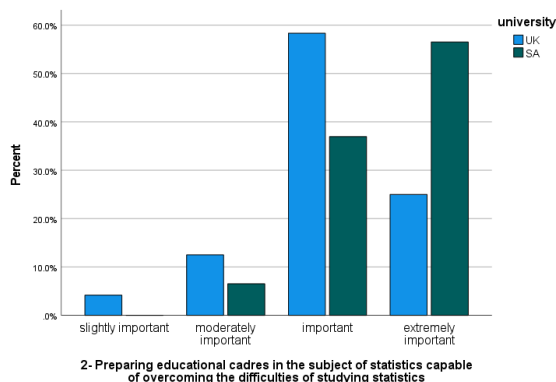
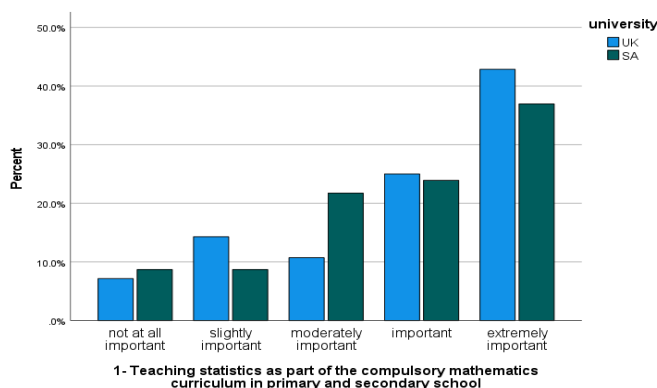


Figure 4-8: Comparison between UK and SA responses for the possible alternative ways to enhance greater accuracy in the use of statistical methods in doctoral research

The descriptive Statistics showed that the UK and SA PhD students want to increase their ability to apply Statistics in their research. From the inferential statistics independent-sample t-test for summed Likert scales results, the table given below (Table4-5) shows the group Statistics for the last part of the questionnaire while highlighting the values of mean and standard deviation. This helps to understand whether there are statistically significant differences among group variables or not. It can be observed that equal variances were assumed, and there was a significant difference in scores for Saudi (M = 3.96, SD = .43) and UK (M = 3.58, SD = .62; $t(76) = 3.12, p = .003$). The possible alternative ways to enhance greater accuracy in statistical methods in doctoral research were not equal, and differences have been found. The difference in favour of SA PhD students, that means SA students need the alternative ways to enhance greater accuracy in the use of statistical methods in doctoral research more than the UK PhD students. (Appendix E 5-1).

Table 4-5: Independent-sample t-test for the possible alternative ways to enhance greater accuracy in the use of statistical methods in doctoral research

| PhD students | N | Mean | T | df | P-value |
|--------------|----|------|------|----|---------|
| UK | 32 | 3.58 | 3.12 | 76 | .003 |
| SA | 46 | 3.96 | | | |

4.8 Analysis of open-ended questions

This section provided some responses from UK and SA PhD students when they were asked to give their views about different statistical methods, i.e., Quantitative method, Qualitative method, and Mixed method. When both groups of students were asked about their preferences to use quantitative methods, there were a large number of students in both groups who were undecided about the selection of quantitative methods

for their research. A similar trend can be seen in (Figure 4-9), there was also a huge number of respondents who agreed and strongly agreed in both cases. Whereas the SA PhD students preferred more quantitative research.

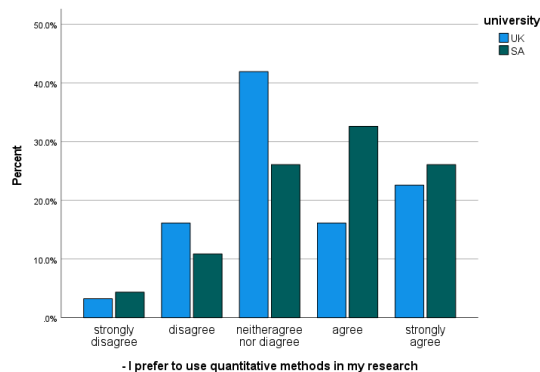


Figure 4-9: Preference for Quantitative Method

In addition, they were asked to explain why they prefer or don't prefer to use quantitative methods in their research, the UK respondents preferred the quantitative method because it is often regarded more positively, more interesting, most of them depend on the nature of the research, more straightforward, more convincing, more reliable and unbiased, easier to analyse, clear results by using numbers, can get large numbers of samples, other respondents said 'I prefer to use quantitative methods because of my background as a Math teacher'. Also, the literature of my topic shows that quantitative methods are the best for my research questions.' Five of the respondents mentioned, that they don't feel confident in running statistical analyses by themselves, provide hard data to analyse and are not a big fan of Maths.

SA respondents preferred the Quantitative method because it is more accurate especially in big samples, It also generalise the result, easy to use, some respondents said that the type of study dictates which method is suitable to use, easy to explain and deal with, more straight forward and convincing than other methods, more clear results when using numbers, and lastly, some Saudi respondents stated that it is compulsory from the department of the university and others do not have any background in it and they stated that they Lack in statistic and maths.

In the case of the qualitative method, there was a higher number of UK students who preferred to use qualitative methods over quantitative methods, although substantial numbers of individuals neither agreed nor disagreed. While looking at the responses of SA students, a larger number of people were undecided about their choices to select a suitable qualitative method. However, there are still some respondents who like qualitative methods if they were given an option (Figure 4-10).

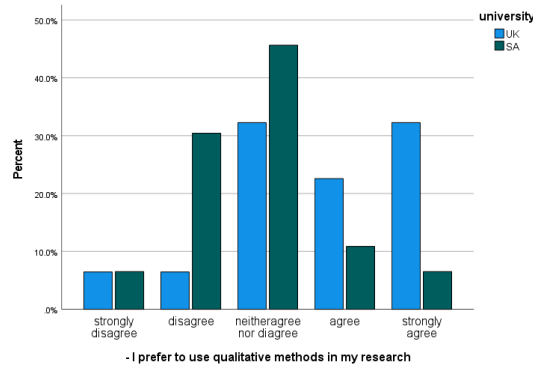


Figure 4-10: Preference for Qualitative Method

When asked why they prefer or do not prefer the qualitative method, UK respondents stated, it deals with people directly, is easy to use, obtain more in depth data, achieving meaningful results, helps to understand the issue in-depth, is more detailed, prefer to use as it is not part of Statistics, on the other hand, some said it is more biased, do not have the knowledge to use it in their research, some respondents lack and do not feel comfortable using Maths and numbers, too subjected when the topic is contentious, in Saudi Arabia, some respondents said that they do not use it often there, lacks information about the method, hard to deal with, needs time and effort some of the respondents said “*We don’t commonly use qualitative method thus, there is no experience from the student and the supervisor*”.

While reviewing students’ liking of the mixed method, respondents were asked to specify their preferences, and the findings are presented in Figure 4-11 below. From the results, it can be interpreted that the majority of the students from SA (47.8%) and UK (35.7%) students prefer to use mixed methods. In the question preferring mixed method in their research the number of respondents who were undecided about the selection of mixed methods was lower in this case. This means the mixed method was the most preferred choice of PhD students for their thesis in both the UK and SA.

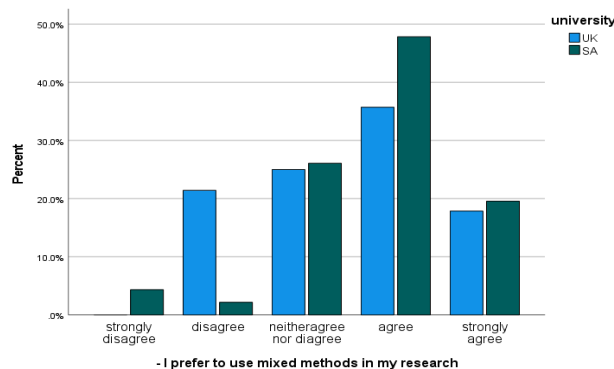


Figure 4-11: Mixed Methods

Some UK respondents agreed that using mixed methods makes them more confident in the results, is more efficient, can give a better understanding of the problem and yield more complete evidence, gives a clearer picture of the issue as well as the results, It gives the search strength and accuracy, Both are complementary to one another, others mentioned, it is complicated, feel like two PhD, It would be hard and time consuming to have both. SA respondents mentioned that it Combined advantages between both methods, the qualitative method completes the quantitative method and confirms the result, gives more precise results, generalise the result, is great in comparison, understanding the results more, makes the research stronger, some respondents do not prefer to use the mixed method because, time consuming, have no confidence in using it, and hard to use and tiring.

The following are suggestions for other ways to enhance postgraduate students' knowledge of statistics from respondents.

Table 4-6: suggestions for other ways to enhance postgraduate students' knowledge of statistics from UK and SA respondents

| N | F | SA Responses |
|---|---|--|
| 1 | 3 | Everything you mentioned and asked was enough |
| 2 | 2 | Support research projects in the humanities and sciences and allocate a budget |
| 3 | 1 | Identify important statistical lessons on YouTube and share them with postgraduate students. |
| 4 | 2 | Support the PhD student financially to seek the help of statistical experts |
| 5 | 1 | Holding conferences that include various activities on statistics |
| 6 | 2 | Integration of statistics with research methods |
| 7 | 1 | Focusing more on applying the concepts of statistics |
| 8 | 2 | Statistics is essential for postgraduate studies as well as for school. |
| 9 | 4 | Holding workshops on the use of statistical methods in research |

| | | |
|----|---|--|
| 10 | 1 | Seeking alternative institutes to teach statistics when the university cannot supply |
| 11 | 1 | Delivering classes via Zoom so everyone can learn about the statistical programme without costing the university, the member teaching the course, or the student. |
| 12 | 3 | provide qualified statisticians to teach PhD students the proper technique for analysing statistics, because students often seek help from others and take huge amounts of money, and the method of analysis becomes incorrect. |
| 13 | | At the postgraduate level, we were only taught to solve equations without connecting them to the nature of the research, so students were not assigned to examine some research papers to discuss what statistical methods were used in order to know what statistical method was appropriate for their study. |

| N | F | UK Responses |
|----------|----------|---|
| 1 | 2 | providing tutor or peer to help with the statistics |
| 2 | 1 | It would be good to have a non-threatening environment where statistical problems can be discussed and possibly published papers discussed. There are some groups PhD students can attend but they're most aimed at staff and are a bit intimidating. |
| 3 | 3 | I think studying it from middle school, even elementary school would make people feel more comfortable. |
| 4 | 2 | Doing more courses for statistics |
| 5 | 2 | Workshops in statistics |
| 6 | 2 | Stat Courses with computer lab exercises |
| 7 | 2 | assign tutor to help in statistics |

There are additional comments from the respondents relating to add on this topic:

Table 4-7: Additional comments from the respondents relating to add on this topic

| N | F | SA Responses |
|---|----|---|
| 1 | 2 | Replacing some of the repeated subjects in the bachelor's and postgraduate degrees with statistics courses |
| 2 | 2 | At the master's level, I faced great difficulties because the supervisor was not interested in educating me statistically, leading me to fall into the hands of exploiters from abroad and wasting my time and money. |
| 3 | 4 | It is recommended that courses in advanced statistics be offered periodically, for example, every month |
| 4 | 1 | Having a survey to express satisfaction with the module and the lecturer. and allow the student to select their module lecturer. |
| 5 | 10 | A very, very important survey that we hope will result in practical decisions |
| 6 | 1 | Statistics is essential but the way of teaching it in university courses is basic, and we should be taught by statisticians rather than lecturers from other specialisations. |

| N | F | UK Responses |
|---|---|---|
| 1 | 2 | Your research is excellent, and I hope its results will be applied |
| 2 | 5 | The analysis of qualitative data is more complex than quantitative analysis. However, students are often afraid to do quantitative research due to their limited knowledge on this subject. |

4.9 Conclusion

As a final observation, the questionnaire explained how PhD students from various educational backgrounds view the selection and application of statistical methods for doctoral research. UK PhD students are more prepared to conduct statistical methods due to a better theoretical understanding of the concepts of Statistics of statistical methods, a better ability to learn statistical methods, and more confidence in selecting the appropriate statistical methods for their research and , as well as they are less anxious than SA PhD students when they use statistical methods, so SA PhD students tend to seek assistance from statisticians to conduct statistical methods. For these reasons, SA PhD students want to improve their abilities and expand their skills, as they support alternate ways to facilitate the problem more than UK PhD students.

Chapter 5: Qualitative Analysis

5.1 Introduction

This section offers an analysis of qualitative data gathered through five semi-structured interviews performed with post-graduate teaching staff having at least five years of teaching experience or supervisory experience of PhD research from the participating KSA university. The interviews were conducted with the main aim to investigate the efficiency of statistical methods used in PhD research at Saudi universities, and the interviewees were asked to share their experiences while highlighting the readiness of PhD students in the selection and application of statistical research methods. The interviews were conducted in the Arabic language, owing to the participants' proficiency in the language. The subsequent transcription of the interviews was also performed in Arabic, followed by a translation into English. The translated version of the semi-structured interviews was used for the thematic analysis.

5.2 Thematic Analysis

Thematic analysis is a process of evaluating qualitative research that entails searching through data gathering to locate, analyse, and record reoccurring themes. The goal of thematic analysis is to identify themes, or noteworthy structures, in research and then use those themes to underline the substantive content of the research (Terry et al., 2017).

As mentioned in Chapter 3, thematic analysis was chosen as the qualitative data analysis technique for this study due to its flexibility, depth, and simplicity. This method is particularly well-suited for exploring patterns within qualitative data, making it an ideal approach to understanding the experiences of the participants. Thematic analysis is favoured in qualitative research because it allows for the identification of key themes while keeping the voices of the participants at the forefront. It also provides nuanced insights into complex experiences and is practical and resource-efficient, making it accessible for analysing large data.

The decision to use thematic analysis was justified by its adaptability to the inductive approach employed in this study. The inductive approach involves interpreting the data without any preconceived notions or hypotheses, allowing the themes to emerge naturally. In this case, the descriptive coding method was used, where in each paragraph or sentence was summarized with one or two words, acknowledging that some sentences might have multiple codes. This bottom-up approach means that the codes and themes were not predetermined but developed directly from the data, ensuring that the analysis was grounded in the participants' actual responses.

By using thematic analysis with inductive coding, the study was able to explore patterns and themes in an organic way, ensuring that the findings were a true reflection of the participants' experiences and insights, rather than being shaped by researcher assumptions or expectations. Four themes emerged in the following sections: the themes are organised based on their relation to the research questions. The themes and their sub-themes were discussed in separate sections. This aims to understand the perceived level of preparedness of PhD students, perceived by their instructors to undertake statistical analysis in their research studies and how it can enhance the quality and standard of research at Saudi Arabia's universities.

5.2.1 Perceptions of the readiness of PhD Students to Conduct Statistical Analysis in PhD research

Figure 5-1 illustrated the themes and subthemes related to the readiness of PhD students to conduct statistical analysis in PhD research.

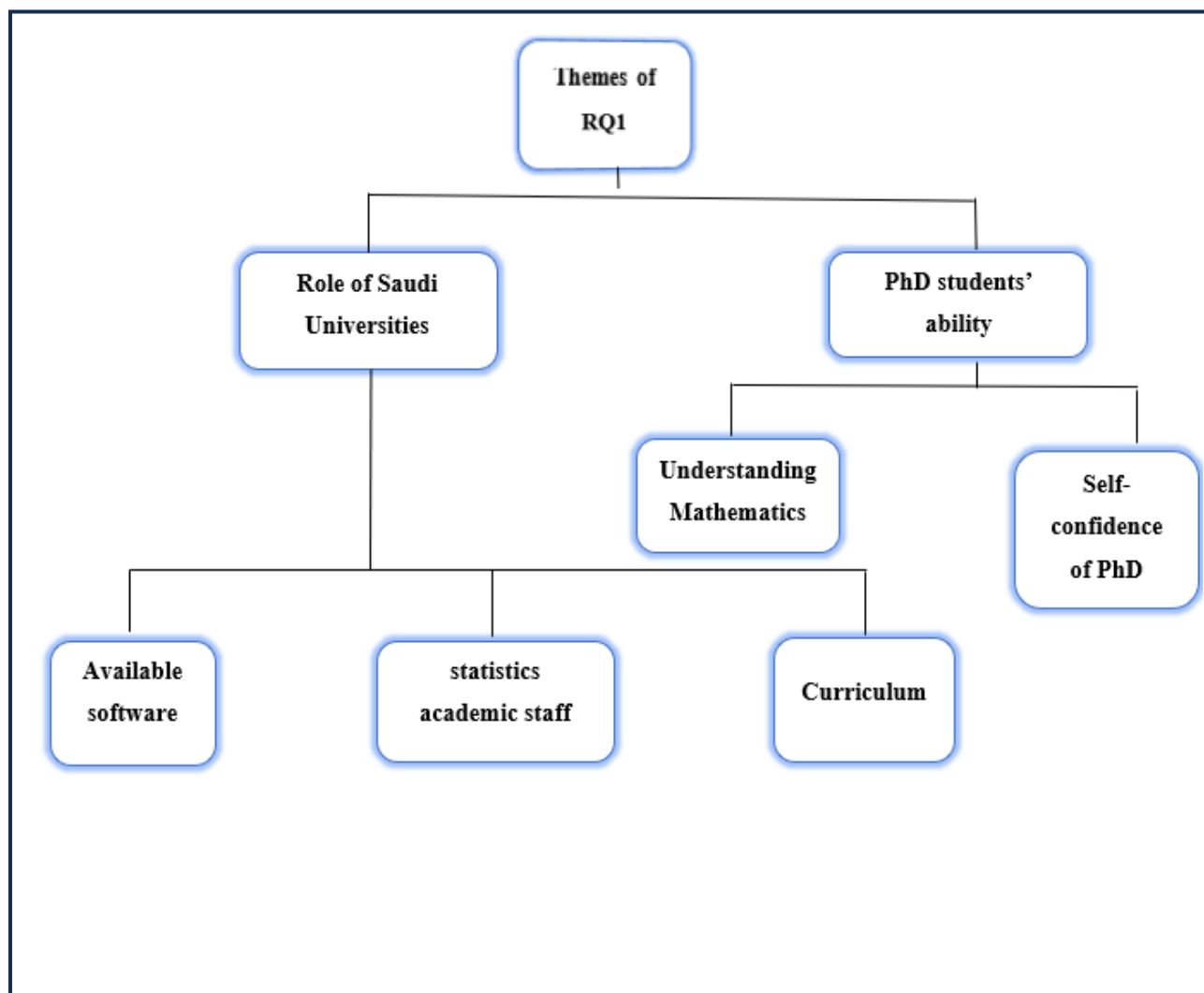


Figure 5-2: The themes and subthemes of the first research question (readiness of PhD students to conduct statistical analysis in PhD research)

5.2.1.1 Role of Saudi universities

From the analysis of interview data, it was observed that the Saudi university are not able to meet to needs of PhD students regarding statistical knowledge. One of the major themes that emerged from the interviews, was the availability of Statistics-related resources in Saudi institutions. Sub-themes included the availability of software programs, the qualifications and abilities of teachers and curriculum development. Many interviewees expressed dissatisfaction with the lack of resources and expertise, particularly in social statistics. This seen as problematic because it impedes students' ability to learn and conduct research effectively.

To be specific, the lack of availability of statistical software was mentioned several times, as one respondent said that *“many of the Saudi universities may supply the necessary software program for Statistics department but never provide anything to the Social Sciences or education departments”*. Additionally, another interviewee stated that unfortunately, most Saudi universities have not provided the appropriate programs for Statistics to help students understand Statistics, citing this example from the interviewee *“I need to work with AMOS (additional SPSS software that enhances structural equation modelling) which is not available”*. Another participant remarked that some Saudi universities do not equip students with the essential programs to help them learn Statistics. However, one of the interviewees believed that many Saudi institutions are working to develop Statistics as in certain Saudi universities, SPSS is offered. The previous interviewee added that *“since students now pay for PhD courses, the institution should offer a SPSS for free and at least two days a week for training”*.

Moreover, the interviews indicated a lack of Statistics academic staff in educational departments repeatedly, for example, in interview 1 (Respondent: I 1) the participant stated, *“The statisticians in the university who do not master social Statistics remain with the faculty for only one term due to the lack of experience in Social Statistics”*. Furthermore, another interviewee mentioned, *“Our universities do not have any social statisticians and in many of our universities, the staff is limited to general pure Statistics. Some lecturers can deliver the content, and some cannot”*. Another mentioned that *“the supervisor of the thesis does not follow the PhD student’s analysis stage they only look at the general shape of the tables and the graphics. Some supervisors encouraged their students to go to student centres that do not have qualified statisticians to do postgraduate research. The same interviewee mentioned “Postgraduate topics are taught in English, and students are frequently weak in the English language making it difficult for them to succeed and some*

faculty members are non-Arabs which makes it hard to communicate with them”, the interviewee also mentioned that *“some lecturers memorise the steps and processes, and they teach the curriculum twice or three times, then they understand the memorisation of the content”*.

Based on the respondent in interview 4 (Respondent: I 4) mentioned that *“the academic staff at the Faculty of Social Sciences takes courses to learn SPSS and then teaches the SPSS program to students, but they do not comprehend the logic of Statistics. They merely throw processes at students and drown them with mathematical operations to demonstrate that they understand Mathematics and are experts”*. It causes problems with the comprehension of students furthermore; it causes problems with the students' data analysis process in their research.

Another interviewee supported this by saying *“The problem we have is that while some Statistics academic staff are studying for their doctorate, they take a course in Statistics, and the university might accept them to teach Statistics even though they are not qualified, and they only took a Statistic course in their PhD. They then teach Statistics and therefore unable to deliver the subject and over time, they memorise the curriculum’*. This shows that the lecturers' ability to teach Statistics has a huge impact on PhD students' readiness.

Another noteworthy point has arisen, the university's Statistics curriculum in the postgraduate program is not enough in the education and social science departments and most of the PhD students are from literacy pathway backgrounds they do not understand very well so the lecturer only explains the basics because there is no time to improve their foundation in Mathematics, and this is what all the interviewees agreed on. Moreover, according to one interviewee, there is no specific curriculum for teaching Statistics that is offered to PhD students; the content in undergraduate studies is the same as in postgraduate studies; it is just a small difference between the two curricula. In interview 2 (Respondent: I 2), the participant noted that *“students should be trained in how to use Statistics, not just theoretical material”*.

5.2.1.2 PhD Students' Ability

The interview analysis advocates that many PhD students in Saudi Arabia struggle with understanding and applying statistical methodologies, particularly those who come from literacy pathway without a strong Mathematics background. There is also a lack of qualified academic staff to teach Statistics at the PhD level, and many students lack confidence in their abilities and seek assistance in data analysis.

A major difficulty raised by most respondents was that some PhD students are not skilled in Mathematics; the reason for this was mentioned by interviewee I 2, that *“Maths background is essential. Anyone with this*

background can overcome the difficulty, but others who do not have this background suffer several obstacles, they graduated from literacy pathways such as Geography and History, which do not have Mathematics and Statistics information given to them, so they are not qualified to use it without external assistance". Additionally, interviewee I 4 stated that *"the high school literacy pathway should teach students fundamental Maths. Given that the majority of PhD students state they haven't taken Maths Since middle school, some PhD students fail to recognise that 0.05 is less than 0.1"*. Also, one of the interviewees revealed that just a few students have mastered the use of statistical methods during data analysis while several students do not understand Statistics *"when I asked PhD students about Statistics, many of them said we do not understand anything in Statistics, and we want you to teach us the basis from the beginning"*. Another interviewee confirmed that, *"most of the PhD students in Education department came from literacy pathway far from Mathematics and Arithmetic operations, in which it is difficult to deal with numbers and statistical methods"*. In the interviews, the majority of the interviewees who were asked about PhD students' comprehension of statistical techniques felt that this level of understanding was quite low, and this was because of the student's poor academic backgrounds. As a result, most of the PhD students seek assistance and rely on others to analyse their quantitative data. For example, interview 3 (Respondent: I 3) *"Statistics are problematic and difficult to comprehend for the literacy pathways; they never studied Mathematics because the students come from a literacy background. They rely on others and select assistants to analyse the data for them"*.

Moreover, the self-confidence of PhD students in using statistical methods in their research was confirmed by some of the interviewees, that Saudi students have the ability, but they do not have confidence in themselves to depend on. Where one of the interviewees stated, *"Unfortunately, PhD students who have abilities seek assistance from others in the analysis since they lack confidence in themselves"*. Another participant also showed that some PhD students comprehend statistical procedures but fail to put what they have learned into practice; They lack confidence in their abilities, study Statistics, pass their examinations, and then seek the assistance of an analyst to analyse their data.

Two interviewees explained that all Saudis are more obsessed with fear, success, and failure than learning, so they seek help in the analysis, as well as they are far from self-learning, as the two interviewees said *"When we find something difficult, what do we do? We rely on others and get a private teacher to teach us, not for understanding but to pass the course for success only and not for learning and They do not have the ability to seek/learn by themselves"*. Obaidullah Al-Juhani (2021) supported this by saying motivating and encouraging students to self-learn, as self-learning is an appropriate and preferred educational process for

preparing learners for lifelong learning and keeping them constantly aware of developments and changes in their field of specialization and all aspects of their lives.

To summarise, the findings of the interviews revealed that several Saudi universities have not provided essential Statistics initiatives or specific programs to assist PhD students in understanding Statistics, which might have devastating implications. Additionally, there is a lack of qualified academic staff to teach Statistics at the PhD level, and PhD students, particularly those from literary departments, struggle to understand and apply statistical methodologies. Furthermore, universities should be interested in increasing the motivation of PhD students to learn and become self-reliant.

5.2.2 Pre-Analysis Steps in Statistical Methods Applied by PhD Students

Figure 5-2 showed the themes and subthemes related to what extent to which PhD students apply the steps of statistical methods before conducting statistical analysis.

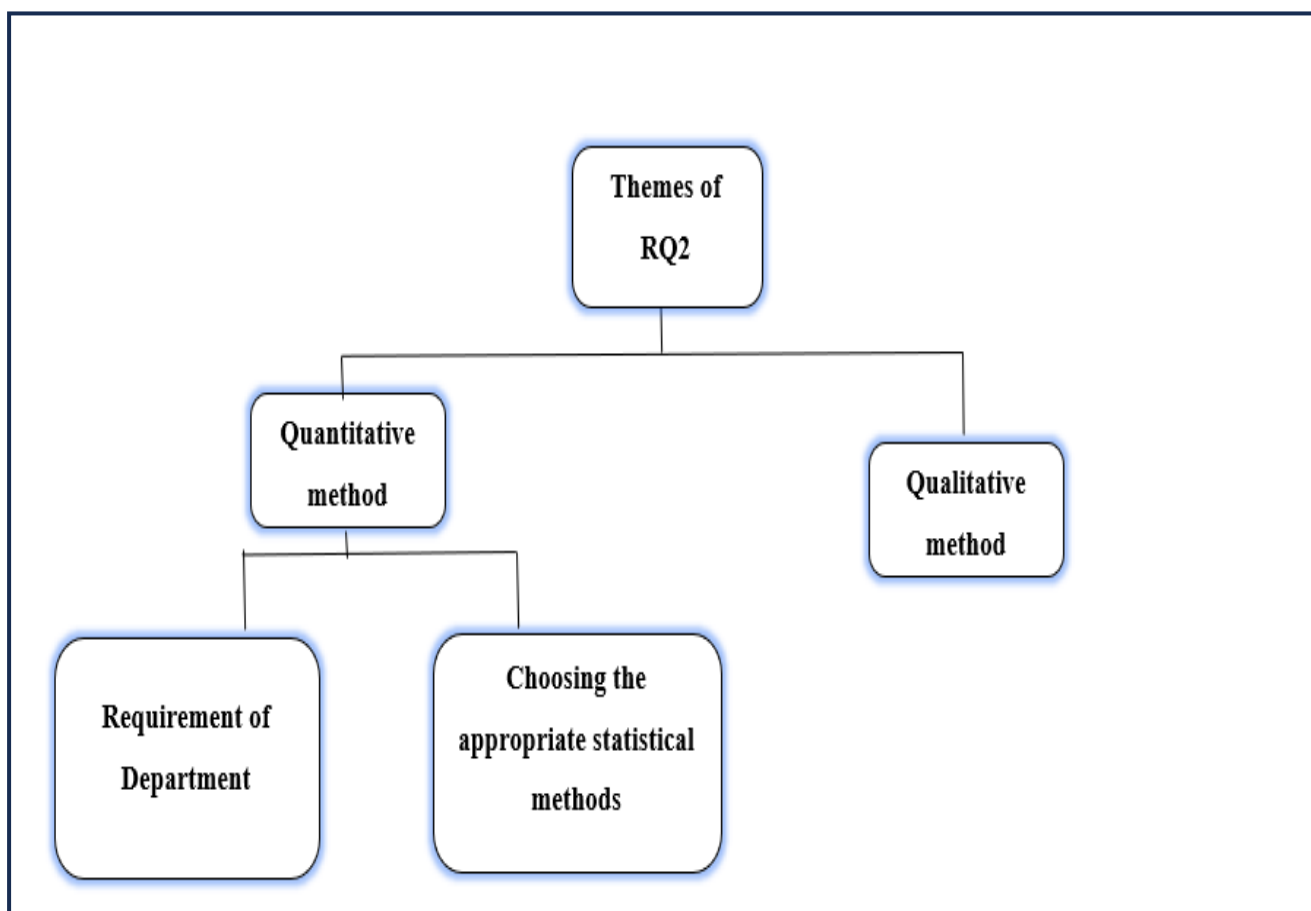


Figure 5-3: The themes and subthemes of the second research question (the extent to which PhD students apply the steps of statistical methods before conducting statistical analysis)

5.2.2.1 Quantitative method

From the data analysis, it emerged that PhD students in Saudi Arabia heavily rely on quantitative approaches, particularly questionnaires, due to departmental preferences and convenience. However, they often make errors in selecting appropriate statistical methods, such as choosing between parametric and non-parametric tests, and in classifying data by measurement scales. Additionally, they struggle with selecting appropriate samples and understanding the concept behind the statistical analysis and often rely on non-specialised offices for data input.

During the interview, all of the participants emphasized the use of the quantitative approach multiple times. They claimed that, even though many students do not fully comprehend the difference between quantitative and qualitative approaches, they favour quantitative methods since the department relies heavily on questionnaires. For example, one of the interviewees said, *“In the Social Sciences, it is often used quantitative, and this is a preference from the department and the faculty members, not the students.”*. Furthermore, most of the interviewees mentioned that the essential thing for students is to attain their goals as quickly and easily as possible via the use of a questionnaire.

