The Effect Of Quality Of Higher Education System On The Compatibility Between The Skills Of Graduates And The Requirements Of The Labour Market In Egypt

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By

Osama Ahmed Abdella Ahmed

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Supervisory Team

Prof. Alfredo Moscardini

Prof. Mohamed A. Ragheb

Prof. Aiman A. Ragab

<u>Copyright Statement</u>

<u>Dedication</u>

To all members of my large family

My father, my mother, my brother, and my sister

To all members of my small family

My wife and my daughters, Remas and Retaj

<u>Acknowledgement</u>

<u>Publications</u>

- Ragheb, M. A., Ragab, A. A., and Abdella, O. A. (2014), "Reasons of the Gap between Outcome Characteristics of Private Higher Education, and Job Requirements of the Private Sector in Egypt (Reasons Related to Universities)", International Journal of African and Asian Studies - An Open Access International Journal, Vol. 3.

<u>Abstract</u>

Research to date has addressed that there is incompatibility (gap) between the skills of university graduates and the labour market requirements in Egypt. The factors that affect this gap, as well as HOW to bridge the gap, have not been surveyed in previous studies in Egypt. The purpose of this research is to identify the key factors in the Egyptian higher education (HE) system which affect the quality of the public universities, and to explore the changes that must be made by the Egyptian HE Management (Ministry of HE) within the boundaries factors to achieve significant and real improvements in the quality of the Egyptian HE system; thus the skills gap will then be bridged and the mismatch between skills of the university graduates and the skills needed by market will be decreased. This study develops a new model (system dynamics model) of the factors that leads to the gap between the skills of the Egyptian university graduates and the requirements of the labour market. Particular focus is on identification of the key structural changes that need to be made to reduce this gap and their effects, using public Egyptian universities as a case study.

The initial influence diagram is built based on relationships identified by semi-structured interviews with the administrative and academic staff members from various public universities in Egypt; all these staff members have experience in the quality of the HE system. This initial structure has been validated by using two groups of standard system dynamics tests, namely the structural validation and behavioural validation tests and empirical tests using a group of administrative and academic staff members with experience that exceeds 15 years in the HE system. The model contains more than90 variables that are associated with the quality of Egyptian HE system. PowerSim Studio 10 Academic® is used as system dynamics software to build a stocks-and-flows diagram from the influence diagram. Many scenarios have been made to test the effects of different variables in order to find the dominant variables. The model is simulated over a five-year period from the academic year 2012-2013 till the academic year 2016-2017.As shown in this study, there are seven key variables that influence the quality of the Egyptian HE system and thus affect the skills gap. Some of these factors have instant and rapid effects, while others take time for their effects to appear on the quality of services provided by Egyptian universities. The increase of these variables leads to increase the quality of services provided by the Egyptian universities. Therefore, this increase will lead to an uptake of the skills of graduates and then a decrease of the skills gap. This achieves the compatibility between the skills of university graduates and the requirements of the labour market in Egypt.

Key words: Higher Education, System Dynamics, PowerSim, Quality of graduates, Skills Gap, compatibility

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List of Abbreviations

AED	Academy of Educational Development
ACC	American Chamber of Commerce
AASTMT	Arab Academy for Science, Technology and Maritime Transport
CIA	Central Intelligence Agency
CSRL	Civil Service Reform Law
CAPMAS	Central Agency for Public Mobilization and Statistics of Egypt
DPF	Development Policy Financing
EHDR	Egyptian Human Development Report
EFF	Extended Fund Facility
GDP	Gross Domestic Product
HE	Higher Education
HEIs	Higher Education Institutions
ILO	International Labour Organization
KTP	Knowledge Transfer Partnerships
MDGs	Millennium Development Goals
MOHESR	Ministry of Higher Education and Scientific Research
MMI	Ministry of Manpower and Immigration
NARS	National Academic Reference Standards
NAQAAE	National Authority for Quality Assurance and Accreditation in Education
NCHER	National Commission on Higher Education Reform
NQF	National Qualifications Framework
OECD	Organisation for Economic Co-operation and Development

PVE	Post-secondary Vocational Education
QAU	Quality Assurance Unit
SCHRD	Supreme Council for Human Resources Development
SCPU	Supreme Council of Private Universities
SCU	Supreme Council of Public Universities
SYPE	Survey of Young People in Egypt
SDS	Sustainable Development Strategy
SABER	System Approach for Better Education Results
SD	System Dynamics
TVET	Technical and Vocational Education and Training
UNDP	United Nations Development Programme
YENAP	Youth Employment National Action Plan

Chapter One: Introduction

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CHAPTER 1
INTRODUCTION

This chapter represents an introduction for the thesis. Sections [1.1], [1.2] and [1.3] display the research background, the research problem, and its purpose respectively. Next, Section [1.4] highlights the researcher's motivation for choosing the topic of the research. A brief context about Egypt is provided in Section [1.5]. Moreover, the research importance (both theoretical and practical) is identified in Section [1.6]. Section [1.7] discusses research aim and objectives. This chapter also provides a preface to the research methodology in Section [1.8]. It also shows the dynamic hypothesis, which represents a summary of the model of the study, in Section [1.9]. Finally, an overview of the thesis structure is listed in Section [1.10].

1.1 Research Background

The most important factor behind the development of any country is its human resources (Maher, 2018); defined as the knowledge, skills, experience, education and competencies attributed to the individuals of the country that contribute to realizing the country's goals; this begins with the intellectual wealth of citizens (Seleim and Bontis, 2013).The major contributors to providing these human resources are the universities.

The first university is thought to have been the Academy formed by Plato in Athens in 387 BC. Membership was exclusive and there was no clear distinction between teachers and students. It is often said to have been a school for would-be politicians in the ancient world. Their role mirrored Plato's philosophy and concentrated on producing an "educated "man – a citizen of Athens. This used some combination of:

"Savoir faire" - WHAT to do – vocational training (hands);

"Savoir vivre" - HOW to do it – recognising ones place in Society (heart) and

Savoir d'etre" - WHY we are what we are – understanding and meaning (brain.)

The balance between these three roles was thought to give birth to Wisdom. The curriculum was divided into the "trivium" consisting of Grammar, Logic and Rhetoric, (teaching how to express oneself and one's ideas) and the Quadrium consisting of Arithmetic (for Finance), Geometry (geography), Astronomy (knowing one's place in the Universe) and Music (achieving inner harmony) (Theocaris, 1995).

The origins of European universities date back to medieval times. The earliest and most famous are Oxford and Cambridge in England, Salamanca in Spain, Padova and Bologna in Italy. They all had the role to train Catholic priests and were subsidised by the Catholic Church in Rome. Although the roles in different countries eventually diverged, it is instructive to analyse them in terms of the original purpose of the Academy. In chapter two, developments in France, Germany and England are discussed which feature major innovators such as Humboldt and Newman (Haskins, 2017).

The focus of this research is a major development in the purpose of a University which is the vocational aspect – i.e. preparing graduates for employment. Maher (2018) highlighted the importance of efficiently and effectively preparing and training the nation's human resources with the ultimate goal of meeting the requirements of the Egyptian labour market. Thus, universities must provide learners with the required knowledge and skills to meet the urgent need for highly trained graduates (Mintzberg, 2004; Wren et al., 2007; Weligamage, 2009; Oyo, 2010; Al-Nahdi and Katbakhna, 2014). HE is vital for active participation within the knowledge of society, which in turn quickens the growth of economy. Quality education is a pre-requisite to gaining knowledge, which assures economic progress. This makes the condition of HE in Egypt

a very precarious issue; HE is considered a major sector in the Egyptian market that should produce qualified graduates (El-Awady, 2013).

HE in Egypt is facing extraordinary challenges in the 21st century arising from the impacts of globalisation, the increasing importance of the main driver of growth (knowledge) (Forest & Altbach, 2006). Currently, many graduates are not employed because their skills are not what the market desires – thus there is a skills gap between supply and demand which has resulted in high unemployment (Mintzberg, 2004; Wren et al., 2007; Weligamage, 2009; Loveluck, 2012; and Amin 2014).

Aring (2012) reviews the literature via surveys undertaken on 120 employers from developing and developed countries. It has documented the existence of the skills gap in many countries, where CEOs all over the world consider skill gap one of their top five major problems.

Achieving the fit between supply and demand is something that requires continuous coordination between HE systems from one side and the labour market from the other side. Therefore, this skills gap can be bridged through increasing the quality of the Egyptian HE system components, which represent the key variables that affect HE systems; this increases the quality of services provided by universities, which is subsequently reflected in the increase of the skills of the graduates. This then better aligns the compatibility between the skills that the graduates have and the skills required by the labour market, which eventually leads to bridging the skills gap (Elsadda, 2008; Maher, 2018).

In the light of the problems that face HE in Egypt, the Egyptian government has taken positive steps to overcome these problems; in 1997, the Egyptian Government established the National Commission on Higher Education Reform (NCHER) to diagnose the challenges facing HE. As a consequence, NCHER became responsible for quality assurance and improvement of HE institutions (Lulat, 2005). In the year 2000, a National Conference aimed to set up a long-term reform program within a period of seventeen years (Perna and Smart, 2006). Since then there has been a development and improvement of the National Qualifications Framework (NQF) in Egypt.

In 2017, NQF in Egypt was finalized and endorsed. As a result of a Presidential Decree in 2006, National Authority for Quality Assurance and Accreditation in Education (NAQAAE) was established. It became mandatory later in 2010. One of NAQAAE's achievements is to develop the National Academic Reference Standards (NARS) for HE. NARS plays an important role in defining the graduate attributes that should be included in the academic programmes (EACEA, 2017).

1.2 Research Problem

The young citizens of Egypt acknowledge their frustration with the many challenges they face as a result of the revolution. These young Egyptians believe opportunities do exist only for those who can navigate the hurdles ahead such as inadequate training and lack of information about marketplace needs (Elhini and Moursi, 2015).

On the side of demand, employers of different sectors informed a great mismatch between supply and demand that continues to plague sector businesses. While employers continue to need qualified and skilled workers, the available pool of potential employees consistently falls short in meeting the requirements of the market. (Weligamage, 2009; Loveluck, 2012; and Amin 2014).

There are many previous studies that studied and analysed the HE system in Egypt and abroad. Where they studied many topics related to the HE system such as; the role of HE in human development in the Middle East and North Africa (Kenawy, 2006; Zaytoun, 2008; and Karoly, 2010), the employability skills of graduates, and factors that are related to the HE system which lead to the weakness of these skills (Ogbeide, 2006; Cleary et al., 2007; Hasan et al., 2008; Yusoff et al., 2010; Blom and Saeki, 2011; Murata, 2014; and Amin, 2014), HE policies (The World Bank, 2010), Students' experiences of transition from study to work (Stiwne and Jungert, 2010), developing curriculum in Egyptian universities (Sheta, 2012), evaluation of the quality of teaching in universities (Douglas and Douglas, 2006), and the importance of applying the quality assurance within the higher education institutions (HEIs)(Coates,2005; Gift and Bell-Hutchinson, 2007). Also, a few previous studies have investigated the mismatch between the skills that the graduates acquire and the labour market's requirements in Egypt (OECD, 2010; Osman, 2011; Malak, 2011; Loveluck, 2012; Aring, 2012; Amin, 2014; Schomaker, 2015), but these studies did not address the reasons for this gap, as well as how to bridge this gap has not been discussed so far (especially from the universities' perspective).

For these reasons, the researcher focuses on studying the compatibility between the skills of university graduates and the requirements of the Egyptian labour market. Therefore, the research problem is articulated as follows; the effect of quality of the HE system on the compatibility between the skills of graduates and the requirements of the labour market in Egypt. This compatibility is measured by the size of the gap between the skills of university graduates and the skills needed by the labour market.

1.3 Research Purpose

The purpose of this study is to develop a modelling approach to identify the key factors within the quality of the public HE system, which affect the compatibility between the skills of university graduates and the requirements of the labour market in Egypt (the factors that contribute to the gap between skills of public university graduates and the requirements of the labour market in Egypt). The purpose of this research also extends to investigating changes that must be made by the Egyptian HE Management (ministry of HE) within these factors to achieve the significant and real effect of the quality of the HE system in Egypt which is reflected in increasing the quality of services provided by the Egyptian public universities; this increases the skills of graduates and also increases their compatibility with the requirements of the labour market (skills needed by labour market). Ultimately this leads to bridging the skills gap.

1.4 Researcher's Motivation for Choosing Topic

The researcher worked in the academic field after his graduation in 1996 when he worked in the Arab Academy for Science, Technology and Maritime Transport (AASTMT) firstly as a teaching assistant then as assistant lecturer until the present. Therefore his experience exceeds 20 years in the field of HE. This enabled him to study and analyse the Egyptian HE system in a way that made him aware of the problems within this system. The researcher developed an interest towards resolving these problems and as a result started his Master thesis in the field of quality of the HE system which was titled *"The Fit between Outcome Characteristics of the Private Higher Education, and Job Requirements in the Private Sector in Egypt"*.

The researcher prepared four papers related to the reasons of the skills gap. Each one of the four papers investigated the reasons for the gap from a different perspective; the perspectives of the university, society, graduates and employers. One of these four papers was published in 2014 in the International Journal of African and Asian Studies titled *"Reasons of the Gap between Outcome Characteristics of Private Higher Education, and Job Requirements of the Private Sector in Egypt (Reasons Related to Universities)"*.

This study focuses on investigating the effect of the quality of the HE system on the compatibility between skills of graduates and the requirements of the labour market in Egypt (skills gap). Among the different perspectives of the reasons for the skills gap, the most important and impacting reasons are those related to the HE system in Egypt. Moreover, these reasons are apparent within public HE more so than in private education (Abou-Setta, 2014). Consequently, this research focuses on how to increase the compatibility between the skills of university graduates and the requirements of the Egyptian labour market, through increasing the quality of the HE system and by using the Egyptian public universities as a case study. So, the researcher focuses in this study on the perspective of universities as an internal stakeholder in HE rather than any of the other viewpoints; they have the most perception and knowledge about the research problem and are the most concerned and experienced party with reference to the problems and shortages within the Egyptian HE system.

Furthermore, universities play a vital role in the preparation and qualifying of their graduates as the main outputs of the HE system; graduates are one of the most important factors of production. And the economic growth and development in any developing or developed country (El-Awady, 2013). Also, the universities are responsible for producing graduates with the skills, expertise and knowledge required by the labour market (Wren et al., 2007; Weligamage, 2009; Oyo, 2010).

Therefore, It is very important to study the research problem from the university's perspective rather than any of the other perspectives in order to identify the factors inside the Egyptian HE system that lead to incompatibility between the skills of graduates, the requirements of the labour market and the occurrence of the skills gap; this helps the researcher by receiving the opinions of experts – located within the universities in the field of quality within the HE system– in determining how to deal with these problems and shortages and how to solve them. This in turn leads to increasing the quality of the Egyptian HE system and improving the skills of the graduates output. A consequence of this is that the compatibility between the skills of graduates and the requirements of the labour market in Egypt is improved, which ultimately leads to bridging the skills gap. This finding is the main aim of this study.

1.5 The Context of Egypt

The population in Egypt is among the highest three in Africa and the highest in the Arab world. The population in Egypt exceeds 90 million inhabitants, with two-thirds of citizens under the age of 29 years. About 95% of the Egyptian population live in the Nile valley (which represents less than 5% of the total area of Egypt); this makes the Nile Valley one of the most densely populated locations in the world, especially in the country's capital Cairo, Alexandria and other big cities (UNDP, 2018).

The topography of Egypt is dominated by the Nile (the longest river in the world). The course of the Nile River in Egypt is approximately 1,200 km. From the river's entrance at Lake Nasser to Cairo, the Nile is hemmed by bordering cliffs into its trench-like valley, but these disappear at Cairo and the river fans out into its delta. The Nile and the delta form the first region of the four main physiographic regions in Egypt; the other three are

the Eastern Desert, the Western Desert, and the Sinai Peninsula (Encyclopædia Britannica, 2018).

The geographical position of Egypt is very unique; it lies in Northeast Africa between Europe and Asia and it has shores on both the Mediterranean and Red Sea. It is connected through the Nile Valley to Sub Saharan Africa. Egypt is located at the middle of the Arab world and has control over the Suez Canal which connects the Indian Ocean to the Mediterranean Sea. Egypt is bordered to the north by the Mediterranean Sea, to the northeast by the Gaza Strip, to the east by the Gulf of Aqaba and the Red Sea, to the south by Sudan and to the west by Libya (UNDP, 2018). This is shown in the map in Figure (1.1).

Figure 1-1: Map of Egypt

Indeed, the country's rich agricultural productivity – it is one of the region's major food producers – where has big part of population living in rural which are working the land. However, Present-day Egypt is largely urban. Cairo is the capital city, it represents one of the world's largest urban cities, and trade and manufacturing have exceeded agriculture as the largest sectors of the Egyptian economy. Tourism is playing a vital role in providing an enormous portion of foreign exchange, but that industry has faced many fluctuations during times of civil and political unrest in the region (Encyclopædia Britannica, 2018).

Egypt has witnessed a revolution that started on January 25, 2011 when masses of young Egyptians took to the streets of Cairo and other major cities, and sustained peaceful demonstrations for 18 days until Former President Mubarak stepped down. This action initiated a new political phase in the country's history. The country has undergone dramatic and continuously changing political, economic and social situations which affected both it and the development of its partner's priorities and actions. The country has gone through significant economic and political changes since the revolution in 2011. This transition included periods of political unrest. Moreover, there has been a negative impact on the main income sources of the economy, particularly in the tourism sector. Also revenues from oil, the Suez Canal, and transfer of funds from Egyptians working abroad have been negatively affected (UNDP, 2018).

The government started in 2014 to implement a transformational and bold reforms program. This program aimed at enhancing the business environment in the country, improving the economy, and achieving a balanced and inclusive growth. The first wave of reforms concentrated on rebalancing the macroeconomic aspects, including difficult policy choices that were applied simultaneously; such as holding the high growth of the wage bill, reducing energy subsides, and the liberation of the Egyptian Pound. The second

wave of reforms targeted improving governance and investment climate; this includes the Civil Service Reform Law (CSRL), which was passed in October 2016, in addition to a set of undergoing reforms targeting removal of investment barriers and attracting local and foreign investments. The Egyptian Government of this reform program is endorsed by the World Bank's Programmatic Development Policy Financing (DPF) series, the African Development Bank parallel financing, and Extended Fund Facility (EFF) (The World Bank, 2018).Going forward, the economy is expected to continue recovering over the medium-term. Budget shortage is predicted to continue declining and economic growth is expected to continue increasing. However, this optimistic outlook is constrained by the abilities of the government to face real sector problems whichdecrease the ability of the Egyptian economy to compete and undermine growth prospects; in particular, the absence of a level-playing field and the cumbersome business environment (The World Bank, 2018).

Recently, the Suez Canal is being widened and massive reserves of gas have been discovered off the Mediterranean coast, (which is a joint venture between Egypt and Italy). Egypt is aiming to be a net exporter of gas by the end of 2019. President Sisi has initiated massive construction programmes and is beginning to attract foreign investment. A working plan named "Egypt's Vision 2030" has been launched by the Egyptian Government, and also known as Sustainable Development Strategy (SDS).This working plan encompasses the social, economic and environmental dimensions of development. The aim of SDS is to achieve economic improvement based on social integrity, participation and justice (UNDP, 2018).

The gradual restoration of stability and confidence as well as the implementation of these reforms are starting to produce positive results. The economy is gradually improving with the annual rates of Gross domestic product (GDP) growth reaching 4.3% in the fiscal year 2015/2016, up from an average of only 2% during the period 2010/11-2013/14, and grew at 5.2% in first half of the fiscal year 2018, compared to 3.7% a year earlier, mainly driven by consumption, exports, and investment. The budget deficit declined in the first half of fiscal year 2017 to 5.4% of GDP, down from 6.4% in the same period in the fiscal year 2016, then decreased by 1 percentage point to 4.4% and 0.3% of GDP, respectively, through first half of the fiscal year 2018 (July/June). The floatation of the local currency resulted in volatility of the exchange rate. However, as a result of the strong foreign financier demand for local debt instruments, the exchange rate subsequently started to strengthen. Net international reserves reached high record of US$42.5 billion at the end of February 2018, after the most recent international bond issuance of US$4 billion Eurobond to help plug the country's financing needs (The World Bank, 2018).

Egypt ranks 131 out of 155 countries on the Gender Inequality Index. Nowadays, Women hold 89 of parliamentary seats; this is the highest in Egypt's history. 44% have reached at least secondary education compared to 60% of their male counterparts, and 23% participate in the labour market compared to 74% for men (UNDP, 2018).

The ability of the private sector to create jobs for the youth and for women is essential to gain the benefits of these reforms. To that end, a series of key parliamentary reforms has been introduced by the government to improve the business environment. These reforms include a new investment law, capital markets law, industrial licensing law, bankruptcy law, as well as adjustments to the companies' law and each law dealing with vital aspects of the business environment in Egypt. The impact of these wide reforms on job-creation

and private sector activity will depend on their effective implementation (The World Bank, 2018).

Despite the noticed progress to accomplish the Millennium Development Goals (MDGs), Egypt unfortunately has not achieved the expected targets for environment protection, gender equity, and poverty reduction. On the latter topic, although positive trends are beginning to appear, Egypt is still working on issues related to gender equality and the empowerment of women (UNDP, 2018).

Despite the current efforts of the Egyptian Government, social conditions stay difficult due to the erosion of real incomes and high inflation. While extreme poverty in Egypt is almost eliminated, high inflation over the course of fiscal year 2017 had negative effects on economic and social conditions. Poverty rates reaching as high as 60% in some governorates, regional disparities are an enduring characteristic, and Upper Rural Egypt continues to lag behind other regions. The unemployment rate has declined to 11.3% in second quarter of fiscal year 2018, reaching its lowest level since 2010.However, unemployment are still considerably high especially among youth and women (The World Bank, 2018).

All these developments point to a prosperous more industrialised future for Egypt. This makes it essential that the Egyptian workforce is modernised. This means that the universities must reform their vocational role which gives context and relevance to this research.

1.6 Research Importance

The importance of this research stems from two basic dimensions; theoretical importance and practical importance. The following subsection will discuss the both in details.

1.6.1 Theoretical Importance

A review of previous studies and literature shows that this study has a theoretical importance, which is as follows:

Firstly, literature review shows the importance of the HE sector in advancing the economic growth and development of any country or society. However, there are few previous studies that address the importance of this sector and the challenges, obstacles and problems facing it, especially in the Arab countries such as Egypt (Mintzberg, 2004; Forest and Altbach, 2006; Wren et al., 2007; Weligamage, 2009; Oyo, 2010; El-Awady, 2013; and Amin 2014). Thus, this study helps to understand the importance of the HE sector as one of the pillars of economic development and growth in the countries of the Middle East in general and in Egypt in particular.

Secondly, many previous studies confirmed that most of the developing countries suffer from the low quality of the HE system and the low quality of its outputs. Hence, there is a gap between the outputs of the HE system (represented by the skills of graduates) and the skills required by the labour market. However, previous studies that examined this gap in developing countries are few and insufficient (such as Osman, 2011; Loveluck, 2012; Aring, 2012; Amin 2014; and Van & Agune, 2015). Therefore, this study helps to understand the nature of this gap, focuses on the importance of studying it, and determining its causes; thus contributing to reducing the knowledge gap on this topic.

Thirdly, literature review indicates that most of the previous studies that dealt with the skills gap emphasized the existence of the problem and concentrated on the importance of developing the HE sector so that its outputs correspond to the requirements of the Egyptian labour market without being exposure to the reasons that led to that gap. Thus, these studies were studying the symptoms of the problem not the real reasons that led to the existence of this problem (such asMintzberg, 2004; Wren et al., 2007; Tomlinson, 2007; Allan et al., 2015). Therefore, this study is considered one of the first studies that study the real reasons that lead to the low quality of HE, the low quality of its outputs, and then the emergence of a skills gap between the skills of university graduates and skills needed by the labour market.

Fourthly: Literature review indicates that there are many studies that have examined the quality of the HE system from the perspective of many stakeholders. However, most of these studies examined the HE system from the point of view of external stakeholders, especially from the point of view of employers (Osman, 2011; Amin, 2014; Elassy, 2015; Helmy, 2017). But, the current study explore HE from the point of view of one of the most important internal stakeholders, namely academics and administrators staff members. Because the researcher considers them from his point of view the most experienced and dealing with the HE system and more aware of the problems and obstacles that face this system. Therefore, this study contributes to the determination of the factors that impact the quality of the HE system and the quality of its outputs. And also contributes to identifying the changes that should be made by the HE management to improve the quality of the Egyptian HE system and the quality of its outputs by a correct and accurate manner.

Therefore, this study helps to build a SD model that fills the gaps discussed earlier, by investigating the factors that affect the quality of the Egyptian HE system and the quality of its outputs. As well as to explore the changes that must be made by the HE management to increase the compatibility between the graduates' skills and the requirements of the Egyptian labour market.

1.6.2 Practical Importance

This research enables the Egyptian government to understand the importance of the HE sector as one of the pillars of the country's economic growth and development. Therefore, the government should pay attention to it, support it, and increase government spending directed to this sector, especially because it suffers from a severe shortage of resources. It is also necessary to pay attention to solving its problems and overcoming the obstacles facing it, so that it can be developed and improved in quality and thus improve the quality of its outputs.

This research also supports the Egyptian HE Management (the Ministry of HE) in general and the management of Egyptian public universities in particular to know and understand the main factors that impact the quality of the HE system, which leads to the incompatibility of its outputs (graduates' skills) with the requirements of the Egyptian labour market, and thus the emergence of the skills gap.

Additionally, the new model of the Egyptian HE System, which was developed in this study, benefits to identify the changes that must be made by the HE management and their appropriate amounts to improve the quality of the Egyptian HE system and improve the quality of its outputs, therefore increase the compatibility between the skills of university graduates and the requirements of the labour market in Egypt. Eventually, this led to bridge the skills gap.

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1.7 Research Aim and Objectives

This research fouses on one aspect concerning the quality of Egyptian public universities namely the ability to provide the skills needed by its graduates to obtain employment, which in this thesis is called "the skills gap". Therefore, the research aim is:

"To improve the quality of Egyptian public universities which will increase the compatibility between skills of graduates and skills required by the labour market"

In order to achieve this aim, the following objectives must be achieved:

- To thoroughly explore the dimensions of the Egyptian HE system that contributes to this skills gap.

    (This objective will be thoroughly investigated in Chapters 2)

- To identify the factors that affect the quality of the Egyptian HE system.

    (This objective will be thoroughly investigated in Chapter 4)

- To develop a system dynamics model that simulates the real HE system in Egypt, by using the factors investigated in the second objective.

    (This objective will be thoroughly investigated in Chapter 4)

- To validate this model and use it to explore and investigate the relative importance of each of the key factors that affect the quality of the Egyptian HE system.

    (This objective will be thoroughly investigated in Chapter 5)

- To make conclusions and recommendations by the necessary changes that must be made by the Egyptian HE management to improve the quality of the HE system.

    (This objective will be thoroughly investigated in Chapter 6)

1.8 Preface to Research Methodology

A longitudinal research design is employed to achieve the objectives. This includes a pragmatic philosophy employing a mixed methods approach. The research uses a sequential exploratory method following the stages of System Dynamics modelling, starting with the qualitative phase then the quantitative phase. The qualitative phase involves two stages, conceptualisation and formulation; while the quantitative phase involves two stages, validation and implementation. This is summarised in the next sections.

1.8.1 Qualitative Phase

The first phase in the research is an exploratory phase using qualitative methods. Semi-structured interviews are used to collect data in this phase. The data is then analysed to study the components of the higher edcuation system in Egypt. At the end of this phase, the researcher has built a conceptual model that simulates the system of HE in Egypt.

1.8.2 Quantitative Phase

The conceptual model is then used as a template to construct a System Dynamic model using PowerSim Studio 10 Academic as the simulation software. Secondary data is used to validate the model which can then be used for policy making.

1.9 Dynamic Hypothesis

A dynamic hypothesis is defined as a theory about how the observed behaviour is generated by the system structure and by the decision policies (Oliva, 2003). This theory is applied by a model in which equations and initial conditions generate the causal links between variables that represent the structure and also generate the simulated behavioural

output. In presenting the dynamic hypothesis in this study, Figure (1.2) shows the main

relationships and loops which represent a simplified model of the Egyptian HE system.

In this dynamic hypothesis, the research problem is explained by complex relationships

involving seven key variables: quality of staff, quality of research, quality of resources,

quality of facilities, quality of curriculum, quality of internship, and quality of teaching..
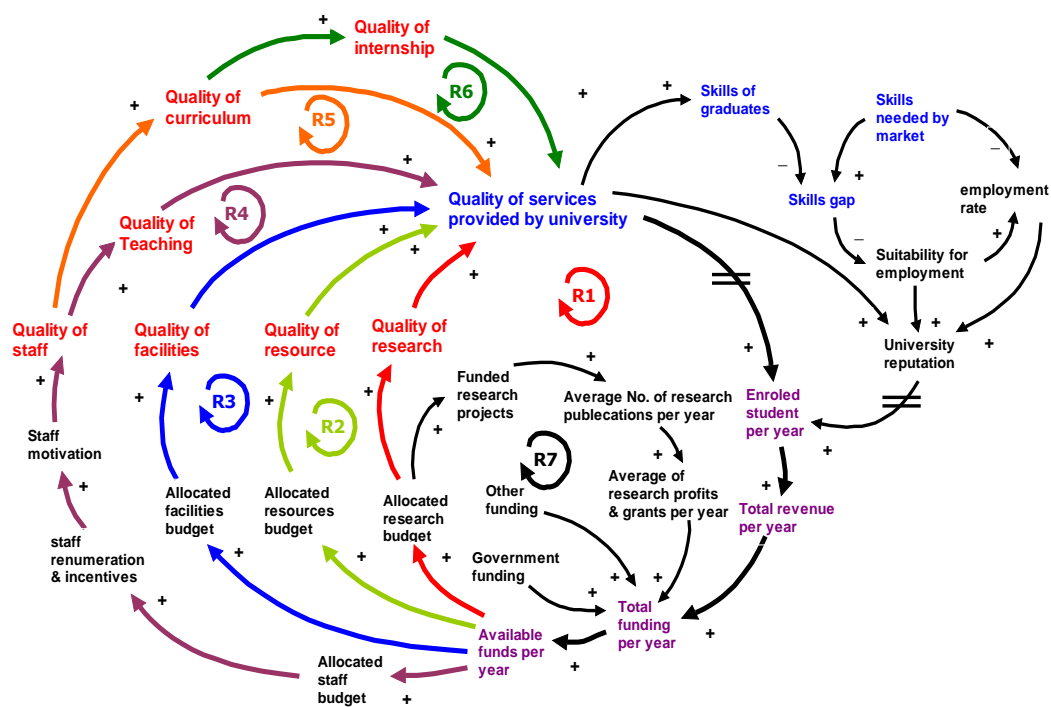
Figure 1-2: Dynamic Hypotheses

The figure contains seven positive feedback loops: from R1 to R7. These loops explain

how each key variable affect the "Quality of services provided by universities", which in

turn affects "skills of graduates" which is considered the outcome of the Egyptian HE

system. Loop R1 explains how quality of research interacts with different variables. Loop

R1 articulates that: an increase in "Available funds per year" increases "Allocated

research budget" which will lead to an increase in "Quality of research" and, in turn,

"Quality of services provided by university". However, when "Quality of services

provided by university" increases, this will lead to an increase in "Enrolled students per

year", "Total revenue per year" and "Total funding per year", which finally increases "Available funding per year" again. This is called reinforcing or positive loop because it reinforces change with even more change. The causal explanations of loops R2 to R7 are similar to R1.

This dynamic hypothesis is considered a simplified causal model that represents the factors that affect the quality of the Egyptian HE system which affects the compatibility between skills of graduates and requirements of labour market. It provides a guide on how the Egyptian HE system works and shows the dynamicity inside this system. This simplified causal model is explained in details in Chapter 4 to show the relationships between the key variables as well as the sub-variables that affect these key variables.

1.10 Structure of the Thesis

This thesis consists of six chapters, where the first chapter of the thesis provides an introduction. The following chapters will come after the introduction chapter.

Chapter Two: Literature Review

The purpose of this chapter is to achieve the first objective by searching the relevant literature to obtain information on how the Egyptian universities are responding to the skills gap. There has always been a dichotomy between the role of a university in preparing citizens for society and the more straightforward vocational role. This research centres on the second role but both are researched in this chapter. The chapter starts with the roles and purposes of universities including the role of Humboldt and Newman; identifying three roles – socialisation, employment and sustainable development. It then looks at different HE system models before looking at seven different aspects of HE in

Egypt. There is then a section on quality issues in Egypt. The labour market is an important part of this work, so there is then a section that covers the labour market and the gap that needs to be bridged.

Chapter Three: Methodology

The purpose of this chapter is to explain and justify the selected methodology used in this research which would help the researcher to achieve the research objectives. Firstly, the appropriate research philosophy is chosen. Secondly, the researcher decided to use mixed approaches. Penultimately, the researcher decided to use System Dynamics as the research method in this research. The research then was divided into two main phases: qualitative phase followed by quantitative phase. Finally, the researcher justifies the choices of data collection techniques and data analysis procedures in each phase.

Chapter Four: Qualitative Phase (Conceptualisation and Formulation)

The purpose of this chapter is to achieve the second and third objectives by analysing the data obtained from semi-structured interviews in order to identify the factors that affect the quality of the Egyptian HE system. Then, using these factors to build the model of this research. This chapter represents the first phase of the SD modelling, the qualitative phase. It includes the first two steps, conceptualisation and formulation. Firstly, in the conceptualisation step, the semi-structured interviews are analysed using thematic analysis. Then, in the formulation step, the results of this analysis are used to build a model which represents the real system of Egyptian HE.

Chapter Five: Quantitative Phase (Validation & Implementation)

The purpose of this chapter is to achieve the fourth objective by firstly validating the model that was built in the first phase, and secondly to use this model to explore and investigate the relative importance of each of the key factors that affect the quality of the Egyptian HE system. This chapter represents the second phase of the SD modelling, the quantitative phase. It includes the last two steps, validation and implementation. In the validation step, the model was validated using two groups of validation tests: structure validation tests and behaviour validation tests. Then, in the implementation step, different scenarios were investigated to find the best situation that would improve the quality of the Egyptian HE system.

Chapter Six: Conclusion & Recommendations

The purpose of this chapter is to achieve the fifth objective by providing a conclusion of the research and presenting recommendations to the Egyptian HE management. Firstly, a summary of the research is provided and conclusions of the study are outlined. After that, the researcher discusses the results of the research and how these results were used to develop recommendations for HE management in Egypt. Then, the researcher shows how the research objectives were achieved. The researcher also sheds light on the contribution of the research, both theoretical and practical. Finally, the research limitations are discussed and directions for future research are presented.

Chapter Two: Literature Review

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CHAPTER 2
LITERATURE REVIEW

The first objective of this research is to thoroughly explore the dimensions of the Egyptian HE system that contributes to the skills gap. Due to the absence of research in Egypt on this topic and the exploratory nature of the study, the researcher suggests using the inductive approach (theory building), as will be shown in Chapter 3. According to Saunders et al. (2016), induction allows an in-depth understanding of the phenomenon under study; it enables the researcher to conduct interviews with experts in the field of HE quality to discover ideas, insights from the point of view of them, and finally to construct the model of the study.

In this type of research, the literature review plays a much smaller role than in theory testing researches, where, the techniques used in this research allows the researcher to enter the research setting without investigating previous literature before starting data collection and analysis. As sometimes the literature review is not relevant to the collected data, the research proceeds into totally different literature which may contradict with the new emerging model (Bryant, 2009). For explanatory purposes, however, it has been found that a brief review of the literature of the general field of quality of HE system could be of significant importance to gain a better understanding and familiarity of the phenomenon under study.

The purpose of this chapter is to provide a brief overview of the literature of quality of the Egyptian HE system. This chapter is divided into six main parts arranged as follows: [2.1] Roles and purpose of universities; [2.2] HE systems; [2.3] HE system in Egypt; [2.4] Quality of HE in Egypt; [2.5] Labour market in Egypt; and [2.6] Summary.

2.1 Roles and Purpose of HE

There are several definitions of HE. For example, Rezaei et al. (2017) defined HE as an activity and gained experience in institutes which is regulated and funded by governmental or private authorities. This activity and gained experience define the characteristics of the people who develop the society. A more rich definition was given by Eltemsahi and El Ragal (2004), who looked at HE as a process in which inputs are transformed into outputs. Inputs could be the time of the academic staff, the time of students, facilities, and resources. These inputs are processed through teaching and research to be transformed into the outputs, which are the qualified and skilled graduates.

The common definition of HE around the world refers to the education at the degree level or higher. The diploma level is excluded from this definition because of the decreasing interest in diploma education by HE stakeholders (students and employers, for example). Consequently, HE is restricted to the education that leads to a Bachelor's degree, post-graduate diploma, post-graduate certificate, Master's degree, or Doctoral degree (Oyo, 2010).

Concerning the definition of HE in Egypt, it includes all types of academic, technical, and professional education that are available in various educational institutions, like universities or institutes, providing that enrolled students are above 18 years old and have completed secondary education (Emira, 2014). Although definition of HE vary between different countries, they all agree in defining the roles and purpose of HE in preparing and qualifying human resources in societies, and in driving the development cycle. The HE system plays many roles. However, three roles are considered the most important roles and they are recognised by HE systems in many countries. These roles are:

socialisation of the citizens, employment, and sustainable development (Doland, 2001; Yizengaw, 2008; Henard and Roseveare, 2012; El-Awady, 2013; Abou-Setta, 2014; Hadidi and Kirby, 2015; Maher, 2018). These three roles are now discussed:

2.1.1 Socialisation of the citizens

HE plays a significant role in the socialization of responsible and enlightened citizens. It develops the intellectual abilities of individuals to satisfy their learning needs and aspirations. It, therefore, helps individuals to use their talents to make the best use of the opportunities offered by society. It is responsible for the creation and transmission of knowledge. Therefore it ensures a continued pursuit of intellectual inquiry in all fields through teaching and research. HE is the main producer of the high-competence human capital necessary for developing a modern society. The ultimate goal of HE is to create well-trained people that are capable of fulfilling specialized social functions and pursuing vocations in industry, administration, trade, or the arts (Doland, 2001; El-Awady, 2013; Maher, 2018).

2.1.2 Employment

The HE system also has a great effect on the employment of young people. University educations, and the skills acquired at university, play an important role in preparing graduates for entry to the work environment, and equipping them with suitable skills and knowledge that enables them to keep up with the labour market. To achieve these goals, however, there should be more understanding of working life along with creating knowledge. Also, close connections with the working environment through different internships and academic projects can create opportunities to gain both basic and professional competencies and to acquire the required skills and qualifications for employment after graduation (Henard and Roseveare, 2012)

2.1.3 Sustainable Development

HE plays a very important role in driving sustainable development in countries. Developed countries understand that HE is a pivotal link in the process of development and consequently it should have a major priority. International donors have realised that HE in Egypt is an important engine of development. This engine generates knowledge and produces qualified human capital; thus allowing building the necessary institutions in Egypt as well as participating in the global knowledge economy (Yizengaw, 2008).

Moreover, the importance of HE has increased significantly in Egypt (Ball, 2017). Therefore, a high quality education is essential for the desired changes in the country. According to this, it is necessary to identify the suitable shape of the HE reform needed in Egypt in order to contribute to the economic, political, and social development in Egypt (Abou-Setta, 2014).

However, in the recent years, Egyptian authorities have sensed weaknesses in education system in Egypt (including HE). It has become necessary to apply some changes to make this system compatible with the needs of the society. The main cause of these weaknesses, especially in HE, is the fact that universities are neither transferring knowledge effectively nor producing creative graduates. In addition, few universities make strong connections with the industrial sector (Hadidi and Kirby, 2015).

From the researcher's point of view, the most important role of HE in Egypt is employment. The reason for this is HE in Egypt is supposed to be the practical stage that provides the graduates with science, knowledge, and experience related to specific jobs matching their specialisations. Thus, making the graduates' skills and knowledge increase their adaptation in their jobs and satisfying the current and future needs of the society.

Moreover, employment is considered to be the income main source of for most of the graduates. Therefore, it is important to provide enough job opportunities for graduates in the Egyptian labour market, which fit their specialisations to ensure their success in practical lives. This role of HE can't be effective without continuous cooperation between HE institutions from one side and the labour market from the other side to achieve the required level of compatibility between skills of graduates and the requirements of the labour market. This is, in my opinion, the ultimate role of HE in Egypt. Therefore, this is the core idea of this research.

2.2 Higher Education Systems

As mentioned in chapter one, most universities follow the example of the Academia founded by Plato in 300 BC. University of Karueein is the oldest existing and still operating HE institution in the world. It was founded in 859 AD in Fez, Morocco by Fatima al-Fihri with an associated madrasa. It subsequently became one of the leading educational and spiritual centres of the historic Muslim world. It was incorporated into Morocco's modern state university system in 1963 (Theocaris, 1995).

Al-Azhar University was established as early as 970 AD in Cairo. Again, it was originally a 'madrasa', teaching students from primary to tertiary level, Al-Azhar University was first known as a centre of Islamic learning but has since developed a modern curriculum of secular subjects, ensuring its survival. Through its time, the school has seen much political instability, most notably in the 12th century when a new dynasty took power and destroyed over 100,000 texts. Today, Al-Azhar University is ranked 801-1000 in the world rankings, and 50th in the QS Arab Region University Rankings 2017. In addition to traditional studies, the school also offers programs in business, economics, science, medicine, engineering and agriculture (EACEA, 2017).

In common with their Arabic counterparts, the first European universities were developed around 1100 AD as religious schools. After Napoleon, a number of different models arose. The French, German and English system are now discussed (Haskins, 2017).

2.2.1 The French Model

Around the time of the Renaissance, the emphasis switched from religious to more specialized institutions around the world. In France, this trend was later encouraged by Napoleon who wanted trained civil servants to run the country. The peak of the education pinnacle in France became the "*Grandes Ecoles*" – relatively small and highly selective schools. They are well funded, have smaller classes and employ top teaching staff. The students have the status of army officers and the top Ecole, "*the Polytechnique*", has always been ranked in the top ten universities of the world. These universities provided a confined HE to the future elites of the nation– tomorrow's senior civil servants "*haut fonctionnaires*", top military brass, leaders of industry, physicists, top politicians, engineers, and others. It is a paradox that in spite of the French preoccupation with equality and equal opportunities, the top end of the French HE systems is very elitist (Lazuech, 1998).

These Ecoles are extremely selective. Since 1960, these Ecoles have produced 5600 senior French civil servants and 2900 from overseas. They teach the "baccalaureate" which is normally a six-year program and there is an emphasis on links with business and industry. They employ visiting lecturers from home and abroad and the teaching of foreign languages is important. They often incorporate a year abroad into the curriculum. Until the 1990s, training was characterized by emphasis on contents, focus on disciplinary logic and scientific knowledge, while allowing much space to knowledge of the company. The result of this was a strong vocational orientation of training that was recognized at

the national level. However, it was insufficiently at the international level. To meet the challenges created by the internationalization of training, The Grandes École's strongly invested in foreign language competencies: bilingualism and sometimes trilingualism, internships abroad and long stays, education to international issues. Furthermore, the adaptation to European standards led to emphasizing academic skills and setting up a pedagogy centred on the dual system alternating between methodological reflections and training for action (Calmand et al, 2009).

The teaching role of the Ecoles tends to favour savoir faire and savoir d'etre. Research is conducted in public research institutes and universities including the CNRS (*Centre National de la Recherche Scientifique*- National Centre for Scientific Research), INRA (*Institut National de la Recherche Agronomique* - the National Institute of Agricultural Research) and INSERM (*Institut National de la Santé et de la Recherche Médicale* - National Institute of Health and Medical Research). These public institutes are very prestigious. The CNRS is, for example, the leading research institute in the world in terms of number of scientific publications. Recently, these institutions have come under attack and president macron is planning to close down the ENA (Ecole Nationale d'Administration) which is one of the more prestigious ones. The complaints against ENA are numerous: less than half of its students are female, most of its students are from the highest social strata, about half are from the Paris region (THE, 2019).

2.2.2 The German Model

The key figure in German HE is Wilhelm von Humboldt (1767 –1835). In 1811 he opened the Humboldt University in Berlin which became the most progressive university in Europe. It used a holistic system integrating arts and science, theory and practice. Systematic learning and education through music and art had the same importance as

mathematics to the training of the mind, the critical thinking ability was more important than strict vocational training. "*Knowledge is power and education is liberty*," was Humboldt's credo (Mund, 2017).

When Humboldt died in 1835, he left behind the idea to nurture confident, educated citizens, independent of their family background or their class. These educational ideals still serve as a model for present-day school and education policy in Germany although regional political interests and packed curricula are beginning to interfere with the general ideal. Humboldt's cosmopolitan, liberal-minded educational philosophy still remains a utopian ideal in Germany and the Humboldt University (now the University of Berlin) is one of the leading European universities. This model stands in great contrast to the French system, both in execution and ideals. There is a strong element of savoir – vivre in the curriculum. Its main features included the pursuit of higher learning in the philosophy faculty, the unity of teaching and research, the educational ideal of *Bildung* based on neo-humanist admiration for ancient Greece, freedom of study for students (*Lernfreiheit*, contrasted with the prescriptive curricula of the French system), corporate autonomy for universities despite their funding by the state and the notion of academic freedom. The group of reformers in Prussia involved philosophers like Humboldt, Schleiermacher and Fichte, and Berlin University was a focus of national cultural revival. The influence of the German model reached central, eastern, and northern Europe (Anderson, 2004).

2.2.3 The English Model

A major influence on universities in the UK was Newman (1801-1890). His book *"The Idea of a University"* is still a classic work on university education. Newman is famous for his advocacy of a "*liberal education*" as the principal purpose of a university. He defines a liberal education as *"a comprehensive view of truth in all its branches, of the*

relations of science to science, of their mutual bearings, and their respective values." He believed that the real cultivation of mind which he defines as "*a properly trained and formed intellect which grasps what it perceives through the senses*" (Ker, 2010).

Newman is returning to the classic Greek tradition thinking of the seven liberal arts of the medieval university, which, comprised grammar, rhetoric, logic and mathematics, which was subdivided into geometry, arithmetic, astronomy and music. Newman believed that these liberal arts were able in the Middle Ages to withstand the challenge of the new subjects of theology, law and medicine, because they were "*acknowledged to be the best instruments of mental cultivation, and the best guarantees for intellectual progress*" (Newman, 2006).

Newman thought (contrary to common misconceptions) that after his version of a liberal education, students could proceed immediately to a professional degree such as medicine, although of course they could also proceed to what we could call an arts degree. At Newman's university, it is clear that the medieval concept of the liberal arts was modified by including both theology and science. This resulted in a top elite headed by Oxford, Cambridge and Durham who established a collegiate system i.e. a student enrolled in a college rather than the university. Most syllabuses were classical, and Science wasn't taught well. In the late nineteenth century, eight more universities were formed, now referred to as Redbrick. These were Liverpool, Birmingham, Manchester, Leeds, Sheffield, Reading and Bristol. The system was elitist and in 1950 only 20 000 degrees were awarded against a total of 500 000 today. Thus, till then, the English system was similar to the French system (Ker, 2010).

Overall participation in HE increased from 3.4% in 1950, to 8.4% in 1970, 19.3% in 1990 and 33% in 2000. The sharp rise in the 1970's came after the formation of the polytechnics. The polytechnics were seen as providers of a technical university and were more similar to the German ideal. Many did not have medical and law schools but concentrated on a more vocational role, teaching the skills needed for the local area. There was a connection to industry and much work and research was shared between them. They were seen as a central and essential part of the local community involved in regional development and local economic growth. It normally works very closely with the local community and local industry (Bolton, 2012)

Many thought the Polytechnics were a good idea, but government policy dictated their change to "new" universities which eventually happened in the 1990s. The number of universities increased from 56 in 1990 to over 150 in 2019. This history of university development set up a distinction between the "old" universities and the "new" universities which still exists today (Seeber et al., 2019).

The role of English universities is usually stated as Research, Teaching and Knowledge Exchange. A typical example of Knowledge Exchange in the UK is the Innovate UK's Knowledge Transfer Partnerships (KTPs). This partnership enables a business to bring in the latest academic thinking as well a new skills to deliver a strategic innovation project through a knowledge-based partnership. The academic partner employs a graduate known as an Associate who works at the company for the duration of the KTP on the project. Each KTP lasts between 12 and 36 months, depending on what the project is and the needs of the business and is co-funded by the external organization and Innovate UK (Wynn & Jones, 2019).

Despite the imposition of university fees in the UK in the 1990s, demand for places continues to grow. However, some of the new universities are now struggling. All rankings reflect the three roles and achieving a balance between them is problematic. The spectrum varies between highly research-oriented establishments such as Oxford and Cambridge and the more vocational role taken by the new universities which arose from their polytechnic origins. In most rankings, the top fifty universities are mainly what could be termed as "old". In general, the English curriculum tends to be savoir-faire (Seeber et al., 2019).

All of the previous models of HE have reviewed the key factors that affect the quality of HE in the western countries. All of these models represent the HE in developed countries, which have a high compatibility between the skills of graduates and the requirements of the labour market. For instance, the review of the French model showed some actions such as increasing of HE funding, giving enough attention to curricula, training students to gain work skills, and improving the scientific research. These actions lead to improvements of the quality of HE system and bridging the skills gap.

As for the German model, it combined both sides of HE: theoretical and practical. It also had interest in critical thinking, curricula, and career-independency for students. These also lead to enhancing the quality of HE system and bridging the skills gap.

The final model, the English model, seeks to increase the cooperation between the universities and the industry. It also showed big interest in teaching the skills needed in the local labour market. Moreover, it encouraged undergoing combined researches between universities and the industry. These steps also lead to improving the quality of HE system and bridging the skills gap.

The employment system in these countries is more organised than the employment system in developing countries. Also, sometimes the skills gap is not noticeable in these developed countries; the graduates of these countries are highly qualified, and even some times over-qualified, than the requirements of the labour market. Unlike the graduates in the developing countries. All of these factors encourage the researcher to study the research problem in the Egyptian society.

2.2.4 The Egyptian Model

The tradition of education and scholarship is deep-rooted in Egypt. It is the birthplace of the Library of Alexandria, the largest source of knowledge in the ancient world. It is also the home of Al-Azhar, which is considered one of the oldest universities in the world still running till now. During the Islamic and the Pharaonic eras, its scholars made important developments in all fields such as the engineering, mathematics, medicine, and the sciences (Ersado, 2013).

The recorded history of Egypt is more than 5,000 years. From ancient times, the Egyptians needed to be educated about farming and about the River Nile to survive. Education and religion were inseparable (Krapp, 1999). 'Oan University', which means 'Sun/Heliopolis' in ancient Egyptian language, is one of the oldest universities in the world (Mina, 2001). Worshipping the sun was common among ancient Egyptians during that era. This university continued to deliver knowledge for about 30 centuries. Akhenaten and Amenhotep, two of the most famous pharaohs in ancient Egypt, were graduated from this university (Emira, 2014).