In addition, the interviewees discussed the extent to PhD students apply the steps of statistical methods before conducting statistical analysis they use parametric Statistics test more than non-parametric Statistics test because they think it has more confidence as it's quite common in Saudi Arabia than non-parametric Statistics test due to a lack of experience.

Most of the individuals interviewed while talking about the common errors made by the PhD students during their statistical data analysis process feel that several students have been found to make errors in the data classification by measurements (ordinal or nominal) during their statistical data analysis procedure. Moreover, interview 2 (Respondent: I 2) confirmed that *“the process of classifying data by Scales either nominal or ordinal, If the classification begins incorrect, the selection of appropriate statistical tests is typically incorrect for example, the selection of tools such as non-parameter or parameters”*.

In interview 3 (Respondent: I 3), the interviewee discussed about the extent of PhD students apply the steps of statistical methods before conducting statistical analysis, *“PhD students are having difficulty selecting an appropriate sample for their research, and it is also challenging for the student to distinguish between independent and dependent variables, as well as measurement scales .and the researchers have a problem selecting the effective methodology for their research and do not understand the concept behind the*

application of Statistics and do not realise that statistical analysis is the most crucial tool of quantitative research, also the PhD student is dependent on others, such as non-specialised offices in data input, where numerous errors occur". Additionally, another interviewee highlighted that students often have a problem choosing the appropriate methods for their research, the interviewee explained that " *the inaccuracy of choosing appropriate statistical methods by PhD students is a problem, as the student typically takes the data and analyses it in statistical assistance centre to assist them at this stage and they are not specialised in Statistics*". It was also revealed by the participant I 5 that, " *The students have difficulties selecting a sample because they use a questionnaire from a previous study and neglect to take into account that this study was conducted five years ago, when much has changed in society*".

5.2.2.2 Qualitative Method

From the interview analysis, it emerged that PhD students in Saudi Arabia face challenges in applying statistical methods, particularly in selecting appropriate samples and statistical tests. Additionally, the preference for quantitative research methods over qualitative ones, driven in part by university requirements, may limit the scope and depth of research. This is problematic because it may lead to incomplete or inaccurate findings and limit the potential impact of research.

Most of the interviewees claimed that the qualitative method is not frequently used in Saudi universities. To illustrate that, Interview 4 (Respondent: I 4), the interviewee emphasized that "*qualitative research is rarely employed at SA university and most of the research are almost entirely (99%) quantitative research*". A few interviewees mentioned that perhaps qualitative research includes a case study, an in-depth interview, and observation, script of the interview, and it will be exhausting for them to study, and some of these studies require extensive observation in the interviews, and they lack patience. In particular, interviewee I 5 stated, " *It is not common to use qualitative approach because they think the qualitative is more exhausting than the quantitative, also, it is difficult to go back to the sample every period to make an interview with the same person again. Moreover, our privacy is essential in Saudi Arabia, which is why respondents frequently decline*".

In summary, PhD students find it difficult to apply the steps of statistical methods before conducting statistical analysis, as PhD students sometimes do not differentiate between quantitative, qualitative, and mixed approaches, and they use quantitative more because it was required by the university in Saudi Arabia, and they think that using a questionnaire is easier than conducting interviews, as well as they explained that PhD students struggle to choose the sample and the appropriate statistical methods for their research.

5.2.3 competence of Statistical Methods and Interpretation in PhD Research

Figure 5-3 illustrated the themes and subthemes related to the competence of PhD students applying statistical methods and data interpretation based on the statistical methods selected and the implications.

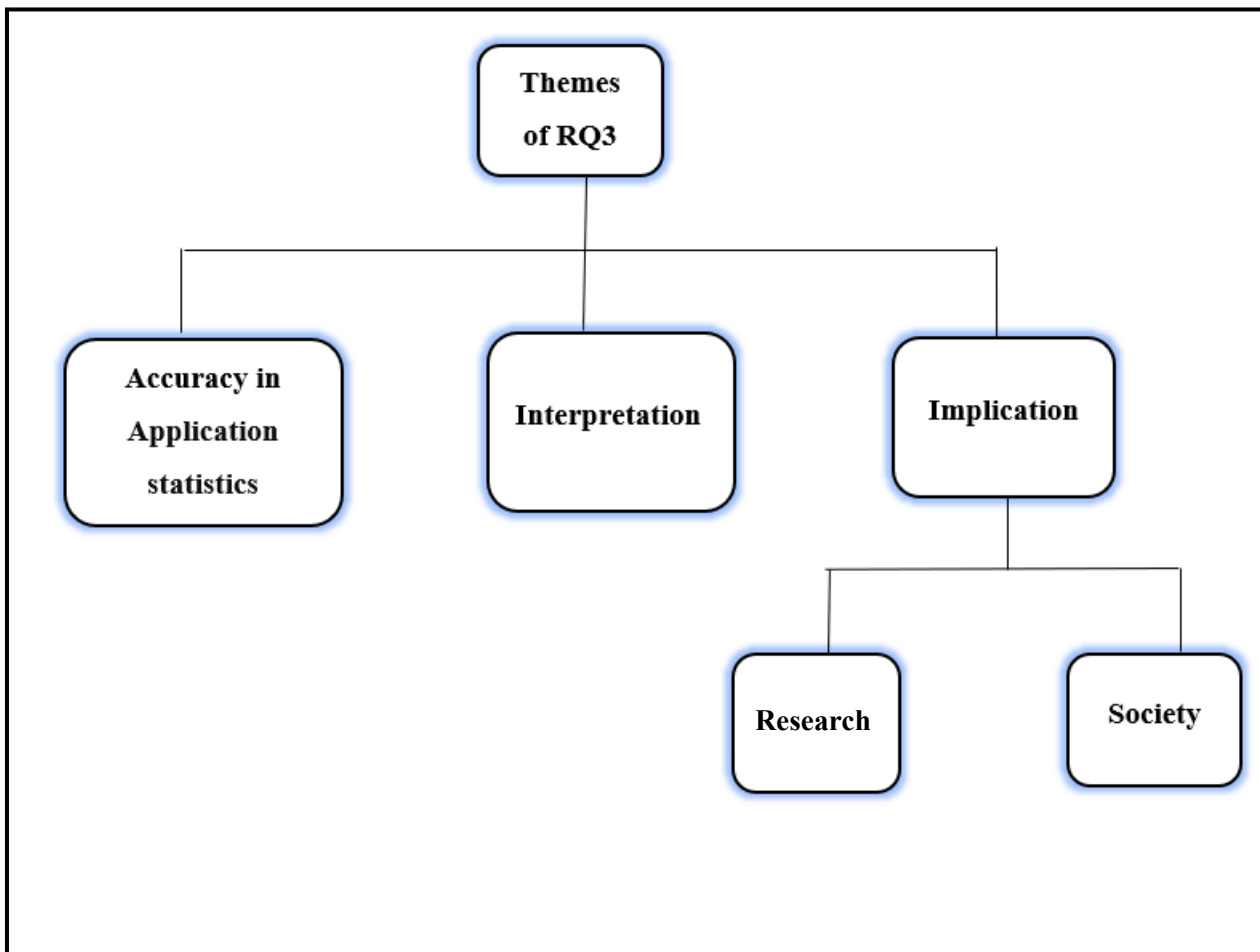


Figure 5-4 :The themes and subthemes of the third research Question (the competence of PhD students’ application of statistical methods and data interpretation based on statistical methods selected)

5.2.3.1 Accuracy in Application Statistical Research

The interview analysis revealed a lack of theoretical understanding among PhD students regarding statistical methods, leading to the misapplication of complex methods and inappropriate test selection. This issue affects the validity of research findings and highlights the need for specialised statistical training for

PhD students. Additionally, some students rely heavily on statistical assistance centres, leading to inaccuracies in data analysis. While reviewing the interview data, the lack of a theoretical basis for PhD students has been noted several times. In interview 4 (Respondent: I 4), the interviewee confirmed that *“the PhD students do not understand the theoretical basis on which the statistical methods are built”*.

Moreover, the misapplication of statistical methods and its impact on the validity of the research findings was highlighted multiple times by interviewees. For example, in interview 4 (Respondent: I 4), the interviewee said, *“some students assume that Statistics is a goal rather than a means, such as employing a statistical method until it is stated that they utilised it, even though their research does not necessitate the use of a complex (contains many stages) statistical method”*. The participant in interview 1 (Respondent: I 1) confirmed that *“PhD students choose complex methods and tables and drawings such as bar charts, in order to claim that they used them regardless of whether they fit or not, because they believe it adds greater value to their research and it is inconvenient for their research”*, the participant continued to mention that *“there is a huge problem when apply the inappropriate statistical methods”*. In addition, interviewee I 3 demonstrate that *“there is inaccuracy in the application of Statistics, they are unsure how to deal with missing data, and they rely on the statistical assistance centre to enter data into SPSS and apply statistical methods; they are not specialised in Statistics, and they are materialistic”*. Another interviewee (I 1) revealed some common mistakes among students during the use of statistical methods *“most postgraduate students in educational, religion, human, and social departments rely on the questionnaire and often apply statistical methods incorrectly to their data. Additionally, they use parametric test selection, for example, t-tests or regression which are often inappropriate for questionnaire data in their research.”* The interviewee continued that there are common methods that students use in their research *“They most often derive percentages and frequencies, variance, median and descriptive Statistics.”* Interview (4) showed that *“our university students work on a correlation but do not understand the theoretical basis of correlation, that is, what does the correlation coefficient mean?”*.

As for interview (1), explained that *“some students have very simple statistical information about regression. Also, they used t-test just to show they have tables, but their research did not need it”*.

5.2.3.2 Interpretation

Themes that emerged from the interview data suggests that PhD students have weak interpretation skills and heavily rely on statistical assistance centres. Most postgraduate students in certain fields tend to misinterpret data from questionnaires. There is also a significant link between errors in the statistical application and errors in interpretation, indicating a need for specialised statistical training for PhD students.

Interpretation skills are necessary to solve a research problem appropriately. Hence, a researcher requires accurate skill in translating what the numbers indicate after conducting statistical tests (Zidan, 2015).

However, the interviewees stated repeatedly that the PhD students' interpretation is weak, and they do not have the knowledge in analysis. An interviewee also highlighted that most postgraduate students in the fields of education, Law, and Human and Social Sciences depend on questionnaires survey to collect data and often misinterpret the results of these surveys. Moreover, one interviewee mentioned, *"Most students' interpretation of the data based on the statistical report is quite inadequate, and their level of comprehension and choice of statistical procedures are both very poor."* Interviewee, I 1 mentioned, *"that interpretation is just a description, and it usually does not make sense, and PhD students do not link their interpretation to previous studies"*. Two interviewees mentioned that, if the application of Statistics has errors thus, the interpretation has errors. Overall, the results showed that the statistical report-based interpretation of the data by students is also quite poor. Interviewee, I 3 stated, *"the researchers may misinterpret p-values, assuming that a significant result necessarily implies a meaningful effect size. Alternatively, they may interpret correlation coefficients as indicating causation when in fact, correlation does not necessarily imply causation"*. The participant in interview (3), explained that there are errors in reading the existing tables in PhD research, thus affecting the interpretation of the research results.

5.2.3.3 Implications

Data analysis is frequently viewed as a step in the research cycle in which a variety of statistical applications are used, and a great deal of attention is paid to statistical aspects. To interpret the data, the researchers must correctly analyse it and completely comprehend their findings (Adèr et al., 2011). However, the analysis of interview data suggests that the misapplication of statistical methods can have a significant impact on the validity of research findings and affect decision-making processes, leading to incorrect conclusions and predictions for the future. PhD students often make mistakes in data analysis and interpretation, which affects the credibility of their research and future studies that rely on their research, ultimately impacting society's progress negatively. Hence, participants agreed that the utilisation of appropriate statistical procedures is imperative in research, as any use of inappropriate methods would impact the study's findings and credibility adversely.

The participant in interview 3 (Respondent: I 3) felt that the student's results and suggestions would be erroneous if the PhD student utilised the improper statistical approach *"If the method of statistical analysis is incorrect, then it gives us misleading results, and these are based on other studies and affect the results"*

of other studies in the future". The interviewee continued by saying that *"all the research that comes after this research, in which the use of Statistics was inaccurate, support its results"*.

Hence, most of the participants asserted that because the decision-making process is heavily reliant on the findings of the research, any inaccuracies in the findings will lead to incorrect conclusions and predictions for the future making the research useless. PhD Students often make mistakes in data analysis, including misinterpreting pre-existing data research without altering what their research requires, failing to choose a research sample and using the wrong statistical techniques. Inconsistencies in statistical data will have an impact on both the research's accuracy and the community as a whole because if Statistics are misinterpreted, society is at risk of being misled or deceived. One interviewee added that *"if a country is studying a future project that depends on statistical methods, then they need to pay close attention to this issue because, if the analysis is right, it will provide good predictions"*. Interviewee I 4 mentioned, *"If statistical approaches are misapplied in research, misleading results will be achieved, causing a negative impact on society and, as a result, no development for society"*. Consequently, it was clear that the interviewees considered Statistics as the backbone of national growth because, if the analysis is accurate, it will aid in making exact predictions when analysing a future project that relies on statistical methodologies. All participants agreed that if the research employed inappropriate statistical methods, the findings and suggestions would have a negative impact on societal progress if implemented.

As a result of this, the interviewees agreed that PhD students have a problem applying Statistics in their research and then interpreting the results obtained from statistical analysis and that this affects the credibility of the research and future research that depends on this research, as well as affecting decision-makers decisions, which may have a negative impact on society's progress.

5.2.4 Alternative Ways to Enhance Accuracy in the Use of Statistical Methods

Figure 5-4 demonstrated the themes and subthemes related to the possible alternative ways to enhance greater accuracy in the use of statistical methods in doctoral.

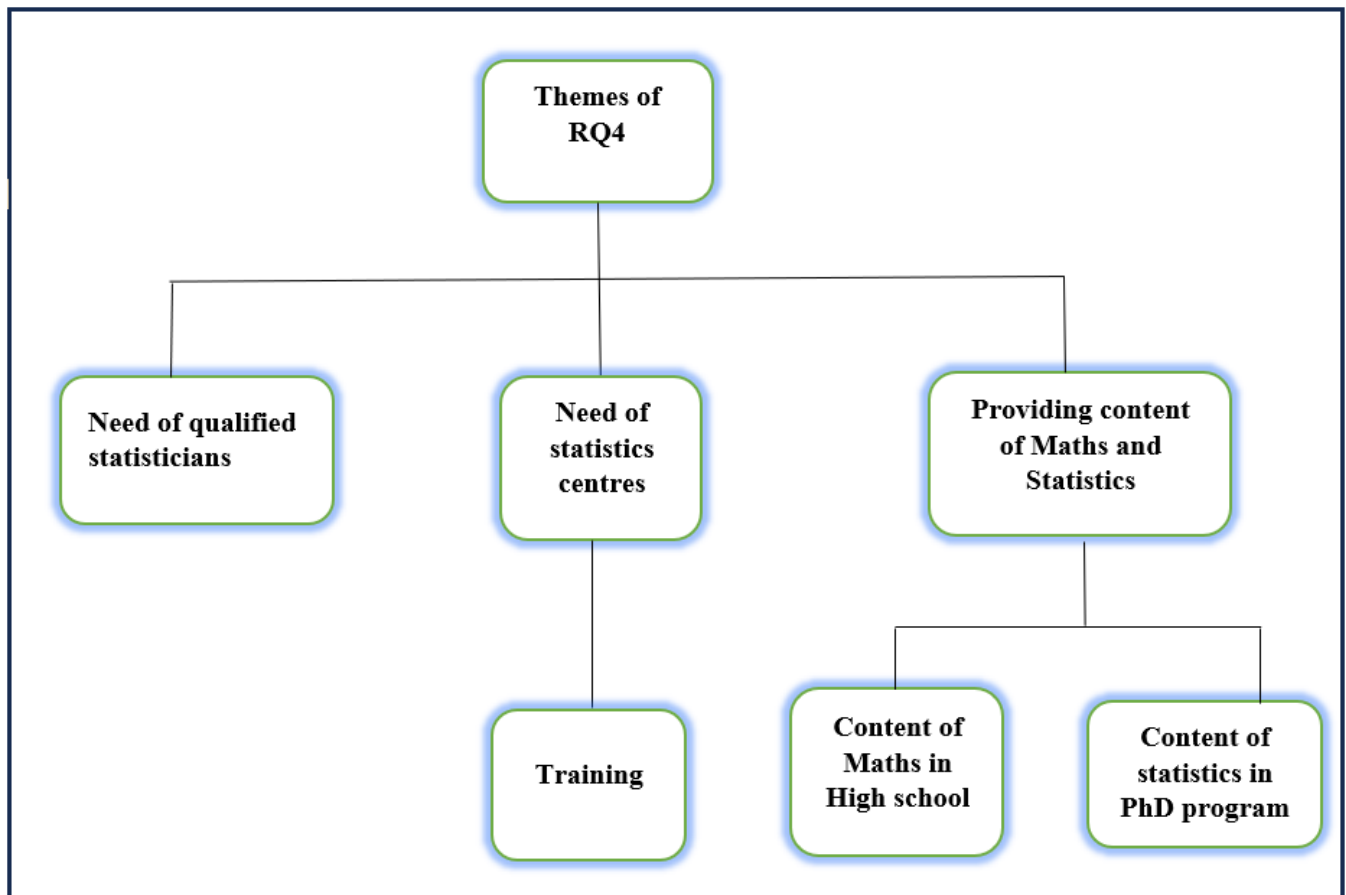


Figure 5-5 :The Themes and subthemes of the fourth research question (the alternative ways to enhance greater accuracy in the use of statistical methods)

5.2.4.1 Need of Qualified Statisticians

Throughout the interviews, numerous times it was stated that there is a need to employ qualified Statistics academic staff to teach Statistics to PhD students at university. This is critical for improving PhD students' understanding and ability to apply Statistics. Therefore, most of the participants agreed on some points for example, it is necessary to provide specialised competencies in the field of Statistics to teach Statistics subject to PhD students, each according to his specialisation, where Statistics in the Social Sciences is different from Statistics in science. Also, universities should employ consultants in Statistics to help students.

For instance, interviewee I 1 mentioned” *appointing statistical consultants to assist PhD students in the stage of applying Statistics in their study, who are different from the thesis supervisor*”. Moreover, in interview 4 (Respondent: I 4) the participant mentioned that PhD students should be offered SPSS, as well as other statistical applications and appoint statistical consultants to assist PhD students. Additionally,

another participant noted that *“people who come to the Kingdom of Saudi Arabia to teach Statistics must pass a statistical exam that determines their competence levels and establishes a minimum standard for practitioners”*.

In summary, the consensus among participants was found that universities need to employ qualified Statistics academic staff to teach Statistics to PhD students. Participants also emphasized the importance of providing specialised competencies in Statistics and appointing statistical consultants to assist PhD students in applying Statistics in their research. Moreover, the participants suggested that statistical consultants should be different from the thesis supervisor and that individuals teaching Statistics in Saudi Arabia should pass a statistical exam to establish a minimum standard for practitioners.

5.2.4.2 Need for Statistics Centres

In the Statistics centre theme, the interviewees emphasized the importance of creating Statistics centre PhD students can seek advice from a statistician. One of the participants mentioned that universities should supervise these centres. Furthermore, another interviewee who agreed with the previous participant suggested that universities should create Statistics centres inside the universities. One of the participants in SA university faculty members said that legislation for the Statistical assistant centre is first and foremost needed to ensure the quality of statistical techniques utilised at the PhD level. The participant continued by saying that *“everyone with an accounting license must ensure that the individual is qualified to conduct the work”*. All participants confirmed that there is a statistical centre that currently exists, and that PhD students ask them to help conduct their statistical methods; there are no competent statisticians, and the goal of these institutes is usually materialistic.

Additionally, all interviewees agreed that Statistics training for PhD students is necessary, according to one of the interviewees, *“The universities should provide training centre, that has Statistics programs, and this program is divided for all levels, lower-intermediate-advanced with consideration the level of all students as the literacy pathway, do not have enough background for conducting research and considering differences in postgraduate students understanding”*. Moreover, the participant I 3 stated that *“having Statistics training institutes with a statistical consultant to assist PhD students with any difficulties they may have, for example, training PhD students on how to enter their data, apply statistical methods or extract and understand the findings of their study”*.

In summary, the interviewees highlighted the need for a well-equipped Statistics centre to assist PhD students in their research and emphasized the importance of having qualified statisticians to provide guidance. They also called for the establishment of Statistics training centres with programs tailored to the needs of students at different levels of statistical literacy. Additionally, the interviewees identified the lack of competent statisticians and the materialistic goals of existing institutes as major challenges in this area.

5.2.4.3 Providing Content Maths and Statistics Content

All respondents agreed and repeated numerous times, that PhD students who completed high school in the literacy pathway suffer more from understanding and applying Statistics at the PhD level than science pathway graduates. The interviewees were all in agreement, it is critical to solve this issue by including Mathematics in the high school literacy pathway. In interview 4 (Respondent: I 4), the interviewee stated that *“the content of Mathematics in science pathway in high school is good, but it should be added to the literacy pathway”*. However, one of the respondents confirmed that *“there is a deficiency in teaching Mathematics at the high school level, which is supported by the results of TIMSS”*. Similarly, a few interviewees stated that the content of the curriculum of Statistics in the PhD program at the university is insufficient to establish students who can use what they have learned in their studies, thus it must be improved. Interviewee I 1 added that *“descriptive Statistics should be added to the PhD program”*. The majority of interviewees agreed that PhD students in Saudi Arabia require qualified teachers to teach Statistics in the university-mandated doctoral program. Moreover, introducing Statistics training courses, adding the Mathematics curriculum in literacy pathway in high school and improving the Statistics curriculum at the doctoral level so can enable PhD students to perform statistical analysis independently and efficiently.

In summary, the interviews revealed a consensus among participants that PhD students face challenges in understanding and applying Statistics, and that Mathematics education in literacy pathway in high school should be improved. Additionally, there is a need for qualified Statistics teachers and a Statistics centre to assist PhD students at the university level. Furthermore, the Statistics curriculum in the PhD program needs to be improved, including the addition of descriptive Statistics.

5.3 Conclusion

In conclusion, the findings of the analysis of the interviews revealed that a majority of interviewees hold the belief that there are only a limited number of students who possess average to good skills in Statistics. Additionally, it was noted that many students often struggle with utilising statistical methods effectively due to a lack of understanding and an inability to track the results. These insights highlight the need for improvements in the teaching and learning of Statistics among PhD students. All participants unanimously agreed that to overcome these challenges, PhD students need to be trained in descriptive Statistics as an additional course. This would enable them to establish a strong foundation in Mathematics, which would serve as a basis for their advanced Statistics studies. Furthermore, there is a need to reform the school and university systems in Saudi Arabia to provide students with high-quality statistical education, to strengthen the nation's intellectual resources in response to the changing landscape. There is no denying that statistical

education plays a significant role in a country's academic development. When students have a strong foundation in Statistics and learn to apply statistical methods effectively to their future projects, it can lead to high accuracy and success in their efforts. While many respondents acknowledge that the current education system in Saudi Arabia leaves them underprepared to select and apply appropriate statistical methods in their research, they also recognize that waiting for broad educational reforms may not provide the immediate help and assistance they need. As a result, they suggested a two-pronged solution: long-term systemic changes combined with short-term targeted support through specialized statistics centers and consultants.

Specialist centres and consultants can offer immediate, hands-on assistance to PhD students struggling with statistical methods and analysis. By providing direct access to statisticians, these centres can help students bridge the gap between theoretical knowledge and practical application, offering personalized guidance that improves their ability to conduct relevant analyses. Such centers increase the university's current resources and teaching capabilities, enhancing a more flourishing and supportive learning environment. As shown by the respondents, this combination of systemic reform and short-term targeted support could more effectively address the challenges PhD students face in statistical research in Saudi Arabia.

Chapter 6: Discussion

6.1 Introduction

The role of research is of utmost importance in the progression of knowledge and enhancement of the standard of living within a particular community. However, the quality and standard of research in Saudi Arabian universities have been a topic of concern. Thus, this study sought to investigate the selection and utilization of research methods at the doctoral level, specifically focusing on the use of statistical practices in the Education field. Moreover, the research question of the thesis is to investigate 'How do academics and PhD students from Education departments in a selected university in SA and a university in Scotland/UK, from different educational backgrounds, view their readiness, selection, and utilization of statistical methods in PhD research.' The sub-questions that have been addressed include the perception of readiness of PhD students to conduct statistical analysis, the extent to which PhD students apply the steps of statistical methods before conducting statistical analysis, the competence of PhD students in applying statistical methods and data interpretation based on statistical methods, the possible alternative ways to enhance greater accuracy in the application of statistical techniques in doctoral research, and the similarities and differences in the statistical analysis procedures used in a university of KSA and a university of the UK for PhD research. A concern was to evidence the need for reforms are needed in Saudi Arabia's education system and why future university students should have sufficient mathematical understanding to maintain the researcher's basic knowledge base (Mathematics and Statistics).

Furthermore, the approach utilized in the thesis was a mixed method using both qualitative and quantitative data analysis. The data was collected through a questionnaire that contained multiple-choice questions, open-ended questions, and six-point Likert-scale statements. The questionnaire was distributed to 46 PhD students from Saudi Arabia and 32 PhD students from the United Kingdom, and it also collected information about the student's educational backgrounds. The quantitative analysis was used to investigate the relationship between statistical literacy and the perception of preparedness of doctoral-level students to undertake statistical analysis in their research. Additionally, the quantitative method was used to compare the statistical approaches utilized in analysing doctoral study data in the KSA and the UK research programs. The qualitative analysis involved conducting a thematic analysis of the data from five interviews to identify themes related to the readiness of PhD students to conduct statistical analysis, the pre-analysis steps in statistical methods applied by PhD students, the accuracy of statistical methods and interpretation in PhD research, and alternative ways to enhance accuracy in the use of statistical methods. Additionally, the analysis explored the level of understanding of mathematical operations and statistics among Saudi PhD students.

This chapter is divided into several sections. It begins by describing the perception of readiness of PhD students for statistical analysis, understanding the level of Mathematics and Statistics among PhD students, moving on to the steps of statistical methods in doctoral research, common errors in the data analysis process, in addition to the accuracy of statistical methods and data interpretation, after that the similarities and differences in statistical method analysis procedures in the different fields. Moreover, in this chapter, all recommendations and conclusions are presented regarding the research topic, i.e., statistical education's importance in post-graduation studies. This chapter also acknowledges the research's limitations while identifying the zones where the research might have been influenced or constrained. In this chapter, recommendations have also been offered to different stakeholders, including academic advisors, policymakers, universities, and PhD students. Lastly, this chapter outlined the direction of future research and recognizes the study areas where more research is required to deepen and expand the understanding of how statistical education plays an important role in post-graduate research. Then finishing with the conclusion.

6.2 Perception of readiness of PhD students for statistical analysis

The findings of this research explored that there is a significant contrast in the readiness of the UK and Saudi Arabia PhD students to conduct statistical analysis; as outlined in Chapter Four, the overall statistical findings have revealed that the UK PhD students have more readiness than SA PhD students to conduct statistical analysis related to their research. Moreover, the UK PhD students appear to have a stronger theoretical understanding of Statistics, greater confidence in their ability to select statistical methods suitable to test their research hypotheses, and their ability to learn statistical methods more than SA PhD students in each statement. However, the study also revealed significant challenges facing SA PhD students in their readiness to conduct statistical analysis. The lack of proficiency in statistical analysis among PhD students in Saudi Arabia presents a significant obstacle to their academic progress. This issue can be attributed to the insufficient emphasis placed on statistical and mathematical education within the country's educational system. As a result, many students lack the necessary skills to independently conduct statistical analysis, which can cause challenges in completing their research projects. Readiness is the required stock of abilities that are prerequisites for learning. If individuals cannot learn, they must go back and inquire about the prior requirements that they must have (Touq & Adass, 1991). One of the fundamental prerequisites and a vital component in selecting a goal and attaining achievement is readiness (Al-Baaj, 2017). Additionally, the Pearson correlation in this research between key variables confirmed a positive relationship between the Readiness of PhD Students to conduct Statistical Analysis in PhD research and

PhD students' accuracy when applying statistical methods and data interpretation and vice versa. Furthermore, there is a statistically significant positive relationship between the greater extent to which PhD students apply the steps of the statistical method before conducting statistical analysis with the more accurate PhD students to apply statistical methods and data interpretation, and vice versa.

Murray (1982) emphasized in his theory of readiness that every flaw in school preparedness causes a delay or barrier in the educational process. The interviews demonstrated in this study that PhD students who graduated from the literacy pathway have difficulty learning Statistics at the doctoral level, as well, that the Statistics curriculum to be studied at the doctoral level is insufficient, that those who teach Statistics lack the necessary knowledge, skills and competence, and that Statistics programmes are not available. Likewise, all interviewees agreed that there are no statistical courses in Saudi universities to support students in using Statistics in their research and that Saudi students need more confidence in themselves in learning or using statistical methods in their research.

Teachers have a substantial influence on educational achievement; the quality of the education produced is directly proportionate to the quality of the teacher (Anthony & Walshaw, 2009). This educational gap may lead to difficulties in performing statistical analysis, particularly when conducting research projects at the university level. Given that many PhD students in Saudi Arabia are not adequately prepared to conduct statistical analysis on their own. Hence, these challenges have the potential to impede the ability of SA PhD students to learn and conduct research effectively, which can be particularly problematic for students in Social Sciences and educational departments. The lack of appropriate software programs for Statistics and inadequate provision of training are also significant obstacles to effective statistical analysis among SA PhD students. This conclusion has also been confirmed in the literature review by Al-Dawish (2019, p.112), that Saudi student's previous experience in Mathematics in high school is limited and does not assist them accomplish the mathematical assignments. Investing mathematical knowledge in other academic subjects represents realizing the integration of experience. He also stated that developing mathematical abilities helps in the development of the capacity to collect and classify quantitative data, tabulate, and interpret.

As evidenced by the literature review, Jasim et al. (2018) discussed that there are a large number of students in many Arab countries who do not have the ability to perform simple arithmetic operations in writing or mentally. The Arab region has seen significant investment in education in the past two decades, but the educational achievements continue to lag behind other countries at similar levels of economic development. Middle Eastern countries have achieved maximum enrolment in primary education and almost tripled enrolment in secondary schools since 1970 (Abouammoh, 2018). However, the results of international tests

show that the educational outcomes of Arab countries in Science and Mathematics remain drastically below the results achieved by Organisation for Economic Cooperation and Development (OECD) countries. Similarly, in the literature, Research conducted by Al-Maleky (2001) highlighted that there had been a significant lack of statistical knowledge amongst university students in Saudi Arabia as well as a low awareness level of the importance of the varying statistical methods. It was found that students were at a disadvantage due to the tutors being not academically qualified to provide sufficient knowledge of statistical methods. Ultimately, for these students, this meant that their research data was distorted due to mismanagement and ill-use of appropriate statistical methods used at the analysis stage. This affects the quality of research conducted in the region and the reliability and validity of its findings.

6.3 Understanding Level of Mathematics and Statistics among PhD Students

The level of Mathematics and Statistics proficiency among PhD students can vary depending on the discipline they are studying and the research methodologies they use. However, it is generally expected that PhD students have a solid understanding of Statistics and Mathematics and can utilize those skills in their scholarly investigations. Wood (2002), a lecturer at Portsmouth university, stated that many students find Mathematics and Statistics complex and challenging to grasp. He stated that students come from diverse backgrounds with varying levels of preparation in Mathematics, and many have yet to have prior exposure to the subject. As a result, they struggle with the concepts and often become disinterested in the subject Wood (2002, p.20). This statement about students' difficulty while learning Mathematics and Statistics is particularly relevant to PhD students. However, many PhD students come from different educational backgrounds, and some may not have a strong foundation in Mathematics and Statistics. PhD students must understand Mathematics and Statistics well to conduct research, analyse data, and communicate their findings effectively. Without a solid foundation in these subjects, PhD students may struggle to complete their research or may produce inaccurate results. The results of the interviews conducted for this study confirmed that certain PhD students in Saudi Arabia struggle to comprehend mathematical operations when studying Statistics for their PhD program. Additionally, several Saudi responded to the questionnaire in this research suggested that it is necessary to focus on establishing students in Mathematics at the high school. Therefore, universities must provide resources and support to assist PhD students in developing their knowledge of Statistics and Mathematics. This could include access to qualified teachers, tutoring services, or online resources to help students improve their skills. Overall, Wood's statement highlights the importance of addressing the understanding level of Mathematics and Statistics among PhD students. universities must provide appropriate support and resources to help these students develop their skills and knowledge in these critical areas.

Moreover, Pia (2015) confirmed that many students lack a strong background in Mathematics, which can hinder their ability to complete mathematical assignments. The author suggested that integrating mathematical knowledge into other academic subjects can help students develop their abilities to collect and classify quantitative data, tabulate, and interpret. This highlights the importance of having a solid foundation in Mathematics and Statistics, as it can improve students' understanding of statistical techniques used in research. The use of statistics in practice is further emphasized by Hand (1998). When discussing doctoral programs, Hand's claimed that Statistics are essential in finding solutions to practical problems is especially pertinent. As PhD students engage in research, they are required to collect, analyse, and interpret data to make meaningful contributions to their respective fields. The ability to do so effectively requires a strong understanding of Statistics. Therefore, PhD students must have a good grasp of statistical concepts and techniques to be able to conduct research successfully. However, several researchers noted that the research foundation on Statistics learning is considered a sub-domain of research methods. However, many learners were identified as having difficulty grasping and implementing fundamental statistical ideas. These studies also found that Social Science postgraduates had difficulty grasping descriptive Statistics and often made common mistakes in the field (Broers 2002; Garfield & Ahlgren 1988; Zaidan et al. 2012).

These findings are also supported by the literature review in which Gardenier and Resnik (2002) and Currie (2009) have recognised that using statistical knowledge appropriately is a crucial aspect of research integrity. It is essential to understand the role of Statistics in scientific research to comprehend the implications of misapplying statistical knowledge. Gardenier and Resnik (2002) have stated that the misapplication of statistical knowledge can be classified as misconduct or misapplication resulting from a lack of competence or negligence by the researcher or student. In the literature review, Brown et al. (2018) also emphasised the importance of statistical methodology and strategies in ensuring the accuracy and reliability of research conclusions, they argue that statistical analysis errors involve methods that do not provide reliable evidence for the results issues. Therefore, Thomas and Pencina (2016) asserted that a proper understanding of statistical methodology is crucial in preventing the manipulation of statistical information and evidence.

Moreover, Resnik (2000) also highlighted the importance of the appropriate application of statistical techniques in research to make sure the reliability and quality of the findings. However, Connolly (2007) argued that every student, even those who are initially intimidated by Statistics, has the potential to acquire the knowledge and skills necessary to perform routine quantitative research effectively. The author emphasises that mathematical formulae can be overwhelming, but understanding the key theories and concepts of quantitative data analysis is straightforward. Additionally, Connolly (2007) suggested that the concepts in statistics are likely to be easier to understand than those encountered in other courses, such as

sociology, education, psychology, and philosophy. In conclusion, PhD students should not be discouraged by their perceived lack of mathematical ability, as the essential concepts in Statistics are easy to comprehend, and they can learn to perform quantitative research at a high level.

Moreover, it is highlighted in the literature review by Buckley et al. (2016) found that a low level of mathematical reasoning ability in early schooling leads to a feeling of despair and helplessness when faced with Mathematics and statistical problems later on. This lack of confidence can further develop into a perception of a low likelihood of success in Statistics, ultimately resulting in a reduction in self-confidence. Additionally, a lack of foundational knowledge in Mathematics often translates to lower levels of knowledge in Statistics (Richardson and Woolfolk, 1980). This lack of knowledge can also lead to a decrease in self-esteem, as students may view themselves as inadequate or incapable of performing well in these areas (Maloney et al., 2011). These challenges can reinforce statistical and Mathematics anxiety among PhD students, making it difficult for them to learn and apply statistical concepts effectively. In addition to the challenges faced by PhD students in understanding Mathematics and Statistics, the lack of suitable teaching and training in these subjects can also have negative consequences. Sterba (2006) highlighted that inadequate teaching and training in Statistics can lead to inefficient and wasteful use of resources, misguided managerial interventions, and even contamination of the scientific knowledge base. This underscores the importance of universities in the kingdom of Saudi Arabia providing appropriate training and support to ensure that PhD students have the requisite competencies and expertise to undertake their studies using a robust methodology. According to the findings of this study, some PhD students in the Kingdom of Saudi Arabia have difficulty understanding Statistics at the doctoral level, and the main reason for this is that they did not study Mathematics in previous academic stages and do not have a strong foundation in Mathematics.

6.4 Steps of Statistical Methods in PhD Research

Statistical methods play a crucial role in PhD research. They provide a framework for collecting, analysing, and interpreting data and help researchers draw valid and reliable conclusions. However, to ensure the accuracy and validity of research results, it is essential to follow a structured approach when using statistical methods.

The first step in using statistical methods in PhD research is to present the findings related to the application of these methods. This involves reviewing the literature to identify appropriate statistical techniques for the research question, selecting the appropriate data collection method, and collecting data. The literature

analysis corroborated this idea by showing that the first step in every investigation is to establish a precise inquiry about the issue at hand. To formulate the research questions, it is necessary to evaluate the relevant literature. The literature review also served the purpose of comprehending the research methodology, which encompasses the experimental design that forms the foundation for gathering both primary and secondary information and analysing the results (Loewen & Gass, 2009). Additionally, the Pearson correlation in this research between key variables confirmed a positive relationship between the greater the extent to which PhD students apply the steps of statistical methods before conducting statistical analysis and PhD students' accuracy when applying statistical methods and data interpretation and vice versa. However, this study showed that SA PhD students had difficulty determining the statistical methods by reviewing the methods used in previous studies more than their counterparts in the UK.

Once the data has been collected, the next step is to prepare it for analysis by cleaning, coding, and checking for accuracy. Descriptive Statistics such as means, standard deviations, and frequencies can be used to summarise the data and identify patterns and trends. After that, statistical methods such as correlation, regression, and analysis of variance (ANOVA) can be used to test hypotheses and make predictions. The literature review also emphasized the significance of the research methods section of a dissertation, which details the strategy used to acquire the necessary information. To address the problems that arise from the study purpose, researchers use a variety of research methodologies (Saunders et al., 2009). However, it was also discovered by Bryman (2016) that not everyone might agree with this view, as Theofanidis and Fountouki (2018) argued that strict adherence to the methodology could limit creativity and innovation in research and that the most groundbreaking discoveries often come from taking unconventional approaches. According to Queirós et al. (2017), strict adherence to the methodology can lead to a lack of diversity and inclusivity in research, as it may privilege certain types of knowledge and exclude marginalized perspectives. Yet, the research reported in this thesis may support the notion that methodology is generally perceived as a set of knowledge and principles that allows for systematic research because it is based on evidence and research that has shown the usefulness and effectiveness of such an approach. A methodology has been developed over time through a rigorous process of testing and refinement, and it provides researchers with a structured approach to conducting research that helps to ensure the validity and reliability of their findings (Thomas & Pencina, 2016).

As a result, some students may skip necessary steps, such as data cleaning and preparation, or may use inappropriate statistical techniques, leading to unreliable and invalid results. This was stated by the interviewees, who also confirmed that some Saudi students find it challenging to choose statistical methods that are appropriate for their research, the selection of tools such as non-parameter or parameters, it is also

difficult for the some students to distinguish between independent and dependent variables, difficulty in the process of cleaning data, as well as measurement scales, also struggle with selecting appropriate samples and the researchers have a problem selecting the effective methodology for their research and do not understand the concept behind the application of Statistics and do not realise that statistical analysis is the most crucial tool of quantitative research, also the PhD student is dependent on others, such as non-specialised offices in data input, where numerous errors occur. This idea was also supported by the literature review since skipping statistical steps can also result in wasted time and resources. If the data needs to be properly cleaned and prepared, it may need to be re-analysed or even discarded, resulting in additional time and effort. Additionally, if the results are unreliable, the research may need to be repeated, leading to wasted resources (Gibbs et al., 2015). However, the literature review also found that postgraduate students need to be better equipped to successfully undertake the research by employing proper methodology because they are not given adequate instruction in Statistics. This might have negative results for the community because of poor and unproductive application of existing resources, incorrect management initiatives, and the possibility that the study could taint the scientific information base (Sterba, 2006). However, despite the importance of following a structured approach when using statistical methods, this study illustrated that many SA PhD students still need to apply these steps fully. This can be due to a lack of knowledge and, depending on assistance, time constraints, or the perception that statistical methods are complex and difficult to apply. In this thesis, some participants from Saudi PhD students reported it was challenging to determine their variables more than UK PhD students and to select the proper statistical methods by reviewing existing studies.

The use of statistical methods by researchers in Saudi Arabia was also investigated in a study by Al-Maleky (2001). This study found that researchers in Saudi Arabia heavily rely on quantitative approaches, particularly questionnaires. Interviewees in this research agreed that SA students rely on quantitative due to departmental preferences and convenience. Thus, it is crucial for doctoral candidates to meticulously evaluate the advantages and drawbacks of each methodology when selecting the appropriate statistical tool for their research; the most commonly used statistical software by PhD students is Statistical Package for Social Sciences (SPSS), which is a computer program commonly used in data analysis in social sciences research. The strengths of SPSS include its ability to handle large datasets, its ease of use, and its versatility in carrying out a variety of statistical analyses. However, it is noteworthy that while SPSS is frequently employed, it has limitations, i.e., it can only be used for quantitative data and often needs further training to make full use of all its capabilities. Prior knowledge of Statistics is considered a prerequisite for students utilizing SPSS. Therefore, some Saudi PhD students' resort to unqualified offices to help them enter their data into SPSS, perform their statistical analyses, and extract and interpret results. Unfortunately,

inadequate attention was not placed on the statistical discipline during the selection and application of statistical methods for their research, which raised concerns about not achieving the desired research results and misleading future research or not achieving benefit to the society in which it is applied, this was confirmed by the interviews in this research.

Furthermore, the reasons behind the selection and utilization of statistical methods among PhD students are affected by several elements, such as the lack of proper training and guidance, whether from research supervisors or from the academic staff who teach Statistics to PhD students' failure to grasp the significance of Statistics, lack of prior knowledge and experience, the complexity of statistical concepts and the difficulty in applying them in practice. The findings of this study also indicated that students commonly encounter difficulties in comprehending statistical concepts due to a lack of prior knowledge. Whereas for academic staff when teaching Statistics in Saudi universities for PhD students lack the necessary knowledge, skills and competence. It can be presumed that individuals utilizing the SPSS software possess prior knowledge regarding the subject matter. The respondents from the interviews clarified that there are no courses that instruct students on utilising SPSS or selecting the best statistical methods for their study. The inadequate emphasis on fundamental courses such as statistics is becoming a growing concern for individuals aspiring to pursue higher education.

Interviewees in this research mentioned that a deficiency in mathematical expertise and a limited understanding of weak bases exists among a significant number of Saudi Arabian students who did not pursue a scientific curriculum during their secondary. Students' lack of familiarity with statistical ideas and methods is a potential source of trouble when it comes to analysing data, particularly in the context of academic research projects. Moreover, according to Poon and Ainuddin (2011), statistical misapplication is also widespread among researchers who have not received enough education or training in the field. This research agrees with the Saudi Arabian studies such as, Abu Haimad (2013), Al-Ajlan (1990), Al-Maleky (2017), Al-najjar (1991), and Al-Rashidi (2004) that there is statistical misapplication in some scientific research in KSA due to a lack of knowledge and understanding of the statistical methods, and these studies confirmed that universities and academic institutions in KSA need to provide adequate resources and support to help students overcome these challenges and develop a strong foundation in statistical methods.

However, applying the steps of statistical methods in PhD research can offer several benefits. Firstly, it can help ensure the accuracy and reliability of research results by minimizing errors and biases. Secondly, it can improve the validity and generalisability of research findings by using appropriate statistical techniques to test hypotheses and make predictions. Finally, it can enhance the reproducibility and transparency of

research by providing a clear and structured approach to data analysis and interpretation. It is also supported by the literature review in which it was found that applying proper statistical methods in data analysis can help minimize errors and biases and improve the reliability of research findings (Saunders et al., 2016). Similarly, Al Qisas (2007) also determined that using appropriate statistical techniques can increase the accuracy and validity of research results and improve their generalizability to other populations and settings.

6.5 Common Errors in Data Analysis Process

Data analysis is an essential component of any research project, as it allows researchers to derive meaningful conclusions from the data collected. However, errors in data analysis can have serious consequences, leading to incorrect or invalid conclusions that can undermine the credibility of research findings. One of the most common errors researchers make during data analysis is the inappropriate application of statistical methods. This can occur when researchers lack a proper understanding of statistical concepts or when they use inappropriate statistical methods to analyse their data. This issue appeared in the questionnaire for this research: the majority of Saudis oscillated between disagreeing and strongly disagreeing that they had a good theoretical knowledge of the concepts of statistics. This was also true for the statements, "I am confident in my ability to choose appropriate statistical methods to test my research hypotheses" and "I am confident in my ability to learn statistical methods. The interviewers, lecturers of statistics for PhD students in Saudi Arabia, confirmed all the above.

The literature review also supported this viewpoint, stating that if a researcher obtains findings that contradict the proper application of statistical procedures, their findings might turn out to be deceptive. Because of the mistakes, the study could fail to adequately answer the examiner's hypothesis. The study's reliability and credibility in producing reliable knowledge will also be compromised as a result (Castellan, 2010; Richardson, 2011). Similarly, Abdul Rahman (2015), Al-Rashidi (2004) -also concurred with the aforementioned views, arguing that there is consensus among investigations carried out in Arab countries on the topic of the prevalence of mistakes made by academics employing wrong statistical approaches at the data analysis phase being the primary cause of resulting in the incorrect findings of the research.

Moreover, the utilization of poor statistical methods was further confirmed by the results presented by Al-Malaki (2001), who found that 206 of a total of 423 projects made mistakes due to improperly using statistical methodologies. He continued by stating that incorrect application of statistical procedures and choosing a smaller sample size, are the leading causes of inaccuracy in quantitative studies. This claim was also supported by a study from the College of Education at Mosul university in Iraq in 2009, which found that over 110 articles had been deemed inappropriate because students had chosen inappropriate study

approaches and had been incapable of using statistical techniques like the t-test. According to the study's findings, misapplying statistical techniques damages inexperienced doctoral and master's students more since it obstructs their investigation and causes their outcomes to be misperceived in comparison with standard statistical techniques (Almurad, 2009).

Furthermore, even if researchers use appropriate statistical techniques and handle their data properly, they may still make errors in interpreting the results. This can occur when researchers fail to clean or pre-process their data properly, leading to incorrect or incomplete results. Where the results of the interviews in this study showed that some researchers may fail to choose the appropriate sample and identify and remove outliers or missing values, leading to biased or inaccurate results. Additionally, they may also misinterpret p-values, assuming that a significant result necessarily implies a meaningful effect size. Alternatively, they may interpret correlation coefficients as indicating causation when in fact, correlation does not necessarily imply causation. Such errors can lead to incorrect conclusions, which can be further propagated in subsequent studies. Moreover, the interviewees in this study illustrated that most students' interpretation of the data based on the statistical report is quite inadequate, and their level of comprehension and choice of statistical procedures are both very poor, and the interpretation is just a description, and it usually does not make sense and does not link their interpretation to previous studies. Garca-Pérez (2012) supported this viewpoint, arguing that many research conclusions are erroneous owing to a combination of variables, such as biases in research methodology and data processing and a propensity to perceive poor or unreliable findings as substantial.

However, the misapplication of statistical techniques can happen if the researcher is not familiar with the statistical procedures and strategies being used. The literature review corroborated this by claiming that poor concentration on learning about statistical approaches and Statistics as a whole has an adverse impact on the standard of the study that is eventually made public (Mitchell & Alfuraih, 2018). Al-Maleky (2017) also determined that in the case of Saudi Arabian universities, learners were not only woefully underprepared for their careers but also severely unaware of the significance of the many different statistical approaches available to them. This was confirmed by interviewees participating in the research reported in this thesis that having instructors lack the academic credentials to give an adequate understanding of statistical procedures also put students at an edge. Thus, this indicated that the students' study data had been misinterpreted because of poor data management and inappropriate statistical procedures utilized during the analysis.

Furthermore, Poon and Ainuddin (2011, p.318) also claimed that the researcher's or student's chances of misapplying statistical procedures due to inexperience grow if the person conducting the research has not

finished a thorough study and acquired a comprehensive knowledge of statistics. Based on Resnik (2000, p. 166) provided a variety of examples of the improper utilization of statistical procedures brought on by a lack of statistical understanding, such as using correlation analysis to examine causal associations, employing structural equation modelling to address and evaluate the hypothesis of research using an extremely limited amount of assessments in the information set, and employing regression to determine the link between an independent and a dependent variable that does not correspond linearly. Similarly, this research showed that some SA PhD students have difficulties, as they responded to the questionnaire in this study that they disagreed with the statements "I define the type of my research variables by reviewing previous studies" and "I determine the statistical techniques of my data analysis by reviewing the techniques used in previous studies." Moreover, the SA PhD students contradicted the statement "I have good skills in analysing and interpreting statistical data.". Equally, most of the individuals interviewed while talking about the common errors made by some PhD students during their statistical data analysis process felt that several students have been found to make errors in the data classification by Measurements (ordinal or nominal). Additionally, interview4 (Respondent: I 4) showed that " *some of our university students work on a correlation but need help understanding the theoretical basis of correlation, what does the correlation mean*"; another interviewee said, that some students had very simple statistical information about regression, they used t-test just to show they had tables, but their research did not need it. Moreover, participant in interview 3 (Respondent: I 3) explained that " *there are errors in reading the existing tables in PHD research, thus affecting the interpretation of the research results*". As this showed, some KSA PhD researchers lack knowledge of statistical methods and may be more prone to making errors in their analysis.

6.6 competence of Statistical Methods and Data Interpretation

The accuracy of data interpretation and statistical methods is critical in doctoral research, as it can impact the validity and reliability of research findings. Statistical methods are used to analyse and interpret data, and the accuracy of these methods is essential to ensure that research findings are valid and reliable. Data interpretation is also crucial, as it involves making sense of the results obtained from statistical analyses. Inaccurate interpretation can lead to incorrect conclusions, which can have significant implications for future research and real-world applications in society. Furthermore, Al-Maleky (2001, p.113) also remarked that mistakes made when managing the data in some Saudi research, such as using outdated or incorrect information, may potentially contribute to erroneous conclusions and prejudices in the study. These mistakes may cause unsatisfactory or missing results if they are not detected and fixed. He continued stating that in research, the possibility of influence on the field of study is substantial, these characteristics may have significant repercussions for the reliability and trustworthiness of research results. This research result

aligns with the above findings that some SA PhD students struggle when applying statistical methods. Consequently, the number of SA PhD students who agree with the statement "I have good skills in analysing and interpreting statistical data" is around half of those who agree from the UK PhD students. Nevertheless, the results from the questionnaire and interviews in this research highlighted that most SA respondents favoured the quantitative approach since its easier particularly when extrapolating from large samples and required from the university department.

However, according to Ott & Longnecker (2015), multiple elements could impact the precision of data interpretation and statistical approaches, including the integrity of the data, the suitability of the statistical techniques employed, the existence of biases, and the possibility of misinterpretation errors. According to Khusainova et al. (2016) based on the findings of the literature review findings, using a suitable statistical approach for data analysis result in trustworthy and sound inferences. Therefore, the deductions derived from scientific investigations are rendered invalid and lack significance. Gardenier & Resnik (2002) also pointed out that investigators could be more prone to comprehend the findings in a manner that matches what they were anticipating when they possess a prior concept or prejudice regarding the anticipated outcomes of a study. This raises the risk of erroneous conclusions being drawn from the study.

Similarly, Almurad (2009) also underlined the implementation of inadequate statistical procedures, which might jeopardise the reliability of the findings. If a researcher employs a statistical technique that is inappropriate for the type of information being analysed or the study question at Hand, the findings could underestimate the basic relations or structures in the information being analysed. The interviewees repeatedly agreed that the some SA PhD students' interpretation is weak and do not have the knowledge in analysis and how this influences the research's outcomes and trustworthiness, as well as the growth of society.

A study by Castellan (2010) indicated that the conclusion could potentially be deceptive if a researcher has produced findings that are contradictory to the proper application of statistical techniques. This result is also in accordance with the view attained by Gibbs et al. (2015), which stated that if a researcher fails to apply the appropriate research approaches properly, then the analysis performed, and any inferences obtained from the investigation will probably be inaccurate. Additionally, several studies done in Arab countries concur that the primary issue resulting in the erroneous results attained in research is the prevalence of mistakes made by academics employing statistical approaches at the data analysis phase. Many studies also contended that the majority of the study done in the past is probably not trustworthy. Not only that but using it to make decisions would be risky (Al-Najjar, 1991; Al-Rashidi, 2004). A study by Al-Najjar (1991) provided additional support for this claim by asserting that publications originating from

universities in Saudi Arabia lacked accuracy. He argued that the utilization of correct statistical techniques in dissertations was significantly lower than the utilization of incorrect statistical approaches.

6.7 Similarities and Differences in Statistical Methods analysis procedures in KSA and UK

KSA and UK both countries have strong academic traditions and invest heavily in research and development; however, the educational system in Saudi Arabia and the United Kingdom is different in many ways. In the UK, the education system focuses on encouraging critical thinking and creativity (Al-Dakhil, 2015). In contrast, according to Alhammad (2010), the academic method advocated in Saudi schools is a major source of concern for Saudi students in the Kingdom of Saudi Arabia. In these institutions, instructors emphasise a system of inefficient memorisation and a shallow grasp of information for the only aim of clearing an exam. This kind of education goes much beyond the high school level and into the tertiary education system. Alharthi et al. (2019) provided further support for this viewpoint by arguing that students are routinely instructed in exam-passing strategies instead of being encouraged to critically interact with the content to build their own opinion to optimise their comprehension and mental abilities. The majority of the interviews in this research confirmed what was confirmed by the previous Saudi studies above, that there is a need for qualified academic staff to teach statistics in Saudi universities. This part included the answer to the fifth question of this research, which referred to similarities and differences between UK and SA PhD students, as the results of the comparison between the two samples showed the differences and similarities between them.

As outlined in Chapter Four, the overall statistical findings from the Independent-Samples t-test results revealed a statistically significant difference between the two samples. UK PhD students showed more readiness than SA PhD students to conduct statistical analysis related to their research. Moreover, UK PhD students appeared to have a stronger theoretical understanding of statistics and greater confidence in their ability to select suitable statistical methods to test their research hypotheses and to learn statistical methods, compared to SA PhD students. Additionally, UK PhD students preferred to rely on themselves to perform statistical analysis in their research more than SA PhD students. This demonstrates the disparity between the two countries' approaches to statistical analysis.

Moreover, in this thesis, a few differences were found between the two study samples. Some participating Saudi PhD students reported finding it more challenging than UK PhD students to determine their variables and select the proper statistical methods by reviewing existing studies. However, the overall statistical findings from the Independent-Samples t-test results revealed that there was no statistically significant

difference between the two samples of PhD students. Both UK PhD students and SA PhD students have the ability to perform pre-analysis steps in statistical methods. Notably, SA PhD students represented approximately one-third of the sample of PhD students in the UK, as shown in Chapter Four, section 4.3.

This research result also demonstrated that some SA PhD students struggled with performing statistical analysis. In the statement "having good skills in analysing and interpreting statistical data," the number of SA PhD students who agreed was around half of those who agreed from the UK PhD students.

Moreover, an independent sample t-test was used to analyse the differences between the two samples, demonstrating that equal variance was not assumed. The difference between the two samples of PhD SA students and PhD UK students was statistically significant. The competence of PhD students in applying statistical methods and interpreting data was not equal, and differences were found. The differential favoured UK PhD students. UK students utilized statistical methods more accurately than SA PhD students and were more competent in data interpretation based on statistical approaches than SA PhD students.

Most SA respondents favoured the quantitative approach since its easier particularly when extrapolating from large samples and required from the university department. In contrary, several UK respondents concurred that employing a qualitative approach because it deals with people directly, is easy to use, obtains more in-depth data, achieves meaningful results, and helps to understand the issue in depth.

Also, In the questionnaire, both samples understood the difference between variables in quantitative research (e.g., independent, dependent, and mediating variables) and had the ability to use statistical analysis software (e.g., SPSS, Minitab) very well. Similarly, both samples realize the importance of a pilot study in their research to test the validity and reliability and can choose an appropriate sample type for their research.

SA and UK PhD students agreed on the importance of different strategies for improving accuracy in applying statistical methods in doctorate research and they believe that using inappropriate statistical methods in the research leads to inaccuracy results. However, SA PhD students depend on unqualified statistical centres rather than themselves and they need to gain self-learning skills, as some academic staff stated in the interviews.

Saudi's participants in this research reported that providing a good cadre in the subject of Statistics capable of overcoming the difficulties of studying Statistics is necessary, as interviewees confirmed that the academic staff for teaching statistics at the university in SA lacks competence and specialization, and the

curriculum at the university is insufficient. PhD students from SA and the UK agreed that teaching Mathematics in schools is essential. The independent-sample t-test result showed differences between the two samples in the possible alternative ways to enhance greater accuracy in the use of statistical methods in doctoral research. The difference favoured SA PhD students, indicating that SA students needed alternative ways to enhance greater accuracy in the use of statistical methods in doctoral research more than UK PhD students.

Moreover, in KSA, there is a greater emphasis on descriptive Statistics, like frequencies, standard deviations, and mean, rather than inferential statistics. This is likely because many research studies in KSA are still in the exploratory phase, seeking to describe the characteristics of a particular population or phenomenon (Ibrahim, 2016).

Additionally, another difference is in the use of statistical software. In the UK, it is common for researchers to use software such as SPSS, Stata, or R for data analysis. These software programs have been widely adopted by academic institutions and provide a user-friendly interface for conducting statistical analyses. In KSA, however, institutions lack in providing software programs, as the interviewees confirmed. Poon and Ainuddin (2011) concurred with this narrative, arguing that statistical misapplication is more likely to occur when researchers lack a solid foundation and training in the field. However, Saudi Arabia's educational and training system is currently undergoing a period of significant growth. Several goals were laid forth for Saudi Arabia's educational system in its 2030 vision (General Authority for Statistics, 2019). Therefore, the differences in statistical methods used by academics and PhD students in Saudi Arabia compared to the UK have significant implications for the quality of doctoral research in Saudi Arabia. Where these differences between the two countries help to confirm that there is a statistical misapplication in some scientific research due to a lack of background and understanding of the statistical methods among Saudi PhD students, and this problem must be solved from its roots. Some Saudi studies such as, Abu Haimad (2013), Al-Ajlan (1990), Al-Maleky (2001), Al-najjar (1991), and Al-Rashidi (2004) and this study agree in there is a statistical misapplication in some scientific research. However, it is distinct from them in looking for the causes of certain Saudi students' lack of statistical understanding and difficulties applying it in their study, as it goes back to the students' foundation in Statistics and Mathematics to understand the steps of statistical analysis.

6.8 Alternative Ways for Enhancing Accuracy in Statistical Methods

The utilisation of statistical techniques is of utmost importance in doctoral research, as it offers a structured approach to gathering, scrutinising, and comprehending data. Improper application of statistical techniques

may result in erroneous research outcomes and impede the advancement of scientific exploration. Consequently, it is imperative to guarantee precision in the application of statistical techniques in doctoral studies. There are several alternative approaches to improve the precision of statistical methods employed in doctoral research. These approaches include augmenting the doctoral education course of study, implementing training programs, and establishing quality control systems.

One of the primary ways to enhance the accuracy of statistical methods in doctoral research is to improve the curriculum of doctoral education. This involves incorporating more rigorous statistical courses and research methodology into the doctoral program's curriculum. However, according to Mitchell and Alfuraih's (2018) findings, the education framework in Saudi Arabia exhibits a notable deficiency in adaptability and a dearth of emphasis on mathematical proficiency. The author further posited that an absence of mathematics expertise and an insufficient awareness of inadequate foundations are prevalent among Saudi Arabian students who did not pursue a scientific curriculum during their secondary schooling. The lack of a robust foundation in statistical theory and methods among students is anticipated to pose difficulties in performing statistical analysis, particularly in the context of research endeavours at the university level. Thus, doctoral programs could provide mandatory courses on statistical analysis, data management, and research design. Such courses would help to improve students' knowledge and skills in statistical methods, enabling them to perform statistical analysis accurately. The literature review also supported the premise that a growing percentage of learners in social sciences globally are currently required to participate in statistical education as a consequence of their courses of study (Dombrowski et al., 2019).