Al-Azhar is the oldest university in Egypt. Mohammed Ali, the governor of Egypt in 1805, introduced modern secular education. Since then, special attention was paid to

science in the Egyptian educational system; it has been highly valued and encouraged. After that, the education system went through some phases in which changes were made by the wielders of power according to their different interests (Krapp, 1999).

The first National Egyptian University in Egypt was founded in 1908 by donations from a group of Egyptian leaders. They were inspired by the noticeable growth of the educated class in Egypt; which encouraged them to donate and found that university, later known as Cairo University. This private institution had a focus on liberal arts. European teachers of Oriental Studies were available in this university to teach many courses such as economics, history, literature, and philosophy. The university received great support by the Khedive Abbass (the Egyptian King at that time), who assigned his son, Fouad I, to be university president. In 1940, it was renamed Fouad I University (EACEA, 2017).

The first Egyptian state university was built in 1917. It was joined with Cairo University in 1923, and called "the Egyptian University". This university was attached to the Ministry of Public Knowledge and became the first official university in Egypt according to the Royal Decree in 1925 (Sekran, 2001; Emira, 2014).

In 1919, another stage of HE began by the creation of the American University in Cairo. It was founded as an English-language university by a group of Americans who wanted to spread American culture in the Middle East. After that, the government started to understand the importance of HE and the need of creating new educational facilities. This made the government created two other universities: Alexandria University in 1942 and Ain Shams University in 1950. This was also a response to the rapidly increasing number of secondary education graduates. Since the 1952 Revolution, there has been a significant increase in enrolment. This trend was transferred to other Arab and African countries, where Egypt offered scholarships to hundreds of these countries' students, despite its

economical limitations. In return, Egypt was allowed to play a vital role in the development of these countries (EACEA, 2017).

After the Revolution, the government founded seven new public universities, mostly by converting already existing university branches into fully independent universities. The new universities were chosen to be located far from the densely populated governorates of Cairo, Giza and Alexandria. This provided more opportunities for students from all over the country to have access to a HE near to their hometowns (El-Awady, 2013).

Until 1957, there had been only five public Egyptian universities. After that the expansion of HE system began. In the 1960s, the government applied a policy of HE expansion that depended mainly on opening university branches in several regions of the country, then transforming these branches into fully independent universities afterwards. For example: The branch of Assiut University in Al-Minya was turned into Al-Minya University. This policy is still in practice today. It plays a very vital role in forming different faculties and technical colleges (EACEA, 2017).

All of the previous studies and models tackled the main factors that affect the quality of HE in developed countries, and have high compatibility between skills of graduates and requirements of the labour market. However, the results of these studies can't be accurately generalised for the phenomena under study in Egypt, because of the differences in economic culture, educational system, traditions, and many other factors. Where, the HE system in Egypt has many points of weaknesses. This increased the interest of the researcher to study this phenomena in Egypt. This phenomena is not thoroughly investigated in our region, especially in Egypt. From those few studies that investigated this phenomena in the Arab region, there was Ragheb et al. (2014) who argued that the

Egyptian HE system faces many problems, from which the most important one is the incompatibility between the skills of graduates and the skills required by the labour market (the skills gap). Also, Abdella (2006) assured the existence of this gap and determined a number of groups of reasons responsible for this gap; reasons related to the universities, reasons related to the graduates, reasons related to the Egyptian perspective towards HE, and reasons related to the businessmen who represent the labour market.

From the previous context, we can observe a variety in the reasons of the skills gap. Also, the relative importance of each of these reasons. This, as mentioned before, encouraged the researcher to further investigate the research problem. Moreover, the current research is considered the first study in Egypt that uses SD modelling and simulation in assessing the quality of the HE system in Egypt and the compatibility between the skills of its graduates and the requirements of the labour market. This is considered one of the main contributions of this study, in both theoretical and practical fields.

It's hope that the results of this study will contribute to the ongoing efforts of experts, researchers, and practitioners of HE to identify the underline factors that contribute to improve the compatibility between the skills of graduates and the requirements of the labour market, and help the HE decision makers to understand and work on the changes that must be taken to improve the quality of the HE system, which leads to improve the compatibility and then bridge the skills gap. HE System in Egypt.

2.3 HE system in Egypt

After the 1952 Revolution, the education system became a much more social system. The centralised nature of the education system started to affect the socialist framework. Consequently, there was a demand for the right of all Egyptians to be educated. This was clearly preserved in a constitutional amendment, which stated that all Egyptians should be granted the opportunity to access HE. In 1992, Law 101 opened the door for more private universities. As a result, this encouraged emerging new types of institutions and new education providers started to increase (EACEA, 2017).

2.3.1 Management Structure of Egyptian HE

In Egypt, education is managed by two ministries: the Ministry of Education (MOE) and the Ministry of HE and scientific research (MOHESR). MOE is responsible for pre-university education (pre-school, primary and secondary education), while MOHESR is responsible for post-secondary education. There is another ministry that controls a system of specialist institutes, the Ministry of Al-Azhar Affairs. This ministry supervises denominational education (from primary to secondary education) presented at the Al-Azhar schools, and HE presented at Al-Azhar University. This system awards diplomas which are equivalent to those obtained at corresponding public institutions (Nuffic, 2015). Concerning HE only, the Ministry of HE and Scientific Research is responsible for developing and implementing HE policies. Four executive bodies are responsible for the process of implementation of HE policies by monitoring and evaluating the outcomes of the processes, as shown in Figure (2.1). The Supreme Council of Public Universities (SCU) is the public body responsible for accrediting new universities. It has a department for giving foreigners from non-Egyptian universities certificates. The Supreme Council of Private Universities (SCPU) and the Supreme Council of Technical Institutes are

responsible for the coordination of private universities and technical institutions (EACEA, 2017).
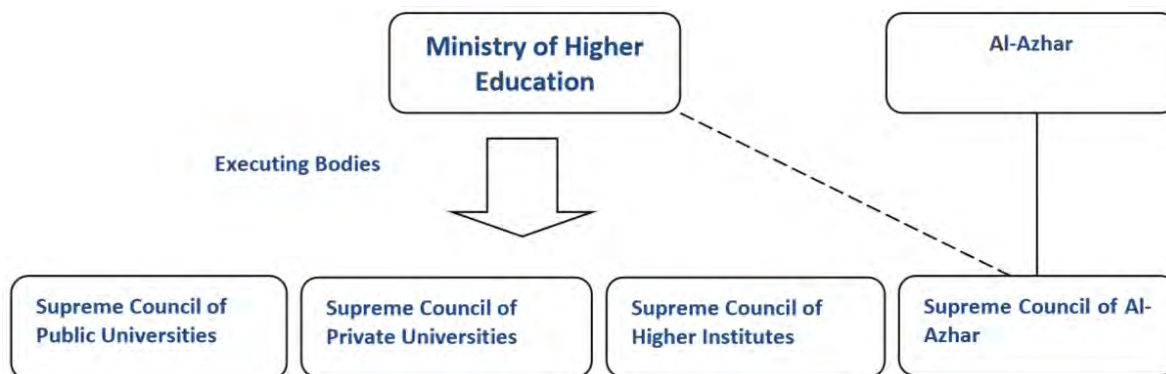
Figure 2-1: Higher Education Bodies in Egypt (Source: EACEA, 2017)

Al-Azhar institutes are controlled by the Al-Azhar Central Administration of Al-Azhar Institutes. It is one of the main bodies that control the HE system in Egypt. However, they are still under the supervision of the Ministry of HE. Its duties include coordination of post-secondary education, quality control, and policy formulation. Another duty of the Ministry is to supervise training of teachers for basic education (Teferra & Knight, 2008).

Many activities are carried out by the SCU under the supervision of the Minister. The Council formulates the policy of education for universities, coordinates the programmes, determines the number of accepted students each year in the various faculties, and coordinates between the government and the universities for funding. The Council is also responsible for dealing with and evaluating foreign universities (Nuffic, 2015).

The Ministry and the Supreme Councils are the main authorities that govern the HE system. However, universities have a high level of delegation concerning regulations, authorities, and sometimes fund raising. Consequently, a university may develop a new

specialisation in an area of local demand (such as mechatronics engineering or bio-medicine). Nevertheless, these new courses must fulfil the general rules specified by the SCU such as the number of studying hours of the course. SCU is represented by the presidents of public universities as well as five representatives from the civil society. The SCU is chaired by the Minister of HE and coordinated by a secretary-general. The main duties of the SCU are to develop the general policies for HE in Egypt according to the needs of the society, to create a general coordination plan between different universities with respect to exams, study periods etc., and to develop the internal by-laws of the universities and the faculties (EACEA, 2017).

2.3.2 Admission to Egyptian HE

In order to enrol in HE in Egypt, a student goes through 12 years of formal education (6 years of primary education, 3 years of preparatory education and 3 years of secondary education), ending with a general exam. This exam is known in many countries as "High School Graduation Exam". This national exam allows students to enter HE. After passing the exam, the students can choose from two different paths: continue to university education (public or private) or join vocational institutes (EACEA, 2017).

Although there are no entrance examinations, each faculty sets minimum final marks in the high school exam. Some faculties such as Medicine, Engineering and Dentistry require high marks in the final secondary exam. Other faculties such as arts, commerce, law and agriculture require lower marks in the final secondary exam. Moreover, students must have taken the correct subject cluster corresponding to each faculty. The two clusters in secondary education are the natural science cluster or the literature and language cluster. Some faculties require passing one or two additional tests such a second foreign language, a personal specific test or a fine arts skill test (Nuffic, 2015).

2.3.3 Types of HE Institutions & Study Procedure

The education system in Egypt consists of general, technical and vocational education. General education begins with primary education, followed by general preparatory schools, then general secondary schools. The final exam of the general secondary level leads to the higher institutes and universities (EACEA, 2017).

HE in Egypt has many degrees. The degree of Bachelor of Arts is awarded for graduates of language and literature studies, while the degree of Bachelor of Science is awarded for graduates of engineering, agricultural and science specialisations. There is also the degree of Licence which is awarded in the law, arts and teacher-training faculties. The Bachelor degree or Licence allows the graduate to take part in the labour market or to continue studying for higher degrees (Master or Doctorate) (Nuffic, 2015).

HEIs in Egypt include: public universities, private universities, universities under special agreements, national non-profit universities, and higher institutes. Universities consist of faculties that cover various specialities. Public universities usually have faculties that cover most of the social sciences, life sciences and humanities specialities, while private universities have faculties that usually target specific specialities. There aren't any public universities in Egypt that concentrate on specific specialisations; they are composed of many faculties in numerous disciplines. The only religious education in basic and HE is done by Al-Azhar University. It follows the same education system, but it offers Islamic subjects as integral parts of the curriculum (EACEA, 2017).

Another typology of HE in Egypt divides it into two main types: HE provided by Higher Institutes and HE provide by universities. Higher Institutes provide higher professional education through 4-year programmes, ending with the Bachelor's degree. According to

the SCU, this degree is considered equivalent to a Bachelor's degree from a university. There are many higher institutes in Egypt, both public and private, and they all fall under the supervision of the Ministry of HE. The other type is the HE provided by universities. They offer higher professional education as well as academic programmes. Universities enjoy a large amount of freedom in preparing the curricula. Usually, there is a project or short thesis at the end of each program. There may also be an internship as a part of the program, depending on the specialisation (Nuffic, 2015).

HE in Egypt is the biggest in the Middle East and North Africa. Most Egyptian universities are present in Cairo, Alexandria, or Asyut. There are five universities in Cairo, including Al-Azhar University and the American University (Ibrahim, 1996). In 2017, the number of Egyptian universities became 43, divided as follows: 24 public universities (including Al-Azhar University) and 19 Private universities, in addition to 18 public and 81 private higher institutes (Miyakoshi, 2016; EACEA, 2017).

There is almost no choice of subjects for the student. There are from six to ten subjects per academic year involving from 20 to 30 hours of lectures and practical classes per week. The long programmes (5 or 6 years) usually start with a preparatory year that provides basic and general subjects; in this case the subsequent year is called the first year (Nuffic, 2015).

The study period is standardised in all universities: four years for most faculties, five years for engineering faculties and six years for medical faculties. These durations are regulated by the SCU. Postgraduate studies are available only for graduates of universities who are holding the Bachelor's degree. Postgraduate studies include two degrees: a Master's degree is acquired through at least two years of postgraduate studies ending with a project or a thesis; a Doctoral degree is acquired through at least two years of studies

after a Master's degree, also ending with a project or a thesis. The HE system in Egypt is illustrated in figure (2.2) (EACEA, 2017).

The academic year starts in September and ends in June, including a break in January. The study week runs from Saturday till Thursday, with the weekend being Friday and Saturday. The final examinations of the universities are in June, with supplementary exams in September (Nuffic, 2015).
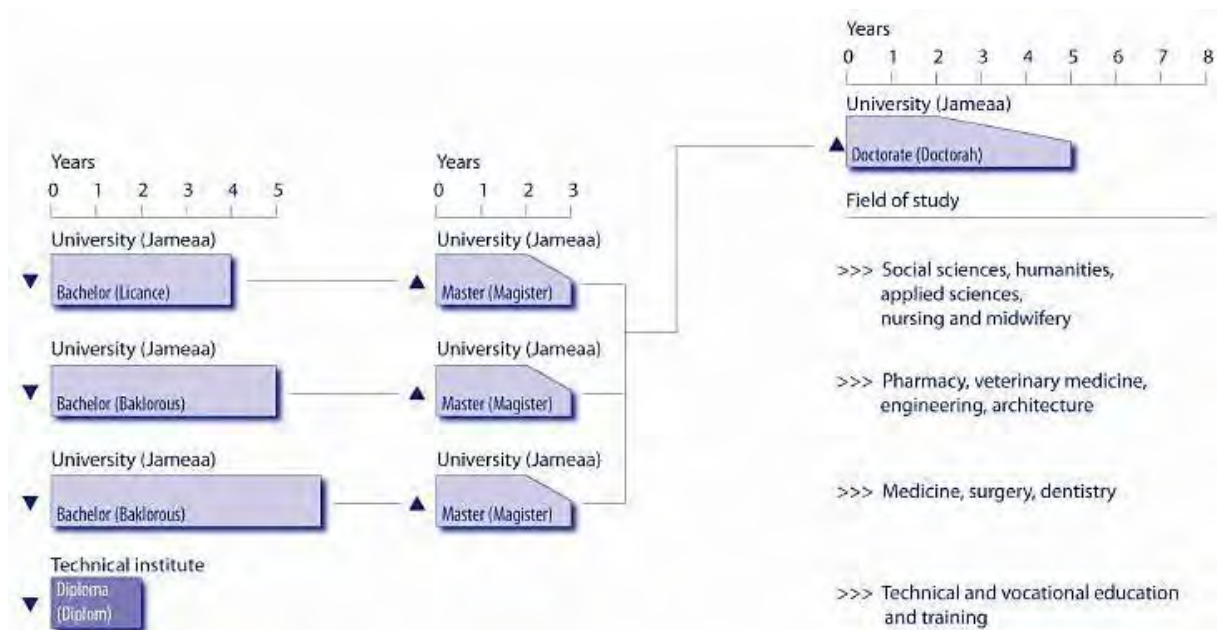
Figure 2-2: The Higher Education System in Egypt (Source: EACEA, 2017)

Arabic is the language of instruction for most of the faculties except for the following ones: Engineering, Medicine, Pharmacy, Dentistry, Veterinary Medicine, Architecture, English Language and Literature, and Natural Sciences. In the Arabic-language faculties, final theses are written in Arabic with an English abstract, vice versa in the English-language faculties. The American University of Cairo is an exception to this, where the language of instruction for all programmes is English (Nuffic, 2015).

2.3.4 Funding of Egyptian HE

Financing of the Egyptian HE system is the Government's responsibility; the Ministry of HE and Scientific Research, as well as public universities receive their budgets from the Ministry of Finance (the Ministry of the Treasury). The Ministry of Finance also controls the spending of these funds. The approval of the budget is based on the request of the university. However, universities may seek further funding from various national and international sources such as donations, projects, consultancy services etc. (Constitution of the Arab Republic of Egypt, 2014).

Over the past few years, public spending on HE hasn't increased to over 28% of total public expenditures on education, according to World Bank data (El-Awady, 2013). In the academic year 2014-2015, expenditure on public education (both university and pre-university education) was 94.4 billion Egyptian pounds which represents 12% of the total state public expenditure. This percentage has been relatively stable in the last few years. At the same year, expenditure on public HE reached 26.4 billion Egyptian pounds representing 28% of state public expenditure on Education and 3.34% of the total state public expenditure. Every fiscal year (July to June), universities get their allocation of funds from the government treasury like anyone else concerned with the Egyptian public budget. Staff and administration are considered as civil servants, so they are audited by central financial and administrative auditing bodies (EACEA, 2017).

2.3.5 Fees of Egyptian HE

The tuition fees for public universities are very small because they are mainly funded by the government as stated in the Egyptian Constitution. However, fees are applicable for postgraduate studies and vary according to the type of the faculty (fees for faculties of

life sciences are higher than those for social sciences). The amounts of fees are regulated

by the University Council and approved by the SCU (EACEA, 2017).

Miyakoshi (2016) stated that the tuition fees for public universities are nearly free. This

began with the tuition-free policy for public HE which was introduced in 1960 by

President Nasser. This is one reason for the high enrolment rate in Egyptian universities

nowadays. Although HE in Egypt has been free, there are some special programmes in

public universities that charge tuition fees. They are sharing the same facilities of the

faculties. The fees for these programmes are set by the university and approved by the

SCU. Incomes from those special programmes go to the universities as self-generated

funds and are distributed into the colleges. Teaching in these programmes is based on the

credit hour system, and fees vary between ten thousand to twenty thousand Egyptian

Pounds per semester (EACEA, 2017).

2.3.6 Egyptian HE Stakeholders

There are different views on the definition of "stakeholders" in HE, depending on the

degree of accuracy or scope of the definition. According to the classic definition, the

stakeholder is defined as "any individual or group that may affect or be affected by the

achievement of the organization objectives" (Freeman, 1994; Marić, 2013). This

definition lists a long list of potential stakeholders in HE (Burrows, 1999; Jongbloed et

al., 2008), which often classified as internal and external stakeholders. On the other hand,

Watson (2012) points out that some of these groups actually have low "risks" related to

their effect, and that they are actually "stakeholders" or not. However, universities must

be able to strike a balance between all these societal voices (stakeholders) (Watson, 2012).

HEIs need to engage in productive relationships with different stakeholders, rethink and re-align their vision, governance, the way of management, and operational mechanisms, for achieve this goal. And in order to maintain coherent relationships with its stakeholders. Within this framework, much remains to be done by the General Authority for HE in Egypt to ensure consistent and effective interaction with its communities and to identify stakeholders properly (Arbo et al., 2007;Jongbloed, et al., 2008).

As well as, successful organizations are those that provide value to stakeholders. For this reason, public HEIs in Egypt have realized the need to reassess their teaching, research and community services functions. It also recognized the need for its management to identify the needs of stakeholders and to reorientation its institutions to meet those needs, in an effort to enhance their competencies (El-Morshedy et al., 2015).

Generally, identifying stakeholders and understanding their potential impact on the organization has become a necessity that should be taken into account by top management when analysing the expected outputs and outcomes of various activities within the organization (Bryson, 2004). The identification of stakeholders involved in HEIs is an essential step towards achieving competitive advantages for these institutions by identifying their needs and finding ways to meet these needs. However, this is not an easy task given the particular nature of these institutions. Where, literature review show a significant number of research articles that tried to identify stakeholders of different Egyptian HEIs - to determine their expectations and needs and their impact on these institutions, such as Kasetwar (2008), Matlay (2009), Junichi and Hiroyuki (2008), Tang and Hussin (2011), and Singh and Weligamage (2011).This was done mainly through conducting interviews with several experts in the field of HE in Egypt at all administrative levels within the HEIs (top management level and other administrative levels in Egyptian

public universities). As a result, collectively 20 stakeholders were identified in all papers, that could be considered as the most important stakeholders of Egyptian HEIs, including 15 external stakeholders (such as employers, various social actors, the media, suppliers, service providers, regulatory agents, business community, etc.), and 5 internal stakeholders (which, represented by the management of universities, faculty members, administrative staff, students, and parents) (Mainardes et al., 2010; El-Morshedy et al., 2015).

As mentioned before in chapter one, the current study will examine the research problem from the perspective of universities (internal stakeholders) as the most familiar and friction with the Egyptian HE system. Where the focus was on the perspective of the management of universities and faculty members and administrators specifically

2.3.7 Statistics about Egyptian HE

In 2014, 308,187 graduated from HE compared to 462,880 in 2013, a decrease of 33.4%. This is due to the decision of the Ministry of Education to increase the primary education period to six years in 2007. Among the 308,187 graduates, 56.5% were males. International graduates were 7,790 representing 2.5% of the total number; 71.1% of them were non-Egyptian Arabs, while Asian students represented 18.8% followed by Africans with 7.9%, and 0.6% were Americans (EACEA, 2017).

As shown in Table (2.1), 2,624,705 HE students were registered during the academic year 2014-2015. 52.2% out of them were males while 47.7% were females. This number represents an increase of 12.3% compared to the 2,337,193 students in the academic year 2013-2014.

In the academic year 2014-2015, the total number of academic staff in public universities including Al-Azhar University was 88,326. 42,087 of them were tenured academic staff in public universities with 4,988 of these at Al-Azhar; while 31,936 were assistant academic staffs at public universities with 8,315 of these at Al-Azhar University (EACEA, 2017).

Table 2-1: Number of Registered Students in HE (2014-2015) (Source: EACEA, 2017)

Type of Higher Education Institutions	Registered Students
Public Universities	1,642,715 (62.6%)
Al-Azhar University	304.072 (11.6%)
Private Universities	110,859 (4.2%)
Academies	27,566 (1.1%)
Private Higher Institutes	379,525 (14.5%)
Upper Middle Institutes: Public and Private (Diploma)	111,398 (4.2%)
Upper Middle Private Institutes (Diploma and BA/BSc)	48,570 (1.9%)
Total	**2,624,705**

2.4 Quality of HE in Egypt

Before the 1950's, the Egyptian HE system was a typical model in the region. It had international standards. Some of the best local and foreign students where graduated from Egyptian universities. Egyptian HE was a source of high-skilled labour and high-trained staff. However, Egypt now suffers from a lack in knowledge and skills (Ersado, 2013).

Egypt has 43 universities with more than 2 million students. However, despite having many instruments to measure and support innovation, the overall rank of the country in terms of innovation is declining (Hadidi and Kirbi, 2015). Egypt was 99 out of 143

countries in 2013/2014 compared with 83 out of 139 in 2010/2011, according to the Global Innovation Index in 2014 (Index, 2014). The report summarises: '*successful innovation rests on a foundation of education and skills*'. However, the HE sector is very weak and centralised. It is governed by the Ministry of HE and the SCU, which results in little independence for the universities. Furthermore, public spending on HE has decreased in recent years (Reda, 2012). The rank of the country in quality of HE and training decreased to 128 out of 139 countries in 2010/2012, comparing with 80 out of 114 in 2005/2006. Similarly, a study by the Global Entrepreneurship Monitor (GEM) (Hattab, 2012) placed Egypt last of the 53 countries that were studied in terms of impact of education on the promotion of enterprise (Hadidy & Kirby, 2016).

There are many reasons for the low quality of HE in the Middle East, especially in Egypt. These reasons include the lack of funding, the high demographic pressure on the HE system and some governance problems regarding management of the HE system. These factors lead to quality problems and eventually affect the outcome of the HE system. The domestic labour market in Egypt is very competitive. Also, the Egyptian universities have high potential in the international HE market. All these factors call for the need for maintaining a high quality of study programs and providing high skills for the graduates. The negative effect of the gap between the labour market's requirements and the skills of graduates is obvious in Egypt and can be seen in the associated problems such as social instability and the absence of life satisfaction among young people (Schomaker, 2015).

2.4.1 Definition of HE Quality

Borahan & Ziarati (2002) stated a definition of quality assurance. According to them, quality assurance means "*planned and systematic actions necessary to provide adequate confidence that a product or service will satisfy given requirements for quality*".

Concerning HE, defining quality of HE is a challenging task (Oyo, 2010). HEIs face hard challenges in maintaining quality management of HE. The first challenge is that there is no specific meaning of HE quality; there are different meanings for different stakeholders (Becket & Brookes, 2008). Different definitions of quality of HE can be articulated by internal and external stakeholders. So, the management of quality as well as its measurement has proven to be a contentious topic due to the difficulty in defining quality (Ismail et al., 2017).

Defining and measuring quality have been very important issues for many organisations seeking higher performance. Although many institutions in the HE sector in Egypt have created systems for monitoring and assessing quality, many issues are still uncovered. The following questions should be answered to effectively assess quality: how is "quality" defined and how it is measured; what is the effect of changing levels of resources; what are the relationships between research and teaching quality; what is the impact of changing the management style (Kennedy, 1998).

Customer satisfaction is one of the main issues in understanding the concept of quality of HE (Arjomandi, et al., 2009). Customers are people who buy products or services. Regarding the HE system, customers are students, graduates, employers, governmental bodies, funding providers and researchers. Madu and Kuei (1993) stated that the student can be considered as the primary stakeholder in the HE system. Beside the student, there are other stakeholders who benefit from the HE system (directly or indirectly) such as parents, potential employers and even the whole society. Furthermore, accessing all the stakeholders is nearly impossible.

Cheong Cheng (2003) stated that HE quality is uncertain and has many different perceptions. Generally, HE quality can be defined as the set of elements that control and assess the process, inputs and outputs of the HE system. HE quality is responsible for providing services that totally satisfy the stakeholders by meeting their expectations.