Contrarily, Benson, et al. (2018) affirmed that Statistics education could elicit anxiety among some students. Faber et al. (2018, p.5) also supported this notion by stating that the negative affective and cognitive reactions experienced by certain students during their pursuit of Statistics coursework at the collegiate level may result in a decline in their academic achievement. This phenomenon may also account for the tendency of some college students to avoid enrolling in Statistics courses actively. However, it is also important to note that Statistics education can provide numerous benefits to students, including enhanced critical thinking skills, improved problem-solving abilities, and increased research literacy (Richardson, 2011). Furthermore, statistical methods are crucial for conducting rigorous and reliable research, particularly in fields such as social sciences and medicine, and an understanding of statistics is essential for interpreting research findings and making informed decisions based on data (Marley & Levin, 2011).

Moreover, incorporating more research methodology courses into the doctoral program's curriculum can help students understand the research process, including hypothesis formulation, data collection, and data analysis. These courses could also introduce students to various statistical software, such as SPSS and others, which can aid in the statistical analysis of data. This would provide students with a solid foundation in statistical methods and enable them to conduct independent research more accurately (Alghamdi et al., 2019). Moreover, the evidence presented by Karasik (2015) previously also corroborates the argument that enhancing the education curriculum can lead to several benefits, such as improved accuracy in statistical analysis and data interpretation, which could increase the reliability and validity of research findings. Moreover, it could enhance students' employability and research competencies, leading to more research opportunities and better job prospects, obtain skills and knowledge needed for the workplace and society in the mid-21st century.

Furthermore, General Authority for Statistics (2019) also highlighted another way to enhance the accuracy of statistical methods in doctoral research to provide training programs. These programs could be offered to students and faculty members and could cover various statistical topics, such as regression analysis, multivariate analysis, and structural equation modelling. Training programs could be offered as short courses, workshops, or webinars and could be tailored to meet the specific needs of different disciplines. Similarly, Al-Dawish (2019) stated that developing mathematical abilities helps develop the capacity to collect and classify quantitative data, tabulate, and interpret. Al-Dakhil (2015), gave an example of the Education Ministry of Singapore, explored that Singapore has become a role model in the world in education, especially with the adoption of the Singapore Curriculum for Mathematics.

Furthermore, the curriculum positively affects the knowledge seekers' level of giving and intelligence and vice versa. Moreover, training programs could improve the dissemination of research findings by providing researchers with the necessary statistical knowledge to report their results accurately. On the other hand, Zhang et al. (2010) argued that providing training programs could be challenging, as it requires significant resources and time. Additionally, some students and faculty members may not be interested in attending training programs, which could hinder the dissemination of knowledge. However, despite the challenges, it is still recommended to provide training programs for placing our students in the suitable course of study at the next level of education. (Reyes & Gopinathan, 2015).

Moreover, developing quality assurance mechanisms is another way to enhance the accuracy of statistical methods in doctoral research. Quality assurance mechanisms could include regular audits of statistical analyses and the use of standardised protocols for statistical analysis. These mechanisms could be

implemented at the institutional level or the departmental level and could ensure that statistical analyses are accurate and reliable. Quality assurance mechanisms can lead to several benefits, such as improving the accuracy and reliability of research findings, increasing the quality of research, and promoting transparency and accountability in research (Schneider, 2013). On the other hand, the literature review also highlighted that implementing quality assurance mechanisms can be challenging, as it requires significant resources, including financial resources and human capital. Moreover, quality assurance mechanisms may face resistance from faculty members who may view it as an additional burden on their workload or a threat to their academic freedom. Therefore, it is important to provide faculty members with adequate support and training on how to comply with quality assurance mechanisms while ensuring their academic freedom (Wasserman, 2013).

This study supported all previous studies in improving the quality of research and the educational system with all its facilities. The finding of questionnaire results in this research showed that both groups of UK and SA PhD students support the possible alternative ways to enhance greater accuracy in the use of statistical methods in doctoral research. The differences between the two groups were not equal, and the differences have been discovered about the possible alternative ways to enhance greater accuracy in the use of statistical methods in doctoral research in favour of SA PhD students, that means SA students need the alternative ways to enhance greater accuracy in the use of statistical methods in doctoral research more than the UK PhD students. The difference in support and preparedness between UK and Saudi Arabian SA PhD students indicates that SA students may need alternative methods to improve their accuracy in using statistical methods in doctoral research. This suggested that the educational systems in the UK and Saudi Arabia differ significantly in support Structures, counselling services, Independent Learning, and Critical Thinking. These support systems help UK students develop strong research skills, including accurately applying statistical methods. SA students might need alternative strategies and additional resources to reach a similar level of proficiency in their doctoral research.

Also, the interviewees (staff academic in SA) suggested several recommendations, for instance, that students in high school should have a foundation in Mathematics, especially students in literacy pathway, as some lecturers said that PhD students lack understanding of simple calculations during Statistics lectures, there should be courses in Statistics, specialists in Statistical centre to help students when choosing and conducting statistical methods, and the commercial statistical centre that PhD students resort to should be under the supervision of universities. Thus, improving the accuracy of statistical methods and data interpretation in doctoral research is essential for ensuring the quality and validity of research findings. While there are challenges associated with enhancing the curriculum of doctoral education, providing training programs, and implementing quality assurance mechanisms, there are also significant benefits to

be gained. By implementing these alternative ways, Saudi Arabian universities can improve the quality of doctoral research and contribute to the advancement of knowledge in their respective fields.

6.9 Recommendations

As per this research's findings, the following are some recommendations for enhancing the precision of data interpretation and statistical methods in PhD students of Saudi Arabia.

6.9.1 Recommendations for Policymakers

In SA, the establishment of academic cadres in Statistics should be prioritized by the policymakers, so the rising need for statistical knowledge in different fields can be fulfilled. Policymakers should aim towards providing Statistics and Maths content in schools same as the Singaporean curriculum. Also, at the high school level, adding a foundation in Mathematics for student's literacy pathway, or making Mathematics a compulsory subject, and developing the Statistic curriculum in postgraduate program, to enhance the accuracy level while using statistical techniques in PhD research. Moreover, policymakers should seek opportunities to fund research to support the development of statistical centres. This could not boost the number of statistical experts in different fields but will also modify policy development and decision-making process. Policymakers can collaborate with centres or academic institutions, prioritize establishing educational initiatives or programs that endorse the usage of statistical methods in different sectors and fields, and establish opportunities to fund research. However, there might be inadequate funding, insufficient support, or resistance from some faculty or academic institutions to include statistical methods in their work. Policymakers can implement these recommendations to enhance their recognition and reputation as persons of authority who prioritize research and education and enhance research opportunities among different sectors and fields.

6.9.2 Recommendations for universities

In the Kingdom of Saudi Arabia, universities should make it compulsory for all postgraduate students to attend advanced courses in Statistics. This step can make sure that every postgraduate student has a strong base of statistical knowledge. Moreover, universities should build Statistics centres as well, so students can be provided with the essential support and resources to increase their statistical skills and knowledge. universities should also encourage the usage of both quantitative and qualitative research methods. Furthermore, lecturers specializing in statistics for graduate students could be employed in the departments of education and social sciences. If these recommendations are followed by universities, it will lead to improvement in research quality, enhanced appreciation as a top-notch. But challenges might arise from inadequate resources or having a qualified academic staff in Statistics. These challenges can be tackled if

universities start an experimental program in those departments where it is particularly important to impart statistical skills and knowledge, seek partnerships or external funding for supporting the enhancement of resources or development of statistical centres for PhD students.

6.9.3 Recommendations for Academic Advisors

Students should be encouraged by their academic advisors to enrol in advanced courses in Statistics. Academic advisors should also provide their students the essential resources for enhancing their statistical skills and knowledge. Furthermore, advisors should help the students in choosing suitable statistical methods, selecting accurate samples for ensuring the accuracy and validity of their studies and categorizing data as per measurement scales. Advisors and Statistics centres should also collaborate for supporting students and making sure that the provided statistical resources are of a high standard. Taking these steps can modify the standard of students' research, improve their recognition and reputation as academic advisors who offer high-standard research.

Not only but also, there are also some potential challenges, such as limited resources and time for supporting students, the resistance shown by students while adopting new methods of Statistics or including both quantitative and qualitative methods in the research, insufficient availability of skilled statisticians or Statistics centres for collaboration, etc. These challenges can be handled if advisors' partner with Statistics departments or centres for providing resources and support for both students and advisors, incentives for producing top-notch research and offering opportunities for professional development or training to increase their own skills and knowledge of Statistics.

6.9.4 Recommendations for PhD Students

In SA, PhD students should modify their statistical skills and knowledge by participating in certain statistical classes for higher education, engaging in Statistics courses comprising computer lab training, and attending workshops. Students should also ask statisticians to provide support, so they can enhance their comprehension regarding data interpretation and statistical analysis. Moreover, PhD students should think about including both quantitative and qualitative methods within their research studies for providing an increasingly comprehensive and triangulated analysis. Doing this will increase their employability, boost their confidence while conducting the analysis, and increase the data interpretation's accuracy and research quality. But there are also some significant challenges in this regard, such as limited or no access to statistical support or resources, limited resources and time for attending Statistics Courses and workshops, and hesitance to incorporate both quantitative and qualitative research methods. These challenges can be

addressed by establishing partnerships with research centres or universities to acquire statistical support and resources, offering accessible and flexible Statistics Course or workshop options, and providing recognition or incentives for successfully including both quantitative and qualitative methods within research. Students should raise their confidence and be confident when doing statistical methods in their own research. They should also build their self-learning capabilities, which are critical in improving skills while conducting all research procedures.

6.10 Limitations of Research

Research studies help in understanding different types of studies and advancing knowledge. However, every study comprises certain limitations. Any challenges or factors that might impact the generalizability, validity and overall standard of a particular research study are known as limitations. This section discusses all limitations that came forward in this research study, due to various challenges faced in the research procedure, such as delays in acquiring ethical approval, communication problems regarding the sample, insufficient number of sources, unresponsiveness shown by a specific institution, hardships in contacting pertinent stakeholders, challenges due to small size of the sample, and limited availability of staffing resources. All researchers must address and identify these limitations for ensuring the reliability and transparency of the research findings. As this research took place during covid-19 time, the circumstances affected the research progress as the researcher was affected by the virus multiple times.

Delay in Ethical Approval

In the case of the concerned research study, ethical approval was not easily obtained. Ethical approval proves to be a crucial step in a research study, as it ensures that all ethical principles are adhered to, and the well-being and rights of participants are safeguarded. But the researcher suffered from delays in acquiring ethical approval, causing disruptions in the study's timeline, and limiting the research opportunities. Delays in obtaining ethical approval have shortened the period for data analysis, interpretation, and collection. The ethical approval was also delayed because of Covid-19 circumstances.

Limitations in Staffing Resource

In this research study, staffing resources in universities were limited. This limited or unavailability of staff, probably due to logistical challenges, might have influenced the research procedure. Insufficient staffing might have increased time constraints and workload. Due to short staffing the data was delayed such as, data collection, data analysis, data entry, and other tasks related to research and analyse.

Limited Availability of Sources

A considerable limitation that this research study faced was a limited number of available resources. When topics of research are unique, there are limited sources and literature available for reviewing them. An

extensive review of related literature is crucial for establishing the contextual background and theoretical framework of research. limited sources might have caused insufficient or incomplete information, impacting the quality and depth of the outcomes of the research.

Challenges with Small Sample Size

Due to COVID, collecting more than 78 responses from one university in SA and one university in Scotland/ UK was challenging. The pandemic created significant obstacles, such as limited access to participants, restrictions on in-person interactions, and increased workload and stress for potential respondents. These factors made it difficult to reach a larger sample size, impacting the breadth of data collection and the overall scope of the study. Despite these challenges, the responses obtained still provide valuable insights into the research topic.

The small sample size presented additional challenges for the research study. Smaller samples often result in insufficient statistical power, reducing the ability to detect significant relationships or effects. This limitation makes it difficult to generalize the research outcomes to a wider population. Furthermore, a small sample size increases the risk of sampling bias, where the characteristics of the sample might inaccurately represent the target population. A small sample size might influence the external generalizability and validity of the outcomes of the research. keeping in mind the UK sample one third were Saudis.

Overall, the results suggested that the study has a reasonable level of generalizability. The data shows clear differences between UK and Saudi PhD students in some aspects studied, and these differences are supported by statistical significance. The study has good generalizability, with most results supported by strong statistical significance and low standard errors, increasing confidence that the findings can be generalized to larger populations of PhD students in the UK and Saudi Arabia. Cohen, Manion, and Morrison (2007) recommended using around 30 participants per group for quantitative research to ensure valid statistical analysis (Cohen, Manion, and Morrison, 2007). Moreover, Creswell (2014) stated that sample sizes for quantitative research typically vary from 15 to 30 people per group, depending on the statistical techniques used and the research design. He emphasises that many statistical analyses, including regression analysis, t-tests, and ANOVAs, usually yield valid findings within this range.

Unresponsiveness from Institution

Another limitation faced by this research was the unresponsiveness shown by proposed participant institution. despite multiple emails being sent. This unresponsiveness might have decreased the researcher's ability to access relevant data, collaboration opportunities, or information, potentially influencing the validity and comprehensiveness of this research study.

Difficulties in Contacting Research Respondents

It was also difficult to establish contact with the pertinent stakeholders, causing another research limitation. When the questionnaire was published, it also generated further limitations for this research study. Delays in getting in touch with the pertinent stakeholders might have caused delays in acquiring necessary approvals or permissions, possibly affecting the quality and timeline of the concerned research.

Unique Nature of Research

The nature of this research topic is unique, as it focuses on increasing the standard and quality of research studies in KSA's universities and particularly investigates the usage of statistical techniques in advanced degrees. This unique nature presented various limitations, which influenced the comprehensiveness of the findings of this research. The study was conducted in Saudi Arabia, which means that the results may not be generalizable to other regions, different cultural, social, and economic factors may affect statistical methods' application in different contexts in doctoral research. Another possible limitation of this research is the insufficient amount of available research and literature on the concerned topic. This topic of research pays attention to how Saudi Arabian universities utilise statistical procedures in advanced degrees. This can create difficulties in ensuring that the literature review is comprehensive, which influenced the variables' conceptualisation, overall contextual comprehension, and suggested recommendations of this research study, hence why it was important to look at approaches in other systems. The insufficient amount of detailed literature limited the accessibility of validated and existing research instruments as well, which might have influenced the reliability and validity of this research's outcomes. Another possible limitation faced by this research study is the confidentiality and sensitivity of this research topic. Assessing the standard and quality of research studies in KSA's universities, and specifically the statistical methods' usage in advanced degrees, involved analysing and accessing specific information, like research protocols, unpublished research, or academic records. This was impossible because of hardships in obtaining proper approvals, like ethical permissions and approvals from pertinent stakeholders, thus influencing the processes of data analysis and data collection. A participant was surprised that a woman was behind this research because it was thought to be difficult, as it was an encouragement for the researcher.

6.11 Future Research Directions

Future research should aim to increase the sample size and the number of universities. This approach will enhance the generalizability of the findings and reduce sampling bias.

It is necessary to explore why students find it hard to use statistical methodologies, particularly those students who have weak Mathematic and strong literary backgrounds. Moreover, further research should be conducted for examining how effective are various approaches in teaching statistical knowledge to PhD students, e.g., the usage of online resources or workshops.

To facilitate future research, another direction is investigating the influence produced by the insufficient amount of statistical expertise and resources on the outcomes of research within SA institutions. This direction could involve an assessment of the validity and quality of research outcomes in various disciplines that depend on the analysis of statistical data, such as economics, engineering, and health sciences. Moreover, the part played by international partnerships in modifying the standing statistics research and education in SA could also be explored by future research.

In Saudi Arabian institutes, emerging areas of interest and trends in statistical analysis of data in PhD research offer researchers the opportunity to increase their knowledge and expertise and contribute towards advancing the field. A significant area of interest in this regard is evaluating the influence produced by cultural factors on the statistical analysis of data in Saudi Arabia's doctoral research. This research is capable of exploring how cultural norms, practices, and values influence the interpretation and use of statistical techniques and methods in PhD research. For instance, it can explore how cultural aspects might impact the statistical tests' selection, the way missing data is dealt with, and the understanding of the results. Exploring the technology's role in increasing skills in statistical data analysis among SA's PhD students is another significant area of interest. Researching this area can discover how technology is used, such as online resources and software programs, in teaching PhD students the skills of statistical data analysis. A comparison can be made between technology-cantered approaches and traditional methods of teaching (workshops or lectures), to find which teaching method is more effective.

Another noteworthy area of interest in this regard is measuring the proficiency of various teaching strategies and methods for improving skills in statistical data analysis among postgraduate students within SA. This way, it can be assessed how different approaches produce different influences, such as project-based learning, blended learning, and peer learning, on the skill development and learning outcomes of students. Likewise, another emerging trend is assessing the capacity the artificial intelligence and machine learning in increasing statistical analysis of data in SA's PhD research.

In short, Saudi Arabian institutes should conduct further research regarding how statistical analysis of data in PhD research can create new methods and techniques that can improve the validity and quality of research done within the country. Creating the conditions to improve the research culture would also create an environment where researchers are motivated to assess these emerging areas of interest and trends in research so they can participate in advancing the field. Also, to better understand the factors that impact the

use of statistical methods in doctoral research, comparative studies could be conducted across different countries and regions.

6.12 Conclusion

This study sought to investigate the selection and utilisation of research methods at the doctoral level, specifically focusing on the use of statistical practices in different fields. A key question was ‘How do academics and PhD students from different educational backgrounds perceive their readiness, selection, and utilisation of statistical methods in doctoral research?’. This research investigated the perception of how well-prepared doctoral-level students are to do statistical analysis in their research by discovering about PhD students' competence and understanding of using statistical methods, as well as the PhD student's perception of the extent of their ability to select the appropriate statistical methods for their research accurately to show the need for why reforms are needed in Saudi Arabia's education system and why future university students should have sufficient mathematical understanding to maintain the researcher's basic knowledge base (Mathematics and Statistics). It also sought to quantify the similarities and differences in the statistical analysis procedures used in the analysis of some doctoral theses data in the KSA and the UK research programs. This study has additionally determined prevalent shortcomings that arise from the incorrect application of statistical processes. Furthermore, recommendations have been made for ensuring enhanced reliability of statistical methods and a better standard of doctoral thesis in Saudi Arabia. The results showed that in quantitative research at the PhD level, the researcher's background knowledge is crucial and that PhD learners require a solid grasp of Math and Statistics to overcome the difficulties that arise from the improper use of these tools. The study outcomes also discovered that SA PhD researchers' inability to ground their use of statistical techniques in practice theoretically undermines the reliability of their findings and, ultimately, their ability to make reliable projections about the future. The study's main conclusions also indicate that some Saudi Arabia PhD students exhibit a lack of preparedness for statistical evaluation in comparison to their UK counterparts. Meanwhile, some PhD students from KSA concurred on the significance of improving precision in statistical techniques and devising approaches to assess and instruct statistical concepts in PhD curricula. The research findings also suggested that the utilisation of statistical techniques in doctoral studies could be improved by ensuring the availability of competent mathematicians, establishing statistics centres, and providing comprehensive statistical knowledge.

Chapter 7: Conclusion

7.1 Introduction

This chapter provides a synopsis of the discoveries from the data collected through questionnaires and interviews, highlighting the chief outcomes and results of the research study. It includes a summary of the questionnaire and interview data findings, followed by a comprehensive conclusion. The conclusion discusses the finding's implications and emphasizes the importance of statistical education in enhancing the quality of postgraduate research.

7.2 Summary of Findings

It is vital to address the statistical misapplication because enhanced quality, reliability, and validity of the research increases the likelihood of suitable findings and aid in efficiently allocating limited available resources to maximise the efficiency. It could enhance students' employability and research competencies, leading to more research opportunities and better job prospects.

In contrast, the issue of statistical misapplication in some research is more a consequence of inadequate background knowledge and understanding of the statistical methods within KSA.

The students should be equipped with the requisite knowledge and skill set can perform better at the doctoral level. Such as they would be able to select a viable research method and implement numeracy skills while using statistical tools in their research.

So, it must change to include more significant investment in education to overcome the statistical misapplication, including the development of technical understanding and the knowledge that makes the base for the students regarding statistical knowledge and its application in the research process that can improve research validity and credibility.

It ensures that students adequately equipped with the requisite knowledge and skill set can perform better at the doctoral level. Such as they would be able to select a viable research method and implement numeracy skills while using statistical tools in their research. The chosen method for investigation is the mixed methods approach to obtain insights and information from postgraduate students in the SA and UK on their scale of competency and readiness in statistical education for PhD students. Semi-structured interviews were used to obtain the qualitative components of the investigation, whereas a Likert-scale questionnaire was implemented to obtain the quantitative aspects.

7.2.1 Summary of Questionnaire

In the analysis of the questionnaire, the responses to the Likert scale were recorded in the range of 0-5. Moreover, the calculation of Cronbach's Alphas was also done for measuring the internal evenness of the concerned questionnaire. The analytically acceptable ratio for PhD students in UK and SA is shown by the Alpha results for statements. The questionnaire's validity was assessed by calculating the correlation among key variables, and the results depicted a statistically considerable positive association between the Readiness of PhD students in the UK and SA to utilize Statistical education in postgraduate studies with how accurately data interpretation and statistical methods are applied and the extent to which SA and UK PhD students apply the steps of statistical methods before conducting statistical analysis with how accurate are SA and UK PhD students' apply statistical methods and data interpretation.

Furthermore, the aim of questionnaire analysis was to investigate the perception of PhD students' readiness to do statistical analysis, while focusing on the dissimilarities between SA and UK students. Most of the PhD students in the UK neither disagreed nor agreed about having essential skills for conducting statistical analysis. However, the majority of PhD students in SA disagreed in this regard. The SA students were overshadowed by the UK students concerning the readiness to use statistical analysis. But additional analysis was needed for understanding the variations between both samples. The frequency of the statements in the questionnaire was presented in Chapter Four. For example, in the statement, "I am confident in selecting the most suitable statistical methods to test my research hypotheses," the UK PhD students were more confident than the SA PhD students. Most of the UK PhD students agreed with the statement, "I am confident I can learn statistical methods," whereas the SA PhD students disagreed. The means of both groups were compared through an independent-sample t-test, which indicated a statistically significant variation between the two samples. The PhD students in the UK showed a higher perception of readiness for using statistical knowledge in their research compared to the PhD students in SA. The questionnaire analysis also suggested that the variations in readiness to conduct statistical analysis between the students of both countries could influence their capability of conducting statistical analysis within their research.

The results regarding the extent of the ability of PhD students to apply the steps of statistical methods before conducting statistical analysis showed that the majority of PhD students in the UK prefer using qualitative methods. In contrast, some PhD students in SA prefer mixed and quantitative methods. Moreover, the probability of PhD students in the UK describing the research variable's types and reviewing previous research to define the statistical tactics of data analysis is higher as compared to the SA postgraduate students. Yet, the independent results of the independent-sample t-test show no statically considerable

variation between the UK and SA students concerning the implementation of statistical methods in their post-graduate studies, noting that 11 respondents from the UK sample were Saudis, which is 1/3 of the overall UK respondents. Hence, the level to which statistical methods are applied before doing statistical analysis tends to be alike in both UK and SA.

Furthermore, this research also assessed how accurately PhD students interpret data and apply statistical methods. Both SA and UK PhD students agreed on the majority of the statements, but the UK PhD students scored higher in the statement of having good skills in interpreting and analysing statistical data. According to both groups, appropriate utilization of statistical methods is necessary for avoiding inaccurate results. But an independently conducted t-test depicted a statistically considerable variation between students of both countries, with PhD students in the UK doing data interpretation and implementing statistical methods more accurately.

Additionally, the study analyzed the responses shown by SA and UK PhD students and used this analysis to offer other alternative methods for enhancing further accuracy while using statistical techniques in PhD studies. The findings show that students of both countries agreed regarding the significance of increasing accuracy within statistical methods. But there were a few variations in their answers, like the significance of establishing institutions of Statistics and making it mandatory for all postgraduate students to enroll in advanced Statistics programs. When responses of SA and UK students were compared, it indicated that students of both countries agreed that Statistics should be taught within the mandatory Mathematics syllabus in secondary and primary schools. According to the PhD students of the UK, it is important to prepare academic cadres within the field of Statistics, but the SA PhD students deem this extremely essential. Furthermore, both groups also form a consensus on the significance of creating methods of teaching and evaluating statistical knowledge in post-graduate programs. Moreover, when using frequency, both groups demonstrated the significance of the aforementioned statements. But The result of the t-test showed that there was a statistically significant variation between UK and SA PhD students in the potential alternative methods for further enhancing accuracy while using statistical techniques in postgraduate studies, favouring SA PhD students. Generally, the findings suggested that PhD students in SA were keen to improve their statistical skills and knowledge.

Finally, the open-ended question provided data in the form of responses given by SA and UK postgraduate students about their preferences and views regarding statistical methods, particularly qualitative, mixed, and quantitative methods. In both samples, the majority of students are unsure about selecting quantitative methods for conducting their research. Quantitative research is preferred by PhD students in Saudi Arabia. Whereas UK PhD students prefer quantitative methods as it is more convincing and interesting. On the other hand, a mixed method of conducting research is preferred by both groups. In the case of the qualitative

research method, it is preferred over the quantitative research method by UK PhD students. In contrast, the majority of SA PhD students appear to be unsure about selecting a qualitative method of research. The qualitative method is liked by the UK respondents as it directly deals with individuals, gains increasingly extensive data, and obtains meaningful outcomes, while SA PhD students have limited experience in using qualitative methods of research and find it difficult to tackle. Last, of all, suggestions have been given to participants in the questionnaire for increasing their statistical knowledge, such as including specific Statistics classes in higher degrees, asking statisticians to provide support, Stat Courses, and workshops with exercises in computer labs.

7.2.2 Summary of Interview

In the interviews, it came to light that there is the insufficient availability of statistical resources in Saudi Arabian institutions, for instance, the software programs' availability, and qualifications of teachers, and providing of training. Many interviewees were dissatisfied with the insufficient expertise and resources, specifically in the field of Social Statistics. This trend proves to be problematic as it hinders the students' capability of learning and conducting research effectively. Moreover, the educational departments also greatly lack academic staff in the field of Statistics, and some of the appointed Statistics lecturers have concerns about eligibility and suitability. It was also confirmed by the analysis of the interviews that the majority of SA PhD students find it difficult to apply and understand statistical methodologies, specifically, those students who were previously enrolled in literary departments and did not comprise a strong background in Mathematics. Many students are not confident regarding their capabilities and ask others for assistance while conducting data analysis. It has been argued by the interviewees that this insufficient willingness among postgraduate students poses a serious issue that must be addressed so that the research quality can improve in Saudi institutions.

Furthermore, the study also assessed the statistical methods' usage by Saudi Arabian students pursuing postgraduate studies. It was revealed by the analysis that postgraduate students heavily depend on quantitative methods, specifically questionnaires, because of convenience and departmental preferences. However, they often make mistakes in choosing accurate statistical methods, categorizing data by scales of measurement, and selecting suitable samples. PhD students struggle with applying statistical methods' steps before doing statistical analysis. For example, they also find it difficult to select the appropriate sample and statistical method for conducting their research.

Chapter five analyzed how statistical methods were applied and research findings were interpreted by the PhD students. There is an insufficient theoretical comprehension regarding statistical methods, misapplication of statistical methods and inaccurate test selection. All these factors tend to influence the

rationality of research outcomes negatively. Additionally, PhD students also heavily depend on centers of statistical assistance, leading to mistakes while conducting data analysis. The postgraduate students also have weak interpretation skills, leading to misinterpretations of data gained from questionnaires. This indicates a dire requirement for expert statistical training. When misapplied statistical methods, they can significantly influence the rationality of research outcomes and decision-making procedures, leading to wrong predictions and conclusions regarding the future. This impacts their research's credibility, which further influences future research that will rely on their studies, ultimately negatively influencing societal progress. Hence, it is essential to use appropriate procedures of Statistics to avoid mistakes in research outcomes.

In addition, chapter five also discussed alternative methods of enhancing accuracy while using statistical techniques in postgraduate research. Interviews were conducted, which helped in the identification of subthemes and themes pertinent to this research question. The three identified themes are the requirement to establish Statistics centers, the requirement for skilled statisticians, enhancing Statistics content to postgraduate programs and providing Math content to literacy pathways in high school in KSA. Most interviewees confirmed that PhD students in Saudi Arabia need a strong foundation in Mathematics, as it is difficult for them to understand some mathematical steps related to statistical methods while studying Statistics at the postgraduate level, especially graduate students from the literary pathway in high school. Likewise, the Statistics curriculum at the postgraduate level in Saudi universities is not sufficient and does not qualify students to apply statistical methods in their research.

All participants reached a consensus regarding the pressing need for institutions to employ skilled academic staff Statistics for teaching postgraduate students, provide specialized capabilities in Statistics, and appoint statistical consultants to assist postgraduate students while using Statistics in their studies. Furthermore, the interviewees recognized other significant problems in this field, such as insufficient materialistic goals and incompetent statisticians in the existing institutes. This chapter also discussed the significance of including math in the literacy pathway of high school and modifying the statistics curriculum at the PhD level.

7.3 Conclusion

The primary goal of this study was to evaluate the efficacy of research methodologies employed in doctoral dissertations, with a special emphasis on quantitative research that necessitates statistical procedures. This study investigated PhD students' readiness for conducting statistical analysis, their knowledge of Statistics and Math, and the similarities as well as the distinctions between statistical methods for data analysis implemented in the UK and Saudi Arabia. The study also found other causes of data analysis problems, including faulty statistical technique application, an absence of pre-existing mathematical understanding,

incorrect data processing, and erroneous result analysis. This study ensures the accuracy of statistical methods, training programmes, curriculum development, and effective mentorship to ensure improved precision of statistical approaches and higher quality of PhD research in Saudi Arabia. The results also showed that the researcher's knowledge base is significant in doctoral-level quantitative research and that PhD students need to have a solid grasp of statistical methods and Mathematics to avoid mistakes that frequently occur when statistical techniques are applied incorrectly. This finding addressed the main research question, which was "How do academics and PhD students from different educational backgrounds view the selection and utilisation of statistical techniques?"