2.4.2 Importance of Quality assurance

The advantages of accreditation lie in the continuous-control and the standardization of the targeted quality of outcomes (Stensaker and Harvey, 2006). The ultimate aim of the accreditation is to ensure the continuity of the high quality. Good accreditation has the ability to contribute to the operative and planned quality of the HE institutions, to the quality of study programs and to the quality of outcomes. A study in the USA showed that more than 95% of the staff from public and private HE institutions (including university presidents, faculty deans, vice presidents and other senior administrators in the HE system) agreed that accreditation "*fulfilled the function of promoting quality at their institution*" (Alam, 2006).

Quality control and quality assurance have gained a lot of attention from most governments. The traditional methods of academic control are inadequate to the present challenges. Therefore, more explicit quality assurance is needed. The quality assurance systems have the ability to ensure the skills of graduates. However, all quality assurance systems face the crucial challenge of measuring quality. It is very important to measure quality as objectively and accurately as possible (Ramadan et al., 2011).

2.4.3 Quality Assurance Framework

Quality management is not concerned only with quality of products or services, but also includes the methods and tools of achieving this quality and maintaining it in the future.

Therefore, quality assurance processes are used to reach steady quality. The procedures of quality assurance are related (directly or indirectly) to the external stakeholders (Becket & Brookes, 2008; Ismail et al., 2017).

There are three alternative orientations to indicate HE quality: input-orientation, output-orientation and outcome-orientation. Input-orientation indicators include the financial resources, technical and personal resources, library access, relations between student and staff, etc. Output-orientation indicators include average grades of students, percentage of dropouts, average pass rates, etc. Outcome-orientation indicators are concerned with the educational outcomes (learning and teaching). The first two presumed indicators (input-orientation and output-orientation) can be easily identified and measured while the third one is very difficult to measure. However, the third one (outcome-orientation) is the most sensible indicator of HE quality from an economic perspective. However, there are two important indicators of HE quality: students' competences and employability. Students' competences have a very strong influence over their prospects to match labour market requirements with the level of their academic skills. Employability is also a great signal of outcome quality. The most promising approaches to collect information about these vital indicators include regular tracing studies and the involvement of potential international employers and all stakeholders in curriculum design (although these approaches could be administratively cumbersome and methodologically demanding to implement) (Ramadan et al., 2011).

Positive steps were taken by the Egyptian government to improve the public HE system. A national conference in 2000 was held to discuss the requirements to achieve the desired level of quality of HE. There has been a need to create a national quality assurance system regarding HE system with the aims of improving the educational process, to provide high

confidence levels to the Egyptian public universities and to ensure students 'and graduates 'satisfaction. A long-term plan was made to reform the HE system. This plan included twenty-five specific projects which were mainly funded by the World Bank as well as by local contributions (Elassy, 2015).

HE quality can be observed through the fundamentals which represent the inputs and outputs of the education system. These fundamentals should satisfy the stakeholders by meeting their explicit and implicit needs (Praeg, 2010). If HE is observed as a complicated system, then any quality assessment program must evaluate inputs and outputs of the system as well as the educational process (Kanji et al., 1999; Wankhade, & Dabade, 2010).

Boyer & Verma (2009) presented a comprehensive framework based on an input-throughput-output model for quality management of the HE system. Kyriazoglou (2012) presented this comprehensive framework as an abstract system in which HEIs seek to satisfy the stakeholders' needs. When the outputs of these institutions fit the external expectations, this has a great effect on their success and continuity. Consequently, the relation among the HE institutions and the stakeholders has a great importance relevant to the development of the HE system itself. Figure (2.3) shows the input-throughput-output model for quality management and the connections between education from one side and the supporting processes from the other side.
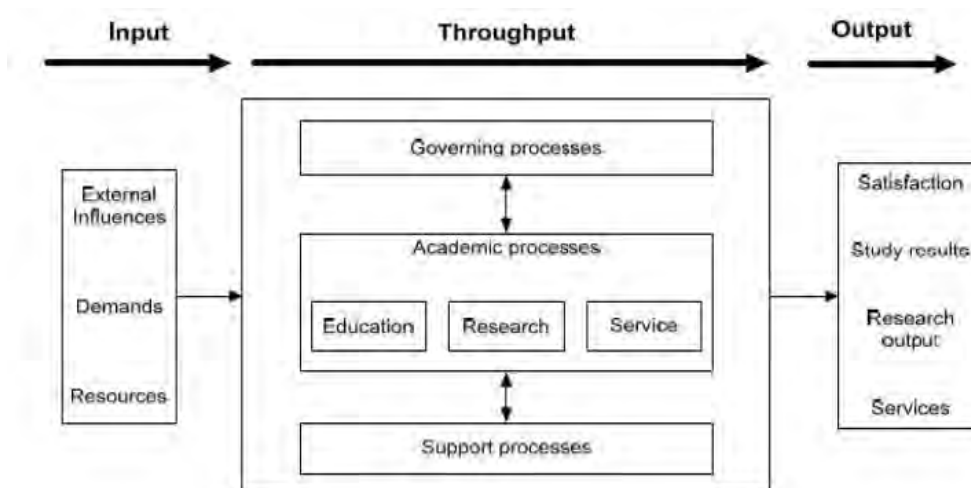
Figure 2-3: Framework for HE Quality Management (Source: Boyer & Verma, 2009)

This comprehensive framework presents the dynamic nature of the HE system in which the internal processes of the system affect quality. Furthermore, the conceptual framework extends the single elements of the HE system into a connected system structure with different relationships and multiple feedbacks as shown in Figure (2.3) (Csizmadia et al., 2008).

NQF is still under development in Egypt. The NAQAAE was mandated in 2010, based on the Presidential Decree Number (82) of 2006, in order to establish the NQF for the country which was finalized and endorsed in 2017. The NQF took this long time because its regulations require a lot of consultation and involvement with stakeholders from industry, syndicates, and education. The main goals of NAQAAE are to insure high quality education at all levels in Egypt, and give accreditation to educational institutions. As a result of NAQAAE's mandates, NARS have been developed for HE. The objective of NARS is to set out the academic characteristics and graduate attributes required to be achieved in the academic programmes. Moreover, NARS is an independent body that reports directly to the Prime Minister. Table (2.2) shows the eight levels of education in Egypt that were identified, with HE being from Level 4 till Level 8 (EACEA, 2017).

Table 2-2: Education Levels According to the NQF (Source: EACEA, 2017)

	NQF Levels	General Education Path	Technical Vocational Education TVET Path
Higher Education	**Level 8**	Ph.D.	
	Level 7	Master	Technical (Professional) Master
	Level 6	Post Graduate Studies	Post Graduate Studies
	Level 5	Bachelor Degree (4, 5, 6 years)	Technical Applied Degree
	Level 4	Post-secondary diploma	
Basic Education	**Level 3**	General Secondary Certificate	Technical Education Certificate
	Level 2	General Preparatory Certificate	Vocational Preparatory Certificate
	Level 1	Primary Certificate (Illiteracy Level)	

2.4.4 Quality of Egyptian University Graduates as Perceived by both Employers and University

When hiring new graduates, employers expect graduates with minimum amount of quality. Where, Employers are looking for graduates with a diverse range of skills and attributes. Which, reflect the quality of their education (Kavanagh & Drennan, 2008).

Most employers in different fields and sectors indicate that the quality of graduates of Egyptian universities does not qualify them to get a suitable job once they graduate. Where, their skills, experiences and knowledge (which the university is called to gain from their studies) are incompatible with what the labour market needs (Loveluck, 2012; Amin, 2014).

The number of Egyptian university graduates is very high. However, there are many jobs do not find those who meet the requirements of occupancy. Where, there are 24 public universities and 19 private universities in Egypt which produce more than 300,000 graduates each year, but, many of them don't get employed after graduation. As an example, about 38% of the unemployed in Cairo have a university degree or above, but their skills don't match the requirements of the Egyptian labour market (Kirby and Ibrahim, 2012). This requires employers to train new graduates on the skills they need before assigning work to them. Moreover, they spend a lot of money, time and effort in a job that was supposed to be done by the university and not by them (Barsoum et al., 2014).

On the other hand, the university claims that the quality of graduates (as outputs of the educational process) is appropriate for the funding, facilities and resources available to the university (as inputs of the educational process). In addition, this quality does not fully meet the requirements of the labour market. So, the government should increase the funding of the HE sector, and as the result the universities can increase the financial allocations for: scientific research, curriculum development, training of faculty members, increasing their salaries and incentives, and increasing allocations of resources and facilities. So that, HE system can increase the quality of services provided by Egyptian universities, and thus increase the skills of graduates. This ultimately reduces the gap between skills of graduates and the requirements of the labour market (Kavanagh and Drennan, 2008). This will only be achieved through continuous coordination between universities on the one hand and labour market requirements on the other (Elsadda, 2008; Maher, 2018).

2.4.5 Causes of Low HE Quality

Since 1957, the Egyptian tertiary education system has been expanded by the government. However, this expansion needs to be supported by sufficient resources for educational institutions to deliver valuable knowledge. The result of the lack of resources was the production of under employed (or unemployed) graduates each year. Tertiary education has been struggling to achieve a quality education with its unequipped laboratories and overcrowded classrooms. The high number of students is expected to increase even more according to the current increase rates. The already crowded HE system is expected to include 1.1 million additional students over the next 15 years, with an average 3% annual growth rate (Ersado, 2013).

The tuition-free policy in the Egyptian public universities raised the rate of student enrolment very much lately. As a consequence, there is a high student-professor ratio which produces a number of drawbacks: a very high teaching load for professors, a unidirectional information transmission to a large number of students, the inability of professors to provide continuous support for students, and no time for professors to increase their skills through training. Furthermore, the curricula are out-of-date, which results in forming a gap between skills of graduates and skills required by the labour market. (OECD and the World Bank, 2010). For engineering and technology education in the world's top 10 universities, the average student-to-professor ratio is 11 according to World University Rankings (Times Higher Education, 2016). This ratio is 30 in Egypt for engineering and technology education, which is much higher (OECD and the World Bank, 2010). One solution for this problem is by allowing teaching assistants (TAs) to take some of the courses to decrease the teaching loads of professors. TAs, however, would have little time for their studies, so it is common that they take more than 5 to 7 years to finish a Master Degree while working as TAs (Miyakoshi, 2016).

The quality of HE (university and technical college levels) needs intensive attention in Egypt. The HE system lacks highly trained professors and proper equipment and resources to graduate a qualified workforce. Professors are under-paid and often lack teaching experience. Moreover, students are not suitably prepared for employment; the curricula are out of date and don't include practical skills development. The HE system struggles to provide the labour market with skilled graduates (Ersado, 2013).

One of the main reasons of the low quality of Egyptian HE is the lack of qualified staff. Instructors suffer from underpay which consequently leads to under-motivation. Another reason is the poor curriculum content. It concentrates on memorizing while lacking practical skills and learning materials. What makes this worse is the lack of facilities, resources and equipment (OECD, 2010).

HE in Egypt doesn't provide sufficient training to students. According to a survey by the Egypt Labour Market Panel (2012), 90% of people who started working during the 3 months of the survey (14,488 respondents) stated that they did not have any training program. Moreover, most of the others who have participated in training programs (42%) received the training from employers, not during their university studies, as shown in Figure (2.4) (Helmy, 2017).

Besides the lack of professional training in public universities, the number of non-state training providers is limited and includes training units in companies, private training courses and well-structured training programmes provided by foundations. Yet most of these programmes are still on trial (SABER, 2014).
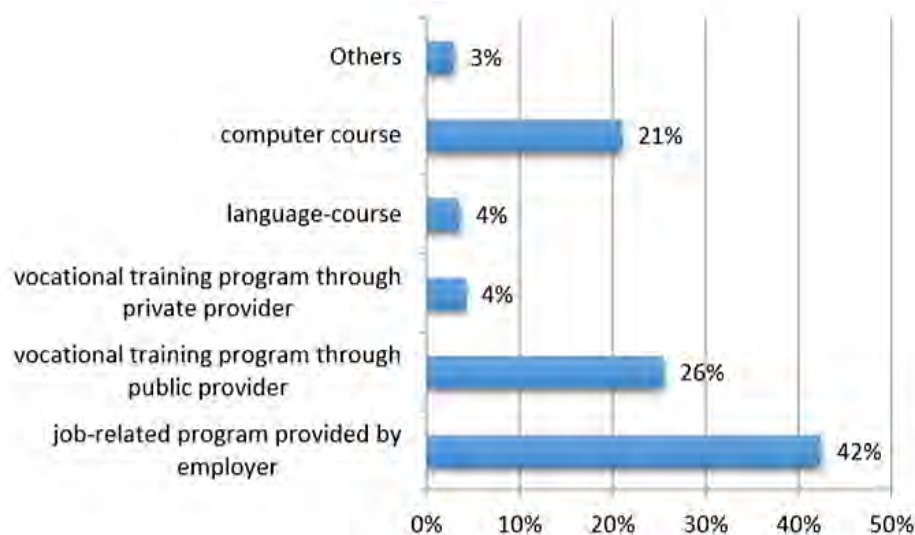
Figure 2-4: Training Programs Participation (Source: Assaad and Krafft, 2016)

The Egyptian government has undertaken several actions regarding the quality of education and training, such as: establishing the Supreme Council for Human Resources Development (SCHRD), establishing the NAQAAE and the development of a Training Fund (Amin, 2014).

The quality of HE in Egypt can be improved by measuring skills of graduates and working on upgrading these skills. However, increasing skills of graduates of HE has proven to be very difficult. It requires massive financing resources for updating curricula, improving teaching techniques, technological development, and increasing skills and salaries of the academic staff. Therefore, the improvement of quality of Egyptian HE is highly dependent on improving the Egyptian economy (Elassy, 2015).

The curricula should be adjusted to meet the labour market's needs. The absence of the practical skills in the curricula is a major problem that affects the graduates. The lack of these skills results in weak performances of the graduates, which consequently decreases their chances of employment because of the high competitiveness of the modern labour

market, and therefore *"opportunities appear much less promising than those of the previous generations"* (Osman, 2010).

Therefore, all of the above reasons are considered to be the main reasons for the low level of quality of HE in Egypt, which effectively affect the compatibility between skills of university graduates (as outputs of the Egyptian HE system) and the requirements of the labour market. And by extension, this leads to increase the skills gap.

2.5 The Labour Market in Egypt

Policies taken by the Egyptian government in the last fifty years weren't as effective as Egypt's labour market needed. There has been an increasing demand for decent and productive jobs for all Egyptian job hunters, especially fresh graduates (Amin, 2014).

This problem has been increasing during the last few years after the January 2011 Revolution. People expect the economy and the labour market of the country to improve at a high rate; much higher than the actual rate. However, this high rate of improvement cannot be achieved without major modifications being implemented regarding industrial, education and training issues through organised dialogue between the government and other partners like employers, graduates and customers (Van & Agune, 2015).

In 2012, Egypt's labour force was 27.1 million compared to 25.4 million in 2009. The percentage of participating women in the labour market was between 22 to 23% each year. It was estimated that 600,000 to 700,000 new entrants would be introduced every year to the labour market (CAPMAS, 2014). In the first quarter of 2017, the labour force reached 29.1 million (CAPMAS, 2017).

Table 2-3: Labour Force in Egypt from 2009 to 2012 (Source: CAPMAS, 2014)

Year	2009	2010	2011	2012
Labour Force (millions)	25.4	26.2	25.5	27.1
% of males	77%	77%	78%	77%
% of females	23%	23%	22%	23%

The Egyptian Labour Market has many characteristics such as a high unemployment rate even for highly educated graduates, an increasing informal sector, very little return on education, the dominance of private employment over public employment, low labour productivity, and the lack of a skilled labour force who matches the competitive requirements of the labour market (Amin, 2014).

One issue that affects the labour market in Egypt is the high levels of informal employment, especially among young employees. A very high percentage of young workers in Egypt (91.1%) are informally employed (the percentage is almost the same between rural and urban areas, and between women and men) (Barsoum et al. 2014). Among all paid employees in Egypt, only one third have legal contacts. Only 30% of the paid employees have social insurance while only 21% have medical insurance (SABER, 2014).

The main problem in the labour market in Egypt is the increasing unemployment rate, especially the unemployment of highly-educated graduates, within the past 15 years. Although there is an over-supply of graduates, especially in the field of social sciences, this over supply does not meet the requirements of the labour market due to the low quality of education (ILO, 2010; OECD, 2010).

2.5.1 Unemployment in Egypt

The labour market in Egypt suffers from many problems: underemployment, low female labour participation, a high level of informal employment and a high youth unemployment rate (between 18 to 29 years) (Said, 2014).

In January 2011, several factors in Egypt such as youth unemployment, high poverty rates, political imbalances and social instabilities, triggered the Revolution of January 2011. After the Revolution, however, Egypt's future stability has been even more challenging. Real actions must be taken to generate enough jobs that match the supply of 600,000 to 700,000 new entrants to the labour market each year. Otherwise, the unemployment rate would remain high or even get higher (Amin, 2014).

Unemployed youth represent the largest percentage of all unemployed Egyptians. According to the Egyptian Human Development Report (EHDR) in 2009, the unemployment rate for young people (between 15 to 29 years) was 60.1%, while in 2006 over 80% of the total unemployed were below the age of 29 and 82% of the total unemployed had never worked before. Moreover, it is shocking to know that young Egyptians are highly educated now more than ever (Angel-Urdinola & Semlali, 2010). The problem is much greater for young women; 80% of those aged 22-29 are out of the labour force while the percentage is only 13% for men (Aring, 2012).

Egyptian young people (from 15 to 29 years) represent more than 25% of the total population (El Zanaty et. al, 2007). Unemployment rates of the youth differ according to the way of computation of unemployment. According to the Central Intelligence Agency (CIA) Egypt 2010 Fact Book, the Egyptian youth unemployment rate is 24.8% for youth between 15 and 24 years, while according to the United Nations Development

Programme (UNDP), the unemployment rate for youth between 16 and 29 is 60% for males and over 80% for females (Aring, 2012).

In 2013, the unemployment rate rose to over 13% compared to 12.7% in 2012. Almost three-quarters of the unemployed were young people from the age of 15 to 29. The unemployment rate for women was at least five times higher (38.1% compared to 6.8%) than men (Barsoum et al. 2014). One of the reasons is that women searched for jobs in the public sector to find the adequate quality and security they can't find in the private sector (Krafft and Assaad, 2015). Figure (2.5) shows the unemployment rates in Egypt from 2007 to 2017.
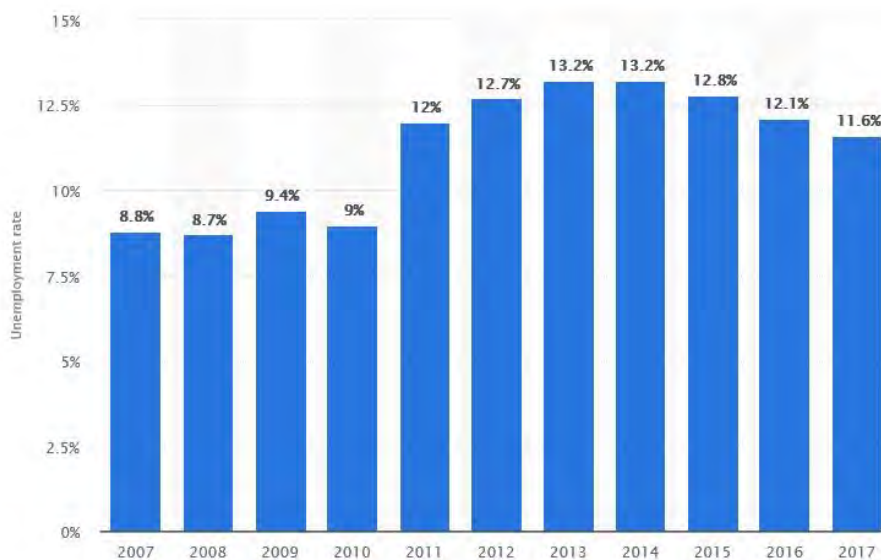
Figure 2-5: Unemployment Rate in Egypt from 2007 to 2017 (Source: Plecher, 2019)

The unemployment rate increased in 2012 to 12.7%, compared to 9.4% in 2009. It was estimated to have increased to 13.2% in 2013. By mid-2016, despite the economic improvement and the increase in the annual GDP compared to 2015, the unemployment rate was still high with a percentage of 12.8 % (Said, 2014). According to labour market experts, however, the real unemployment is actually to be significantly higher than the official announced figures (Amin, 2014).

2.5.1.1 New Employment Opportunities in Egypt

According to the American Chamber of Commerce (ACC), *"Egyptians have counted on education to lead them to a public sector job. But graduates now wait years instead of months. In the meantime, they are underemployed, unemployed, or working in the informal sector"* (AMCHAM, 2011).

Young people aged between 15 and 29 suffer from the absence of appropriate work opportunities in Egypt, especially in rural areas. About 10% of the labour force is employed in the modern sectors while the rest are employed in the traditional and governmental sectors. Despite the creation of millions of work opportunities during the last ten years, the majority of these jobs exist in the informal sector, and they are characterised by low pay and low productivity. The lack of decent work opportunities consequentially drives young people away from rural areas and driving them into urban and over-crowded areas, where job opportunities are not much higher (Amin, 2014).

Another dimension of the problem is Egyptian society's view of Technical and Vocational Education and Training (TVET) as a lower form of education. Therefore, TVET suffers from low investment and underdevelopment and, as a consequence, the labour market suffers from the lack of technical and professional skills (SABER, 2014).

2.5.1.2 Unemployment of the Highly Educated Youth

It has been found that unemployment was higher for graduates of technical institutions and universities compared to others, (see Table 2.4). However, even if the unemployment rate of graduates of Post-secondary Vocational Education (PVE) is much lower compared to graduates of universities and intermediate institutions, the number of graduates of

universities and intermediate institutions is much higher than the graduates of PVE (Amin, 2014).

Table 2-4: Unemployed Numbers in Urban and Rural Areas by Gender and Education Levels (2010), Units are in Thousands (Source: CAPMAS, 2011)

	Urban			Rural			Total		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Illiterate	31	12	43	10	4	14	41	16	57
Read & Write	16	4	20	5	5	10	21	9	30
Less than Intermediate	37	14	51	14	17	31	51	31	82
Intermediate	24	6	30	13	9	22	37	15	52
Technical Intermediate	**219**	**261**	**480**	**180**	**331**	**511**	**399**	**592**	**991**
Above Intermediate	54	82	136	24	46	70	78	128	206
University and Above	**245**	**388**	**633**	**115**	**184**	**299**	**360**	**572**	**932**
Total	627	767	1364	361	596	957	988	1363	2351

Although the recent figures have claimed that the youth have started to participate in the labour market more than before, youth unemployment has increased to reach 26.7% in 2016 (CAPMAS, 2017). The highest groups affected by unemployment were new entrants, females and highly educated people (Assaad & Krafft, 2016; Said, 2014). Barsoum et al. (2014) supported this fact by stating that most of the unemployed youth were university graduates followed by technical vocational education graduates (Helmy, 2017).

The following figure, Figure (2.6), shows the unemployment rates of the youth in Egypt compared to total unemployment from 2007 to 2016. It is clear that the unemployment problem in Egypt is much worse for the youth (ILO, 2017).
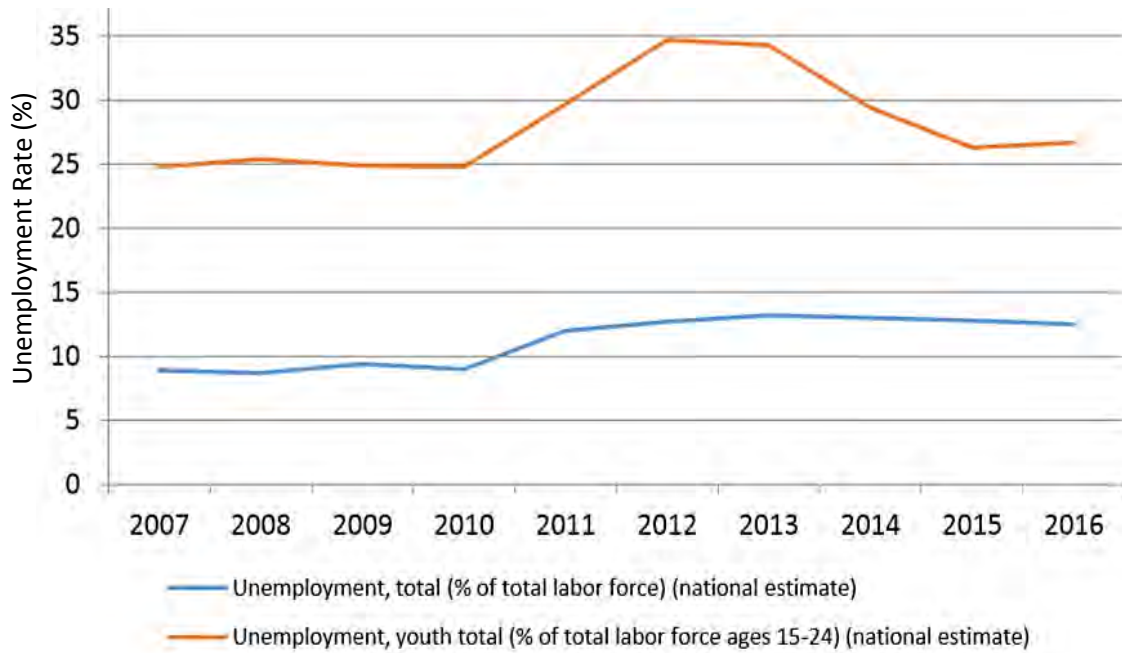
Figure 2-6: Youth Unemployment Compared to Total Unemployment (Source: ILO, 2017)

As the unemployment rate in Egypt has reached 24.8 % of the youth (between 15 and 24) (CIA, 2012) and because most of the unemployed youth are university graduates, it has become very important to examine Egyptian HE and its capability to graduate employable graduates. University graduates represent 40% of the total unemployed labour force while illiterates contribute with only 2.4% (CAPMAS, 2012a; 2012b). These statistics increase the importance of investigating the HE system and studying the employability problem within it. It is becoming increasingly difficult, especially after the revolution in 2011, to discuss any inclusive educational reform in Egypt without putting employability as the key goal of the educational process (Abou-Setta, 2014).

2.5.1.3 Causes of Unemployment

There are many causes of the high unemployment rate among the youth in Egypt. The labour market is characterised by rigid regulations, limited mobility and insufficient labour demand. Concerning the supply side, the main reason is the low educational

quality, due to outdated curriculums and unqualified teachers, which leads to a mismatch between skills of new entrants to the labour market and the skills that are desired by employers (Assaad & Barsoum, 2007). A survey by the International Labour Organization (ILO) stated that 48% of the youth in Egypt are working in jobs not matching their education. Moreover, 8.8% earn less than they deserved because they are overeducated, while 39% have very low productivity because they are undereducated (Barsoum et al., 2014).

According to the Organisation for Economic Co-operation and Development (OECD) and the World Bank (2010), the main reasons of unemployment in Egypt are the cultural attitudes that lead to favouring particular professions and qualifications, the absence of real cooperation between HE institutions and employers and the lack of career advisory services for students (Abou-Setta, 2014). The main difficulties of inserting of young people in to the labour market are the results of a number of factors that were identified by (Amin, 2014; Helmy, 2017) as follows:

- **The Demographic Structure**

The demographic transition in Egypt resulted in a large number of new entrants to the labour market each year. The people below the age of 29 are more than half of the total population of Egypt, which makes Egypt's population very young. The labour market in Egypt receives 600,000 to 700,000 new entrants annually. Although these numbers are expected to decrease, they are still causing a very high stress on the labour market.

- **Absence of Labour Market Information Systems and Job-matching Services**

Most new competitors in the labour market find their jobs through social networks and personal contacts with who are already employed. This reflects the weakness of the few job-matching service providers. There is a lack of merit-based and transparent recruitment mechanisms which involve open and equal or fair competition.

- **Mismatch Between the Needs of Labour Markets and the Output of the HE System**

The outcome of the HE system in Egypt does not match with the requirements of the labour market. EHDR 2010 shows that there is an evolution of employment growth by type of occupation which indicates that there is a gap between the outputs of the education system and the categories of jobs created.

- **Limitations in the Business Environment**

There is highly restricting limitations regarding creating a new company. The conditions of the financial sector don't encourage entrepreneurship and self-employment, despite their positive impact on employability and labour market insertion.

2.5.2 High Labour Supply

The quality of HE is essential to ensure a competent labour force. Beyond this dimension, however, other factors have a great influence on the labour market, such as the high labour supply in Egypt. Over the past two decades, the number of graduates joining the labour market in Egypt has increased significantly, while the chance to get a decent job that matches the qualifications of the graduate has decreased (El Zanaty et. al, 2007; Osman, 2011). As long as the number of the enrolled in universities (either public or private) is increasing each year at a high rate, it gets very hard for university graduates to find work opportunities, unless real actions are taken so that the labour market can accommodate this large number of graduates (El-Awady, 2013).

According to OECD and the World Bank (2010), HE enrolment rates were estimated to have risen in 2006 from 18.1 % to 32.6 %. This large percentage of enrolment would cause an over-supply to the labour market. The report concludes that there is a gap between the supply (the graduates of the HE system) and the demand (the labour market requirements) that results in the failure of the graduates to find jobs that match their qualifications and their fields of study (Abou-Setta, 2014).

The HE system in Egypt provides "quantity solutions" instead of "quality solutions". The consequence is the increasing over crowdedness students in the HE system. The number of students in the HE system is still increasing at a rate of 6% (60,000 students) each year. Moreover, the HE enrolment rate is expected to increase till it reaches 35%, while the percentage of working age youth is expected to reach 67% in 2020 (Osman, 2011).

According to the workforce development report by the System Approach for Better Education Results (SABER), Egypt's policymakers as well as the Egyptian government are well aware of the problem of disconnection between the labour market requirements and the existing abilities of the HE system, and the consequent negative effect of this problem on employment. University education in Egypt witnessed strong growth in the past twenty years. Today, one of every three Egyptians attends university (regarding its age group). This growth in university education still causes an excess supply of graduates over the demand of the labour market (Van & Agune, 2015).

In the developed nations, the aging of the population causes a skills shortage (insufficient number of skilled workers). However, in the developing countries, there are a limited number of work opportunies compared with the unemployed labour force. These countries suffer from a high labour supply, especially for young people in the age from 15 to 24 years old (Aring, 2012).

Although the unemployment in Egypt seems to be related to the absorbing capacity of the labour market (and of course the high labour supply), the quality of the HE system is of higher importance. This is because the quality of education is very important not only for enrolment in the local labour market, but also for competitiveness in the international labour market (Tyler and Holmes, 2008). As the OECD (2010) summarized: "the *Egyptian higher education system is not serving the country's current needs well, and without far-reaching reforms it will hold back Egypt's economic and social progress*".

The labour supply problem in Egypt is one of the causes of the mismatch between the skills of graduates and the skills required for employment. Because of the structural nature of employment in Egypt, however, increasing the labour market demand alone without increasing the quality of the labour force cannot solve the problem. The problems that face the labour market in Egypt are more quality related than supply related. Many of the youth who seek to be employed find themselves not qualified enough for the jobs they desire. Furthermore, Many employers reported a complained from not finding high-skilled candidates to fill their current job vacancies. Where, according to a study in 2012, 600,000 vacancies in private sector firms couldn't find qualified candidates to fill them, despite the large number of job seekers in Egypt. So, creating new job opportunities to face the increase in the demand for the labour market is a necessary but not sufficient solution for unemployment problem in Egypt (Helmy, 2017).

2.5.3 The Gap between Skills of Graduates and Skills Needed by the Labour Market

The negative impacts of the mismatch between skills of graduates and requirements of the labour market are witnessed in many problems, including the high unemployment rates, problems of satisfaction and social stability of young people, as well as employers' satisfaction (Schomaker, 2015).

CEOs all over the world are well aware of the skills gap and consider it one of their major concerns. The problems of the skills gap appears in both developing and developed countries; skills gaps limit companies' growth and innovation, and prevents companies from meeting quality standards, environmental standards and social requirements. Moreover, companies suffer from several problems due to skills gaps. Even in countries with high youth populations, companies hardly find the skilled labour regardless of the large number of highly educated young people who have tertiary degrees. According to extensive searches on employers' awareness of skills gaps; it has been found that employers around the world consider skills gap one of their top five issues. Therefore, Bridging skills gaps can lead to direct improvement in employment, productivity, and innovation in both the formal and informal sector (Aring, 2012).

The impacts of skills gaps forced some countries, even countries with high youth population and high unemployment rates, to relax their immigration laws in order to import foreign skilled labour. This new imported skilled labour would fill the jobs that couldn't be filled by the local labour force. This strategy is believed to take away pressure from countries so that they can take some actions to link their education systems to the needs of the labour market (Aring, 2012; Van & Agune, 2015).

A study was carried out by Tomlinson (2007) on 53 senior students looking to get employed in the UK after graduation. He concluded that students consider employability as the most important factor they need to work on. According to his results, students cannot see a direct link between the available work opportunities and their qualifications, so they instead try to develop alternative plans which are more proactive and aggressive. On the other hand, Al-Harthi (2011) concluded that students don't focus on the competitiveness of the labour market; instead they believe that the employability problem is caused by the incompatibility between the skills they acquired in HE and the skills required by employers (Abou-Setta, 2014).

Other studies conducted interviews with employers from several countries: South Africa, Egypt, Senegal, Botswana, Namibia and Ghana. They all show problems with skills gaps, especially in the entrepreneurial skills of young people. In Namibia, employers stated that there is a serious problem because *"skilled people from outside the country are being imported while high unemployment rates of 51% prevail"*. Most employers, if not all of them, believe that the only remaining solution is importing skilled labour force. Furthermore, a survey by Manpower Group's 2011 ranked the percentages of employers who identify skills gap as one of the major factors that affect productivity. As shown in Table (2.5), the countries that suffer most from skills gap problem were Brazil, the Russian Federation and Egypt (Aring, 2012).

Table 2-5: Percentage of Firms Identifying Labour Skill Level as a Major Factor in Productivity (Source: Aring, 2012)

Country	Percentage
Brazil (2009)	**69 %**
Russian Federation (2004)	**57 %**
Egypt (2008)	**50 %**
Colombia (2010)	**38 %**
Costa Rica (2010)	**38 %**
Jordan (2006)	**33 %**
Botswana (2010)	**32 %**
China (2003)	**31 %**
Morocco	**31 %**
India (2006)	**14 %**
Ghana (2007)	**5 %**

In the Middle East region, Arab CEOs identified the lack of skills and training as the greatest threat for sustainable development. The result of a survey carried out with employers in the Middle East showed the dimensions of the problem. Only 50% of the employers believed that the number of qualified graduates is sufficient, with only half of them believing that the new graduates have the required skills set. The least satisfied employers were Gulf leaders, with only 37% of them citing their satisfaction about the supply of employable graduates. Skills gaps are considered so severe in the Middle East, that a simple Google search would yield tens of media pages that contain stories and reports about the problem (Metrejean & Noland, 2011; Aring, 2012).

Low salaries, poor working conditions, and the temporary nature of the jobs were stated by half of the youth who were surveyed in 2012 (Barsoum et al. 2014) as reasons when they asked why they would like to replace their jobs. Others stated that their level of qualification is higher than their current jobs. According to the survey, 47.7% of the labour force is in occupations not matching their education and qualifications. This phenomenon indicates a mismatch between the skills of workers and the skills required by the labour market, which has a strong negative impact on productivity and satisfaction (Van & Agune, 2015)

According to a World Bank White Paper on labour markets in Egypt, the majority of Egyptian youth cannot find good jobs despite the HE achievements (from 14 to 19% for males and from 9 to 14% for females. The paper's authors (Angel-Urdinola & Semlali, 2010) mentioned skills gap as one of the three key factors causing the joblessness. In the World Economic Forum's report regarding skills gaps, Egypt ranks second from the bottom (Aring, 2012).

2.5.3.1 Skills Sets Required for Employment in Both Egypt and Abroad

Employers have concerns with the skills of graduates and the difficulty of the current labour force to fill the current vacancies. These concerns are consequences of two reasons: the first reason is the skills shortage (which means that there are not enough number of graduates with a particular level of qualification or a particular field of study), while the second one is the skills mismatch (which means that the young labour force, even if they are highly educated, lack the skills that the labour market desires). The majority of the employers in Egypt today have problems finding graduates with the skills they need. Figure (2.7) shows some of the applied skills and their importance according to employers (Aring, 2012).

Skill	Percentage
Crticial Thinking/ Problem Solving *	77.8%
Information Technology *	77.4%
Teamwork *	74.2%
Creativity/ Innovation *	73.6%
Diversity *	67.1%
Leadership *	66.9%
Oral Communications *	65.9%
Professionalism/ Work Ethic *	64.4%
Ethics/Social Responsibility *	64.3%
Written Communications *	64.0%
Life Long Learning/ Self Direction *	64.0%
Foreign Languages	63.3%
Mathematics	48.8%
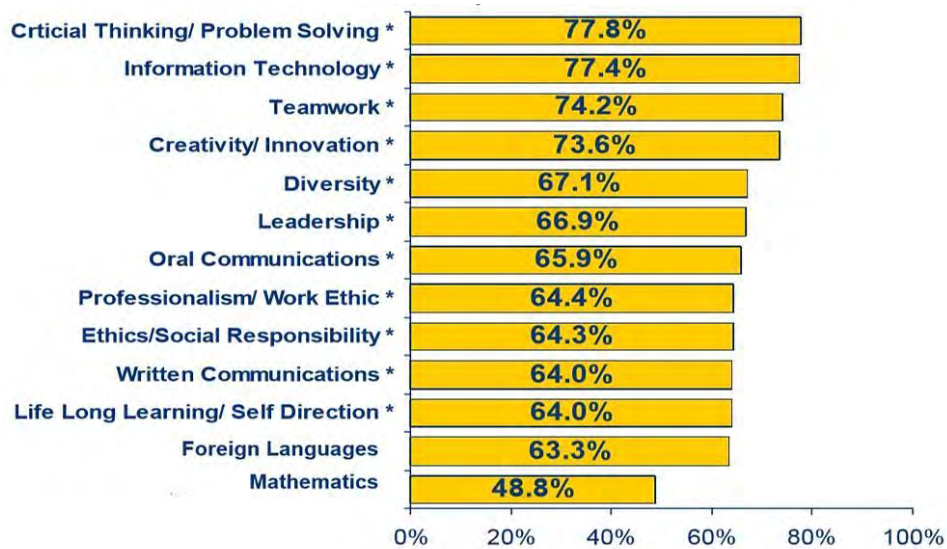
Figure 2-7: Importance of Applied Skills to Employers (Source: Aring, 2012)

The labour market in Egypt has undergone fundamental changes in the past 50 years which have led to an increase in the demand for non-routine mental and interpersonal skills and a decrease in the demand for routine craft skills and repetitive physical tasks (OECD, 2010). Graduates face hard challenges as they the enter labour market, which is characterised by risk, speed, complexity and uncertainty (Henard and Roseveare, 2012).

According to OECD (2010), there are four types of the skills required by the labour market. These skills are the most demanded by employers and the least available in graduates (Diaconu et al., 2011). They are as follows:

- **Cultural Skills**

One of the most demanded employability skills is the ability to understand and navigate the unique culture of the workplace. Each organization gets its work done in a different and unique way. Therefore, workers inside the organisations should decode its unwritten rules and understand its secrets and culture (For example, to know how to create new ideas inside a specific cultural context or to know whom and how to invite in the

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organisation). One also should know how to be effective even when dealing with people that are from different cultures and believes. Employers consider cultural skills to be very hard to teach and very hard to find.

- **Interpersonal Skills**

The next skill set in order of difficulty is interpersonal skills. It represents one's personal abilities: his way of listening, speaking, presenting information and Persuasion.

- **Intra-personal Skills**

These skills represent one's ability to control his life; to know how to manage his emotions, resources such as money and time, and how to be comfortable with uncertainty. Employers believe that these skills are extremely hard to teach or to be found, and they also believe that these skills are usually acquired from the family.

- **Technical Skills (Job Specific Skills)**

These are specific skills which require an ability to use specific tools, machines or even software. Employers state that these skills are the easiest to teach. However, these skills can sometimes be hard to find. According to a survey in the US, employers had to interview more than 10 individuals just to find one who could read at a Grade 7 level, and to do math at a Grade 5 level.

Table (2.6) shows the employability skills gaps that were found in the review of 120 surveys and categorises them into the four types mentioned earlier (Aring, 2012).

Table 2-6: Employability Skills Gaps and Typology (Source: Aring, 2012)

Employability skills	Cultural	Interpersonal	Intrapersonal	Technical
Literacy				x
Numeracy				x
Written communications	x	x	X	x
Ability to use information	x	x	X	x
Oral presentation skills	x	xx	X	
Ability to handle large amounts of information		x	Xx	
Technical ability				xx
Ability to use new information	x		X	
Computer literacy				xx
Proficiency in English		x		xx
Prior exposure to the work	x	x	X	x
Knowing the organisation	xx	x	X	
Understanding economic and business realities			X	x
Ability to formulate and check assumptions	x		X	
Ability to follow and construct logical arguments			X	x
Ability to choose appropriate information to address problems	x			x

Table 2-6 "continued": Employability Skills Gaps and Typology (Source: Aring, 2012)

Employability skills (continued)	Cultural	Interpersonal	Intrapersonal	Technical
Ability to plan and execute tasks independently			xx	x
Appropriate approach to problem solving	x	x	x	x
Ability to observe and evaluate activities of own work			xx	x
Ability to relate particular issues to wider contexts	x		x	x
Ability to implement knowledge to new situations			x	x
Ability to develop methods to improve own actions			xx	x
Ability to deal with different cultural practices	xx			
Openness and flexibility			xx	
Negotiation skills	x	xx	x	x
Self-initiative and Self-motivation			xx	
Ability to network	x	xx		
Creativity and innovation			xx	
Ability to interact with a wide range of people	xx	x		
Team participation	x	xx		
Self-confidence and Sense of identity			xx	

In Egypt, employers seek more than technical skills or knowledge, they seek practical soft skills. Both employers and graduates think that the current HE system doesn't have the ability to teach these skills. HE in Egypt has many problems regarding curriculum rigidness, focus on memorisation, lack of facilities and deficient preparation. HE in Egypt depends upon on out-dated and rigid curricula where the lecturer has full control and where memorising dominates over critical thinking abilities (Abou-Setta, 2014).

A survey by the Academy of Educational Development (AED) in 2008 targeted employers in Egypt to find the skills they required. 94% of employers stated that skill requirements had increased and the types of required skills had changed over the previous two years due to many reasons including the increase in technology, customer demand, competition and the need for higher quality of services. Figure (2.8) shows the required skills and their importance according to the 93 employers of the survey (Aring, 2012).
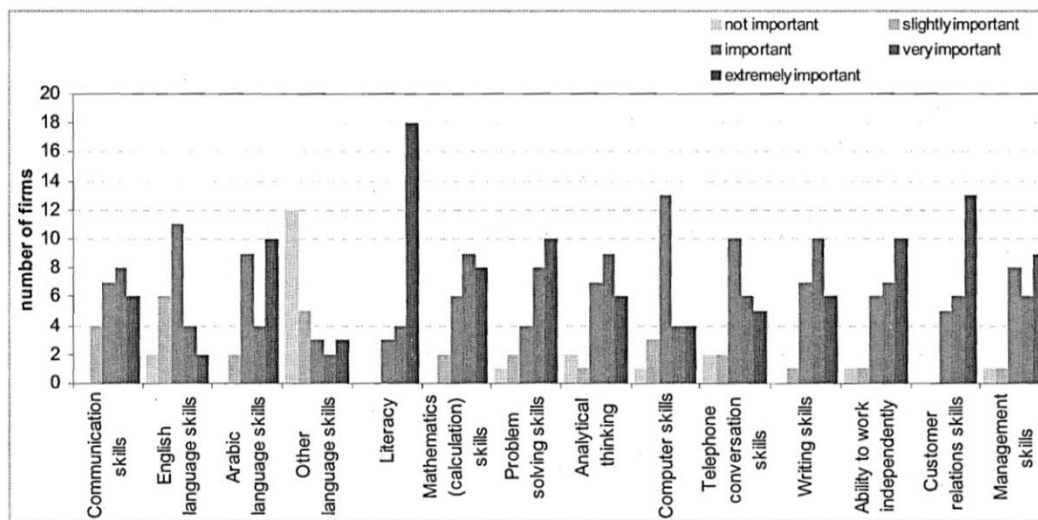
Figure 2-8: Importance of Applied Skills According to Employers (Source: Aring, 2012)

Employers seek graduates who have "soft skills" next to their technical knowledge "hard skills" (OECD, 2010). Employers need graduates who excel in at least one foreign language, who are skilful with computer and information technology, and who have good communication skills and teamwork capabilities. Employers want the graduates to be able to participate in daily business and take initiatives regardless of their educational level or specialisation. The definition of "employability" involves many skills such as writing, mathematics, oral communication, decision-making, computer, research, critical thinking, teamwork, and lifelong learning skills. It is essential to include these skills within the course of study during education, not after graduation. The HE system in Egypt has to provide these skills to students to enhance their employability (Osman, 2011).

2.5.3.2 Skills of Graduates

There is an attitude among young students towards HE. They are aware that the HE system lacks the practical skills they need and they, as a consequence, tend to treat the HE system superficially. Students graduate without many of the skills required by the labour market, which the HE system is not able to provide. As a consequence, employers don't find the skills they desire and they spend a lot of money and time to train the new graduates before employment (Diaconue et al., 2011).

A survey by El Zanaty et. al (2007) shows that the graduates entering the labour market don't have a lot of required skills such as teamwork, leadership, interpersonal relationships, professional ethics, and assertiveness. 90% of students in the survey state that practical training is poor in universities. Over 61% think that communication skills are poor while 87% rate the ability to apply the learned knowledge as poor. 13.5% of applicants can be considered "prepared" for work (Aring, 2012). According to (Diaconu et al., 2011), the graduates' skills falls into two categories:

- **Professional Skills**

Professional skills represent the ability of the graduate to combine and use the knowledge, skills and values he/she learned in the university to solve a particular problem. These skills also include the understanding and use of a specific foreign language, critical and constructive reflection, creativity and innovation.

- **Transversal Skills**

These represent values and attitudes of the graduate that transcend a particular field and have a cross-disciplinary nature. They include teamwork, communication skills, the use of technology, problem solving, decision making and the openness to lifelong learning.

Regarding technical skills, the survey that was carried out by AED as well as the survey by El-Zanaty show that 81% of employers in Egypt rate levels of technical skills of graduates as fair or poor. In order to compensate for the skills gaps, over 66% of employers prefer candidates with previously-obtained skills, and over 50% consider education the most important factor for employment (El Zanaty et. al, 2007). What is interesting is that less than 10% of employers in Egypt provide training for applicants- they prefer good previous experience. This puts job seekers in an endless vortex between needing a job to get experience and needing experience to get a job (Aring, 2012).

In general, the HE system in Egypt doesn't increase the possibility of the graduates to get employed. More than 83% of HE graduates are not able to work in the formal sector without waiting for a very long period, up to five years after graduation. There are many reasons for this problem, such as the lack of employment-oriented training in all educational levels (except in the technical and vocational education), and the lack of employability skills transfer (El Zanaty et. al, 2007).

The Egypt Labour Market Panel Survey (2012) shows that 90% of graduates who started working during the previous 3 months (14,488 respondents) didn't get any training other than normal education before they started their jobs. Moreover, according to the Survey of Young People in Egypt (SYPE) in 2014, the majority of the training programs were by the employers as shown in Table (2.7). The percentage of youth who acquired the skills for their job from formal education and vocational training decreased dramatically while the on-the-job training increased significantly (Roushdy & Sieverding, 2015). This sharp increase indicates that the Egyptian employers pay the cost for the little and weak training provided by the formal education system (Helmy, 2017).

Table 2-7: Skills Learning Survey (Employed Youth Aged 15-29) (Source: Roushdy & Sieverding, 2015)

How did you learn your skills?	2009			2014		
	Male	Female	Total	Male	Female	Total
Formal education	11.1 %	34.6 %	14 %	9.2 %	39.1 %	12.2 %
Vocational training	26.3 %	45 %	28.6 %	13 %	23 %	14 %
Apprenticeship	43.9 %	5.6 %	39.2 %	45.2 %	10.7 %	41.8 %
On the job training	3.3 %	1.1 %	3 %	19.9 %	15.7 %	19.4 %
Family/Self-trained	11.5 %	6.8 %	11 %	11.9 %	11.4 %	11.9 %
Others	3.9 %	6.9 %	4.3 %	0.9 %	0.0 %	0.8 %

2.5.3.3 Cooperation between HE & Employers

The challenge that faces universities all over the world is not only the good preparation of the students, but also how the university is linked to industry and business. When learning is rooted in the labour market, this could help the educational institutions to respond to the challenges and problems of the labour market, using other ways of teaching and learning techniques such as the project-based learning (Henard and Roseveare, 2012). Although the HE system in Egypt started to work on connecting industry and businesses to student teaching and training programs, a significant expansion of these efforts is required to link students with job opportunities just after graduation (Ersado, 2013).

The 2011-2012 Global Competiveness Report stated that the inadequately educated workforce is one of the two most problematic obstacles against doing business in Egypt. Formal education institutions should satisfy the private sector needs ensuring that graduates have the skills that will prepare them to join the workforce (Ersado, 2013).

There is a problem of how to measure the skills of graduates because employers, educators and policymakers each measure skills of graduates differently. While employers prefer to use opinion surveys as a tool to measure skills of graduates, economists and policymakers use educational achievement as a guide. As most employers believe that skills of graduates of most HE institutions are low, various countries (Beinhocker et al., 2007) state that using educational achievement as a guide for skills of graduates is not helpful. Alternatively, other measuring techniques to provide the shared language and standards among employers, educators and job seekers could be employed (Aring, 2012).

There is very little cooperation between the HE system in Egypt and employers. This issue has proved to be of significant importance, especially in the recent years. However, some efforts were exerted in order to overcome this problem. Some HEIs have improved their study curricula to include internship programmes. Few universities provide internship in cooperation with authorities, to give opportunities for students to experience the work environment in public administration. Courses in private universities are usually based on the requirements of the labour market, unlike in the public universities. The need to create career guidance offices at the public universities is crucial for the future of the universities (EACEA, 2017).

2.5.3.4 How to Bridge the Gap

The HE system in Egypt provides "Education for All" without asking the question, "Education for What?" A social dialogue is needed to bring employers and educators together to set their shared goals for employability. This type of social dialog is missing in countries such as Egypt. Skills gaps need to be more analysed, especially in the

informal sector, which represents the largest percentage of the young labour force. Skill standards should be developed in a way that allows the education and training system to unleash the possibilities of the young people in Egypt. The HE system in Egypt must understand the fact that employability skills can be learned only through application or doing (Aring, 2012).

Employability skills can't be learned through traditional talk and training methods. As no one can learn to ride a bicycle by just reading a book, employability skills are learned by application or by doing. Skill exchange is another solution to overcome the skills gaps a (Morgan, 2013). In order to overcome the mismatch between the output of the HE system and the requirements of the labour market, The Youth Employment National Action Plan (YENAP) of 2010–15 outlines a strategy for Egypt to guarantee sufficient and better jobs for the youth, and seeks to improve the policies and programmes of the labour market by creating formal employment offices, and labour market information centres, as well as improving the existing labour market information units in the Ministry of Manpower and Migration (ILO, 2010).