The study also aimed to identify the readiness of PhD students to conduct statistical analysis in PhD research, and the level of Mathematics and statistical literacy among PhD students. The study's main findings suggested that SA PhD students indicated a reduced level of readiness for carrying out statistical analysis compared to UK PhD students. Moreover, SA PhD students acknowledged the necessity of improving statistical accuracy and developing methods of evaluating and teaching statistics material in PhD programs. The study recommended that skilled statisticians, Statistics centres, and quality Mathematics and Statistics content be provided to improve the accuracy of statistical methods used in PhD research. These results, however, have important ramifications for doctoral education and research in Saudi Arabia and highlight the need for enhancements in the accessibility of Statistics-related resources and expertise, theoretical comprehension of statistical methods, and the development of thorough frameworks to guarantee greater accuracy of statistical methods and higher quality doctoral research in Saudi Arabia. Students having a good foundation in quantitative methods, for instance, may feel more at ease with statistical approaches and place greater importance on their usage in research. Students with a lesser foundation in quantitative methods, on the other hand, maybe frightened by statistical procedures and choose to employ other research methods. It has also been explored that the UK may have an upper hand in terms of making Maths as a mandatory subject for high school students compared to Saudi Arabia. However, it is important to note that this is a generalization and individual experiences may vary. Thus, further research would be needed to make a more accurate comparison between the two countries. Moreover, the research provided insights into the importance of preparing educational cadres in the subject of Statistics and making advanced Statistics courses mandatory for postgraduate students to enhance the quality and credibility of research conducted in Saudi Arabia. The study also highlighted the need for qualified statisticians, Statistics centres, and providing content maths and Statistics content to enhance greater accuracy in the use of statistical methods in doctoral research in Saudi Arabia.

The arguments made in the chapter one section on the importance of the study are also in favor of the research's conclusions. The study's findings revealed that difficulties with the use of legitimate and

trustworthy research methodologies have been raised in several studies carried out in Saudi Arabia and other Arab nations. For example, according to Al-Najjir's (1991) research, the proportion of research publications that used acceptable statistical procedures was significantly lower than that of those that used inappropriate statistical methods. Similarly, Al-Maleky's (2001) study found a substantial lack of Statistics knowledge among Saudi university students, resulting in mismanagement and ill-use of proper statistical approaches throughout the analysis stage. Other investigations, which include those carried out by the College of Education at Mosul university in Iraq (Almurad, 2009) and Al-Fateh university in Sudan (Abdul Rahman, 2015), have identified statistical methods' improper use as a barrier to conducting effective research. Al-Ajlan (1990), Al-Najjar (1991), and Al-Rashidi (2004) studies also verified the widespread misuse of statistical methods in diverse research papers. Furthermore, the studies demonstrated that the problems stem from a lack of understanding of the significance of Statistics as a subject, mismanagement by educators, and a lack of suitable instructional strategies and resources for students to gain adequate knowledge of different methods of research. These concerns eventually result in researchers selecting unsuitable statistical approaches, which causes imperfections in the process when the analysis is applied.

In conclusion, the study aimed to investigate the effectiveness of research methods used in doctoral dissertations, with a particular focus on quantitative research that requires statistical techniques. The findings indicated that the readiness of PhD students to conduct statistical analysis is crucial, and they need to have a good understanding of statistical methods and Mathematics to avoid common errors resulting from the misapplication of statistical techniques. The study recommends the need for qualified statisticians, Statistics centres, and providing content Maths and Statistics content to enhance greater accuracy in the use of statistical methods in doctoral research. The research is significant in addressing the research question of how academics and PhD students from different educational backgrounds view the selection and utilization of statistical methods for PhD research in Saudi Arabia. The results of this study are also supported by prior research, which highlighted the improper application of statistical methods as a barrier to the research process because of a lack of appreciation for the significance of Statistics as a subject, poor management by educators, and a lack of facilities and teaching strategies that are appropriate for students. However, significant changes must be made in the accessibility of Statistics-related resources and expertise, as well as in the theoretical understanding of statistical methods and the development of comprehensive frameworks, to ensure greater accuracy of statistical methods and higher quality doctoral research in Saudi Arabia. Thus, these improvements are highlighted by the study and their potential implications for raising the standard of statistical data analysis in PhD research in Saudi Arabia.

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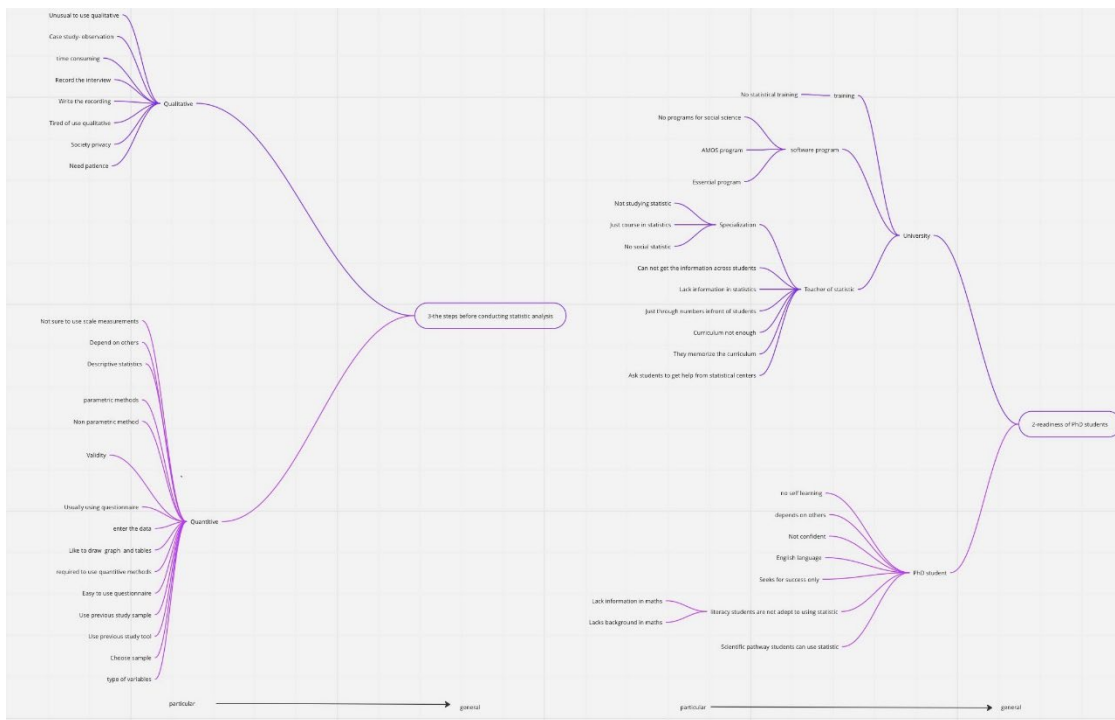
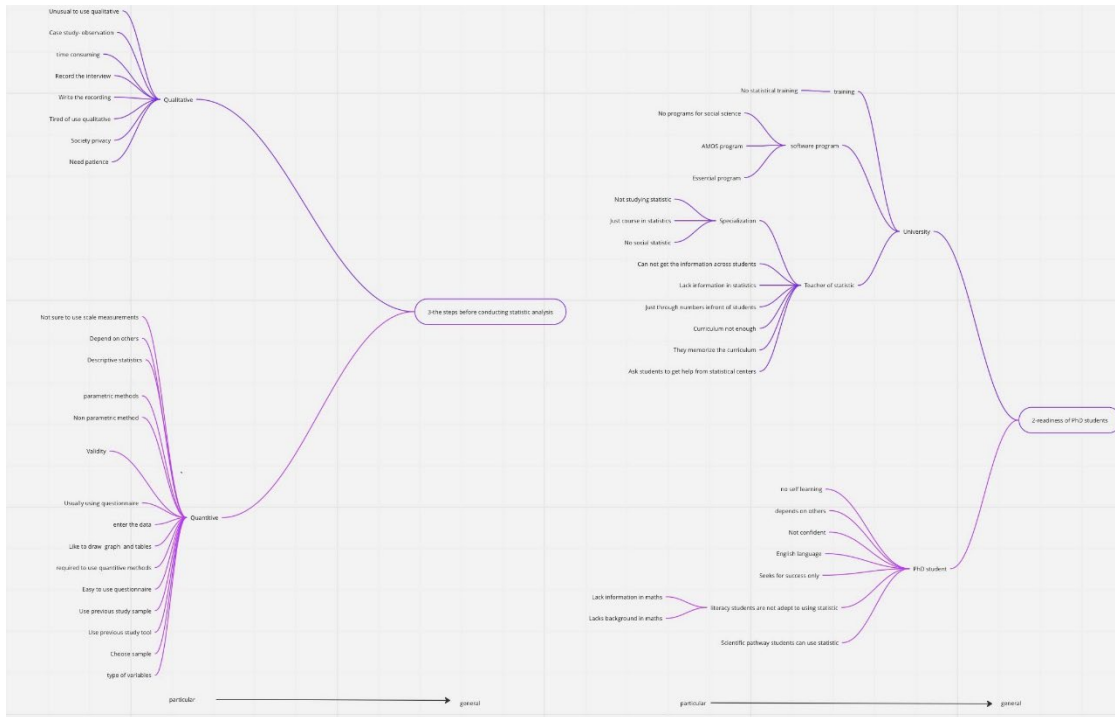
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Appendices

Appendix A



Appendix B

List of questions and statements used in the questionnaire evaluation. The following are key types of questions used: Likert (L), Multiple choice (M), and Open-ended (O).

| Parts | Statements |
|--|---|
| 2-Perception of Readiness of PhD Students to conduct Statistical Analysis | <p>S11: I have a good theoretical knowledge of the concepts of statistics (L)</p> <p>S12: I understand the difference between variables in quantitative research (L)</p> <p>S13: How strongly do you agree/disagree with this statement: “I learned statistics during my PhD through self-study” (L)</p> <p>S14: I can use statistical analysis software very well (L)</p> <p>S15: I am confident to select the most suitable statistical methods to test my research hypotheses (L)</p> <p>S16: I like applying statistics knowledge as part of my research (L)</p> <p>S17: I enjoy taking statistics courses and statistics training for my research (L)</p> <p>S18: For students doing quantitative qualitative research, please answer: “I would feel anxious if I had to use statistics in my research” (L) (inverse statement)</p> <p>S19: I am confident I can learn statistical methods. (L)</p> <p>S10: I prefer to depend on myself to achieve the statistical analysis in my research (L)</p> <p>S111: I prefer getting help from a statistician to do statistical analysis in my research. (L) (inverse statement)</p> <p>S112: Were you offered to attend a statistics course as part of your PhD? (M)</p> <p>S113: If you answered yes to question 13, how strongly do you agree/disagree with this statement: “The statistics course I was offered/required to attend was very useful” (L) (was deleted)</p> <p>S114: Were you required to attend a statistics course as part of your PhD? (M)</p> |

| | |
|--|--|
| | S115: If you answered yes to question 15, how strongly do you agree/disagree with this statement: “The statistics course I was offered/required to attend was very useful” (L) (was deleted) |
| 3- The extent to which PhD students apply the steps of statistical methods before conducting statistical analysis | <p>S21: I realize the importance of a pilot study of my research to test validity and reliability.</p> <p>S22: I prefer to use simple statistical methods in my research (percentages, frequencies and means) (L)(was deleted)</p> <p>S23: I do a preliminary data inspection before I start analysing the data (L)</p> <p>S24: I can choose an appropriate type of sample for my research (L)</p> <p>S25: I define the type of my research variables by reviewing previous studies. (L)</p> <p>S26: I can determine the appropriate sample size for my research (L)</p> <p>S27: I have enough statistical knowledge to be able to avoid using statistical methods that are not appropriate to the nature of my research (L)</p> <p>S28: I determine the statistical techniques of my data analysis by reviewing the techniques used in previous studies. (L)</p> <p>S29: I ensure to use of statistical analysis methods that correspond to the nature of the research. (L)</p> <p>S210: I explain the limitation of generalizing the results of my statistical analysis. (L)</p> <p>S211: I prefer to use quantitative methods in my research</p> <p>S212: Please explain why you prefer or you don't prefer to use quantitative methods in your research (O)</p> <p>S213: I prefer to use qualitative methods in my research (L)</p> <p>S214: Please explain why you prefer or you don't prefer to use qualitative methods in your research (O)</p> <p>S215: I prefer to use the mixed method in my research (L)</p> <p>S216: Please explain why you prefer or you don't prefer to use mixed methods in your research (O)</p> |
| 4- How accurate are | S31: I use the appropriate statistical method regardless of its complexity (L) (inverse statement) |

| | |
|---|---|
| <p>PhD apply students' statistical methods and data interpretation based on statistical methods??</p> <p>What are the implications of that?</p> | <p>S32: I have good skills of analysing and interpreting statistical data(L)</p> <p>S33: I compare the results of my data analysis with the results of previous studies</p> <p>S34: I support my findings with evidence by reviewing the literature (L)</p> <p>S35: I rely on the updated statistical analysis programs to extract data and ensure the accuracy of their statistical outputs. (L)</p> <p>S36: I critically reflect on and discuss the accuracy. and correctness of the statistical methods used in my research after applying statistical methods. (L)</p> <p>S37: Using statistical methods that are inappropriate to the research leads to inaccuracy results. (L)</p> |
| <p>5- Alternatives to enhance greater accuracy in the selection of Statistical Methods</p> | <p>S41: The university assigns an assistant specializing in statistical methods to support me in my research and statistical analysis. (L)</p> <p>S42: Establishing a research unit centre at the university to provide the services of statistical analysis to students at any time. (L)</p> <p>S43: Make advanced statistics courses mandatory for postgraduate students. (L)</p> <p>S44: Providing training courses in using statistical analysis programs that are not compulsory. (L)</p> <p>S45: Organizing seminars and workshops to discuss the academic difficulties facing postgraduate students in learning statistics. (L)</p> <p>S46: Teaching statistics as part of the compulsory mathematics curriculum in primary and secondary school (L)</p> <p>S47: Preparing educational cadres in the subject of statistics capable of overcoming the difficulties of studying statistics. (L)</p> <p>S48: Develop methods of evaluating and teaching statistics material in PhD program. (L).</p> <p>S49: Please suggest other ways to enhance postgraduate students' knowledge of statistics (O)</p> <p>S410: If you have any additional comments you want to add on this topic, please add them here (O)</p> |

key types of questions used: Likert (L), Multiple choice (M), open-end question (o)

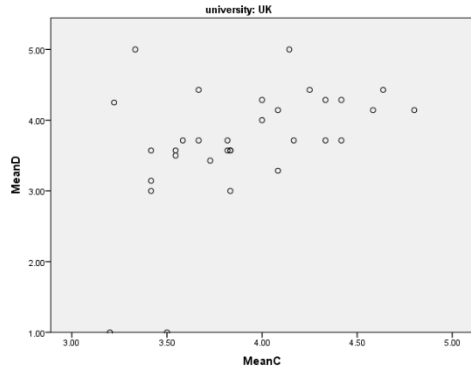
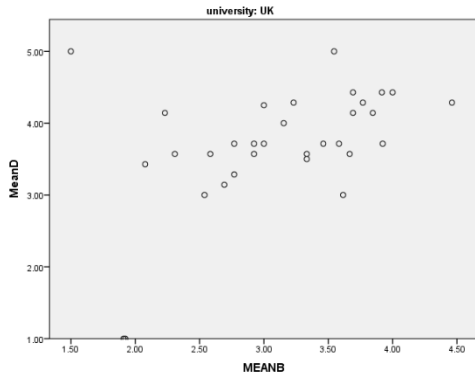
Appendix C

Appendix C BERSON

- For UK PhD students

| Parts (variables) | | Perception of readiness of Ph.D. Students (Mean B) | The extent to which PhD students apply the steps of statistical methods before conducting statistical analysis. (Mean C) | How accurate are PhD students' apply statistical methods and data interpretation (Mean D) |
|---|---|--|--|---|
| Perception of readiness of PhD Students to conduct Statistical Analysis in PhD research (MEAN B) | Pearson Correlation Sig. (2-tailed) N | 1 32 | .402* 32 | .456** 32 |
| (Mean C) The extent to which PhD students apply the steps of statistical methods before conducting statistical analysis. | Pearson Correlation Sig. (2-tailed) N | 402* 32 | 1 32 | .440* 32 |
| How accurate are PhD students' apply statistical methods and data interpretation (Mean D) | Pearson Correlation Sig. (2-tailed) | .456** .009 | .440* .012 | 1 |

| | | | | |
|--|---|----|----|----|
| | N | 32 | 32 | 32 |
|--|---|----|----|----|



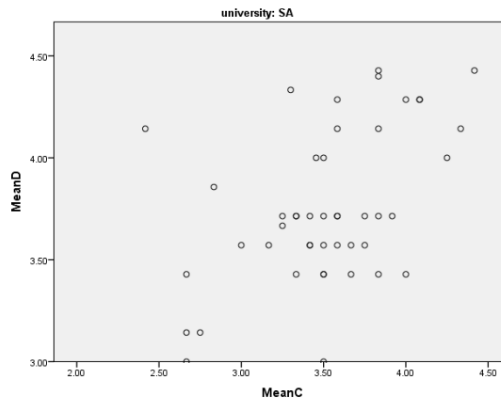
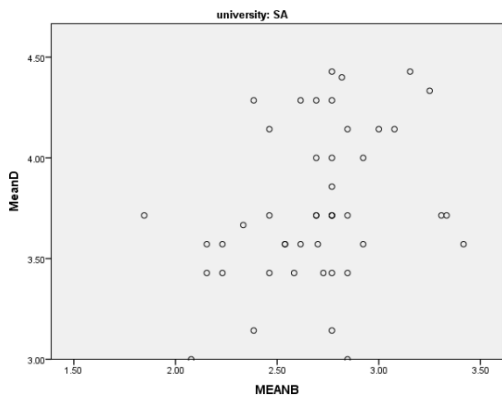
- For SA PhD students

| Parts (variables) | | perception of readiness of Ph.D. Students (Mean B) | The extent to which PhD students apply the steps of statistical methods before conducting statistical analysis. (Mean C) | How accurate are PhD students' apply statistical methods and data interpretation (Mean D) |
|--|---|--|--|---|
| perception of readiness of PhD Students to conduct Statistical Analysis in PhD research (MEAN B) | Pearson Correlation Sig. (2-tailed) N | 1 46 | .456** 46 | .325* 46 |
| | | | .001 | .03 |

| | | | | |
|---|---------------------|--------|--------|--------|
| The extent to which PhD students apply the steps of statistical methods before conducting statistical analysis. (Mean C) | Pearson Correlation | .456** | 1 | .484** |
| | Sig. (2-tailed) | .001 | | .001 |
| | N | 46 | 46 | 46 |
| How accurate are PhD students' apply statistical methods and data interpretation (Mean D) | Pearson Correlation | .325* | .484** | 1 |
| | Sig. (2-tailed) | .03 | .001 | |
| | N | 46 | 46 | 46 |

*. Correlation is significant at the 0.05 level (2-tailed).

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



Appendix D

Part 1: Personal information:

Table of UK and SA PhD students of their personal information

| | | UK | | SA | |
|--|--------------|---------------------|----|---------------------|----|
| | | F | % | F | % |
| country that they finished their Primary school at | UK | 6 | 19 | 0 | 0 |
| | SA | 11 | 34 | 44 | 96 |
| | Others | 15 | 47 | 2 | 4 |
| country that they did their secondary school at | UK | 6 | 19 | 0 | 0 |
| | SA | 11 | 34 | 44 | 96 |
| | Others | 15 | 47 | 2 | 4 |
| country that they did their undergraduate degree at | UK | 5 | 16 | 0 | 0 |
| | SA | 11 | 34 | 43 | 94 |
| | Others a | 16 | 50 | 3 | 7 |
| undergraduate degree you hold | Science | 20 | 63 | 28 | 30 |
| | Humanity | 9 | 28 | 15 | 63 |
| | Others | 3 | 9 | 3 | 7 |
| have another degree? | Yes | 25 | 78 | 9 | 20 |
| | No | 7 | 22 | 37 | 80 |
| Gender | male | 16 | 50 | 15 | 33 |
| | female | 11 | 34 | 29 | 63 |
| | others | 5 | 16 | 2 | 4 |
| type of the research | qualitative | 12 | 31 | 2 | 4 |
| | quantitative | 8 | 22 | 20 | 44 |
| | mixed | 12 | 47 | 23 | 50 |
| | Others | 0 | 0 | 1 | 2 |
| have you already started analysing your data | Yes | 17 | 53 | 22 | 48 |
| | No | 8 | 25 | 22 | 48 |
| | NA | 7 | 22 | 2 | 4 |
| Year that you finish your maths studies at school | Senior year | 10 | 31 | 20 | 44 |
| | Grade 10 | 7 | 22 | 15 | 33 |
| | Others | 15(Diffrenet years) | 47 | 11(Diffrenet years) | 24 |

From part 1: The first question in the survey enquired about where the PhD students have completed Primary and secondary school in the UK, as others were from, Indonesia, Bangladesh, multiple, Greek, China, The Netherlands, USA, German, Malta and lastly Syria. The others of PhD students from SA respondents finished primary education in Yemen and Kuwait. And others of SA's students have completed secondary school in Yemen and USA, And the SA undergraduate degree others from USA and Australia and 2022. The UK undergraduate others from, USA, China, prefer not to say, Indonesia, south Africa, Australia, The Netherlands, Uganda, Malta, Chicago, Germany and 2007.

Moreover, when asked about the undergraduate degree that PhD students have in both SA and the UK, 'other' refers to either a master's or a PhD as they did not specify in what. Also, PhD students in both the UK and SA responded to the gender question that they do not prefer to answer. Otherwise, just one SA PhD student responded to the question on the type of their research by saying 'not yet'. Some PhD students in both countries responded to the question, "Have you already started analysing your data?" by saying that their study is qualitative, while others said NA or not yet.

When asked about the last year they studied mathematics, some students in both countries provided the year, for example, 1995.

Appendix E

Frequency-Mean - Standard deviation

- E-2: Part 2/ perception of Readiness of PhD Students to conduct Statistical Analysis in PhD research

| Strongly agree (SA) | Agree(A) | Neither agree nor disagree (NAVD) | Disagree (DS) | Strongly disagree (SA) |
|---------------------|------------|-----------------------------------|---------------|------------------------|
| 4.21- 5.0 | 3.41- 4.20 | 2.51-3.40 | 1.81 -2.5. | 1.0-1.80 |

-UK PhD students

| No. | Questions/statements | SD | D | N | A | SA | U.K Mean | U.K Standard deviation | level |
|-----|--|----|---|-----|------|------|----------|------------------------|-------|
| 1 | I have a good theoretical knowledge of the concepts of statistics (e.g., mean, Regression). | N | - | 2 | 8 | 13 | 3.9 | .88 | A |
| | | % | - | 6.5 | 25.8 | 41.9 | | | |
| 2 | I understand the difference between variables in quantitative research (e.g., independent, dependent and mediating variables). | N | - | 2 | 3 | 13 | 4.2 | .87 | A |
| | | % | - | 6.5 | 9.7 | 41.9 | | | |

| | | | | | | | | | | |
|-----------|--|------------|-----------|------|------|------|------|------|------|----------|
| 3 | How strongly do you agree/disagree with this statement: “I learned statistics during my PhD through self-study (e.g. through online courses, textbooks, feedback from supervisor) | N | 2 | 4 | 7 | 10 | 6 | 3.48 | 1.18 | A |
| | | % | 6.9 | 13.8 | 24.1 | 34.5 | 20.7 | | | |
| 4 | I can use statistical analysis software (e.g., SPSS, Minitab) very well | N | 2 | 8 | 5 | 11 | 5 | 3.29 | 1.21 | NAN D |
| | | % | 6.3 | 25.8 | 16.1 | 35.5 | 16.1 | | | |
| 5 | Were you offered to attend a statistics course as part of your PhD? | yes | 16 (50%) | | | | | 1.5 | 0.50 | SD |
| | | no | 16 (50%) | | | | | | | |
| 6 | Were you required to attend a statistics course as part of your PhD? | yes | 5(15.6) | | | | | 1.16 | 0.36 | SD |
| | | no | 27(84.4%) | | | | | | | |
| 7 | I am confident to select the most suitable statistical methods to test my research hypotheses | N | - | 5 | 11 | 10 | 4 | 3.4 | .94 | A |
| | | % | - | 16.7 | 36.7 | 33.3 | 13.3 | | | |
| 8 | I like applying statistics as part of my research | N | 2 | 6 | 4 | 8 | 10 | 3.6 | 1.32 | A |
| | | % | 6.7 | 20 | 13.3 | 26.7 | 33.3 | | | |
| 9 | I enjoy taking statistics courses and statistics training for my research | N | 2 | 6 | 3 | 10 | 9 | 3.6 | 1.30 | A |
| | | % | 6.7 | 20 | 10 | 33.3 | 30 | | | |
| 10 | For students doing quantitative qualitative research, please answer: “I would feel anxious if I had to use statistics in my research (Reverse S) | N | 2 | 5 | 9 | 7 | 3 | 3.2 | 1.12 | NAN D |
| | | % | 7.7 | 19.2 | 34.6 | 26.9 | 11.5 | | | |
| 11 | | N | 2 | - | 4 | 14 | 10 | 4.0 | 1.05 | |

| | | | | | | | | | | |
|---|---|---|-----|-----|-----|-----|-----|-----|------|----------|
| | I am confident I can learn statistical methods. | % | 6.7 | - | 13. | 46. | 33. | | | A |
| 12 | I prefer to depend on myself to achieve the statistical analysis in my research | N | 1 | 8 | 7 | 11 | 3 | 3.2 | 1.07 | NAN D |
| | | % | 3.3 | 26. | 23. | 36. | 10 | | | |
| 13 | I prefer getting help from a statistician to do statistical analysis in my research (Reverse S) | N | 4 | 2 | 8 | 10 | 6 | 2.6 | 1.28 | NAN D |
| | | % | 13. | 6.7 | 26. | 33. | 20 | | | |
| perception of Readiness of PhD Students to conduct Statistical Analysis in PhD research | | | | | | | | 3.1 | .75 | NA ND |

- SA PhD students

| No. | Questions/statements | SD | D | N A N D | A | SA | S.A Mea n | S.A Sta nda rd devi atio n | leve l | |
|-----|--|----|-----|------------------|-----|-----|-----------------|--|-----------|----------|
| 1 | I have a good theoretical knowledge of the concepts of statistics (e.g., mean, Regression). | N | 7 | 20 | 4 | 8 | 6 | 2.6 | 1.31 | NA ND |
| | | % | 15. | 44. | 8.9 | 17. | 13. | | | |
| 2 | I understand the difference between variables in quantitative research (e.g., independent, dependent and mediating variables). | N | - | 3 | 6 | 21 | 16 | 4.0 | .87 | A |
| | | % | - | 6.5 | 13 | 45. | 34. | | | |
| | | | | | 7 | 8 | | | | |

| | | | | | | | | | | |
|----|---|-----|-----------|------|------|------|------|------|------|----------|
| 3 | How strongly do you agree/disagree with this statement: “I learned statistics during my PhD through self-study (e.g. through online courses, textbooks, feedback from supervisor) | N | 3 | 8 | 9 | 19 | 6 | 3.3 | 1.13 | NA ND |
| | | % | 6.7 | 17.8 | 20 | 42.2 | 31.3 | | | |
| 4 | I can use statistical analysis software (e.g., SPSS, Minitab) very well | N | 4 | 11 | 9 | 14 | 5 | 3.12 | 1.19 | NA ND |
| | | % | 9.3 | 25.6 | 20.9 | 32.6 | 11.6 | | | |
| 5 | Were you offered to attend a statistics course as part of your PhD? | yes | 26(56.5%) | | | | | 1.57 | 0.50 | SD |
| | | no | 20(43.5) | | | | | | | |
| 6 | Were you required to attend a statistics course as part of your PhD? | yes | 19(41.3%) | | | | | 1.4 | 0.49 | SD |
| | | no | 27(58.7%) | | | | | | | |
| 7 | I am confident to select the most suitable statistical methods to test my research hypotheses | N | 11 | 15 | 11 | 8 | 1 | 2.4 | 1.10 | D |
| | | % | 23.9 | 32.6 | 23.9 | 17.4 | 2.2 | | | |
| 8 | I like applying statistics as part of my research | N | 7 | 5 | 5 | 15 | 13 | 3.4 | 1.42 | A |
| | | % | 15.6 | 11.1 | 11.1 | 33.3 | 28.9 | | | |
| 9 | I enjoy taking statistics courses and statistics training for my research | N | 12 | 11 | 3 | 10 | 8 | 2.8 | 1.52 | NA ND |
| | | % | 27.3 | 25 | 6.8 | 22.7 | 18.2 | | | |
| 10 | For students doing qualitative quantitative research, please answer: “I would feel anxious if I had to use statistics in my research (Reverse S) | N | 8 | 13 | 8 | 10 | 5 | 2.8 | 1.30 | NA ND |
| | | % | 18.2 | 29.5 | 18.2 | 22.7 | 11.4 | | | |

| | | | | | | | | | | |
|---|---|---|------|------|------|------|------|-----|------|----|
| 11 | I am confident I can learn statistical methods. | N | 10 | 14 | 5 | 12 | 5 | 2.4 | 1.35 | NA |
| | | % | 21.7 | 30.4 | 10.9 | 26.1 | 10.9 | | | ND |
| 12 | I prefer to depend on myself to achieve the statistical analysis in my research | N | 12 | 16 | 6 | 6 | 6 | 2.5 | 1.36 | NA |
| | | % | 26.1 | 34.8 | 13 | 13 | 13 | | | ND |
| 13 | I prefer getting help from a statistician to do statistical analysis in my research (Reverse S) | N | - | 2 | 7 | 23 | 12 | 1.9 | .79 | A |
| | | % | - | 4.5 | 15.9 | 52.3 | 27.3 | | | |
| perception of Readiness of PhD Students to conduct Statistical Analysis in PhD research | | | | | | | | 2.5 | .42 | D |

E- 2-1 Independent Samples Test

Group Statistics

| PhD students | N | Mean | Std. Deviation | Std. Error Mean |
|--------------|----|------|----------------|-----------------|
| MEAN UK | 32 | 3.10 | .75 | .13511 |
| B SA | 46 | 2.5 | .42 | .06250 |

Independent Samples Test

| | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|-------------------------------|---|------|------------------------------|----|-----------------|-----------------|-----------------------|---|--------|
| | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference | |
| | | | | | | | | Lower | Upper |
| MEANB Equal variances assumed | 18.163 | .000 | 4.385 | 76 | .000 | .58897 | .13433 | .32138 | .85656 |

| | | | | | | | | | |
|--|--|--|------|-------|------|--------|--------|--------|--------|
| Equal variances not assumed | | | 3.96 | 42.90 | .000 | .58897 | .14886 | .28875 | .88920 |
|--|--|--|------|-------|------|--------|--------|--------|--------|

E-3: Part3/The extent to which PhD students apply the steps of statistical methods before conducting statistical analysis.