Access to employment must be the main goal of the Egyptian education and training systems. This goal can be achieved through promoting self-employment and entrepreneurship in the early stages of education, introducing a National Qualification System that integrates all levels, developing career guidance systems, allowing transparency and recognition of qualifications, and increasing the quality of education to bridge the gap between skills development and the needs of the labour market. In addition, the social and professional image of TVET needs to be improved by creating quality, attractiveness, and clear career paths (Amin, 2014).

The ILO aims at developing skills of graduates through two actions. The first action includes enhancing programmes of technical and vocational training in order to develop skills which are linked with the needs of labour market. The second action is strengthening the connections between education and labour market entry through three main objectives: helping workers and initiatives to be flexible and to adjust to change; matching the labour supply to the current skills demand; and forecasting the new skills that will be demanded in the future and delivering these skills (Van & Agune, 2015).

2.6 Summary

The first and second sections in this chapter aimed at investigating the HE system in Egypt and the management structure in the universities, as well as the quality of the output of this system (the quality of graduates) as perceived by both the university and the employers. It has been found that the employers think that the majority of the graduates don't have the skills required for employment.

The third section investigated the labour market in Egypt, the new employment opportunities available for the graduates, the problem of unemployment in Egypt, which is considered a serious problem with the youth being the largest percentage of the unemployed. Then identified the skills needed by the labour market, which were very different from the skills that the graduates own. Where, most of the employers have to provide training to the graduates before hiring them. As a result, employers admit that there is an incompatibility between the skills of graduates and the skills required for employment, not only in Egypt but also in many countries around the world. This requires continuous coordination between HE system from one side and the labour market from the other side, to bridge this gap (skills gap).

Chapter Three: Methodology

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3.8 Summary

CHAPTER 3
RESEARCH METHODOLOGY

In this chapter, the choice of the research design is being undertaken. This chapter is divided into nine sections. At the beginning, the philosophical assumptions are discussed in section [3.1], as well as a justification for choosing the pragmatic philosophy. Then, section [3.2] deals with the approaches used to achieve the research's objectives. After that, the choice of mixed method and the SD modelling is justified in section [3.3]. Next, sections [3.4] and [3.5] define the time horizon and research population, respectively. In sections [3.6] and [3.7], the techniques of data collection and procedure of data analysis of both qualitative and quantitative phases are discussed. Finally, section [3.8] summarises the chapter.

3.1 Research Philosophy

The aim of any research is to develop knowledge in a specific field. The researcher's assumptions and beliefs about the development of this knowledge are called the "research philosophy". This developed knowledge might not seem to be as dramatic as a huge theory or discovery, but even if the researcher just answers a particular problem in an organisation, he is, for sure, developing new knowledge (Saunders et al., 2016).

Johnson and Clark (2006) stated that, researchers in the field of business and management need to be careful when they choose the research method and strategy. Before the researcher makes these choices, he should develop some philosophical commitments. These commitments are of great importance due to their effect on the researcher's way of understanding and investigating.

The research philosophy depends on critical assumptions about the researcher's way of thinking and how he views the world. In order to choose the suitable nature of philosophy for a research, these philosophical assumptions should be first identified. They help the researcher to build a clear philosophical system as a basis for the research. The different types of assumptions are discussed in the following sections (Tuli, 2010).

3.1.1 Philosophical Assumptions

At each stage of the research, philosophical assumptions are being made. They could be about the realities in the research (ontological assumptions), about the human knowledge (epistemological assumptions), or about how the values of the researcher affect the research process (axiological assumptions). Each set of assumptions has a different impact on the researcher's select of the research procedure. It is very important to have a reliable and well-thought-out set of assumptions to be able to create a credible research philosophy. Creating a credible research philosophy will underpin the researcher's choices of the research method, strategy, data collection techniques, and data analysis procedures. All these should fit together in order to have a coherent research project (Saunders et al., 2016).

After understanding the importance of the philosophy development, it is important to specify the suitable set of assumptions that would lead to the proper philosophy. Morgan (2007) classified the philosophical assumptions into three sets or paradigms. A paradigm is a set of basic philosophical assumptions about the reality (ontology), about the way of understanding this reality (epistemology), or about the way to improve this understanding (methodology). Therefore, a paradigm represents the shared rules, terminologies, philosophical understandings, and research approaches adopted by a particular community.

The importance of developing the philosophical assumptions was assured by (Bryman, 2016). He stated, "*These assumptions will support the researcher's strategy and the methods selected as part of that strategy*". Creswell and Creswell (2017) stated that the philosophical assumptions involve three main paradigms: ontology, epistemology, and axiology. Each paradigm has its own differences that affect the way of thinking of the researcher and his design of the research process.

3.1.2 Types of Philosophies

Bryman (2016) argued that there are many ways of developing knowledge and understanding reality. In most of the literature, there are three main philosophies: Positivism, interpretivism, and realism. These three philosophies are expanded by Saunders et al. (2016) into five major philosophies in business and management. They are: positivism, critical realism, interpretivism, postmodernism and pragmatism.

3.1.3 The Researcher's Choice of Philosophy

The relationship between knowledge and the developed process is the main factor that affects the researcher's choice of philosophy. For example, a research that investigates feelings and perceptions would have a different view from a research that deals with facts (Saunders et al., 2016).

There are debates on the choice between: epistemology and ontology, and positivism and interpretivism. However, they agreed that research objectives are the most important determinant in choosing the proper research philosophy is the. So, the choice of the philosophy should be suitable to achieve the research objectives in the best way (Hanson et al., 2005; Saunders et al., 2016).

As mentioned before in Chapter (1), there are five research objectives needed to be achieved. The first three objectives can be achieved using qualitative methods, due to their qualitative nature and the need for a deep understanding of the research dimensions. On the other hand, the last two objectives can be achieved using quantitative methods, because they involve simulation and validation of the first phase's findings. Consequently, it is essential to employ both methods to best achieve all the research objectives. Therefore, the mixed method is the perfect tool for this research.

Hanson et al. (2005) and Saunders et al. (2016) highlighted the great importance of the research objectives, and encouraged researchers to achieve the research objectives using appropriate methods from both approaches. They stated that mixed methods are best to achieve the research objectives in the field of social sciences, rather than a single method: qualitative or quantitative.

As a comparison between interpretivism and positivism, Cohen et al. (2002) stated that a positivist deals with realities in the world. These realities are present in the world but are waiting to be discovered using scientific methods. This can be done using quantitative methods to discover the truth behind the reality. Tuli (2010) and Saunders et al. (2016) distinguished between positivism and interpretivism regarding the research method related. For the qualitative research, interpretivism is the theoretical framework. On the other side, positivism is the theoretical framework for the quantitative research.

According to the previous discussion, this research needs a philosophy different from interpretivism (qualitative study) and positivism (quantitative study). It needs to combine both of them (qualitative and quantitative) in order to allow for the research to contain all dimensions of the research problem. Therefore, a combination between interpretivism and positivism is adopted, and is called 'pragmatism'.

As concluded from Johnson et al. (2007), Creswell and Creswell (2017), Bryman and Bell (2015), and Saunders et al. (2016), the entire picture of the research can't be obtained by interpreting data using just a single method. Pragmatism allows the researcher to use mixed methods in social-related research. The importance of mixing different methods lies in the fact that no single method, neither the qualitative nor the quantitative, is enough by itself to capture the whole situation. Consequently, the quantitative and the qualitative methods complement each other.

In this research, a mixture of perspectives is used, merging interpretivism and positivism philosophies; subjective and objective points of view; and qualitative and quantitative methods to interpret the data effectively. The ontology of the research combines both subjective and objective points of view, while its epistemology combines both positivism and interpretivism philosophies.

3.2   Research Approach

There are two contrasting approaches to adopt: deductive and inductive. The deductive approach seeks to choose a set of premises or hypotheses to build a theory. The theory is developed with the aid of academic literature, and then tested by collecting data to test its hypotheses. The conclusion of the research is considered to be true when all the

hypotheses are also true. Otherwise, if the results are not consistent with the hypotheses, the theory must be proved wrong or modified and re-tested. In contrast, an inductive approach starts by collecting data to investigate a phenomenon and the researcher then begins to generate a theory, usually in the form of a conceptual framework (Ketokivi and Mantere 2010). The differences between the different approaches are explained in the table (3.1).

Table 3-1: Types of Approaches (Source: Saunders et al., 2016)

	Induction	**Deduction**
Logic	In an inductive inference, known premises are used to generate untested conclusions.	In a deductive inference, when the premises are true, the conclusion must also be true.
Generalizability	From the specific to the general.	From the general to the specific.
Use of data	Used to explore a phenomenon, identify themes and patterns and create a conceptual framework.	Used to evaluate propositions or hypotheses related to an existing theory.
Theory	Theory generation and building.	Theory falsification or verification.

As mentioned before, this research uses a mixture of perspectives; combining positivism and interpretivism. This combination of interpretivism and positivism will consequently lead to a combination of both deductive and inductive approaches. The deductive approach is based on positivism, while the inductive approach is based on interpretivism. The first phase of the research adopts the inductive approach. Then it is followed by the deductive approach in the second phase.
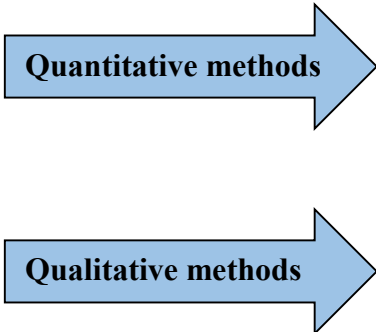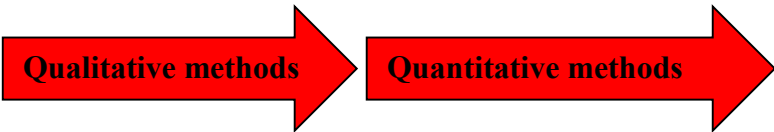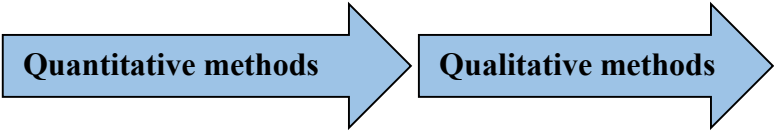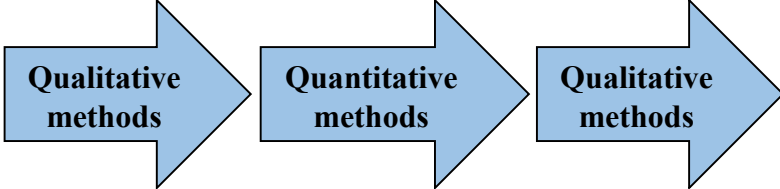
3.3   Research Methods

The researcher adopted the mixed methods in this research. Each method has its own advantages and disadvantages. Therefore, the use of mixed methods has the ability to avoid or neglect some of the weaknesses in each method. For example, the quantitative method can't provide the explanations and insights that can be obtained from qualitative analysis. It has been found that neither the quantitative nor qualitative methods are enough in themselves to capture the entire picture of the research. Therefore, the integration of quantitative and qualitative data collection techniques and analysis procedures is the most suitable for social science researches. Both the quantitative and the qualitative methods are used to complete each other and to capture the whole picture (Tashakkori and Teddlie, 2010; Creswell et al., 2004; Bryman, 2016).

Mertens (2003) and Sekaran and Bougie (2016) had a similar opinion. They proposed using different methods for different purposes in a single research. For example, a researcher may join numeric data (gained by quantitative methods) and specific details (gained by qualitative methods) to identify variables in the research study. Milliken (2001), Bryman (2016) and Saunders et al. (2016) highlighted the advantages of mixing different types of methods. They mentioned that that mixed methods have a great ability to achieve the research objectives, and to provide confidence to the research results.

Quantitative and qualitative research methods may be combined in many ways. Both techniques are combined together in a variety of ways ranging from concurrent (simple) mixtures to the more complex sequential designs (Nastasi et al., 2010; Saunders et al., 2016;Creswell and Clark, 2017). Table (3.2) shows various design ways to mix different research methods.

Table 3-2: Mixed Methods Research Designs (Source: Saunders et al., 2016)

Research method procedure		
Concurrent	Quantitative methods →	
	Qualitative methods →	
Sequential exploratory	Qualitative methods →	Quantitative methods →
Sequential explanatory	Quantitative methods →	Qualitative methods →
Sequential multi-phase	Qualitative methods →	Quantitative methods → Qualitative methods →

3.3.1 Methods of investigating quality of HE

There are several methods and tools to investigate and assess the quality of HE. They include: Data Mining, Analytic Hierarchy Process, Hierarchical Linear Modelling, goal programming, data SD modelling and simulation, and participatory action research (Oyo, 2010; Saunders, 2018). Each one of these methods and its suitability to study the research problem is discussed in the following section.

3.3.1.1 Data Mining

Data mining is the process of identifying new and valid patterns or models that can be useful and ultimately understandable in data to make critical business decisions. In a similar perspective, data mining defines as the process of automatically extracting useful information and relationships from vast amounts of data. Lynham (2002) explains that data mining does not involve searching for specific information, and does not require starting from hypothesis or a question, but research About data Simply searches for patterns that are already in the data.

Modern applications of data mining in higher education generally focus on enrolment management, while addressing topics such as: admission returns (Maltz et al., 2007), student retention and completion of a degree time (Deniz et al., 2002). Specifically, the questions explored include: discovering inquiries that are likely to turn into actual applications; Predicting entry to specific courses to help determine program success rate; Identify and target students at risk of attrition; Achieving optimum graduation, employment and retention rates.

3.3.1.2 Analytic Hierarchy Process

The Analytic Hierarchy Process (AHP) has been applied as a multiple decision-making technique in many of the decision problems of HE since its creation. It is particularly suitable for complex decisions that involve comparison of decision elements that are difficult to quantify. AHP is based on the assumption that when faced with a complex decision the natural human reaction is to group the elements of the decision according to their common characteristics. It involves building a hierarchy (arrangement) of decision elements and then making comparisons between each possible pair in each group (as an array). This gives weight to each component inside a hierarchy level as well as the

consistency ratio (useful for checking data consistency). In summary, AHP consists of three main processes including hierarchy building, priority analysis, and consistency verification (Andersen et al., 2007).

AHP has been applied to several HE decision-making problems as multiple features for decision-making techniques including: budget allocations, Staff member promotions and department process, resource allocation. A full review of AHP use in HE decision fields can be found in Grandzol (2005). In the context of this thesis, AHP is useful in prioritizing budget allocations before running simulations so that realistic decisions about allocating funds are simulated in simulations

3.3.1.3 Hierarchical Linear Modelling

Hierarchical Linear Modelling (HLM) is a technique for modelling multi-level data when observations in the lower levels are intertwined within the notes at a higher level. The importance of HLM in higher education quality research is in creating a hierarchy of structured data in order to improve insights for analysis. Hwang (2002) emphasizes that the use of large-scale secondary data in higher education research, without looking at inherent hierarchical data structures, may lead to inaccurate or misleading conclusions. This argument is supported by a satisfaction questionnaire for more than 1000 students, where the multi-level modelling that was adopted revealed the difference in the classification of satisfaction by different groups of students. There are other Higher education quality studies apps at HLM: the study of program effectiveness at universities; And the study of measuring the relationship between resources and outcomes in Norwegian higher education.

3.3.1.4 Balanced Scorecard

Traditionally, most organizations consider the performance of their companies by reviewing their financial aspects. However, financial measures alone are not a balanced view of the critical success factors of any organization, mainly due to the fact that financial measures tend to measure the past, without carefully examining why it happened. Against this background, Kaplan and Norton (1996) developed the Balanced Scorecard (BSC) in the early 1990s. In their view, "BSC translates the organization's mission and strategy into a comprehensive set of performance measures and provides a framework for strategic measurement and management."

BSC is based on four main perspectives: financial goals, customer perspective, internal operations, learning and growth, where, these perspectives provide an essentially interlinked presentation of quality management studies (Umashankar and Dutta ,2007).

3.3.1.5 Participatory Action Research

The double goal of the PAR approach is to address a problem and to develop generalizations / practical and theoretical theories (Lau, 1999). PAR's approach supports the argument that when theory and practice are interconnected, solving real-world problems while contributing to new knowledge can be achieved simultaneously. This is possible because PAR involves.

Practitioners as subjects and associate researchers. In the same spirit, Lau (1999) explicitly notes: "Whatever the case, the IS procedural researcher serves two different" masters ", the research agent and the research community as a whole. The needs of these two masters are usually quite different and sometimes conflict with each other," Thus, the PAR should not have little distinction between the two parties by offering the potential to reduce the conflict of "servicing two masters".

3.3.2 Justification of using SD modelling

The researcher decided to use System Dynamics as a method in this research. System Dynamics was founded by jay Forrester at MIT in 1961 (Forrester, 1997). Sterman (2000), the current leader of the System Dynamics school of thought, defined System Dynamics as a modelling approach used for analysis and policy design of complex systems. It includes two iterative phases of study: a qualitative phase followed by a quantitative phase, so it can be considered as a sequential exploratory mixed method. The qualitative phase consists of two steps; conceptualisation and formulation. The quantitative phase consists of two steps; validation and implementation (Randers, 1980; Roberts et al., 1983; Wolstenholme, 1990; Richardson and Pugh, 1997; Sterman, 2000).

The topic of this research (HE system) is very complex and contains many variables to study. System dynamics is suitable to study such complexity and dynamicity in HE system. Many researchers adopted system dynamics in their researches about HE, like Kennedy (1998) and Oyo (2010). Oyo's research was related to the current study; he investigated the quality of HE system using system dynamics. The following points shows the potentials of SD modelling and why it is the most suitable to study complex system such as the HE system:

- SD has the ability to explore the behaviours of variables within the HE system over time.

- SD can capture interactions and feedbacks within the system easily.

- Also, it can combine the study of qualitative variables, and quantitative variables and investigate their effects together.

- It also has the ability to predict the consequences of these decisions in the future before implementing them in the real system.

- It can incorporate non-linear relationships, which exist in issues of HE quality.

- It can explore and assess the complexity of situations over time.

- It has the ability to insert time delays into the model. These time delays underpin certain policies on quality in real life. For example, delay of executing research projects, delay of recruiting new staff, etc.

- SD has a high degree of operationality. It depends on formal modelling, which allows the ability of using disciplined thinking and using assumptions to define equations and quantifications to accurately represent the real system being studied.

- It has the ability to visualise and formalise aspects of complex systems such as feedback loops and delays. These aspects are very important when investigating highly complex systems such as HE system, and cannot be easily understood by using other tools.

- SD has a high level of generality, because the use of stocks and flows is a generic form to represent dynamic systems. Which can be used for wide range of similar cases in similar systems.

- SD gives the availability of using powerful application software, such as PowerSim, Stella, Ithink, and VENSIM. These are software that are easy to use and give access to lots of mathematical functions. They also offers techniques of optimization and validation tools.

- SD is very flexible. Which means it has the ability of combining with many other methodologies and tools, both conceptually and formally.

- It can study variables which have different units with each other.

- SD can be used to generate policies and decisions.

The qualitative phase involves collecting and analysing the data from Semi-structured interviews, while the quantitative phase uses sources of secondary data. The purpose of the qualitative phase is to determine the factors that impact the quality of HE system in Egypt, and to create dynamic hypotheses to represent the relationships between these factors, while the purpose of the quantitative phase is to test the hypotheses using secondary data. Chapter (4) includes the detailed analysis of the qualitative phase, while Chapter (5) includes the detailed analysis of the quantitative phase.

3.4   Research Time Horizon

An important choice in the research is the research time horizon. There are two types of time horizons: the cross-sectional (snapshot) and the longitudinal (diary). Cross-sectional researches seek to explain the relation between different organisations or to describe the incidence of a phenomenon. Many researchers prefer the cross-sectional time horizon to study a specific phenomenon at a particular time. This is because most academic research projects are time-constrained. Even though, the researcher should use the longitudinal time horizon if there is sufficient time for the research and there are enough data that can be collected over time. The main advantage of the longitudinal time horizon is the capacity to investigate development and changes. It can give the researcher the ability to control and observe the research variables over time. The complex and dynamic nature of the system of HE requires a longitudinal time horizon to make it possible to capture all the cause and effect relationships between the variables (Saunders et al., 2016).

The Egyptian revolution in January, 2011, witnessed great changes to the country, including the system of HE. Therefore, the research start time is chosen to be after the revolution (the 2011/2012 education year). A period of five years is sufficient to investigate the system, so the research end time is (the 2016/2017 education year).

Another reason for this is the lack of the data after the 2016/2017 year. The researcher uses the qualitative data collected in these five years to build the model that simulates the system of HE in Egypt (see chapter 4), while the quantitative data are used in the validation stage (see Chapter 5).

3.5   Research Population

Before selecting the suitable research sample, the research population should be first defined. A section of this population will be selected to be the research sample. Bryman and Bell (2015) defined the research population as the universe of units from which we draw the sample. They are called 'units' because there could be other cases to sample than persons; the researcher could sample from organisations, firms, universities, etc. The term 'population' in the research has a much wider meaning than the usual daily-used term. In this research, the unit may be considered to be the university; because the researcher investigates the HEsystem. This research focuses only on Egyptian public universities for the following reasons:

- The number of Egyptian public universities is higher than the private universities.

- The number of students in Egyptian public universities is higher than in the private universities and, consequently, the number of graduates is also higher.

- The public universities have a higher number of staff members and administrators.

- The number of majors in public universities is higher than in the private ones.

- Public universities exist in all the regions of Egypt; they are not restricted to specific regions like the private ones.

- Public universities are older in establishment than the private ones.

- Public universities are higher in ranking than the private ones (both locally and internationally).

Therefore, the research population will be the 24 public universities in Egypt according to EACEA (2017).

Although it could be possible to collect data from the whole population, it is impracticable to do so (except in the case of using secondary data). Budget and time constraints would prevent gathering data from all the population. Also, the census usually doesn't provide more useful data than the sample that represents the research population. Therefore, it is more practical for the researcher to select a sample. Sampling is equally important whether the researcher is using any of the data collection techniques: questionnaires, interviews, surveys, or any other technique. However, permission to collect data should be obtained before starting the process of data collection (Saunders et al., 2016).

Sampling could be even more efficient than collecting data from the entire population. According to Barnett (2002), sampling could lead to a higher accuracy than a census. The smaller number of participants in the case of sampling gives you more time to design the data collection technique. Furthermore, fewer participants allow for more details to be gathered from each participant. The researcher can devote more time to collect data from hard-to-reach participants. Another advantage, after the data have been collected, is having more time to check and test the data before the analysis. However, the researcher should define the sample of the research wisely. The most important point to consider while selecting the method of sampling is the ability to achieve the research objectives.

3.6   Qualitative phase

The purpose of the first phase in the research is to gain more insights about the system of HE in Egypt and understand the cause-and-effect relationships between the variables inside the system. The complex and dynamic nature of the system requires it to be

qualitatively investigated in order to be understood. According to System Dynamics Modelling, the aim of the first stage is to create dynamic hypotheses about the HE system. The suitable data collection technique in this phase is conducting *semi-structured interviews* with the experienced staff and administrative members who are responsible for the quality of HE system.

The findings from this phase are very important as they help the researcher to generate the necessary ideas and insights that he needs to develop hypotheses. In more detail, the qualitative phase enables the researcher to identify the stakeholders, develop a model to identify the influencing factors and key changes, and to develop a system dynamics model (dynamic hypotheses) that will be validated in the quantitative phase.

3.6.1 Sampling of qualitative phase

There are two main groups of sampling: probability and non-probability sampling. According to Saunders et al. (2016), the non-probability sampling is the most suitable in the exploratory stage of the research. It provides a range of sampling techniques like judgmental (purposive), convenience, and quota sampling. **Judgmental** sampling is the most suitable for this research. This technique allows the researcher to use his judgment to select cases that are able to meet the research objectives. It is used when the samples are relatively small and when the researcher wants to select particularly informative cases. There are a number of specific types of judgmental sampling to choose from. The researcher chooses the **homogenous judgmental sampling technique**, which is a technique that focuses on a group of sample members who have similar characteristics (In this research all the sample members have experience of more than 15 years in the field of quality of HE in Egypt). This allows the researcher to explore the participants' insights in greater depth and get rich and valuable information.

After choosing the type of the sample, the size of the sample is defined. Saunders et al. (2016) stated that for all types of non-probability sampling techniques, except quota sampling, there are no specific rules to define the sample size. Alternatively, the sample size is defined based on the research objectives. The researcher should collect the data until he finds what he is looking for, what would be useful for the research, and what would have credibility. This is exactly the purpose of collecting qualitative data by conducting semi-structured interviews. Therefore, the validity and reliability of the collected data would depend more on the researcher's skills in collecting and analysing the data rather than the sample size (Patton, 2002). As a rule of thumb, the researcher should keep collecting data until data saturation is reached (i.e. the additional data doesn't provide any new information). However, the researcher should have an initial estimation of the sample size before starting the process of data collection.

According to Guest el al. (2006), 12 in-depth interviews are sufficient to get enough data from a homogenous group. For Creswell (2013) and Lewis (2015), this number is insufficient. He suggests a number between 5 and 30 interviews. Also, Saunders et al. (2016) stated that the expected number of semi-structured interviews lies in the range between 5 and 25. According to this discussion, the researcher suggests a number of 24 semi-structured interviews as initial estimation.

This research focuses only on Egyptian public universities and doesn't include private universities for the reasons mentioned before in this chapter in section 3.5.In this phase, the sample size was 24 chosen from four public universities: Cairo University, Alexandria University, El-Mansoura University, and Ein Shams University. These universities were chosen for the following reasons:

- They have the highest ranking in the Egyptian public universities according to the world ranking (Ranking Web of Universities, 2018).

- They contain the largest number of students, graduates, staff and administrative members.

- They have all the specialisations in Egyptian HE.

- They are the oldest in creation.

According to this, the researcher conducted 6 interviews within each of these selected four universities. The researcher chose those who are responsible for quality assurance in these universities, and who have experience of more than 15 years in this field. Therefore, the researcher targeted the members of quality assurance units in these universities. The researcher found that the number of academic staff members in the quality assurance units is approximately twice the number of administrative staff members. Therefore, interviews are conducted with 4 academic staff members and 2 administrative staff members within each quality assurance unit; with a total number of 24 interviews. After the 24 interviews, it has been found that saturation was reached and no additional interviews were required.

3.6.2 Data Collection Technique in the Qualitative Phase

Data is collected in this phase from semi-structured interviews. The main advantage of semi-structured interviews is flexibility; they allow bringing new questions during the interview depending on the interviewees' responses. They have the ability to clarify doubts by rephrasing or repeating the questions to insure that the interviewee understands the questions clearly. They also provide another types of data that aren't available in other data collection techniques, non-verbal cues, other body languages, etc. (Sekaran and Bougie, 2016).

There are also disadvantages in conducting interviews to collect data. The most affecting disadvantage is the geographical limitation, which is the difficulty to interview a large number of participants in a short time. Another disadvantage is that participants could feel uncomfortable to talk about some sensitive topics (Saunders et al., 2016). However, according to Bryman (2016), the researcher can overcome these disadvantages through his professionalism in conducting the interviews and analysing the data.

3.6.2.1 Ethical Considerations

Before starting to collect the data, permission is required from an authorised organisation to ensure that the data collection process agrees with the ethical considerations (Saunders et al., 2016). This stage was approved by the Cardiff School of Management Ethics Committee; **the Ethics Committee Application Reference Number is 2015S0032** (See **Appendix A**). The participants were informed that the interviews are confidential and that they will not be able to be identified from the published results. Additionally, all the raw data will only ever been seen by the researcher. Some of the interviewees are working in the public universities administration. So, they will need to be absolutely certain that their participation is voluntary and confidential, as they may worry that the output of the research could affect their posts in the future. This is why the researcher must choose the participants carefully. All the participants are informed that they can withdraw at any time. Therefore, there aren't any significant risks associated with this study.

3.6.2.2 Topics of semi-structured interviews

The purpose of the interviews is to know the variables that affect the quality of Egyptian HE and the relationships between these variables. The variables will be used to develop a model of the HE system in Egypt. The semi-structured interviews contained two types of questions: open questions and probing questions. The researcher developed an

interview guide which included a list of open questions in order to focus the conversation on the required topics without forcing the participants into a particular format (See **Appendix A**). A draft version of the interview guide was revised by experts in the field of HE sector to ensure that they cover all the dimensions of the research problem. This was helpful in adding some extra questions relevant to the quality of HE. These questions were asked to all participants, but the order of the questions varied according to the flow of the conversation. The other type of questions, probing questions, was used for more explanation when the respondent's answer was unclear or insufficient. Examples of probing questions are: "Please explain"; "Why do you think so?"; "Tell me more". These supplementary questions were used when the open questions did not provide clear responses. Therefore, these questions added more value and depth to the data collected.

3.6.2.3 Procedure of Semi-Structured Interviews

Semi-structured interviews were conducted over four weeks in a friendly and informal way. The time and place of the meetings were pre-arranged with the interviewees and they were given brief overview about the purpose of the interview, making sure to give them little information so that they did not prepare answers in advance, which would decrease credibility. They were reminded before the meeting with a sufficient period.

The interviews were carried out one at a time between the researcher and a single participant through a face-to-face meeting. The participants were invited to public places outside universities so that they could feel comfortable in a friendly environment. The time of each interview was approximately one hour, which is acceptable for a one-to-one interview. Although the participants are excellent in English, the researcher wrote the questions in Arabic and the interviews were in Arabic. The reason for that is to allow the participants to express their opinions freely using their original language.

The interview questions didn't have a specific order; they were randomly asked according to the responses of interviewees making sure to cover all the topics. The questions were asked in a neutral tone of voice to increase the reliability of the obtained data and to avoid bias during the interview. Any nervous impressions or other negative signals were avoided by the interviewer to eliminate bias. The researcher listened carefully to the responses of the interviewee to underpin important thoughts.

Each interview was recorded (with the interviewee's permission), and typed directly after it was done. Additional notes and comments were made by the interviewer after the interview to highlight important responses by the interviewees. Moreover, the interviewer made a summary of the interviewee's explanations after each interview. These summaries allowed the interviewer to avoid biased or incomplete information.

3.6.2.4 Validity and Reliability of Semi-Structured Interviews

Validity and reliability are very important concepts and are considered an essential part of any research methodology in qualitative, quantitative, and mixed studies (Wright & Crimp, 1995; Golafshani, 2003). As mentioned before in this chapter, this research uses mixed methods. Although the concept of validity and reliability in qualitative research have different understanding than in quantitative research, validity and reliability in mixed methods research are evaluated by the quality standards followed in the qualitative and quantitative stages (Teddlie & Tashakkori, 2009). Validity and reliability in social researches have many definitions (Winter, 2000). However, all definitions of validity and reliability generally refer to the representations and generalizations of the research that are made by the researcher. They are about the claims and the interpretations of the research; how true these claims are and how acute these interpretations are (Moisander & Valtonen, 2006).

In qualitative research, there are two types of validity: internal and external (Burke, 1997). It should be mentioned that validity of qualitative studies is different from validity of quantitative studies. To achieve validity in quantitative studies, the researcher should make sure that the measuring instruments he uses are credible (Golafshani, 2003). On the other hand, in qualitative studies, the main measuring instrument is the researcher himself (Patton, 1990). Therefore, validity and reliability of qualitative research are highly dependent on the abilities and skills of the researcher (Golafshani, 2003). Specifically, in semi-structured interviews, validity and reliability depend on the experience of the researcher and his professionalism in conducting the interviews (Byers & Wilcox, 1991).

Internal validity can be observed by the researcher's ability to provide meaningful explanations for the cause-and-effect relationships in the research (Byers & Wilcox, 1991). In qualitative researches, internal validity can be enhanced by accurate sample selection (Winter, 2000). In the semi-structured interviews, the researcher tried to guarantee internal validity by selecting accurate sample; experienced staff and administrative members who are responsible for the quality of HE system and who have at least 15 years of experience in this field. Moreover, the researcher made sure to follow all the standard steps in conducting and analysing the semi-structured interviews. Also the combination of qualitative and quantitative methods in the research helped to enhance the internal validity.

Concerning external validity, it is argued that external validity in qualitative research is represented by generalisation degree of the findings across social settings (Riege, 2003; Bryman, 2015). In this research, external validity was accomplished by comparing the results of the semi-structured interviews with existing literature.

On the other hand, concerning reliability of qualitative research, it is measured by research's ability to generate similar results when other researchers replicate the techniques and procedures used in this research (Winter, 2000). In this research, reliability was achieved by carefully and professionally following specific procedures during the analysis of the semi-structured interviews, including transcription, coding and finding themes and patterns.

Patton (1990) argued that the use of mixed methods, qualitative and quantitative, have the ability to increase the validity and reliability of the research. Similarly, Mathison (1988) argued that using mixed methods is very helpful in establishing valid propositions and avoiding bias. Additionally, using mixed methods is a typical strategy to enhance the validity and reliability of the research and to effectively evaluate the findings (Golafshani, 2003). Therefore, the use of mixed methods in this research played a very important role in producing valid findings.

Lincoln & Guba (1985) suggested another way for evaluating the quality of qualitative research. This way includes four criteria: credibility, transferability, dependability and conformability. Credibility, which is similar to internal validity, can be achieved by undergoing the research process according to the rules of good practice (Teddlie & Tashakkori, 2009). In this research, credibility was achieved by showing the results of the semi-structured interviews to the respondents in order to evaluate their responses. Moreover, the quantitative phase that followed the qualitative phase played an important role in achieving credibility (Guba & Lincoln, 1994; Shenton, 2004).

The next evaluation criterion is transferability and it is similar to external validity. It is represented by the ability of the findings of the research to be applied in other frameworks (Lincoln & Guba, 1985). To achieve transferability in a social research, Geertz (1993) suggested conducting what is called '*thick description*' by describing the context and culture of the research. In this research, transferability is achieved by providing a detailed description of the context and culture in the place where the research conducted. This would help other researchers to make judgments about whether the research is transferable other contexts or not (Shenton, 2004; Bryman & Bell, 2015).

Dependability in qualitative research is also similar to reliability; it is represented by the ability to apply the findings of a research at other times or contexts (Bryman & Bell, 2015). In this research, the researcher tried to achieve dependability by keeping complete records in all phases of the research (Bryman & Bell, 2015). The last evaluation criterion to assess quality of the semi-structured interviews data is conformability. This criterion reflects the ability of the researcher maintained objective values in his research by making sure to exclude his personal views or (Bryman & Bell, 2015). In this research, the researcher used several techniques and procedures to make sure to maintain his objectivity and to avoid ant interfering with the respondents' views and thoughts (Lincoln &Guba, 1985).

3.6.3 Data Analysis in the Qualitative Phase

In the qualitative phase, thematic analysis is used to analyse the data. Braun and Clarke (2006) defined thematic analysis as the "foundational method for qualitative analysis". The purpose of thematic analysis is to search for patterns or themes in a set of data (such as a series of interviews). In thematic analysis, the researcher codes the qualitative data to identify themes related to the research question for further analysis.

One advantage of thematic analysis is its flexibility; it isn't tied to a certain philosophy. Thematic analysis can be used regardless of whether the researcher is adopting objectivism or subjectivism. Also, it can be used in realist or interpretivists studies. Thematic analysis can be used irrespective of the researcher's position because it can be considered as a stand-alone analytical technique, not just a part of a methodological approach. Thematic Analysis may also be used in researches that imply deductive and inductive approaches. It is problematic to use a purely deductive or inductive research because this affects the scope of the analysis. Thematic analysis has the ability to move between both approaches (Saunders et al., 2016). This is very helpful in this research because it adopts a mixed approach (induction followed by deduction).

Thematic Analysis is a systematic, flexible and accessible technique used to analyse qualitative data. It analyses these data in a logical and ordered way. It can be used to analyse large or small qualitative data sets to get to rich explanations, descriptions and theories. The most useful advantage in thematic analysis (which plays an important role in this research) is its ability to identify key patterns in the data for further investigation (Braun and Clarke 2006). The themed analysis procedure followed these steps: transcription; coding; and searching for themes and patterns.

3.6.3.1 Transcription

The researcher became more familiar with the data as he produced transcripts of the interviews. Summaries and self-memos that were generated by the researcher helped to gain initial insights and familiarity with the data. Familiarisation with the data requires a continuous involvement with the data along with the research. The researcher needed to read and re-read the data several times during the analysis. This enabled him to look for

interested themes and patterns. Therefore, familiarity is very important to be able to engage in the analytical procedure (Saunders et al., 2016).

3.6.3.2 Coding

Coding highlights data with the same meanings. The researcher begins by labelling each unit of data within data items (the transcripts of interviews) with a code that summarises its concluded meaning. This makes each piece of data ready for further analysis. Therefore, it is an important tool to manage, rearrange, and retrieve the data during the analysis procedure. The process of coding allows one to link units of data that refer to the same aspect or meaning, so that one can compare and contrast. It allows you to rearrange your original data into groupings for the next stage of analysis (Bryman, 2016).

In interview transcripts, a unit of data can be a word, a number of words, a sentence, a number of sentences, or a complete paragraph. If the researcher finds a unit of data that has a similar meaning to a previously coded unit of data, it is labelled with the same code. If the new unit of data doesn't have a similar meaning to any of the previously coded units, a new code is assigned for it. During the analysis procedure, a list of codes was made to make it easier to categorize and observe the new data. Data saturation is reached when there aren't any new codes gained from the new data (Saunders, 2016).

3.6.3.3 Searching for Themes and Patterns

By investigating the generated codes and comparing between each of them, the researcher managed to see the occurrence (or non-occurrence) of a phenomenon. Furthermore, the relationship between different variables could be understood, in addition to the strengths of these relationships. At the end, the researcher developed a dynamic hypothesis in the form of a causal loop diagram shown in Figure (4.12) which represents a model for the

HE system in Egypt. It contains all the variables that contribute to the quality of HE and also the effects of these variables on each other. The causal model and the variables within it are investigated deeply in Chapter 4.

This conceptual model provides clarifications about the variables that affect the system of HE and how they affect and interact with each other. It shows that a simple change in one variable can cause great changes on the overall quality, which is known as dynamicity, of complex systems such as the HE system. However, this model doesn't provide numeric or exact results. Therefore, the purpose of the second phase is to analyse the model quantitatively.

3.7   Quantitative Phase

The findings of the qualitative phase allowed the researcher to develop dynamic hypotheses in the form of a "causal loop diagram". This causal diagram contains the cause-and-effect relationships between the variables that affect the quality of HE in Egypt. The purpose of the quantitative phase is to test these dynamic hypotheses and to prove its reliability and validity. This is achieved through simulation of these hypotheses using the quantitative data collected in the second phase. The following sections discuss the data collection technique and the data analysis procedure of the quantitative phase.

3.7.1 Data Collection Technique in the Quantitative Phase

The researcher chose to use secondary data for this phase. There are many advantages in using secondary data according to Saunders et al. (2016). A lot of secondary data can be collected from few sources. Also, the secondary data are very suitable for longitudinal studies. They can provide comparative data, thus enabling the generalisation of the research. There are also some disadvantages like the difficult or costly access, the

uncontrollable quality of data, and their different purpose of them. These disadvantages can be overridden by the researcher through his professionalism in accessing and analysing the data. Saunders et al. also stated that the researcher needs to make sure that the secondary data cover the whole population and the time horizon of the research. Therefore, the data will be collected from the whole population in the quantitative phase. As mentioned before, the population of this research is the 24 public universities in Egypt. Annual reports, statistical data, or publications can be used as long as they are available for the whole population.

3.7.1.1 Ethical Considerations

Like the first phase, the Cardiff School of Management Ethics Committee approved the data collection in this phase. **The Ethics Committee Application Reference Number is2015S0064** (See **Appendix B**). The researcher made sure to collect the secondary data from authorised and reliable organisations (original sources).

3.7.1.2 Sources of Secondary Data

Secondary data will be collected from the publications and annual reports issued by the formal organisations in Egypt that are directly related to the HE system and the quality management of HE. Information of the all 24 public universities in Egypt can be obtained from many sources. Some of the sources are open to the public, while others require special permission. The researcher managed to get permission to access these data (See **Appendix B**). The sources are as follows:

- Ministry of Higher Education and Scientific Research (MOHESR).
- The Supreme Council of Universities (SCU).
- The Central Agency for Public Mobilization and Statistics of Egypt (CAPMAS).
- Ministry of Manpower and Immigration (MMI) (Egypt).

- National Authority for Quality Assurance and Accreditation of Education (NAQAAE).

- Quality Assurance Unit (QAU) in Egyptian Public Universities.

These secondary data were published in Arabic and were carefully prepared by specialised persons who have considerable experience in these institutions. As a result, their data are reliable.

3.7.2 Data Analysis in the Quantitative Phase

The researcher could identify the relationships between the variables in the qualitative phase. However, he only managed to see that there are relations between the variables without knowing *how* they affect each other. According to Saunders et al. (2016), the question "How does a variable relate to another variable?" can be answered using quantitative simulation and testing. This procedure is known as hypotheses testing; here the researcher is comparing the data that he collected with his theoretical expectations (the model that simulates the system under investigation). Therefore, professional testing can be very helpful to check the validity of the model.

The second phase (quantitative phase) of the research is using simulation to test the model that was created in the first phase (qualitative phase). This is the more conventional phase of system dynamics. Simulation is implied using software (PowerSim Studio 10 Academic). It has the ability to represent all the variables and connect them together (thus representing the relationships between them). This feature enables the researcher to study the change of variables over time. The variables, their units, and their values are identified in the software as well as the equations that represent the relationships between each two variables. In Chapter 5, the process of simulation and testing of the model is presented.

After the creation of the model and testing it, the final step in the research is to use the validated model to predict the behaviour and to develop policies for improvement of the system of HE in Egypt. Different scenarios are fed to the model and the results are investigated to find out which variables are the most effective. Consequently, actions could be applied to these variables to effectively control the system and change it for the better. This will be presented in the recommendations in Chapter 6.

3.8   Summary

The researcher adopts the pragmatism philosophy, using a mixture of perspectives and ideas such as merging different philosophical positions (interpretivism and positivism). Both inductive and deductive approaches are used regarding both objective and subjective points of view.

Sequential exploratory mixed methods research was undertaken, which uses both qualitative and quantitative methods in a sequential procedure to achieve the research objectives. The qualitative phase (the first phase of the research) was to conducted semi-structured interviews to identify the variables that affect the HE system and to create a model. A judgmental sample was used, and 24 interviews were conducted with experienced academic and administrative members who are responsible for quality management in four public universities in Egypt. These interviews were transcribed, then coded, and finally analysed by the researcher following the procedure of thematic analysis. The findings of the first phase enabled the researcher to create a causal model that represents the HE system in Egypt. The qualitative phase is discussed further in Chapter 4.

In the quantitative phase (second phase of this research), secondary data was fed to a simulation software (PowerSim Studio 10 Academic) to simulate the model for testing and validation. The quantitative phase will be discussed further in Chapter 5. After the validation, the model will be used for future predictions of the system and to develop improvement policies and actions, which will be discussed in Chapter 6. Table (3.3) summarises the two phases that will be more discussed in the next chapters.

Table 3-3: The Summery of the Two Phases of the Research

Research Method	System Dynamics	
	Qualitative	**Quantitative**
Goals	• To identify the stakeholders' views regarding structural changes in university management • To identify the factors that affect the system of HE • To create a system dynamics model	• To test and validate the model • To find out the dominant variables • To investigate different scenarios • To develop decisions and actions to improve the HE system in Egypt
Time Horizon	5 Academic years (2012/2013 – 2016/2017)	
Data Collection	Semi-Structured Interviews	Secondary Data
Collection Time	Four Weeks	Four Weeks
Sample	Judgmental	Census
Data Analysis	Thematic Analysis	Simulation (PowerSim)

Chapter Four: Qualitative Phase

4.1 Qualitative Data Analysis & Results

4.1.1 Semi-Structured Interviews: Descriptive Analysis

4.1.2 Semi-Structured Interviews: Detailed Analysis

4.1.2.1 Key Area One: General knowledge about the dimensions of HE

4.1.2.2 Key Area Two: Identifying the factors of quality of HE in Egypt

4.1.2.2.1 Key Variable One: Quality of Staff

4.1.2.2.2 Key Variable Two: Quality of Teaching

4.1.2.2.3 Key Variable Three: Quality of Research

4.1.2.2.4 Key Variable Four: Quality of Curriculum

4.1.2.2.5 Key Variable Five: Quality of Resources

4.1.2.2.6 Key Variable Six: Quality of Facilities

4.1.2.2.7 Key Variable Seven: Quality of Internship

4.2 Conceptualisation Stage

4.2.1 Model Purpose

4.2.2 Model Assumptions

4.2.3 Model Boundary "Key Variables"

4.2.4 Causal Loop Diagram

4.3 Formulation Stage

4.3.1 Variables Formulation

4.3.2 Units of Measurement

4.3.3 Stock-and-Flow Diagram

4.3.3.1 Quality of Curriculum

4.3.3.2 Quality of Internship

4.3.3.3 Quality of facilities, resources and research

4.3.3.4 Quality of staff

4.3.3.5 Quality of teaching

4.3.3.6 Quality of services provided by universities

4.4 Summary

CHAPTER 4
QUALITATIVE PHASE
CONCEPTUALISATION & FORMULATION

As mentioned before in Chapter 3, System Dynamics is used as a method in this thesis. It involves the use of two consecutive phases; the qualitative phase followed by the quantitative phase. This chapter deals with the qualitative phase of the study. Section [4.1] shows the qualitative data analysis and results, starting by the analysis procedures of the semi-structured interviews. The findings from this qualitative analysis are used in the process of model conceptualisation and this is shown in Section [4.2]. In Section [4.3], the process of model formulation is carried out before moving to the quantitative phase of the study in Chapter 5. Finally, the chapter is summarised in Section [4.4].

4.1 Qualitative Data Analysis & Results

In this phase, semi-structured interviews were conducted to identify the key variables and sub-variables of the HE system in Egypt and to investigate the relationships between these variables to understand their impact on the quality of the HE system. This influences the compatibility between the skills of university graduates and those required by labour market. The first section analyses the interviewees and their characteristics; this will help to understand their way of thinking and their experience. The second section deals with the analysis of their discussion and their thoughts that were obtained during the interviews.

4.1.1 Semi-structured Interviews: Descriptive Analysis

Twenty-four semi-structured interviews were conducted. The participants involved in these interviews were selected judgementally on the basis of each of them having more than 15 years of experience in the field of quality in the HE system in Egypt. Therefore, the researcher chose the participants from the quality assurance units in the four public universities; Cairo University, Ain-Shams University, Alexandria University and El-Mansoura University. These four universities were chosen for many reasons as mentioned before in Chapter 3, section 3.6.1.

The participants have different socio-demographic characteristics (gender, experience, job title and occupation). After conducting all the interviews, the different characteristics of the participants were investigated, as shown in Table (4.1).

As illustrated in the table, 75% of the participants were males, while 25% were females. This indicates that the males are three times the females. The experience of the participants varied between 15 years to more than 30 with 50% of the participants having between 21 and 25 years' experience. It has been found that the minimum experience among the members of quality assurance units is 15 years, which is equal to the minimum experience set by the researcher (15 years). This is because the members of the quality assurance units are chosen carefully making sure they are highly experienced.

Table 4-1: Socio-Demographic Characteristics of Respondents

Demographic Description	Number	%
Gender		
• Male	18	75 %
• Female	6	25 %
Experience		
• 15 to 20	6	25 %
• 21 to 25	12	50 %
• 26 to 30	4	17 %
• Above 30	2	8 %
Job Title		
• (Dean) Chairman of Quality Assurance Unit (QAU)	2	8 %
• CEO of QAU	4	17 %
• Vice CEO of QAU	4	17 %
• Official of strategic planning and development in QAU	4	17 %
• Official of training committee in QAU	3	12 %
• Official of measurements in QAU	4	17 %
• Official of self-resources development committee in QAU	2	8 %
• Official of awareness and publishing in QAU	1	4 %
Occupation		
• Academic staff member	16	67 %
• Administrative staff member	8	33 %

The job title of the participants differed, though all deal with quality assurance issues inside the university. The largest percentage of job title type was 17% (4 participants) for each of the following titles; CEO of QAU, vice-CEO of QAU, official of strategic

planning and development in QAU, and official of measurements in QAU. There were

also 3 participants working as officials of the training committee in QAU (with a

percentage of 12 %). After that, there was a percentage of 8% (2 participants) for each

of the titles: chairman of QAU and official of self-resources development committee in

QAU. Finally, the least percentage was 4% (one participant) for the job title: official of

awareness and publishing in QAU. As mentioned before in Chapter 3, 67% of the

participants are academic staff members while 33 % represents the administrative staff

members.

4.1.2 Semi-structured Interviews: Detailed Analysis

Twenty-four academic and administrative members participated in the semi-structured

interviews. After the researcher collected the descriptive data about the participant, the

detailed discussion of the interview consisted of two key sections. The first section

included questions about general knowledge about the dimensions of the Egyptian HE

system contributing to the skills gap between the skills of graduates and the requirements

of the labour market. Also, the first section aimed at knowing the extent of compatibility

of the outputs of the Egyptian HE system with the requirements of the labour market;

whether the graduates are qualified enough or not.

The second section investigates more details about the quality of the Egyptian HE system.

The aim of this section is to determine the key factors and sub-factors that affect the

quality of the Egyptian public HE system. Moreover, this section studies the relationships

between these factors which affect the quality and affect each other as well; with the aim

of using them to develop a SD model that represents the real Egyptian HE system.

The quotes used in this section are attributed anonymously to the respondents. The respondents were divided into two groups according to occupation; academic and administrative. According to this, the first group will be from Academic participant 1 to Academic participant 16, while the second group will be from Administrative participant 1 to Administrative participant 8.

4.1.2.1 Key Section One: General Knowledge about the dimensions of the Egyptian HE System

The researcher started the discussion with the participants by asking them general and personal questions about their universities, their current position, their years of experience in the academic field, their current scientific degree, etc. The aim of this introductory part was to investigate the background, knowledge, and experience of the participants and making sure they are compatible with the research topic. Furthermore, this introductory section prepared them to have more attention towards the research topic, and to make them ready for the discussion on the key research focus areas. It has been found that, based on the backgrounds of the participants, all of them were familiar with the characteristics and quality dimensions of the Egyptian HE system.

Through the discussion, it was noted that the selection procedure of the participants, based on the criteria mentioned in Chapter 3 in page 105 according to the homogenous judgmental sampling technique, was successful in choosing participants who are very experienced and familiar with the quality of the Egyptian HE system and its dimensions.

From the analysis, all participants work in the quality assurance units in their universities. The quality assurance units are responsible for the quality of the Egyptian HE system. Where, most of them (67% of participants) are academic staff members, and the remaining of them (33% of participants) are administrative staff members. Moreover, all of them (100% of participants) have more than 15 years of experience in the field of the quality of the Egyptian HE system, see Table (4.1). Also, all of them (100% of participants) participated in preparing and articulating the organisational structure of their universities, at least once in their career.