- UK PhD students

| N o | Questions/statements | SD | D | N A N D | A | SA | U. K M e a n | U. K S t a n d a r d d e v i a t i o n | LE VE L |
|----------------|-----------------------------|-----------|----------|----------------------------|----------|-----------|---|---|------------------------|
| 1 | | N | - | 5 | 5 | 11 | 9 | | A |

| | | | | | | | | | | |
|----|---|---|-----|------|------|------|------|------|------|----|
| | I realize the importance of a pilot study of my research to test the validity and reliability. | % | - | 16.7 | 16.7 | 36.7 | 30 | 3.80 | 1.06 | |
| 2 | I do a preliminary data inspection before I start analysing the data | N | - | 1 | 5 | 12 | 9 | 4.07 | .83 | A |
| | | % | - | 3.7 | 18.5 | 44.4 | 33.3 | | | |
| 3 | I can choose an appropriate type of sample for my research | N | - | - | 3 | 17 | 9 | 4.21 | .62 | SA |
| | | % | - | - | 10.3 | 58.6 | 31 | | | |
| 4 | I define the type of my research variables by reviewing previous studies | N | - | 2 | 4 | 14 | 8 | 4.00 | .86 | A |
| | | % | - | 7.1 | 14.3 | 50 | 28.6 | | | |
| 5 | I can determine the appropriate sample size for my research | N | - | - | 6 | 15 | 8 | 4.07 | .70 | A |
| | | % | - | - | 20.7 | 51.7 | 27.6 | | | |
| 6 | I have enough statistical knowledge to be able to avoid using statistical methods that are not appropriate to the nature of my research | N | - | 1 | 8 | 14 | 5 | 3.8 | .77 | A |
| | | % | - | 3.6 | 28.6 | 50 | 17.9 | | | |
| 7 | I determine the statistical techniques of my data analysis by reviewing the techniques used in previous studies | N | - | - | 4 | 15 | 8 | 4.2 | .66 | A |
| | | % | - | - | 14.8 | 55.6 | 29.6 | | | |
| 8 | I ensure to use statistical analysis methods that correspond to the nature of the research | N | - | - | 2 | 16 | 10 | 4.29 | .60 | SA |
| | | % | - | - | 7.1 | 57.2 | 35.7 | | | |
| 9 | I explain the limitation of generalizing the results of my statistical analysis | N | - | - | 2 | 16 | 10 | 4.29 | .60 | SA |
| | | % | - | - | 7.2 | 57.1 | 35.7 | | | |
| 10 | I prefer to use quantitative methods in my research | N | 1 | 5 | 13 | 5 | 7 | 3.39 | 1.11 | A |
| | | % | 3.2 | 16.1 | 41.9 | 16.1 | 22.6 | | | |
| 11 | | N | 2 | 2 | 10 | 7 | 10 | | | A |

| | | | | | | | | | | |
|--|---|---|-----|-----|-----|-----|------|----|-----|----|
| | I can determine the appropriate sample size for my research | % | - | 13 | 19. | 37 | 30.4 | 3. | 1.0 | |
| | | | | | 6 | | | 85 | 1 | |
| 6 | I have enough statistical knowledge to be able to avoid using statistical methods that are not appropriate to the nature of my research | N | 4 | 10 | 12 | 16 | 4 | 3. | 1.1 | NA |
| | | % | 8.7 | 21. | 26. | 34. | 8.7 | | | |
| | | | | 7 | 1 | 8 | | | | |
| 7 | I determine the statistical techniques of my data analysis by reviewing the techniques used in previous studies | N | 15 | 9 | 1 | 15 | 6 | 2. | 1.5 | NA |
| | | % | 32. | 19. | 2.2 | 32. | 13 | | | |
| | | | 6 | 6 | | 6 | | | | |
| 8 | I ensure to use statistical analysis methods that correspond to the nature of the research | N | - | - | - | 24 | 21 | 4. | .50 | SA |
| | | % | - | - | - | 53. | 46.7 | | | |
| | | | | | | 3 | | | | |
| 9 | I explain the limitation of generalizing the results of my statistical analysis | N | 9 | 13 | 9 | 9 | 5 | 2. | 1.3 | NA |
| | | % | 20 | 28. | 20 | 20 | 11.1 | | | |
| | | | | 9 | | | | | | |
| 10 | I prefer to use quantitative methods in my research | N | 2 | 5 | 12 | 15 | 12 | 3. | 1.1 | A |
| | | % | 4.3 | 10. | 26. | 32. | 26.1 | | | |
| | | | | 9 | 1 | 6 | | | | |
| 11 | I prefer to use qualitative methods in my research | N | 3 | 14 | 21 | 5 | 3 | 2. | .95 | NA |
| | | % | 6.5 | 30. | 45. | 10. | 6.5 | | | |
| | | | | 4 | 7 | 9 | | | | |
| 12 | I prefer to use mixed methods in my research | N | 2 | 1 | 12 | 22 | 9 | 3. | .94 | A |
| | | % | 4.3 | 2.2 | 26. | 47. | 19.6 | | | |
| | | | | | 1 | 8 | | | | |
| The extent to which PhD students apply the steps of statistical methods before conducting statistical analysis | | | | | | | | 3. | .38 | A |
| | | | | | | | | 75 | | |

E- 3-1 Independent Samples Test

Group Statistics

| PhD students | N | Mean | Std. Deviation | Std. Error Mean |
|--------------|----|------|----------------|-----------------|
| MeanC UK | 32 | 3.69 | .86 | .15300 |
| SA | 46 | 3.75 | .38 | .05606 |

Independent Samples Test

| | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|-------------------------------|---|------|------------------------------|------|-----------------|-----------------|-----------------------|---|--------|
| | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference | |
| | | | | | | | | Lower | Upper |
| MeanC Equal variances assumed | 5.603 | .020 | .41 | 76 | .680 | -.05960 | .14397 | .34634 | .22714 |
| Equal variances not assumed | | | -.36 | 39.3 | .717 | -.05960 | .16295 | .38909 | .26989 |

E-4: part4/ How competence are PhD students in application of statistical methods and data interpretation selected based on statistical methods selected? What are the implications of that?

- UK PhD students

| No | Questions/statements | | S D | D | N A N D | A | S A | U. K Me an | U.K Stan dard devia tion | lev el |
|----|--|---|---------|----------|------------------|----------|----------|---------------------|--------------------------------------|-----------|
| 1 | I use the appropriate statistical method regardless of its complexity (Reverse S) | N | - | 4 | 6 | 11 | 6 | 2.3 | .99 | NA ND |
| | | % | - | 14 .8 | 22 .2 | 40 .8 | 22 .2 | | | |
| 2 | I have good skills of analysing and interpreting statistical data | N | 2 | 2 | 8 | 12 | 6 | 3.6 | 1.10 | A |
| | | % | 6. 7 | 6. 7 | 26 .6 | 40 | 20 | | | |
| 3 | I compare the results of my data analysis with the results of previous studies | N | - | 2 | 4 | 13 | 10 | 4.0 7 | .88 | A |
| | | % | - | 6. 9 | 13 .8 | 44 .8 | 34 .5 | | | |
| 4 | I support my findings with evidence by reviewing the literature | N | - | - | 2 | 11 | 16 | 4.5 | .63 | SA |
| | | % | - | - | 6. 9 | 37 .9 | 55 .2 | | | |
| 5 | I rely on the updated statistical analysis programs to extract data and to ensure the accuracy of their statistical outputs | N | - | 3 | 5 | 13 | 6 | 3.8 | .921 | A |
| | | % | - | 11 .1 | 18 .5 | 48 .2 | 22 .2 | | | |
| 6 | I critically reflect on and discuss the accuracy correctness of the statistical methods used in my research after applying statistical methods | N | - | 1 | 4 | 14 | 8 | 4.0 7 | .78 | A |
| | | % | - | 3. 7 | 14 .8 | 51 .9 | 29 .6 | | | |
| 7 | using statistical methods that is inappropriate to the research leads to inaccuracy results | N | 1 | 2 | 2 | 12 | 11 | 4.0 7 | 1.05 | A |
| | | % | 3. 6 | 7. 1 | 7. 1 | 42 .9 | 39 .3 | | | |

| | | | |
|--|------|-----|---|
| How accurate are PhD students' apply statistical methods and data interpretation selected based on statistical methods selected? What are the implications of that | 3.94 | .42 | A |
|--|------|-----|---|

- SA PhD students

| No | Questions/statements | SD | D | N | A | S | S.A | S.A | lev | |
|----|--|----|------|------|------|------|------|--------------------|------|----------|
| | | | | A | A | A | Mean | Standard deviation | el | |
| | | | | N | A | S | | | | |
| | | | | D | A | A | | | | |
| 1 | I use the appropriate statistical method regardless of its complexity (Reverse S) | N | - | 4 | 8 | 18 | 16 | 2 | .94 | A |
| | | % | - | 8.7 | 17.4 | 39.1 | 34.8 | | | |
| 2 | I have good skills of analysing and interpreting statistical data | N | 5 | 9 | 14 | 13 | 5 | 3.0 | 1.17 | NA ND |
| | | % | 10.9 | 19.6 | 30.4 | 28.3 | 10.9 | | | |
| 3 | I compare the results of my data analysis with the results of previous studies | N | - | 1 | 3 | 20 | 22 | 4.3 | .711 | SA |
| | | % | - | 2.2 | 6.5 | 43.5 | 47.8 | | | |
| 4 | I support my findings with evidence by reviewing the literature | N | - | - | 2 | 22 | 21 | 4.4 | .58 | SA |
| | | % | - | - | 4.4 | 48.9 | 46.7 | | | |
| 5 | I rely on the updated statistical analysis programs to extract data and to ensure the accuracy of their statistical outputs | N | - | 3 | 7 | 16 | 18 | 4.1 | .920 | A |
| | | % | - | 6.8 | 15.9 | 36.4 | 40.9 | | | |
| 6 | I critically reflect on and discuss the accuracy correctness of the statistical methods used in my research after applying statistical methods | N | - | 4 | 14 | 15 | 12 | 3.7 | .95 | A |
| | | % | - | 8.9 | 31.1 | 33.3 | 26.7 | | | |
| 7 | | N | - | - | 3 | 16 | 27 | | | SA |

| | | | | | | | | | |
|--|---|---|---|-----|------|------|------|-----|---|
| using statistical methods that is inappropriate to the research leads to inaccurate results | % | - | - | 6.5 | 34.8 | 58.7 | 4.5 | .62 | |
| How accurate are PhD students' apply statistical methods and data interpretation selected based on statistical methods selected? What are the implications of that | | | | | | | 3.51 | .44 | A |

E- 4-1 Independent Samples Test

Group Statistics

| PhD students | N | Mean | Std. Deviation | Std. Error Mean |
|--------------|----|------|----------------|-----------------|
| MeanD UK | 32 | 3.94 | .42 | .07591 |
| SA | 46 | 3.51 | .44 | .06633 |

Independent Samples Test

| | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|-------------------------------|---|------|------------------------------|-------|-----------------|-----------------|-----------------------|---|--------|
| | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference | |
| | | | | | | | | Lower | Upper |
| MeanD Equal variances assumed | .146 | .704 | 3.73 | 76 | .000 <.001 | .37987 | .10167 | .17738 | .58235 |
| Equal variances not assumed | | | 3.76 | 68.79 | .000 <.001 | .37987 | .10081 | .17875 | .58098 |

E-5: Part 5/ The possible alternative ways to enhance greater accuracy in the use of statistical methods in doctoral research

- UK PhD students

| N o | Questions/statements | N | A | SI | M | I | E | S.A Mea n | S.A Standar d deviatio n | lev el |
|--------|--|---|------|------|------|------|-------|-----------------|--------------------------------------|-----------|
| | | | | | | | | | | |
| 1 | The university assigns an assistant specializing in statistical methods to support me in my research and statistical analysis. | N | 7 | 14 | 2 | 2 | 1 | 3.92 | 1.01 | A |
| | | % | 26.9 | 53.8 | 7.7 | 7.7 | 3.8 | | | |
| 2 | Establishing a research unit centre at the university to provide the services of statistical analysis to students at any time. | N | 1 | 1 | 3 | 14 | 8 | 4.00 | .96 | A |
| | | % | 3.7 | 3.7 | 11.1 | 51.9 | 29.6 | | | |
| 3 | Make advanced statistics courses mandatory for postgraduate students | N | 3 | 5 | 4 | 8 | 8 | 3.46 | 1.37 | A |
| | | % | 10.7 | 17.9 | 14.3 | 28.6 | 28.6 | | | |
| 4 | Providing training courses in using statistical analysis programs that are not compulsory. | N | 9 | 15 | 4 | - | - | 1.82 | .67 | D |
| | | % | 32.1 | 53.6 | 14.3 | - | - | | | |
| 5 | Organizing seminars and workshops to discuss the academic difficulties facing postgraduate students in learning statistics. | N | 1 | 2 | 3 | 10 | 1 | 4.1 | 1.08 | A |
| | | % | 3.6 | 7.1 | 10.7 | 35.7 | 4.2.9 | | | |

| | | | | | | | | | | |
|--|---|---|-----|------|------|------|------|------|------|---|
| 6 | Teaching statistics as part of the compulsory mathematics curriculum in primary and secondary school | N | 2 | 4 | 3 | 7 | 1 | 3.82 | 1.33 | A |
| | | % | 7.1 | 14.3 | 10.7 | 25 | 42.9 | | | |
| 7 | Preparing educational cadres in the subject of statistics capable of overcoming the difficulties of studying statistics | N | - | 1 | 3 | 14 | 6 | 4.04 | .75 | A |
| | | % | - | 4.2 | 12.5 | 58.3 | 25 | | | |
| 8 | Develop methods of evaluating and teaching statistics material in PhD program | N | - | 2 | 2 | 17 | 7 | 4.04 | .79 | A |
| | | % | - | 7.1 | 7.1 | 60.7 | 25 | | | |
| The possible alternative ways to enhance greater accuracy in the use of statistical methods in doctoral research | | | | | | | | 3.58 | .62 | A |

- SA PhD students

| No | Questions/statements | N | A | SI | M | I | E | I | U.K | U.K | level |
|----|--|---|------|------|------|-----|---|------|------|--------------------|-------|
| | | | | | | | | | Mean | Standard deviation | |
| 1 | The university assigns an assistant specializing in statistical methods to support me in my research and statistical analysis. | N | 32 | 8 | 5 | 1 | - | 1.46 | .78 | D | |
| | | % | 69.6 | 17.4 | 10.9 | 2.2 | - | | | | |
| 2 | Establishing a research unit centre at the university to provide the services | N | - | 1 | 4 | 8 | 3 | 3 | 4.59 | .74 | SA |

| | | | | | | | | | | |
|---|---|---|---------|---------|----------|----------|--------------|------|------|----|
| | of statistical analysis to students at any time. | % | - | 2. 2 | 8. 7 | 17 .4 | 7 1. 7 | | | |
| 3 | Make advanced statistics courses mandatory for postgraduate students | N | - | 2 | 10 | 8 | 2 5 | 4.24 | .95 | SA |
| | | % | - | 4. 4 | 22 .2 | 17 .8 | 5 5. 6 | | | |
| 4 | Providing training courses in using statistical analysis programs that are not compulsory. | N | 2 | 2 | 8 | 10 | 2 4 | 4.13 | 1.12 | A |
| | | % | 4. 3 | 4. 3 | 17 .4 | 21 .7 | 5 2. 2 | | | |
| 5 | Organizing seminars and workshops to discuss the academic difficulties facing postgraduate students in learning statistics. | N | - | 2 | 3 | 14 | 2 7 | 4.43 | .81 | SA |
| | | % | - | 4. 3 | 6. 5 | 30 .4 | 5 8. 7 | | | |
| 6 | Teaching statistics as part of the compulsory mathematics curriculum in primary and secondary school | N | 4 | 4 | 10 | 11 | 1 7 | 3.72 | 1.29 | A |
| | | % | 8. 7 | 8. 7 | 21 .7 | 23 .9 | 3 7 | | | |
| 7 | Preparing educational cadres in the subject of statistics capable of overcoming the difficulties of studying statistics | N | - | - | 3 | 17 | 2 6 | 4.50 | .62 | SA |
| | | % | - | - | 6. 5 | 37 | 5 6. 5 | | | |
| 8 | Develop methods of evaluating and teaching statistics material in PhD program | N | - | - | 4 | 8 | 3 3 | 4.64 | .65 | SA |
| | | % | - | - | 8. 9 | 17 .8 | 7 3. 3 | | | |

| | | | |
|--|------|-----|---|
| The possible alternative ways to enhance greater accuracy in the use of statistical methods in doctoral research | 3.96 | .43 | A |
|--|------|-----|---|

E- 5 -1 Independent Samples Test

| | PhD students | N | Mean | Std. Deviation | Std. Error Mean |
|-------|--------------|----|------|----------------|-----------------|
| MeanE | UK | 32 | 3.58 | .62 | .11654 |
| | SA | 46 | 3.96 | .43 | .06403 |

Independent Samples Test

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|-------|-----------------------------|---|------|------------------------------|--------|-----------------|-----------------|-----------------------|---|---------|
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference | |
| | | | | | | | | | Lower | Upper |
| MeanE | Equal variances assumed | 1.687 | .198 | 3.12 | 76 | .003 | -.38313 | .12260 | -.62747 | -.13880 |
| | Equal variances not assumed | | | -2.8 | 44.909 | .006 | -.38313 | .13297 | -.65097 | -.11530 |

Appendix F

F 1-1: Staff academy Interview Questions (English -Arabic)



College of Social
Sciences

Staff academy Interview Questions (English -Arabic)

تعزيز جودة ومستوى البحث في الجامعات السعودية: دراسة حول استخدام الأساليب الإحصائية في الأبحاث

التخصص (Specialization):

1. How much experience do you have with doctoral students and supervision of their PhD research or teaching statistics? Through your experience, what are the most important problems when analysing data?

كم خبرتك مع طلاب الدكتوراه؟ من خلال خبرتك مع طلاب الدكتوراه والإشراف على أبحاث الدكتوراه أو تدريسهم مادة الإحصاء؟ ماهي اهم المشاكل التي تواجههم في تحليل البيانات؟

.....
.....

2- How do you describe:

- The understanding level of Saudi students about statistics and its utilization in doctoral research
- The accuracy of their choice of statistical methods.
- Interpretation of data based on statistical methods

كيف تصف:

- مستوى فهم الطلاب السعوديين للإحصاء واستخدامه في أبحاث الدكتوراه.
- دقة إختيارهم للأساليب الإحصائية وقدرتهم على تفسير البيانات بناءً على الأساليب الإحصائية
- تفسير البيانات بناءً على الأساليب الإحصائية

.....
.....

3. What do doctoral students mostly adopt the common statistical methods in their scientific research? (Qualitative vs. quantitative, survey vs. interview) the methods before conducting statistical analysis?

ما هي الأساليب الإحصائية الشائعة التي يعتمدها طلاب الدكتوراه في بحثهم العلمي؟
(النوعي مقابل الكمي ، استبيان مقابل المقابلة)

.....
.....

4- What are common errors made by doctoral students during their statistical data analysis process ? and its

ما الأخطاء الإحصائية الشائعة التي يقع فيها طلاب مرحلة الدكتوراه ؟

.....
.....

5-How do errors in performing statistical analysis affect the overall quality of research and the community?

كيف تؤثر الأخطاء في إجراء التحليل الإحصائي على الجودة الشاملة للبحث ومن ثم على المجتمع؟

6 - Do you think that Saudi universities have provided the necessary for statistics, for example, qualified teachers, programs to help students understand statistics?

هل تعتقد أن الجامعات وفرت اللازم لمادة الإحصاء على سبيل المثال المدرسين الأكفاء، البرامج اللازمة لمساعدة الطلاب فهم الإحصاء؟

.....
.....

7-In light of the 2030 Vision of KSA, what are your recommendations regarding the quality of statistical methods used in the PhD stage?

في ظل توجهات الدولة لرؤية 2030 ما هو توصياتك فيما يتعلق بجودة الأساليب الإحصائية المستخدمة في مرحلة الدكتوراه ؟

.....
.....

Consent Form (staff academy interview)

Title of Project: **Enhancing the quality and standard of research in Saudi Arabian universities: Selection and use of research methods at doctoral level: An investigative study on the use of research into statistical methods.**

Supervisor: Professor Margery McMahon & Dr Cristina Mio

Name of Researcher: **Manal Abohiamid**

I confirm that I have read and understood the Plain Language Statement for the above study and have had the opportunity to ask questions.

I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, after you withdraw from the study, data will be removed and destroyed.

I acknowledge that participants will be not identified, and a pseudonym will be used in any publication arising from the research. If the researcher desire to use any direct quotes from our interview, I will be contacted by the researcher directly.

I acknowledge that there will be no effect on my employment arising from my participation or non-participation in this research.

I understand that the data collected from this research will be stored securely with my personal details removed exclude the job position and some information may be shared with the researcher's supervisors and agree for it to be held as set out in the Plain Language Statement, the research data will also be stored

and backed up in other systems such as hard-drive and personal laptop (all password-protected) to avoid any loss or theft of data.

Data collection that is needed for the research project will de-identify your personal data from the research data your answers given during the interview through pseudonymisation.

Please note that your confidentiality may be impossible to guarantee for example due to the size of the participant group, location etc. Please see accompanying Plain Language Statement.

If you wish to raise a complaint on how your personal data have been handled, you can contact the university Data Protection Officer who will investigate the matter.

Our Data Protection Officer can be contacted at dataprotectionofficer@glasgow.ac.uk

This project has been ethically approved via the College of Social Sciences Research Ethics Committee or relevant School Ethics Forum in the College.

Your personal data will be retained by the university only for as long as is necessary for processing and no longer than the period of ethical approval. After this time, personal data will be securely deleted.

Your research data will be retained for a period of ten years in line with the university of Glasgow Guidelines, research data will be removed from the research and destroyed.

I consent do not consent to interviews being audio-recorded

I agree to take part in this research study

I do not agree to take part in this research study

Name of Participant Signature

Date

Name of Researcher **Manal Abohiamid** Signature

End of consent form



College of Social
Sciences

نموذج الموافقة (staff academy interview) Consent Form

عنوان البحث: تعزيز جودة ومعايير البحث في جامعات المملكة العربية السعودية: اختيار واستخدام طرق البحث على مستوى الدكتوراه:
دراسة استقصائية حول استخدام البحث في الأساليب الإحصائية

المشرف: الأستاذة ماجري ماك مهون والدكتورة كريستينا مايو

اسم الباحث: منال أبو حيمد

أؤكد أنني قد قرأت وفهمت بيان ورقة المعلومات المرسلة للدراسة أعلاه وأتاحت لي الفرصة لطرح الأسئلة
أفهم أن مشاركتي طوعية وأني حر في الانسحاب في أي وقت دون إبداء أي سبب، وبعد انسحابك من الدراسة، ستتم إزالة البيانات
وإتلافها

أقر بأنه لن يتم تحديد هوية المشاركين، وسيتم استخدام اسم مستعار في أي منشور ينشأ عن البحث. إذا رغب الباحث في
استخدام أي اقتباسات مباشرة من مقابلتنا، فسيتم الاتصال بي مباشرة من قبل الباحث

أقر بأنه لن يكون هناك أي تأثير على وظيفتي نتيجة مشاركتي أو عدم مشاركتي في هذا البحث

أفهم أن البيانات التي تم جمعها من هذا البحث سيتم تخزينها بشكل آمن مع إزالة بياناتي الشخصية باستثناء الوظيفة وقد تتم مشاركة بعض
المعلومات مع مشرفي الباحث وأوافق على الاحتفاظ بها على النحو المبين في بيان اللغة البسيطة، البحث سيتم أيضاً تخزين البيانات
ونسختها احتياطياً في أنظمة أخرى مثل محرك الأقراص الثابتة والكمبيوتر المحمول الشخصي (جميعها محمية بكلمة مرور) لتجنب أي
فقدان أو سرقة للبيانات

سيؤدي جمع البيانات اللازمة لمشروع البحث إلى إلغاء تحديد بياناتك الشخصية من بيانات البحث التي قدمتها إجاباتك أثناء

المقابلة من خلال استخدام الأسماء المستعارة

يرجى ملاحظة أنه قد يكون من المستحيل ضمان سريتك على سبيل المثال نظراً لحجم مجموعة المشاركين والموقع وما إلى ذلك. يرجى

الاطلاع على بيان المعلومات المصاحب

إذا كنت ترغب في تقديم شكوى حول كيفية التعامل مع بياناتك الشخصية، فيمكنك الاتصال بمسؤول حماية البيانات بالجامعة
يمكن الاتصال بمسؤول حماية البيانات لدينا على dataprotectionofficer@glasgow.ac.uk

تمت الموافقة على هذا المشروع أخلاقياً من خلال لجنة أخلاقيات البحث بكلية العلوم الاجتماعية أو منتدى أخلاقيات المدرسة ذي الصلة
في الكلية

ستحتفظ الجامعة ببياناتك الشخصية فقط طالما كانت ضرورية للمعالجة ولم تتجاوز فترة الموافقة الأخلاقية. بعد هذا الوقت، سيتم حذف
البيانات الشخصية بشكل آمن

سيتم الاحتفاظ ببيانات البحث الخاصة بك لمدة عشر سنوات بما يتماشى مع إرشادات جامعة جلاسكو، وستتم إزالة بيانات البحث. من
البحث وإتلافه أو وافق لا أو وافق على تسجيل المقابلات بالصوت

أو وافق على المشاركة في هذه الدراسة البحثية

لا أو وافق على المشاركة في هذه الدراسة البحثية

..... اسم المشارك التوقيع

..... التاريخ

اسم الباحث: منال ابو حيمد التوقيع



College of Social
Sciences

F1-4: Plain Language Statement (staff academy Interview in English)

Plain Language Statement (staff academy Interview)

1. Study title and Researcher Details

Enhancing the quality and standard of research in Saudi Arabian universities: Selection and use of research methods at doctoral level: An investigative study on the use of research into statistical methods

Supervisors: Professor Margery McMahon & Dr Cristina Mio

Researcher: Manal Abohiamid

2. Invitation paragraph

I would like to take the opportunity to invite you to participate in an online interview designed for this research study. I am a PhD student studying at the university of Glasgow and I have an ethical approval for the study. You will be provided with all the required information regarding the scope and aims of this research study. If you are unsure about any aspect of the research or the questions in the interview, please feel free to contact me.

Your participation in this interview will be highly appreciated, as it will enable the researcher to develop useful tools for improving the quality of research in the kingdom of Saudi Arabia. In order to participate in the interview, please click on the link that I will be sending you via email. The interview will not take more than 30 45-minutes of your time. Thank you for taking time to go through all this.

3. What is the purpose of this study?

This study is concerned with the quality of research, as research has significance in the development of society in all economic, political and educational aspects. This research aims to learn about statistical methods used in research in Saudi universities. Whereas the use of statistics is considered to be one of the most important pillars in researches as the results will be important in achieving the aim of the study. As this study aims to know how PhD students will be prepared to conduct Statistical Analysis.

4. Why have I been chosen?

The project looks at how statistics is used in the field of Education research. You have been chosen because you are a principal of teaching statistics for post-graduate students.

5. Do I have to take part?

You can withdraw from the study at any stage of the interview. Please note, that all the data will be secured and will remain personally pseudonymous, if you wish to withdraw from the study all your research data will be destroyed and removed.

6. What will happen to me if I take part?

You will be given a chance to ask me questions regarding the research study before starting the interview. After this, you will be asked to email me with a time slot that is convenient for you. I will send you by email a link for the interview meeting via Zoom and you have to just click on it and enter the interview, which is a free online video conferencing service. Once we have an agreed interview time, answer any questions you have, review the consent forms, and begin audio recording. I will be asking you several questions and then listen and discuss your answers and it will take up to 30-45 minutes of your time. I will use the recording of our interview to transcribe our conversation. I will analyse the transcriptions of all the interviews to analyse common themes and begin answering my research questions. If I desire to use any direct quotes from our interview, I will contact you directly to receive written permission. General themes from our interview will be discussed in my research but you will remain pseudonymous.

7. Will my participation in this study be kept confidential?

Your identity will be replaced by a code. Therefore, you will be pseudonymous. I will not refer to your name, or any likely identifying characteristics in my research. I will use information about your job position. The data would be disposed confidentially, in line with the Data Protection Act and General Data Protection Regulations. Any non-anonymised data in the form of interview transcripts, where applicable, will be discarded so that it cannot be stolen or used inappropriately. Please note that assurances on confidentiality will be strictly adhered to unless evidence of wrongdoing or potential harm is uncovered. In such cases the university may be obliged to contact relevant statutory bodies/agencies. your answers may be shared or discussed with my supervisors. your answers will be kept in a secure place and the saved information in the computer will be secured by password, all data will be disposed after the completion of the study. The

research data will also be stored and backed up in other systems such as hard-drive and personal laptop to avoid any loss or theft of data. This data will remain secure and all data used for the publication of the project will be de-identified. It will be made public for the use of other researchers. All data will be kept for 10 years.

8. What will happen to the results of the study?

The results of this study will be derived from analysing the interview data, which will be presented in the results chapter of PhD thesis. Later on, they will be published in the peer-reviewed journals. The results of this study will be used to provide tentative conclusions to suggest improvements in the quality of research in the Kingdom of Saudi Arabia.

9. Possible Risk

There are no risks to participants in this study. Please note that your confidentiality may be impossible to guarantee for example due to the size of the participant group, location etc. Please see accompanying Plain Language Statement.

Any personal identifiers will be removed from the data and replaced by a code. Data will be stored at the university of Glasgow and my house in the United Kingdom and Saudi Arabia in a secure facility or secured cabinet.

10. Who is organising and funding the research? (If relevant)

The researcher's doctoral studies are funded by the Ministry of Education in Saudi Arabia.

11. Who has reviewed the study?

The project has been reviewed by the College of Social Sciences Research Ethics Committee at the university of Glasgow.

To conduct this research project, I will be working under supervision of:

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13. Contact for Further Information

If you wish to have further information about this study, you may contact me by email at

xxxxxxxx@student.gla.ac.uk

Should you have any concerns regarding the conduct of the research project you can contact the School of Education Ethics Officer by contacting **[Dr Muir Houston: Muir.Houston@glasgow.ac.uk](mailto:Muir.Houston@glasgow.ac.uk)**

THANK YOU FOR YOUR TIME AND CONSIDERATION

F1-5: Plain Language Statement (staff academy Interview in Arabic)



College of Social
Sciences

معلومات عن البحث للأساتذة

Plain Language Statement in Arabic

1. عنوان الدراسة وتفاصيل عن الباحث

تعزيز جودة ومعايير البحث في جامعات المملكة العربية السعودية: اختيار واستخدام طرق البحث على مستوى الدكتوراه: دراسة استقصائية حول استخدام البحث في الأساليب الإحصائية

الباحثة: منال أبوحميد

2. الدعوة:

أود أن أعتنم الفرصة لأدعوك للمشاركة في مقابلة عبر الإنترنت مصممة لهذه الدراسة البحثية. أنا طالب دكتوراه أدرس في جامعة غلاسكو ولدي موافقة أخلاقية على الدراسة. سيتم تزويدك بجميع المعلومات المطلوبة فيما يتعلق بنطاق وأهداف هذه الدراسة البحثية. إذا لم تكن متأكدًا من أي جانب من جوانب البحث أو الأسئلة في المقابلة، فلا تتردد في الاتصال بي. ستكون مشاركتك في هذه المقابلة محل تقدير كبير، لأنها ستمكن الباحث من تطوير أدوات مفيدة لتحسين جودة البحث في المملكة العربية السعودية. من أجل المشاركة في المقابلة، يرجى النقر على المرسل على الايميل الخاص بك لن تستغرق المقابلة أكثر من 30-45 دقيقة من وقتك.

شكرا لأخذنا جزءا من وقتك

3. ما هو الغرض من هذه الدراسة؟

تهتم هذه الدراسة بجودة البحث، حيث إن البحث له أهمية في تطوير المجتمع في جميع الجوانب الاقتصادية والسياسية والتعليمية. يهدف هذا البحث إلى التعرف على الأساليب الإحصائية المستخدمة في البحوث في الجامعات السعودية. وحيث يعتبر استخدام الإحصاءات أحد أهم الركائز في البحوث، حيث ستكون النتائج مهمة في تحقيق هدف الدراسة إلى معرفة كيف سيكون طلاب الدكتوراه على استعداد لإجراء التحليل الإحصائي

4. لماذا تم اختيارك؟

ينظر المشروع في كيفية استخدام الإحصاءات في مجال البحوث التربوية. لقد تم اختيارك لأنك قمت بتدريس الإحصاء لطلاب الدراسات العليا

5. هل يجب أن أشارك؟

يمكنك الانسحاب من الدراسة في أي مرحلة من مراحل المقابلة. ومع ذلك، يرجى ملاحظة أنه بعد تقديم المقابلة لن يكون من الممكن إزالة إجاباتك من البيانات حيث سيتم مناقشة المقابلة في بحثي، ولكنك ستظل مجهول الهوية شخصيا.

6. ماذا سيحدث لي إذا شاركت؟

ستتاح لك الفرصة لطرح أسئلة على بخصوص الدراسة البحثية قبل بدء المقابلة. بعد ذلك، سيطلب منك مراسلتي عبر البريد الإلكتروني مع عليك فقط النقر فوقه والدخول في Zoom فترة زمنية مناسبة لك. سأرسل لك عبر البريد الإلكتروني رابطا لاجتماع المقابلة من خلال المقابلة، وهي خدمة عبر الإنترنت. بمجرد أن يكون لدينا وقت متفق عليه للمقابلة، أجب عن أي أسئلة لديك، مع مراجعة نماذج الموافقة، سأطرح عليك عدة أسئلة ثم أستمع وأناقش إجاباتك وسيستغرق الأمر ما يصل إلى 30-45 دقيقة من وقتك. سأستخدم وأبدأ بالتسجيل تسجيل مقابلتنا لتدوين محادثتنا. سأقوم بتحليل نسخ جميع المقابلات لتحليل الموضوعات المشتركة والبدء في الإجابة على أسئلتك البحثية. إذا كنت أرغب في استخدام أي اقتباسات مباشرة من مقابلتنا، سوف أتصل بك مباشرة للحصول على إذن كتابي. ستنم مناقشة الموضوعات العامة من مقابلتنا في بحثي، ولكنك ستبقى اسما مستعارا

7. هل ستبقى مشاركتي في هذه الدراسة سرية؟

سيتم استبدال هويتك برمز. لذلك، سوف تكون اسم مستعار. لن أشير إلى اسمك، أو أي خصائص تعريف محتملة في بحثي. سأستخدم معلومات حول وظيفتك. سيتم التخلص من البيانات بسرية، بما يتماشى مع قانون حماية البيانات واللوائح العامة لحماية البيانات. سيتم التخلص من أي بيانات مجهولة المصدر في شكل نصوص المقابلة، عند الاقتضاء، بحيث لا يمكن سرقتها أو استخدامها بشكل غير لائق. يرجى ملاحظة أنه سيتم الالتزام الصارم بالضمانات المتعلقة بالسرية ما لم يتم الكشف عن دليل على ارتكاب مخالفات أو ضرر محتمل. في مثل هذه الحالات، قد تكون الجامعة ملزمة بالاتصال بالهيئات / الوكالات القانونية ذات الصلة. قد تتم مشاركة إجاباتك أو مناقشتها مع المشرفين. سيتم الاحتفاظ بإجاباتك في مكان آمن وسيتم تأمين المعلومات المحفوظة في الحاسوب بكلمة مرور، وسيتم التخلص من جميع البيانات بعد الانتهاء من الدراسة

كما سيتم تخزين بيانات البحث ونسخها احتياطياً في أنظمة أخرى مثل القرص الصلب والحاسوب المحمول الشخصي لتجنب أي فقدان أو سرقة للبيانات. ستبقى هذه البيانات آمنة وسيتم إلغاء تحديد جميع البيانات المستخدمة لنشر المشروع. سيتم الإعلان عنها لاستخدام باحثين آخرين. سيتم الاحتفاظ بجميع البيانات لمدة 10 سنوات.

8. ماذا سيحدث لنتائج الدراسة؟

سيتم اشتقاق نتائج هذه الدراسة من تحليل بيانات المقابلة، والتي سيتم تقديمها في فصل النتائج من أطروحة الدكتوراه. في وقت لاحق، سيتم نشرها في المجالات. سيتم استخدام نتائج هذه الدراسة لتقديم استنتاجات مبدئية لاقتراح تحسينات في جودة البحوث في المملكة العربية السعودية.

9. المخاطر المحتملة

لا توجد مخاطر على المشاركين في هذه الدراسة. يرجى ملاحظة أنه قد يكون من المستحيل ضمان سريةك على سبيل المثال بسبب حجم مجموعة المشاركين والموقع وما إلى ذلك. يرجى الاطلاع على بيان المعلومات المرفق. سيتم إزالة أي معرفات شخصية من البيانات واستبدالها برمز. سيتم تخزين البيانات في جامعة غلاسكو ومنزلي في المملكة المتحدة والمملكة العربية السعودية في منشأة آمنة أو خزانة آمنة

10. من يقوم بتنظيم وتمويل البحث؟

يتم تمويل هذه الدراسة من قبل وزارة التربية والتعليم في المملكة العربية السعودية

11. من قام بمراجعة الدراسة؟

وقد تمت مراجعة الدراسة من قبل لجنة أخلاقيات البحوث العلوم الاجتماعية لإجراء هذا المشروع البحثي، سأعمل تحت إشراف:

Professor Margery McMahon

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university address: student.recruitment@glasgow.ac.uk

12. الاتصال للحصول على مزيد من المعلومات

إذا كنت ترغب في الحصول على مزيد من المعلومات حول هذه الدراسة، يمكنك الاتصال بي عن طريق البريد الإلكتروني على

xxxxxxxx@student.gla.ac.uk

إذا كان لديك أي مخاوف بشأن إجراء المشروع البحثي يمكنك الاتصال بمسؤول أخلاقيات كلية التربية والتعليم عن طريق الاتصال

[Dr Muir Houston: Muir.Houston@glasgow.ac.uk](mailto:Dr.Muir.Houston@glasgow.ac.uk)

مع كل الشكر والتقدير

G 1-1 (Questionnaire with English consent form)

Dear Respondent,

The researcher is conducting a study entitled **Enhancing the quality and standard of research in Saudi Arabian universities: Selection and use of research methods at doctoral level: An investigative study on the use of research into statistical methods**

This study aims to:

1. Investigate the use of Statistical Analysis by students in Saudi Arabian universities and investigate how to enhance the quality and standard of research at Saudi Arabian universities.
2. Investigate how accurate is the choice to use and interpret data based on statistical methods.
 - The possible alternative ways to enhance greater accuracy in the use of statistical methods in doctoral research

The perception of the PhD students is essential to achieve the aim of this study.

The following questionnaire contains statements about how well-prepared doctoral level students are to undertake statistical analysis in their research studies.

In this questionnaire the researcher's intention is to collect the PhD student's perception of these statements.

Your participation is vital for the success of this study and would be much appreciated. Completing this online questionnaire will enable the researcher to achieve the aims and objectives of the research, it will take approximately 20 minutes of your time.

The research would use this opportunity to assure you that the data will be treated as strictly confidential and will be used only for the purpose of this study and will be anonymous.

Please:

- For more information about the research please read the Plain Language Statement as it will be attached to your email with the questionnaire link.
- Note that you will indicate your consent to take part in the research by completing the questionnaire, please note that you can withdraw from the survey at any time, Data could not be removed after submitting the questionnaire.
- Do not write your name in this questionnaire
- Note that your answers may be shared or discussed with my Supervisors.
- Your research data will be retained for a period of ten years in line with the university of Glasgow Guidelines. research data will be removed from the research and destroyed.
- the research data will also be stored and backed up in other systems such as hard-drive and personal laptop (all password-protected) to avoid any loss or theft of data.
- If you wish to raise a complaint on how your personal data have been handled, you can contact the university Data Protection Officer who will investigate the matter.

Our Data Protection Officer can be contacted at dataprotectionofficer@glasgow.ac.uk

- This project has been ethically approved via the College of Social Sciences Research Ethics Committee or relevant School Ethics Forum in the College.

Thank you for your participation.

Thank you for your participation in this study, your help is very much appreciated.

Part 1: Personal information:

الجزء الأول :معلومات شخصية

please put (X) next to the appropriate response or type it:

Education background الخلفية التعليمية:

1- In what country did you do the majority of your compulsory education :

- A) Primary school (please type here)
B) secondary school..... (please type here)
C) When did you finish your maths studies at school?
(please type here)

D) In what country did you do your undergraduate degree?
..... (please type here)

ماهي اخر سنة درست فيها مادة الرياضيات في المدرسة؟

E) What undergraduate degree do you hold?
..... (please type here)

F) Do you have another degree?
..... (please type here)

١- في أي بلد اكملت تعليمك

(اكتبها هنا)

.....

أ - المرحلة الابتدائية

ب-المرحلة الثانوية..... (اكتبها هنا)

ج ماهي اخر سنة درست فيها مادة الرياضيات في المدرسة؟

د- في أي دولة أتممت تعليمك الجامعي ؟

..... (اكتبها هنا)

هـ- ما هي الدرجة الجامعية التي تحملها؟ وفي أي تخصص؟

..... (اكتبها هنا)

و- هل لديك درجة أخرى؟ وفي أي تخصص؟ [سؤال مفتوح]

..... (اكتبها هنا)

2) Gender:

..... if you prefer not to disclose (please type here)

٢- الجنس:

..... (اذا كنت تفضل الكشف عن الجنس) (اكتبها هنا)

3-Is your research:

qualitative [], quantitative [], mixed [],

other – please type [.....]?

٣- هل بحثك : نوعي [] ، كمي [] ، مختلط [] ، آخر- (اكتبها هنا) [.....]؟

4-If you are doing some quantitative research, have you already started analysing your data? Yes [],

No[],

Other- please type [.....]?

٤- إذا كان بحثك بحثا كمي ، فهل بدأت بالفعل في تحليل بياناتك؟ نعم [] ، لا [] ،

آخر - ارجو كتابتها هنا [.....]

Part 2: Perception of the readiness of Ph.D. Students to conduct Statistical Analysis

الجزء الثاني: استعداد طلبة الدكتوراه لإجراء التحليل الإحصائي

, please answer the questionnaire questions based on the knowledge, feelings, and attitudes you had before you started the statistical analysis stage

إذا كنت قد بدأت بالفعل في التحليل الإحصائي الكمي ، فيرجى الإجابة على الأسئلة التالية بناءً على المعرفة ، والمشاعر و السلوك التي مررت بها قبل أن تبدأ مرحلة التحليل الإحصائي

| NO | Question | Not Applicable غير مطبق | Strongly Disagree لأوافق بشده | Disagree لا أوافق | Neither agree nor disagree ولا أوافق لا أرفض | agree أوافق | Strongly agree أوافق بشده |
|----|---|----------------------------------|--|-------------------------|---|----------------|------------------------------------|
| 1 | I have a good theoretical knowledge of the concepts of statistics (e.g., mean, Regression). امتلك معرفة جيدة نظرية لمفاهيم الإحصاء (المتوسط, الانحدار) | | | | | | |
| 2 | I understand the difference between variables in quantitative research (e.g., independent, dependent, and mediating variables) أستطيع تحديد نوع المتغيرات الإحصائية في دراستي (متغيرات مستقلة وتابعة وسيطة) | | | | | | |
| 3 | How strongly do you agree/disagree with this statement: "I learned statistics during my PhD through self-study (e.g. through online courses, textbooks, feedback from supervisor)" ما مدى قوة موافقتك/ عدم موافقتك على هذا البيان: "لقد تعلمت الإحصاءات أثناء الدكتوراه من خلال الدراسة الذاتية" على سبيل المثال من خلال الدورات التدريبية عبر الإنترنت والكتب المدرسية والتعليقات من المشرف | | | | | | |

| | | | | | | | |
|-----|---|--|--|--|--|--|--|
| 4 | I can use statistical analysis software (e.g., SPSS, Minitab.) very well أستطيع استخدام برامج التحليل الإحصائية (مثل SPSS, Minitab) | | | | | | |
| 5 F | I am confident to select the most suitable statistical methods to test my research hypotheses. أستطيع اختيار الأسلوب الإحصائي المناسب لاختبار فرضيات بحثي | | | | | | |
| 6 | I like applying statistics as part of my research. استمتع بتطبيق الإحصاء الخاص بدراساتي | | | | | | |
| 7 | I enjoy taking statistics courses and statistics training for my research. أستمتع بأخذ مقررات ودورات الإحصاء تمكني من اجراء التحليلي الني الخاص ببحثي | | | | | | |
| 8 | For students doing quantitative qualitative research, please answer: "I would hfeel anxious if I had to use statistics in my research بالنسبة للطلاب الذين يجرون بحثًا كميًا، يرجى الإجابة: "أشعر بالقلق عندما يتعين علي استخدام الإحصائيات في بحثي." | | | | | | |
| 9 | I am confident I can learn statistical methods. أنا واثق من أنني أستطيع تعلم الأساليب الإحصائية | | | | | | |
| 10 | I prefer to depend on myself to achieve the statistical analysis in my research. أفضل الاعتماد على نفسي لتحقيق التحليل الإحصائي في بحثي | | | | | | |

| | | | | | | | |
|----|---|--|--|--|--|--|--|
| 11 | I prefer getting help from a statistician to do statistical analysis in my research. أفضل الحصول على مساعدة من متخصص في الأساليب الإحصائية | | | | | | |
|----|---|--|--|--|--|--|--|

12) Were you offered to attend a statistics course as part of your PhD?

هل عرض عليك حضور دورة إحصاء كجزء من برنامج الدكتوراه؟

Yes ...

No...

13) If you answered yes to question 13, how strongly do you agree/disagree with this statement: "The statistics course I was offered/required to attend was very useful?"

ما مدى موافقتك/عدم موافقتك على هذا البيان: "كانت دورة الإحصاءات التي عرضت علي/طلب حضورها مفيدة للغاية"

Not Applicable غير مطبق

Strongly Disagree لا أوافق بشدة

Disagree لا أوافق

Neither agree nor disagree لا أوافق ولا أرفض

Agree موافق

Strongly Agree موافق بشدة

14) Were you required to attend a statistics course as part of your PhD?

هل طلب منك حضور دورة إحصاء كجزء من برنامج الدكتوراه؟

YES....

NO....

15) If you answered yes to question 15, how strongly do you agree/disagree with this statement: "The statistics course I was offered/required to attend was very useful."

ما مدى موافقتك/عدم موافقتك على هذا البيان: "كانت دورة الإحصاءات التي عرضت علي/طلب حضورها مفيدة للغاية"

Not Applicable غير مطبق.....

Strongly Disagree لا أوافق بشدة.....

Disagree لا أوافق.....

Neither agree nor disagree لا أوافق ولا أرفض.....

Agree موافق.....

Strongly Agree موافق بشدة....

Part 3: The extent to which PhD students when applying the steps of statistical methods before conducting statistical analysis.

مدى تطبيق طلاب الدكتوراه لخطوات الطرق الإحصائية قبل إجراء التحليل الإحصائي: الجزء الثالث

please answer the questionnaire questions based on the knowledge, feelings, and attitudes you had before you started the statistical analysis stage

إذا كنت قد بدأت بالفعل في التحليل الإحصائي الكمي ، فيرجى الإجابة على الأسئلة التالية بناءً على المعرفة ، والمشاعر و السلوك التي مررت بها قبل أن تبدأ مرحلة التحليل الإحصائي

| NO | Question | Not Applicable غير مطبق | Strongly disagree لا أوافق بشده | Disagree لا أوافق | Neither agree nor disagree لا أوافق ولا أرفض | agree أوافق | Strongly agree أوافق بشدة |
|----|---|----------------------------|------------------------------------|----------------------|---|----------------|------------------------------|
| 1 | I realize the importance of a pilot study of my research to test the validity and reliability. أدرك أهمية إجراء دراسة استطلاعية قبل إجراء البحث، لاختبار الصدق والثبات | | | | | | |
| 2 | I prefer to use simple statistical methods in my research (percentages, frequencies and means) | | | | | | |

| | | | | | | | |
|---|---|--|--|--|--|--|--|
| | أفضل استخدام الأساليب الإحصائية البسيطة في بحثي (التكرارات والنسب المئوية والمتوسطات) | | | | | | |
| 3 | I do a preliminary data inspection before I start analysing the data أقوم بفحص البيانات الأولية قبل أن أبدأ في تحليل البيانات | | | | | | |
| 4 | I can choose an appropriate type of sample for my research لبحثي عينة الدراسة بدقة أستطيع إختيار | | | | | | |
| 5 | I can determine the appropriate sample size for my research يمكنني تحديد حجم العينة المناسب لبحثي | | | | | | |
| 6 | I define the type of my research variables by reviewing previous studies أحدد نوع متغيرات بحثي بمراجعة الدراسات السابقة | | | | | | |
| 7 | I have enough statistical knowledge to be able to avoid using statistical methods that are not appropriate to the nature of my research لدي ما يكفي من المعرفة الإحصائية لأكون قادراً على تجنب استخدام الأساليب الإحصائية التي لا تتناسب مع طبيعة بحثي | | | | | | |
| 7 | I determine the statistical techniques of my data analysis | | | | | | |

| | | | | | | | |
|---|---|--|--|--|--|--|--|
| | by reviewing the techniques used in previous studies أحدد الأساليب الإحصائية لتحليل بياناتي من خلال مراجعة التقنيات المستخدمة في الدراسات السابقة | | | | | | |
| 8 | I ensure to use statistical analysis methods that correspond to the nature of the research أسعى لاستخدام أساليب تحليل احصائي تتوافق وتتناسب مع طبيعة البحث | | | | | | |
| 9 | I explain the limitation of generalizing the results of my statistical analysis أشرح حدود تعميم نتائج التحليل الإحصائي | | | | | | |

10) I prefer to use quantitative methods in my research

أفضل إستخدام المنهج الكمي في بحثي

- Strongly Agree موافق بشدة
- Agree موافق
- Neither agree nor disagree لا أوافق ولا أرفض
- Disagree لا أوافق
- Strongly Disagree لا أوافق بشدة
- Not Applicable غير مطبق

11) please explain why you prefer or you don't prefer to use quantitative methods in your research (please type here هنا أكتبها)

(تفضل استخدام الطرق الكمية في البحث الخاص بك لا أو يرجى شرح لماذا تفضل

.....

12) I prefer to use qualitative methods in my research

أفضل إستخدام المنهج النوعي في بحثي

- Strongly Agree بموافق بشدة.....
- Agree بموافق.....
- Neither agree nor disagree لا أوافق ولا أرفض
- Disagree لا أوافق.....
- Strongly Disagree لا أوافق بشدة.....
- Not Applicable غير مطبق.....

13)please explain why you prefer or you don't prefer to use qualitative methods in your research (please type here (أكتبها هنا)

يرجى شرح لماذا تفضل أو لا تفضل استخدام أساليب النوعية في البحث الخاص بك

.....

14)I prefer to use mixed method in my research

أفضل إستخدام المنهج المختلط في بحثي

- Strongly Agree بموافق بشدة.....
- Agree بموافق.....
- Neither agree nor disagree لا أوافق ولا أرفض
- Disagree لا أوافق.....
- Strongly Disagree لا أوافق بشدة.....
- Not Applicable غير مطبق.....

15)please explain why you prefer or you don't prefer to use mixed methods in your research (please type here (هنا أكتبها)

يرجى شرح لماذا كنت تفضل أو كنت لا تفضل استخدام

.....

Part 4: How accurate are PhD students' in applying statistical methods and data interpretation based on statistical methods selected? What are the implications of that?

الجزء الرابع: ما مدى دقة تطبيق طلاب الدكتوراه للطرق الإحصائية وتفسير البيانات بناء على الأساليب الإحصائية المختارة؟؟ وما هي الآثار المترتبة على ذلك؟

Please answer the questionnaire questions based on the knowledge, feelings, and attitudes you had before you started the statistical analysis stage.

إذا كنت قد بدأت بالفعل في التحليل الإحصائي الكمي ، فيرجى الإجابة على الأسئلة التالية بناءً على المعرفة ، والمشاعر و السلوك التي مررت بها قبل أن تبدأ مرحلة التحليل الإحصائي.

| NO | Question | Not Appli cable غير مطبق | Stron gly disag ree لاأوافق بشده | Disag ree لا أوافق | Neither agree nor disagre e لا أوافق ولا أرفض | agr ee أوا فق | Stron gly agree أوافق بشدة |
|----|---|--------------------------------------|---|--------------------------|---|------------------------|--|
| 1 | I use the appropriate statistical method regardless of its complexity استخدم الطرق الإحصائية المناسبة بغض النظر عن تعقيدها | | | | | | |
| 2 | I have good skills of analysing and interpreting statistical data. لدي مهارة جيدة قراءة وتحليل وتفسير نتائج التحليل الاحصائي | | | | | | |

| | | | | | | | |
|---|--|--|--|--|--|--|--|
| 3 | I compare the results of my data analysis with the results of previous studies أقارن بين نتائج التحليل بنتائج الدراسات السابقة | | | | | | |
| 4 | I support my findings with evidence by reviewing the literature أدعم نتائجي بأدلة من خلال مراجعة الأدبيات | | | | | | |
| 5 | I rely on the updated statistical analysis programs to extract data and to ensure the accuracy of their statistical outputs اعتمد على أحدث برامج التحليل الإحصائي لاستخراج البيانات ولضمان دقة مخرجاتها الإحصائية | | | | | | |
| 6 | I critically reflect on and discuss the accuracy correctness of the statistical methods used in my research after applying statistical methods صحة الطرق ومناقشة نقد أنا أستطيع الإحصائية المستخدمة في بحثي بعد تطبيق الأساليب الإحصائية بدقة | | | | | | |
| 7 | using statistical methods that is inappropriate to the research leads to inaccuracy results استخدام الأساليب الإحصائية التي لا تتناسب مع البحث يؤدي إلى نتائج غير دقيقة | | | | | | |

Part 5: The possible alternative ways to enhance greater accuracy in the use of statistical methods in doctoral research

الجزء الخامس: ماهي الطرق البديلة الممكنة لتعزيز دقة أكبر في استخدام الأساليب الإحصائية في أبحاث الدكتوراه

For each statement below, select from the given scale the level of importance you give to the different ways that the university can support PhD students with statistics

لكل عبارة أدناه، اختر من المقياس المحدد مستوى الأهمية التي تعطيها للطرق المختلفة التي يمكن للجامعة دعم طلاب الدكتوراه في استخدام الإحصاء

Please answer the questionnaire questions based on the knowledge, feelings, and attitudes you had before you started the statistical analysis stage.

إذا كنت قد بدأت بالفعل في التحليل الإحصائي الكمي ، فيرجى الإجابة على الأسئلة التالية بناءً على المعرفة ، والمشاعر و السلوك التي مررت بها قبل أن تبدأ مرحلة التحليل الإحصائي.

| NO | Question/ Statement | Extremely important مهم للغاية | Important مهم | Moderately important مهم باعتدال | Slightly important مهم قليلا | Not at all important ليس مهم على الاطلاق | Not sure لست متأكد |
|----|--|-----------------------------------|------------------|-------------------------------------|---------------------------------|---|-----------------------|
| 1 | The university assigns an assistant specializing in statistical methods to support me in my research and statistical analysis. تعين الجامعة مساعد متخصص في الأساليب الاحصائية مساعدتي ببحثي و في التحليل الاحصائي | | | | | | |
| 2 | Establishing a research unit centre at the university to provide the services of statistical analysis to students at any time. | | | | | | |

| | | | | | | | |
|---|---|--|--|--|--|--|--|
| | إنشاء وحدة بحثية بالجامعة لتقديم خدمات التحليل الإحصائي للطلاب في اي وقت | | | | | | |
| 3 | Make advanced statistics courses mandatory for postgraduate students إلزام طلبة الدراسات العليا بدراسة مقررات إحصائية متقدمة | | | | | | |
| 4 | Providing training courses in using statistical analysis programs that are not compulsory. تقديم برامج تدريبية متخصصة في استخدام برامج التحليل الإحصائي ليست اجبارية | | | | | | |
| 5 | organizing seminars and workshops to discuss the academic difficulties facing postgraduate students in learning statistics. عقد ندوات وورش عمل لمناقشة الصعوبات الأكاديمية التي تواجه طلبة الدراسات العليا في تعلم الاحصاء | | | | | | |
| 6 | Teaching statistics as part of the compulsory mathematics curriculum in primary and secondary school تدريس الاحصاء كجزء من منهج الرياضيات الإلزامي في المدارس الابتدائية والثانوية | | | | | | |
| 7 | Preparing educational cadres in the subject of statistics capable of | | | | | | |

| | | | | | | | |
|----|--|---|--|--|--|--|--|
| | overcoming the difficulties of studying statistics. إعداد كوادر تعليمية في مادة الإحصاء قادرة على تذليل صعوبات دراسة مادة الإحصاء. | | | | | | |
| 8 | Develop methods of evaluating and teaching statistics material in PhD programme. تطوير طرق تقويم وتدريس مادة الإحصاء. | | | | | | |
| 9 | Please suggest other ways to enhance PhD students' knowledge of statistics يرجى اقتراح طرق أخرى لتعزيز معرفة طلاب الدراسات العليا بالإحصاءات | Please type here (هنا اكتبها): | | | | | |
| 10 | If you have any additional comments you want to add on this topic, please add them here. إذا كان لديك أي تعليقات إضافية تريد إضافتها حول هذا الموضوع يرجى إضافتها هنا | Please type here (هنا اكتبها): | | | | | |

G 1-2 (Questionnaire with Arabic consent form)

عزيزي المشارك

يجري الباحث دراسة بعنوان تعزيز جودة ومعايير البحث في الجامعات السعودية: اختيار واستخدام طرق البحث على مستوى الدكتوراه:

دراسة استقصائية حول استخدام البحث في الأساليب الإحصائية

تهدف هذه الدراسة إلى:

التحقيق في استخدام التحليل الإحصائي من قبل الطلاب في جامعات المملكة العربية السعودية والتحقيق في كيفية تحسين جودة ومعايير

البحث في الجامعات السعودية

التحقيق في مدى دقة اختيار استخدام وتفسير البيانات على أساس الأساليب الإحصائي

الطرق البديلة الممكنة لتعزيز دقة أكبر في استخدام الأساليب الإحصائية في أبحاث الدكتوراه

يعتبر تصور طلاب الدكتوراه أمرًا ضروريًا لتحقيق هدف هذه الدراسة

يحتوي الاستبيان التالي على عبارات حول مدى استعداد الطلاب على مستوى الدكتوراه لإجراء تحليل إحصائي في دراساتهم البحثية في هذا الاستبيان، تهدف الباحثة إلى جمع تصور طالب الدكتوراه لهذه العبارات مشاركتك أمر حيوي لنجاح هذه الدراسة وستكون محل تقدير كبير. سيتم إكمال هذا الاستبيان عبر الإنترنت الباحث من تحقيق أهداف البحث وأهدافه، وسيستغرق الأمر حوالي 20 دقيقة من وقتك سوف يستغل البحث هذه الفرصة ليؤكد لك أنه سيتم التعامل مع البيانات بسرية تامة وسيتم استخدامها فقط لغرض هذه الدراسة وستكون مجهولة تمامًا

لمزيد من المعلومات حول البحث، يرجى قراءة بيان اللغة المبسطة حيث سيتم إرفاقه ببريدك الإلكتروني مع رابط الاستبيان لاحظ أنك ستشير إلى موافقتك على المشاركة في البحث من خلال استكمال الاستبيان، يرجى ملاحظة أنه يمكنك الانسحاب من الاستبيان في أي وقت ، ولا يمكن إزالة البيانات بعد إرسال الاستبيان لا تكتب اسمك في هذا الاستبيان لاحظ أنه قد تتم مشاركة إجاباتك أو مناقشتها مع المشرفين سيتم الاحتفاظ ببياناتك البحثية لمدة عشر سنوات بما يتماشى مع إرشادات جامعة جلاسكو. ستتم إزالة بيانات البحث من البحث وإتلافها سيتم أيضًا تخزين بيانات البحث ونسخها احتياطيًا في أنظمة أخرى مثل القرص الصلب والكمبيوتر المحمول الشخصي (جميعها محمية بكلمة مرور) لتجنب أي فقدان أو سرقة للبيانات إذا كنت ترغب في تقديم شكوى حول كيفية التعامل مع بياناتك الشخصية، يمكنك الاتصال بمسؤول حماية البيانات بالجامعة الذي سيحقق في الأمر

يمكن الاتصال بمسؤول حماية البيانات لدينا على dataprotectionofficer@glasgow.ac.uk تمت الموافقة على هذا المشروع أخلاقيًا من خلال لجنة أخلاقيات البحث بكلية العلوم الاجتماعية أو منتدى أخلاقيات المدرسة ذي الصلة في الكلية

أشركم على مشاركتكم

شكرًا لمشاركتك في هذه الدراسة، نقدر مساعدتك كثيرًا

Part 1: Personal information:

الجزء الأول: معلومات شخصية

please put (X) next to the appropriate response or type it:

Education background الخلفية التعليمية:

1- In what country did you do the majority of your compulsory education :

D) Primary school (please type here)

E) secondary school..... (please type here)

F) When did you finish your maths studies at school? (please type here)

D) In what country did you do your undergraduate degree?

..... (please type here)
ماهي اخر سنة درست فيها مادة الرياضيات في المدرسة؟

E) What undergraduate degree do you hold?

..... (please type here)

F) Do you have another degree?

..... (please type here)

١- في أي بلد اكملت تعليمك

(اكتبها هنا)

.....

أ - المرحلة الابتدائية

ب-المرحلة الثانوية..... (اكتبها هنا)

ج ماهي اخر سنة درست فيها مادة الرياضيات في المدرسة؟

د- في أي دولة أتممت تعليمك الجامعي؟

(اكتبها هنا)

هـ- ما هي الدرجة الجامعية التي تحملها؟ وفي أي تخصص؟

..... (اكتبها هنا)

و- هل لديك درجة أخرى؟ وفي أي تخصص؟ [سؤال مفتوح]

..... (اكتبها هنا)

2) Gender:

..... if you prefer not to disclose (please type here)

٢- الجنس:

..... (إذا كنت تفضل الكشف عن الجنس) (اكتبها هنا)

3-Is your research:

qualitative [], quantitative [], mixed [],

other – please type [.....]?

٣- هل بحثك: نوعي []، كمي []، مختلط []، آخر- (اكتبها هنا) [.....]؟

4-If you are doing some quantitative research, have you already started analysing your data? Yes [], No[],

Other- please type [.....]?

٤- إذا كان بحثك بحثا كميًا، فهل بدأت بالفعل في تحليل بياناتك؟ نعم []، لا []،

آخر - ارجو كتابتها هنا [.....]

Part 2: Perception of the readiness of Ph.D. Students to conduct Statistical Analysis

الجزء الثاني: استعداد طلبة الدكتوراه لإجراء التحليل الإحصائي

, please answer the questionnaire questions based on the knowledge, feelings and attitudes you had before you started the statistical analysis stage

إذا كنت قد بدأت بالفعل في التحليل الإحصائي الكمي ، فيرجى الإجابة على الأسئلة التالية بناءً على المعرفة ، والمشاعر و السلوك التي مررت بها قبل أن تبدأ مرحلة التحليل الإحصائي

| NO | Question | Not Applicable غير مطبق | Strongly disagree لا أوافق بشدة | Disagree لا أوافق | Neither agree nor disagree لا أوافق ولا أرفض | agree أوافق | Strongly agree أوافق بشدة |
|----|--|----------------------------------|---|-------------------------|---|----------------|------------------------------------|
| 1 | I have a good theoretical knowledge of the concepts of statistics (e.g., mean, Regression). امتلك معرفة جيدة نظرية لمفاهيم الإحصاء (المتوسط، الانحدار) | | | | | | |
| 2 | I understand the difference between variables in quantitative research (e.g., independent, dependent, and mediating variables) أستطيع تحديد نوع المتغيرات الإحصائية في دراستي (متغيرات مستقلة وتابعة وبسيطة) | | | | | | |
| 3 | How strongly do you agree/disagree with this statement: "I learned statistics during my PhD through self-study (e.g. through online courses, textbooks, feedback from supervisor) ما مدى قوة موافقتك/ عدم موافقتك على هذا البيان " :لقد تعلمت الإحصاءات أثناء الدكتوراه من خلال الدراسة الذاتية "على سبيل المثال من خلال الدورات التدريبية عبر الإنترنت والكتب المدرسية والتعليقات من المشرف | | | | | | |
| 4 | I can use statistical analysis software (e.g., SPSS, Minitab) very well | | | | | | |

| | | | | | | | |
|-----|--|--|--|--|--|--|--|
| | أستطيع استخدام برامج التحليل الإحصائية (مثل)SPSS, Minitab | | | | | | |
| 5 F | I am confident to select the most suitable statistical methods to test my research hypotheses أستطيع اختيار الأسلوب الإحصائي المناسب لاختبار فرضيات بحثي | | | | | | |
| 6 | I like applying statistics as part of my research استمتع بتطبيق الإحصاء الخاص بدراساتي | | | | | | |
| 7 | I enjoy taking statistics courses and statistics training for my research أستمتع بأخذ مقررات ودورات الإحصاء تمكني من اجراء التحليلي الني الخاص ببحثي | | | | | | |
| 8 | For students doing qualitative quantitative research, please answer: "I would hfeel anxious if I had to use statistics in my research بالنسبة للطلاب الذين يجرون بحثًا كميًا، يرجى الإجابة: "أشعر بالقلق عندما يتعين علي استخدام الإحصائيات في بحثي." | | | | | | |
| 9 | I am confident I can learn statistical methods. أنا واثق من أنني أستطيع تعلم الأساليب الإحصائية | | | | | | |
| 10 | I prefer to depend on myself to achieve the statistical analysis in my research أفضل الاعتماد على نفسي لتحقيق التحليل الإحصائي في بحثي | | | | | | |
| 11 | I prefer getting help from a statistician to do statistical analysis in my research | | | | | | |

| | | | | | | | |
|--|--|--|--|--|--|--|--|
| أفضل الحصول على مساعدة من متخصص في الأساليب الإحصائية | | | | | | | |
|--|--|--|--|--|--|--|--|

12) Were you offered to attend a statistics course as part of your PhD?

هل عرض عليك حضور دورة إحصاء كجزء من برنامج الدكتوراه؟

Yes ...

No...

13) If you answered yes to question 13, how strongly do you agree/disagree with this statement: "The statistics course I was offered/required to attend was very useful"

ما مدى موافقتك/عدم موافقتك على هذا البيان: "كانت دورة الإحصاءات التي عرضت علي/طلب حضورها مفيدة للغاية"

Not Applicable غير مطبق.....

Strongly Disagree لا أوافق بشدة.....

Disagree لا أوافق.....

Neither agree nor disagree لا أوافق ولا أرفض.....

Agree موافق.....

Strongly Agree موافق بشدة....

14) Were you required to attend a statistics course as part of your PhD?

هل طلب منك حضور دورة إحصاء كجزء من برنامج الدكتوراه؟

YES....

NO.....

15) If you answered yes to question 15, how strongly do you agree/disagree with this statement: "The statistics course I was offered/required to attend was very useful"

ما مدى موافقتك/عدم موافقتك على هذا البيان: "كانت دورة الإحصاءات التي عرضت علي/طلب حضورها مفيدة للغاية"

Not Applicable غير مطبق.....

Strongly Disagree لا أوافق بشدة.....

Disagree لا أوافق.....

Neither agree nor disagree لا أوافق ولا أرفض.....

Agree موافق.....

Strongly Agree موافق بشدة....

Part 3: The extent to which PhD students when applying the steps of statistical methods before conducting statistical analysis.

مدى تطبيق طلاب الدكتوراه لخطوات الطرق الإحصائية قبل إجراء التحليل الإحصائي: الجزء الثالث

please answer the questionnaire questions based on the knowledge, feelings, and attitudes you had before you started the statistical analysis stage

إذا كنت قد بدأت بالفعل في التحليل الإحصائي الكمي ، فيرجى الإجابة على الأسئلة التالية بناءً على المعرفة ، والمشاعر و السلوك التي مررت بها قبل أن تبدأ مرحلة التحليل الإحصائي

| NO | Question | Not Applicable غير مطبق | Strongly disagree لا أوافق بشده | Disagree لا أوافق | Neither agree nor disagree لا أوافق ولا أرفض | agree أوافق | Strongly agree أوافق بشدة |
|----|--|----------------------------|------------------------------------|----------------------|---|----------------|------------------------------|
| 1 | I realize the importance of a pilot study of my research to test the validity and reliability. أدرك أهمية إجراء دراسة استطلاعية قبل إجراء البحث، لاختبار الصدق والثبات. | | | | | | |
| 2 | I prefer to use simple statistical methods in my | | | | | | |

| | | | | | | | |
|---|--|--|--|--|--|--|--|
| | <p>research (percentages, frequencies and means)</p> <p>أفضل استخدام الأساليب الإحصائية البسيطة في بحثي (التكرارات والنسب المئوية والمتوسطات)</p> | | | | | | |
| 3 | <p>I do a preliminary data inspection before I start analysing the data</p> <p>أقوم بفحص البيانات الأولية قبل أن أبدأ في تحليل البيانات</p> | | | | | | |
| 4 | <p>I can choose an appropriate type of sample for my research</p> <p>لبحثي عينة الدراسة بدقة أستطيع إختيار</p> | | | | | | |
| 5 | <p>I can determine the appropriate sample size for my research</p> <p>يمكنني تحديد حجم العينة المناسب لبحثي</p> | | | | | | |
| 6 | <p>I define the type of my research variables by reviewing previous studies</p> <p>أحدد نوع متغيرات بحثي بمراجعة الدراسات السابقة</p> | | | | | | |
| 7 | <p>I have enough statistical knowledge to be able to avoid using statistical methods that are not appropriate to the nature of my research</p> <p>لدي ما يكفي من المعرفة الإحصائية لأكون قادراً على تجنب استخدام الأساليب الإحصائية التي لا تتناسب مع طبيعة بحثي</p> | | | | | | |

| | | | | | | | |
|---|---|--|--|--|--|--|--|
| 7 | I determine the statistical techniques of my data analysis by reviewing the techniques used in previous studies أحدد الأساليب الإحصائية لتحليل بياناتي من خلال مراجعة التقنيات المستخدمة في الدراسات السابقة | | | | | | |
| 8 | I ensure to use statistical analysis methods that correspond to the nature of the research أسعى لاستخدام أساليب تحليل احصائي تتوافق وتتناسب مع طبيعة البحث | | | | | | |
| 9 | I explain the limitation of generalizing the results of my statistical analysis أشرح حدود تعميم نتائج التحليل الإحصائي | | | | | | |

10) I prefer to use quantitative methods in my research

أفضل استخدام المنهج الكمي في بحثي

- Strongly Agree موافق بشدة
- Agree موافق
- Neither agree nor disagree لا أوافق ولا أرفض
- Disagree لا أوافق
- Strongly Disagree لا أوافق بشدة
- Not Applicable غير مطبق

11) please explain why you prefer or you don't prefer to use quantitative methods in your research (please type here هنا أكتبها)

(تفضل استخدام الطرق الكمية في البحث الخاص بك لا أو يرجى شرح لماذا تفضل

.....

12)I prefer to use qualitative methods in my research

أفضل إستخدام المنهج النوعي في بحثي

- Strongly Agree موافق بشدة.....
- Agree موافق.....
- Neither agree nor disagree لا أوافق ولا أرفض
- Disagree لا أوافق.....
- Strongly Disagree لا أوافق بشدة.....
- Not Applicable غير مطبق.....

13)please explain why you prefer or you don't prefer to use qualitative methods in your research (please type here (أكتبها هنا)

يرجى شرح لماذا تفضل أو لا تفضل استخدام أساليب النوعية في البحث الخاص بك

.....

14)I prefer to use mixed method in my research

أفضل إستخدام المنهج المختلط في بحثي

- Strongly Agree موافق بشدة.....
- Agree موافق.....
- Neither agree nor disagree لا أوافق ولا أرفض
- Disagree لا أوافق.....
- Strongly Disagree لا أوافق بشدة.....
- Not Applicable غير مطبق.....

15)please explain why you prefer or you don't prefer to use mixed methods in your research (please type here (هنا أكتبها)

يرجى شرح لماذا كنت تفضل أو كنت لا تفضل استخدام

.....

Part 4: How accurate are PhD students' in applying statistical methods and data interpretation based on statistical methods selected? What are the implications of that?

الجزء الرابع: ما مدى دقة تطبيق طلاب الدكتوراه للطرق الإحصائية وتفسير البيانات بناء على الأساليب الإحصائية المختارة؟؟ وما هي الآثار المترتبة على ذلك؟

please answer the questionnaire questions based on the knowledge, feelings, and attitudes you had before you started the statistical analysis stage

إذا كنت قد بدأت بالفعل في التحليل الإحصائي الكمي ، فيرجى الإجابة على الأسئلة التالية بناءً على المعرفة ، والمشاعر و السلوك التي مررت بها قبل أن تبدأ مرحلة التحليل الإحصائي

| N | Question | Not Applicable غير مطبق | Strongly disagree لا أوافق بشده | Disagree لا أوافق | Neither agree nor disagree لا أوافق ولا أرفض | agree أوافق | Strongly agree أوافق بشدة |
|---|----------|-------------------------------|---------------------------------------|----------------------|--|----------------|---------------------------------|
| | | | | | | | |

| | | | | | | | |
|---|--|--|--|--|--|--|--|
| 1 | I use the appropriate statistical method regardless of its complexity استخدم الطرق الإحصائية المناسبة بغض النظر عن تعقيدها | | | | | | |
| 2 | I have good skills of analysing and interpreting statistical data لدي مهارة جيدة قراءة وتحليل وتفسير نتائج التحليل الإحصائي | | | | | | |
| 3 | I compare the results of my data analysis with the results of previous studies أقارن بين نتائج التحليل بنتائج الدراسات السابقة | | | | | | |
| 4 | I support my findings with evidence by reviewing the literature أدعم نتائجي بأدلة من خلال مراجعة الأدبيات | | | | | | |
| 5 | I rely on the updated statistical analysis programs to extract data and to ensure the accuracy of their statistical outputs اعتمد على أحدث برامج التحليل الإحصائي لاستخراج البيانات ولضمان دقة مخرجاتها الإحصائية | | | | | | |
| 6 | I critically reflect on and discuss the accuracy correctness of the statistical methods used in my research after applying statistical methods صحة الطرق ومناقشة نقد أنا أستطيع الإحصائية المستخدمة في بحثي بعد تطبيق الأساليب الإحصائية بدقة | | | | | | |

| | | | | | | | |
|---|--|--|--|--|--|--|--|
| 7 | using statistical methods that is inappropriate to the research leads to inaccuracy results استخدام الأساليب الإحصائية التي لا تتناسب مع البحث يؤدي إلى نتائج غير دقيقة | | | | | | |
|---|--|--|--|--|--|--|--|

Part 5: The possible alternative ways to enhance greater accuracy in the use of statistical methods in doctoral research

الجزء الخامس: ماهي الطرق البديلة الممكنة لتعزيز دقة أكبر في استخدام الأساليب الإحصائية في أبحاث الدكتوراه

For each statement below, select from the given scale the level of importance you give to the different ways that the university can support PhD students with statistics

لكل عبارة أدناه، اختر من المقياس المحدد مستوى الأهمية التي تعطيتها للطرق المختلفة التي يمكن للجامعة دعم طلاب الدكتوراه في استخدام الإحصاء

please answer the questionnaire questions based on the knowledge, feelings, and attitudes you had before you started the statistical analysis stage

إذا كنت قد بدأت بالفعل في التحليل الإحصائي الكمي ، فيرجى الإجابة على الأسئلة التالية بناءً على المعرفة ، والمشاعر و السلوك التي مررت بها قبل أن تبدأ مرحلة التحليل الإحصائي

| NO | Question/ Statement | Extremely important مهم للغاية | Important مهم | Moderately important مهم باعتدال | Slightly important مهم قليلا | Not at all important ليس مهم على الاطلاق | Not sure لست متأكد |
|----|--|-----------------------------------|------------------|-------------------------------------|---------------------------------|---|-----------------------|
| 1 | The university assigns an assistant specializing in statistical methods to support me in my research and statistical analysis. تعين الجامعة مساعد متخصص في مساعدتي الأساليب الاحصائية ببحثي و في التحليل الاحصائي | | | | | | |
| 2 | Establishing a research unit centre at the university to provide the services of statistical analysis to students at any time. إنشاء وحدة بحثية بالجامعة لتقديم خدمات التحليل الإحصائي للطلاب في اي وقت | | | | | | |
| 3 | Make advanced statistics courses mandatory for postgraduate students إلزام طلبة الدراسات العليا بدراسة مقررات إحصائية متقدمة | | | | | | |
| 4 | Providing training courses in using statistical analysis | | | | | | |

| | | | | | | | |
|---|--|---------------------------------------|--|--|--|--|--|
| | <p>programs that are not compulsory.</p> <p>تقديم برامج تدريبية متخصصة في استخدام برامج التحليل الإحصائي ليست اجبارية</p> | | | | | | |
| 5 | <p>organizing seminars and workshops to discuss the academic difficulties facing postgraduate students in learning statistics.</p> <p>عقد ندوات وورش عمل لمناقشة الصعوبات الأكاديمية التي تواجه طلبة الدراسات العليا في تعلم الإحصاء</p> | | | | | | |
| 6 | <p>Teaching statistics as part of the compulsory mathematics curriculum in primary and secondary school</p> <p>تدريس الإحصاء كجزء من منهج الرياضيات الإلزامي في المدارس الابتدائية والثانوية</p> | | | | | | |
| 7 | <p>Preparing educational cadres in the subject of statistics capable of overcoming the difficulties of studying statistics.</p> <p>إعداد كوادر تعليمية في مادة الإحصاء قادرة على تذليل صعوبات دراسة مادة الإحصاء</p> | | | | | | |
| 8 | <p>Develop methods of evaluating and teaching statistics material in PhD program.</p> <p>تطوير طرق تقييم وتدريس مادة الإحصاء</p> | | | | | | |
| 9 | <p>Please suggest other ways to enhance PhD</p> | <p>Please type here (هنا اكتبها):</p> | | | | | |

| | | |
|----|---|---|
| | students' knowledge of statistics يرجى اقتراح طرق أخرى لتعزيز معرفة طلاب الدراسات العليا بالإحصاءات | |
| 10 | If you have any additional comments you want to add on this topic, please add them here إذا كان لديك أي تعليقات إضافية تريد إضافتها حول هذا الموضوع يرجى إضافتها هنا | Please type here (هنا اكتبها): |

G 1-4 Plain Language Statement (Questionnaire in English)



College of Social Sciences

Plain Language Statement (Questionnaire)

1. Study title and Researcher Details

Enhancing the quality and standard of research in Saudi Arabian universities: Selection and use of research methods at doctoral level: An investigative study on the use of research into statistical methods

Researcher: Manal Abohiamid

Supervisor: Professor Margery McMahon & Dr Cristina Mio

Course: Education

2. Invitation paragraph

Your participation in this online questionnaire will be highly appreciated, as it will enable the researcher to develop useful tools for improving the quality of research in the kingdom of Saudi Arabia. In order to participate in the online questionnaire, please click the link sent to your email and it will direct you to the online questionnaire and follow the on-screen instructions to fill in the questionnaire. Your consent to take part in the research by completing the online questionnaire. The questionnaire will not take more than 20 minutes of your time. Thank you for taking the time to go through all this.

3. What is the purpose of this study?

This study is concerned with the quality of research, as research has significance in the development of society in all economic, political and educational aspects. This research aims to learn about statistical methods used in research in Saudi universities. Whereas the use of statistics is considered to be one of the most important pillars in research as the results will be important in achieving the aim of the study. Where this study aims to know how will PhD students are prepared to conduct Statistical Analysis.

4. Why have I been chosen?

The project looks at how statistics is used in the field of Education research. You have been chosen because you are a PhD student in Education.

5. Do I have to take part?

You can withdraw from the study at any stage of the questionnaire, as the participation is voluntary. Please note, however, that after you submit the questionnaire it will not be possible to remove your answers from the data as the questionnaire will be discussed in my research, but you will remain totally anonymous.

6. What will happen to me if I take part?

You will complete the following questionnaire .it will take around 20 minutes to complete.

All of your responses will be saved securely in the response database for this study, which will be transferred to the paper for further analysis, your data will be discussed in my research, but you will still be anonymous.

7. Will my participation in this study be kept confidential?

All of your responses will be anonymised with no records retained of who completed the questionnaire or responses provided. It is then not possible to identify any individual who took part in the questionnaire. The data collection will be used according to the university of Glasgow approved code of Good Practices in Research. Please note that assurances on confidentiality will be strictly adhered to unless evidence of wrongdoing or potential harm is uncovered. In such cases the university may obliged to contact relevant statutory bodies/agencies. your answers may be shared or discussed with my supervisors. Your answers will be kept in a secure place and the saved information in the computer will be secured by password, all data will be disposed after the completion of the study. The research data will also be stored and backed up

in other systems such as hard-drive and personal laptop to avoid any loss or theft of data. This data will remain secure, and all data used for the publication of the project will be de-identified. It will be made public for the use of other researchers. All data will be kept for 10 years and will be destroyed confidentially.

8. What will happen to the results of the study?

The results of this study will be derived from analysing the online questionnaire data, which will be presented in the results chapter of PhD thesis. Later on, they will be published in the peer-reviewed journals. The results of this study will be used to provide tentative conclusions to suggest improvements in the quality of research in the Kingdom of Saudi Arabia.

9. Possible Risk

There are no risks to participants in this study.

10. Who is organising and funding the research? (If relevant)

The researcher's doctoral studies are funded by the Ministry of Education in Saudi Arabia.

11. Who has reviewed the study?

The project has been reviewed by the College of Social Sciences Research Ethics Committee at the university of Glasgow.

To conduct this research project, I will be working under supervision of

Professor Margery McMahon

Tel No: +44(0)141 330 3002

Email Address: Margery.McMahon@glasgow.ac.uk

Dr. Cristina Mio

Tel No: +44(0)141 330 3423

Email Address: Cristina.Mio@glasgow.ac.uk

university address: student.recruitment@glasgow.ac.uk

13. Contact for Further Information

If you wish to have further information about this study, you may contact me by email at xxxxxxx@student.gla.ac.uk

Should you have any concerns regarding the conduct of the research project you can contact the School of Education Ethics Officer by contacting [Dr Muir Houston: Muir.Houston@glasgow.ac.uk](mailto:Muir.Houston@glasgow.ac.uk)

THANK YOU FOR YOUR TIME AND CONSIDERATION

G-1-4 Plain Language Statement (Questionnaire in Arabic)



College of Social
Sciences

معلومات عن البحث

Plain Language Statement (Questionnaire)

1. عنوان الدراسة وتفاصيل عن الباحث

عنوان البحث: تعزيز جودة ومعايير البحث في جامعات المملكة العربية السعودية: اختيار واستخدام طرق البحث على مستوى الدكتوراه:
دراسة استقصائية حول استخدام البحث في الأساليب الإحصائية

الباحثة: منال أبوحميد

إشراف: ماجري ماك مهون وكريستينا مايو

2. الدعوة:

ستكون مشاركتك في هذا الاستبيان الإلكتروني موضع تقدير كبير، حيث ستمكن الباحث من تطوير أدوات مفيدة لتحسين جودة البحث في المملكة العربية السعودية. من أجل المشاركة في الاستبيان الإلكتروني، يرجى النقر فوق الرابط المرسل إلى بريدك الإلكتروني وسيوجهك موافقتك على المشاركة في البحث من خلال إكمال إلى الاستبيان عبر الإنترنت واتباع التعليمات التي تظهر على الشاشة لملء الاستبيان الاستبيان عبر الإنترنت. لن يستغرق الاستبيان أكثر من 20 دقيقة من وقتك.

شكرا لأخذنا جزءا من وقتك.

3. ما هو الغرض من هذه الدراسة؟

تهتم هذه الدراسة بجودة البحث، حيث إن البحث له أهمية في تطوير المجتمع في جميع الجوانب الاقتصادية والسياسية والتعليمية. يهدف هذا البحث إلى التعرف على الأساليب الإحصائية المستخدمة في البحوث في الجامعات السعودية. وحيث يعتبر استخدام الإحصاءات أحد أهم الركائز في البحوث، حيث ستكون النتائج مهمة في تحقيق هدف الدراسة إلى معرفة كيف سيكون طلاب الدكتوراه على استعداد لإجراء التحليل الإحصائي

4. لماذا تم اختيارك؟

ينظر المشروع في كيفية استخدام الإحصاءات في مجال البحوث. لقد تم اختيارك لأنك طالب دكتوراه

5. هل يجب أن أشارك؟

يمكنك الانسحاب من الدراسة في أي مرحلة من مراحل المقابلة. ومع ذلك، يرجى ملاحظة أنه بعد تقديم المقابلة لن يكون من الممكن إزالة إجاباتك من البيانات حيث سيتم مناقشة المقابلة في بحثي، ولكنك ستظل مجهول الهوية شخصيا.

6. ماذا سيحدث لي إذا شاركت؟

سوف تكمل الاستبيان التالي، وسوف يستغرق حوالي 20 دقيقة لإكماله

سيتم حفظ جميع ردودك بشكل آمن في قاعدة بيانات الردود لهذه الدراسة، والتي سيتم استخدامها لمزيد من التحليل، ستتم مناقشة بياناتك في بحثي، ولكنك ستظل مجهول الهوية.

7. هل ستبقى مشاركتي في هذه الدراسة سرية؟

سنتكون جميع ردودك مجهولة المصدر مع عدم الاحتفاظ بسجلات لمن أكمل الاستبيان أو الردود المقدمة. ومن ثم لا يمكن تحديد أي فرد شارك في الاستبيان. سيتم استخدام جمع البيانات وفقا لمدونة لجنة الاخلاقيات في البحث المعتمدة من جامعة غلاسكو. يرجى ملاحظة أنه سيتم الالتزام الصارم بالضمانات المتعلقة بالسرية ما لم يتم الكشف عن دليل على ارتكاب مخالفات أو ضرر محتمل. في مثل هذه الحالات، قد تكون الجامعة ملزمة بالاتصال بالهيئات / الوكالات القانونية ذات الصلة. قد تتم مشاركة إجاباتك أو مناقشتها مع المشرفين. سيتم الاحتفاظ بإجاباتك في مكان آمن وسيتم تأمين المعلومات المحفوظة في الحاسوب بكلمة مرور، وسيتم التخلص من جميع البيانات بعد الانتهاء من الدراسة. كما سيتم تخزين بيانات البحث ونسخها احتياطيا في أنظمة أخرى مثل القرص الصلب والحاسوب المحمول الشخصي لتجنب أي فقدان أو سرقة للبيانات ستبقى هذه البيانات آمنة وسيتم إلغاء تحديد جميع البيانات المستخدمة لنشر المشروع. سيتم الإعلان عنها لاستخدام باحثين آخرين. سيتم الاحتفاظ بجميع البيانات لمدة 10 سنوات وسيتم إتلافها بسرية.

8. ماذا سيحدث لنتائج الدراسة؟

سيتم اشتقاق نتائج هذه الدراسة من تحليل بيانات الاستبيان الالكتروني، والتي سيتم تقديمها في فصل النتائج من أطروحة الدكتوراه. في وقت لاحق، سيتم نشرها في المجالات التي يراجعها الأقران. سيتم استخدام نتائج هذه الدراسة لتقديم استنتاجات مبدئية لاقتراح تحسينات في جودة البحوث في المملكة العربية السعودية

9. المخاطر المحتملة

لا توجد مخاطر على المشاركين في هذه الدراسة.

10. من يقوم بتنظيم وتمويل البحث؟

يتم تمويل هذه الدراسة من قبل وزارة التربية والتعليم في المملكة العربية السعودية

11. من قام بمراجعة الدراسة؟

وقد تمت مراجعة الدراسة من قبل لجنة أخلاقيات البحوث العلوم الاجتماعية

لإجراء هذا المشروع البحثي، سأعمل تحت إشراف:

Professor Margery McMahon

Tel No: +44(0)141 330 3002

Email Address: Margery.McMahon@glasgow.ac.uk

Dr. Cristina Mio

Tel No: +44(0)141 330 3423

Email Address: Cristina.Mio@glasgow.ac.uk

University address: student.recruitment@glasgow.ac.uk

12. الاتصال للحصول على مزيد من المعلومات

إذا كنت ترغب في الحصول على مزيد من المعلومات حول هذه الدراسة، يمكنك الاتصال بي عن طريق البريد الإلكتروني على

xxxxxxxx@student.gla.ac.uk

إذا كان لديك أي مخاوف بشأن إجراء المشروع البحثي يمكنك الاتصال بمسؤول أخلاقيات كلية التربية والتعليم عن طريق الاتصال

[Dr Muir Houston: Muir.Houston@glasgow.ac.uk](mailto:Muir.Houston@glasgow.ac.uk)

مع كل الشكر والتقدير

Appendix H

H1-1: Glasgow university Approval

18

February 2021

Dear Manal Abohiamid

College of Social Sciences Research Ethics Committee

Project Title: Enhancing the quality and standard of research in Saudi Arabian universities: Selection and use of research methods at doctoral level: An investigative study on the use of research into statistical methods

Application No: 400200053

The College Research Ethics Committee has reviewed your application and has agreed that there is no objection on ethical grounds to the proposed study. It is happy therefore to approve the project, subject to the following conditions:

- Start date of ethical approval: 05/03/2021
- Project end date: 30/09/2021
- Any outstanding permissions needed from third parties in order to recruit research participants or to access facilities or venues for research purposes must be obtained in writing and submitted to the CoSS Research Ethics Administrator before research commences. Permissions you must provide are shown in the *College Ethics Review Feedback* document that has been sent to you as the Collated Comments Document in the online system.
- The data should be held securely for a period of ten years after the completion of the research project, or for longer if specified by the research funder or sponsor, in accordance with the university's Code of Good Practice in Research: (https://www.gla.ac.uk/media/media_490311_en.pdf)

- The research should be carried out only on the sites, and/or with the groups and using the methods defined in the application.
- ◆ **Approval has been granted in principle:** no data collection must be undertaken until the current research restrictions as a result of social distancing and self-isolation are lifted. You will be notified once this restriction is no longer in force.
- Any proposed changes in the protocol should be submitted for reassessment as an amendment to the original application. The **Request for Amendments to an Approved Application** form should be used:
<https://www.gla.ac.uk/colleges/socialsciences/students/ethics/forms/staffandpostgraduateresearchstudents/>

Yours sincerely,

Dr Muir Houston
College Ethics Officer

H 1-2: king Saud Approval

Ref No: KSU-HE-21-369

The Researcher / Manal Abohiamid

Peace, mercy and blessings of God

With reference to the recommendation of the Standing Committee for Scientific Research Ethics to authorize the heads of the Scientific Research Ethics Subcommittees to give approvals.

We inform you the approval of the Sub-Committee on the Ethics of Human and Social Research at its session number (35) of 2020 on 10/06/2021, to conduct the research shown in the following table:

| No. | Name | Research Title | Tool | Status |
|-----|------------------------|---|--|-----------------|
| 1 | Manal Abohiamid | Enhancing the quality and standard of research at Saudi Arabian universities: An investigative study on the use of research into statistical methods | Questionnaire Interview | Approved |

Therefore, we hope that the concerned authorities at the university will facilitate the researcher's task.

Yours sincerely,

Sub-Committee Chair

Human and Social Research Ethics

Dr. Abdul Salam bin Wail Al-Suleiman

15/06/2021