One aim of the introductory questions is to break the ice between the researcher and the participants, and to encourage them to speak freely about all the main dimensions of the Egyptian HE system; contributing to the skills gap. Also, to speak about the compatibility level between the skills of graduates and the requirements of the labour market. Where, the analysis of the answers to these questions showed that there are two types of main dimensions in the Egyptian HE system contributing the skills gap, as shown in Figure (4.1). The first type include dimensions that are directly related to the HE system itself (internal dimensions) which are: roles and purposed of HE, HE system, and quality of HE. The second type include dimensions that are related to the labour market (external dimensions) which are: unemployment, high labour supply, and the gap between skills of graduates and the requirements of the labour market. These dimensions were explored in detail in Chapter 2.
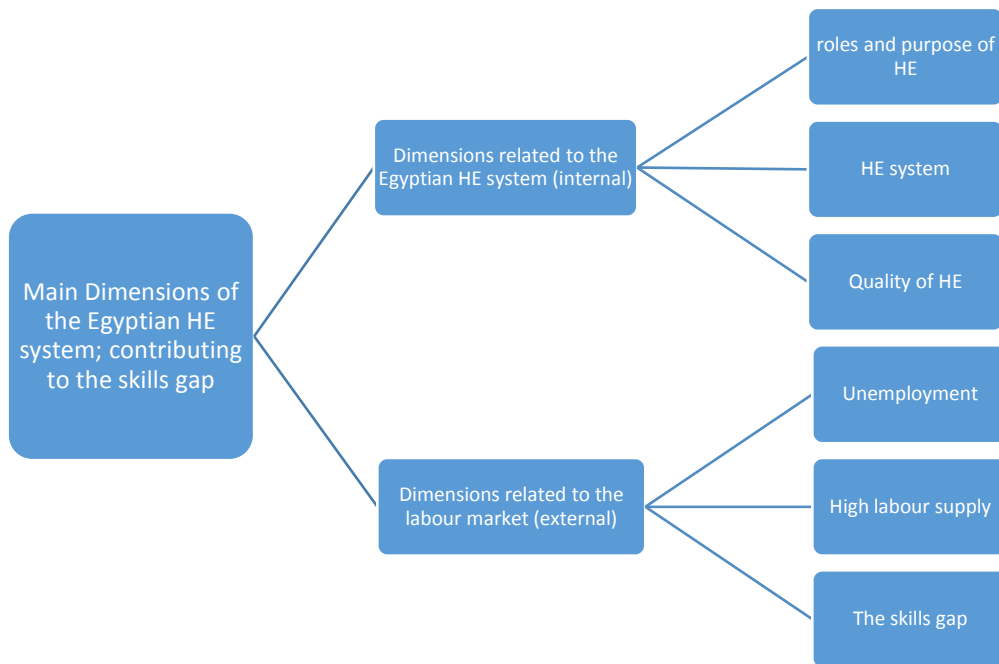
Figure 4-1: Dimensions of the Egyptian HE system (Source: this research)

It was very important for the researcher to explore the dimensions of the real Egyptian public HE system which affect the quality of HE and its outcomes and, consequently, affect the compatibility between the skills of graduates and the requirements of the labour market. Where, all participants agreed that these dimensions related to the research problem are divided into two main types. The first type is related to the Egyptian HE system itself (internal dimensions), while the other type is related to the labour market and its requirements. They also agreed that the incompatibility between the skills of graduates and the requirements of the labour market resulted from the differences between the two types of dimensions.

The initial questions were as follows:

- Are graduates of the Egyptian public universities qualified to work directly in the labour market?
- Are graduates' skills consistent with the skills needed by the labour market?

- Is there a skills gap between skills of Egyptian public universities graduates and the skills needed by the labour market?

All the participants (24 out of 24) agreed that the graduates of the Egyptian public universities were not qualified enough to work directly after graduation in the labour market. This is because their skills were not consistent with the skills needed by the labour market. Therefore, there was a gap in skills between the Egyptian public university graduates and those needed by the labour market. Where, one participant stated that *"Egyptian public universities do not qualify the graduates to directly work in the labour market; because there is no coordination between the universities and the labour market".* **(Academic Participant 3)**. Another participant said *"No, they aren't. Most of the graduates are not qualified enough to work in the labour market without further training".* **(Academic Participant 1)**.

As for the compatibility between skills of graduates and skills required by the labour market, a participant stated that *"Unfortunately, the skills of public universities' graduates are not compatible with the new skills needed by the labour market".* **(Administrative Participant 1).** Another explained that *"There is a mismatch between skills of graduates and labour market requirements; which lead to the existence of the skills gap"* **(Academic Participant 9)**. Furthermore, another participant added a comment that *"There is a big difference between the skills of graduates and the skills needed by the labour market"* **(Academic Participant 15)**. Another participant added *"It is obvious that there is a skills gap between the skills that the graduates have and the skills that the market requires"* **(Academic Participant 4).**

To summarise, the discussion of the first section was useful for the research in confirming and supporting the research problem and the importance of studying this problem. Also, in identifying the main dimensions of this problem. Moreover, the valuable information that the researcher obtained as well as the enthusiasm of the participants and their willingness for answering the questions, all these facts assure the suitability of the participants and their ability to be informative and insightful on the research topic. The obvious agreement between most of the participants in answering the questions confirms the importance of the research problem and the usefulness of investigating this problem. However, this research will focus the dimensions related to the Egyptian public HE system (internal dimensions) which lead to the existence of the skills gap. The researcher advices other researchers to study the dimensions related to the labour market (external dimensions) in the future.

4.1.2.2 Key Section two: Identifying the factors that affect the quality of the Egyptian HE system

In the second area of the discussion, the researcher aimed at identifying the factors that affect the quality of the Egyptian HE system. Through asking a series of open-ended questions as shown in the interview guide in **Appendix A**. The purpose of these open-ended questions is to identify the key variables and sub-variables and the relationships between them. These questions also help to investigate how these variables and sub-variables affect the quality of the Egyptian HE system and, consequently, affect the skills gap.

By analysing the answers for these questions, all participants agreed that the main cause for this skills gap was the low quality of the Egyptian HE system; this was represented by the services provided by universities to the students, which then affected the skills of graduates. They also confirmed that increasing the quality of the HE system components could increase the compatibility between skills of graduates and requirements of the labour market; consequently, this could bridge the skills gap.

The participants stated that *"The low level of the quality of the Egyptian HE system, which is apparent in the poor services that the universities provide to students, leads to lowering the skills of graduates and causes the skills gap"* **(Administrative Participant 7).** *"The low quality of the Egyptian HE system would lead to decreasing the level of the services that universities offers to the graduates, which lead to decreasing their skills, as a consequent, their skills will not be compatible with the requirements of the labour market and the skills gap arises."* **(Academic Participant 4).** "This skills gap can be bridged through improving the quality of the Egyptian HE system in a way that enhances the skills of graduates and increases the compatibility between these skills and requirements of the labour market" **(Administrative participant 3).**

By analysing the insights and opinions of the participants, the researcher managed to determine the key factors and sub-factors that affect the quality of the Egyptian public HE system. As mentioned before in Chapter 3 section 3.6.3, the participants' responses were analysed using thematic analysis. The analysis involved transcription and coding of the interviews. A sample interview transcript is provided in **Appendix C**.

Similar themes and quotes were collected together and they were coded into groups to make it easier to investigate and discuss the responses of the interviewees. After coding the interviews' transcripts, the researcher managed to categorise the variables into levels: main variables, key variables, sub-variables, and sub-sub-variables. The method of coding the interviews' transcript is shown in **Appendix D**.

Then, the researcher investigated the relationships between the variables in different levels, and also between the variables in the same level. The participants argued that the quality of HE system was affected by seven main variables: Quality of staff, Quality of teaching, Quality of teaching, Quality of research, Quality of curriculum, Quality of resources, Quality of facilities, and Quality of internship. Each of these key variables is affected by a number of sub-variables and sub-sub-variables, see Figure (4.12). These variables will be discussed in details in the following part.

4.1.2.2.1 Key variable one: Quality of Staff

All participants stressed the importance of the staff and their role in the educational process. All of them agreed that the quality of staff was a pivotal link that directly affected the quality of the HE system. Where, all of the participants (24 out of 24) agreed that the quality of staff is one of the key variables that affect the quality of the Egyptian HE system. The importance of this key variable is supported by the following quotes:

"The quality of staff members is one of the main factors that directly affect the quality of HE". ***(Academic Participant 1).*** *"There are many factors that affect the quality of Egyptian HE system but I believe that the most important factor is the quality of the staff".* ***(Administrative Participant 8).***

Through further discussion, the researcher managed to identify four sub-variables that affect the quality of staff, which are: staff qualification, staff experience, staff motivation, and staff competence. These sub-variables are discussed in the following:

Staff Qualification

Most of participants agreed that the staff qualification is one of the essential variables that affect quality of staff. Where, most of participants (22 out of 24) agreed that the most affecting variable in determining quality of staff, is staff qualification. One participant stated that "Staff qualification has a direct effect on the quality of staff" (Academic Participant 2). Another participant added: "Staff qualification is a strong indication for the quality of staff" (Administrative Participant 5).

The researcher also identified an important sub-sub-variable which affect the staff qualification, which is staff training. Where, most participants (21 out of 22) agreed that staff qualification is dependent of the staff training. *"I think that the qualification of the staff members depends on their training". (Administrative participant 1). "The more training the staff member gets, the higher his qualifications will be". (Academic Participant 11).*

Staff Experience

From analysis of the discussion of interviews, most of participants (21 out of 24) agreed that the staff experience is considered an important sub-variable that impacts quality of staff. Participants supported this by: *"Staff experience is one of the main variables affecting the quality of staff" (Academic Participant 6). "Experience of the staff member is, with no doubt, one of the factors that shapes his quality" (Academic Participant 2).*

The participants' responses helped the researcher in determining some important sub-sub-variable affecting the staff experience, which are: the number of curriculums prepared, the number of curriculums reviewed, the number of teaching years, and the number of research publications. Most participants (20 out of 21) stated that the number of curriculums prepared by a staff member affects his experience. While, others (17 out of 21) agreed that the staff experience is also dependent of the number of curriculums reviewed by the staff member. All of them (21 of 21) informed that the number of teaching years definitely affects staff experience. The majority (19 of 21) also agreed that the number of research publications also affects the staff experience.

This is supported by the following quotes: *"The more curriculums prepared and curriculums reviewed by the staff member, the higher his experience will get. Also, the experience depends on the number of teaching years and the number of researches published by the staff member".* **(Academic Participant 1).** *"Staff experience depends on many factors such as: the teaching years, the number of prepared curriculums, and number of researches publications".* **(Administrative Participant 4).** *" "The number publications by the staff member affects his experience as well as his teaching years".* **(Administrative Participant 4)**

Staff Motivation

The researcher analysed the discussion of the interviews, and found that most of participants (16 of 24) mentioned staff motivation as a sub-variable that affects quality of staff. One participant said: "If the staff members are well-motivated, their quality will improve" (Administrative Participant 3). Other participant expressed: "Staff motivation has a significant effect on the quality of staff, which reflects back on staff performance" (Academic Participant 12).

The researcher enabled, through analysing the interview outputs, to determine a number of sub-sub-variables that affect the staff motivation. These sub-variables are: salaries and incentives, staff appraisals, student performance, and university reputation. Most participants (15 out of 16) mentioned the salaries and incentives as factors that affect the staff motivation. While, lower number (14 out of 16) agreed that the staff appraisals is also affecting staff motivation. All of them (16 of 16) stated that student performance affects staff motivation. The lowest number of participants (13 out of 16) stated that university reputation affects staff motivation. This is apparent in the following quotes:

"The motivation of the staff members is highly affected by their salaries and incentives. It is also affected by their appraisals, the students' performance and the reputation of the university". (Academic Participant 7). *"The staff motivation depends on many factors, such as: salaries and incentives of course, student performance, and staff appraisals". (Administrative Participant 5).* *"Salaries and incentives are the main factor that affect the staff motivation. After that there are other factors such as the university reputation and the student performance" (Academic Participant 16).*

Staff Competence

It has been found that staff competence is also one of the main four sub-variables that affect quality of staff. This was supported by many participants (19 out of 24). One participant confirmed by saying *"Staff competence has a strong impact on quality of staff" (Administrative Participant 3).* *"Quality of staff also depends on an important factor, which is staff competence" (Academic Participant 11).*

After identifying the sub-variables, the researcher discovered the sub-sub-variables that affect the staff competence, which are: Staff performance, staff appraisals, and number of research publications. Where, all participants (19 out of 19) agreed that staff competence is highly dependent of staff performance. Less portion (16 of 19) agreed that staff appraisals affect the staff competence. While, the effect of number of research publications on staff competence is supported by some participants (12 of 19).

Some quotes supporting this include: *"Competence of the staff member is determined by several factors such as: his performance, his appraisals and the number of researches he publishes"* **(Administrative Participant 7).** *"I think that the staff competence highly depends on their performance and appraisals"* **(Administrative participant 1)**. *"The staff competence can be measured by the staff performance, and also by the number of research publications"* **(Academic Participant 13).** Figure (4.2) Shows the sub-variables and the sub-sub-variables that affected the key variable *"Quality of staff"*.

Figure 4-2: Sub-variables That Affect the Key Variable "Quality of Staff"

(Source: this research)

4.1.2.2.2 Key Variable Two: Quality of Teaching

All of the participants (24 out of 24) indicated that the quality of teaching is considered one of the key variables that affect the quality of HE system. This fact is supported by the following quotes:

"The effect of the quality of teaching isn't less important than the effect of the quality of staff on the quality of HE system" **(Academic Participant 10)***.* "*The quality of teaching have a direct effect on the quality of HE system*" **(Administrative participant 2)***.* *"The quality of staff affects the quality of HE system through the quality of teaching, which mean that the quality of teaching affects the quality of HE system too"* **(Administrative participant 5).** *"The quality of staff affects the quality of teaching, and the quality of teaching affects the quality of HE system"* **(academic participant 8).**

Through the discussions, and from the participants points of view, the researcher determined three sub-variables that affects the quality of teaching; *quality of staff*, *quality of curriculum* and *average class size*. These are discussed in the following part:

Quality of staff (as a sub-variable affect quality of teaching)

All of participants (24 out of 24) agreed that the quality of staff is considered one of the essential sub-variables that affect quality of teaching. Where, one of them stated that *"quality of staff has a direct effect on the quality of teaching"* **(Academic Participant 2).** Another participant added *"quality of staff is a strong indication for the quality of teaching"* **(Administrative Participant 8).** One participant mentioned *"the quality of staff and the quality of teaching cannot be separated"* **(academic participant 14).** One participant added *"the quality of staff and the quality of curriculum cannot be separated when we are talking about the quality of teaching"* **(Administrative Participant 6).**

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Quality of curriculum (as a sub-variable affect quality of teaching)

Most of participants (23 out of 24) stated that the quality of curriculum is considered one of the important sub-variables that affect quality of teaching. Where, one of participants stated that *"quality of curriculum has a big effect on the quality of teaching"* ***(Academic Participant 11).*** Another participant added *"quality of staff and the quality of curriculum are considered to be the two main pillars of the quality of teaching"* ***(academic participant 7).*** One participant mentioned *"the quality of staff and the quality of curriculum cannot be separated considering the quality of teaching"* ***(Administrative Participant 6).***

Average class size

Most of participants (21 out of 24) commented that the average class size is considered one of the sub-variables that affect quality of teaching. Where, one participant said *"average class size has an effect on the quality of teaching"* ***(Academic Participant 4).*** Another participant commented that *"The average class size is considered one of the problems facing the Egyptian HE in a way that affects the quality of teaching"* ***(academic participant 13).*** One participant mentioned *"the average class size is considered one of the important variables that affect the quality of teaching"* ***(Administrative Participant 1).***

From the discussions, the participants stated that the average class size depends on two variables; *the number of classes* and *the total number of students*. Where, all of them (21 out of 21) confirmed that average class size can be measured by using these two main variables. And these two variables are considered the sub-sub-variables that affect *quality of teaching* as the key variable that sequentially affect the quality of the Egyptian HE system.

Some quotes supporting this fact: *"The average class size can be measured by dividing the total number of students by the number of classes"* **(Administrative Participant 2).** *"I think that the average class size can be determined only by using the two variables; the total number of students and the number of classes"* **(Academic participant 9).** *"When dividing the total number of students by the number of classes we get the average class size"* **(Academic Participant 3).**

Figure (4.3) Shows the sub-variables and the sub-sub-variables that affected the key variable *"Quality of teaching"*.

Figure 4-3: Sub-variables That Affect the Key Variable "Quality of Teaching"

(Source: this research)

4.1.2.2.3 Key Variable Three: Quality of Research

All of the participants (24 out of 24) agreed that the quality of research is considered one of the key variables that affect the quality of HE system. The following quotes supports this fact:

"The quality of research represents one of the important key variables that affect the quality of HE system in Egypt" *(Academic Participant 8)*. "The quality of HE system is affected by important several key variables. One of them is the quality of research" *(Administrative participant 3)*. "The quality of research is considered one of the indicators of the quality of HE system in Egypt" *(Administrative participant 4)*. "The quality of Egyptian HE system is affected by the quality of scientific research" (*academic participant 16).*

Through the discussions, the researcher determined three sub-variables affecting the quality of research; number of research publications, allocated research budget and quality of staff. These sub-variables are discussed in the following:

Number of research publications

More than half of participants (16 out of 24) agreed that the number of research publications represents one of the sub-variables that affect quality of research. Where, one participant stated that "Number of research publications has a major effect on the quality of research" (Academic Participant 12). Another participant commented that "Number of research publications is considered one of the sub-variables that affect the quality of research" (academic participant 13). One participant mentioned "The number of research publications is considered one of the important sub-variables that affect the quality of research" (Administrative Participant 6).

Allocated research budget

All of participants (24 out of 24) stated that the allocated research budget is considered one of the important sub-variables that affect quality of research. Where, one of the participants said that *"Allocated research budget has a direct and major effect on the*

quality of research, where, if the allocated research budget increase, the quality of research will increase too" **(Administrative Participant 2).** Another participant added *"Allocated research budget is considered one of the sub-variables that significantly affect the quality of research"* **(academic participant 10).** One participant mentioned *"The quality of research is affected by allocated research budget"* **(Administrative Participant 5).** Other one said *"If the allocated research budget is increased, quality of research is increased as well"* **(Academic Participant 13)**. And another one commented *"Increasing the research budget gives the ability to publish more researches which, in return, increases the quality of research"* **(Academic Participant 1)**.

Quality of staff (as a sub-variable affect quality of research)

Most of participants (20 out of 24) stated that the quality of research is affected by the quality of staff as a sub-variable. Where, one of the participants commented *"Quality of staff has a direct effect on the quality of research"* **(Academic Participant 9).** Another participant stated that *"Quality of staff is considered one of the sub-variables that affect the quality of research"* **(academic participant 15).** One participant agreed that *"The quality of research is affected by an important sub-variable, which is quality of staff"* **(Administrative Participant 8).**

Figure (4.4) Shows the sub-variables that affect the key variable *"Quality of research"*.
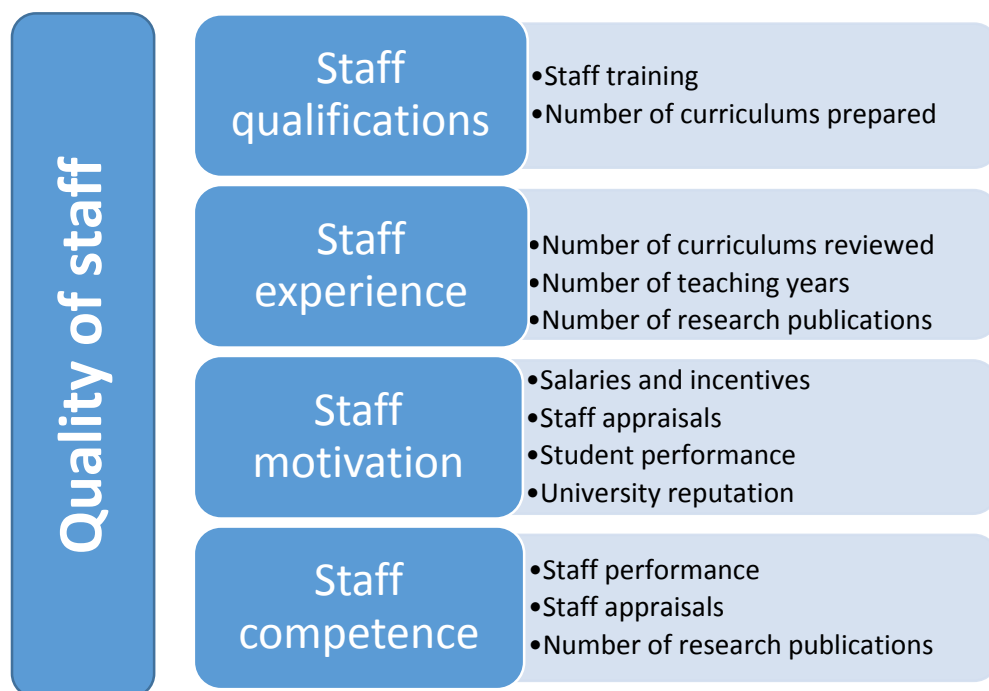
Figure 4-4: Sub-variables That Affect the Key Variable "Quality of Research"

(Source: this research)

4.1.2.2.4 Key Variable four: Quality of Curriculum

All the participants (24 out of 24) indicated that the quality of curriculum is considered one of the key variables that affect the quality of HE system. This fact is supported by using the following quotes:

"*The quality of Egyptian HE system is affected by many key variables, one of these variables is the quality of curriculum*" **(Academic Participant 13).** "*The quality of curriculum is considered one of the indicators of the quality of HE system in Egypt*" **(Administrative participant 1).** "*The quality of HE system is affected by important several key variables one of them is the quality of curriculum*" **(Administrative participant 5).** "*One of the critical key variables that affect the quality of Egyptian HE system is the quality of curriculum*" **(academic participant 16).**

From the discussions, the researcher identified three sub-variables that affects the quality of curriculum. These sub-variables are: *rate of curriculum review*, *quality of curriculum design* and *quality of staff*. These sub-variables are discussed as follows:

Rate of curriculum review

All of participants (24 out of 24) agreed that rate of curriculum review affects the quality of curriculum. Where, one of the participants expressed his opinion by using the following words *"If the rate of curriculum review increased, this consequently would lead to an increase the quality of curriculum"* **(Academic Participant 4).** Another participant stated that *"Rate of curriculum review is considered one of the sub-variables that affect the Quality of curriculum"* **(academic participant 11).** One participant said *"There is a direct relation between the rate of curriculum review and the quality of curriculum, where, any increase in the rate of curriculum review will lead to increase the quality of curriculum"* **(Administrative Participant 2).**

Quality of curriculum design

The discussions showed that all of participants (24 out of 24) agreed that the quality of curriculum is affected by an important sub-variable, which is Quality of curriculum design. Where, one of the participants stated that *"There is a positive relationship between quality of curriculum design and quality of curriculum"* **(Academic Participant 7).** Another participant mentioned *"improving the quality of curriculum design will lead to improve the quality of curriculum"* **(academic participant 5).** One participant said *"we can improve the quality of curriculum through improving the quality of design of these curriculum"* **(Administrative Participant 4).**

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Quality of staff (as a sub-variable affect quality of curriculum)

All of participants (24 out of 24) agreed that the quality of staff as a sub-variable affected the quality of curriculum. Where, one participant indicated that *"Quality of curriculum is affected by the quality of staff, who are responsible for designing and reviewing these curricula"* **(Academic Participant 12).** Another participant stated that *"The academic staff member is the one who prepares the curriculum and, therefore, he directly affects the quality of these curriculum"* **(Administrative participant 3).** One participant agreed that *"The quality of curriculum is affected by a major sub-variable, which is quality of staff"* **(Administrative Participant 4).**

Figure (4.5) Shows the sub-variables that affect the key variable *"Quality of curriculum"*.
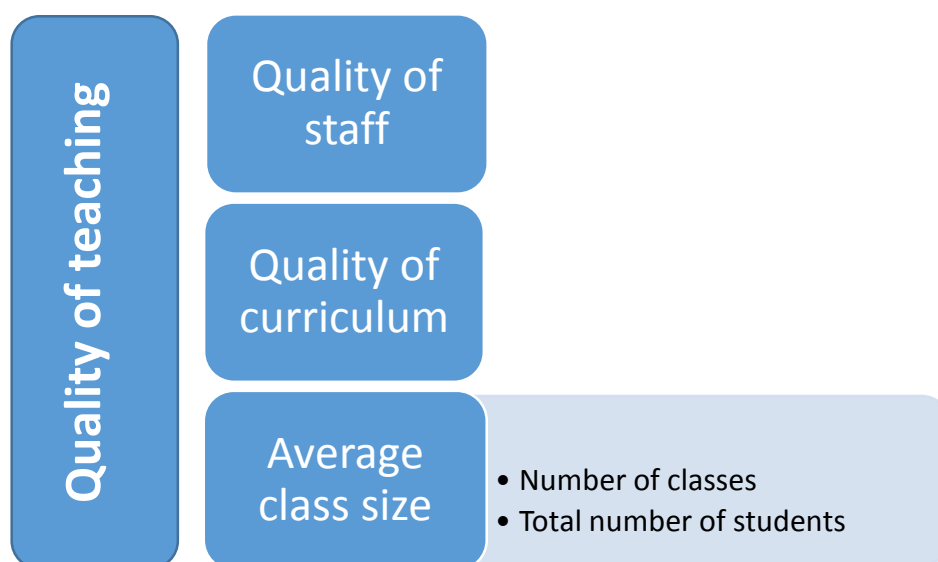

Figure 4-5: Sub-variables That Affect the Key Variable "Quality of Curriculum"

(Source: this research)

4.1.2.2.5 Key Variable Five: Quality of Resources

From the interviews and their discussions, the researcher found that most of the participants (20 out of 24) stated that the quality of resources represents one of the key variables that affect the quality of HE system. This will be shown in the following quotes:

"*The quality of resources is considered one of the important key variables that affect the quality of Egyptian HE system*" *(Academic Participant 7).* "The *quality of resources is considered one of the indicators that indicate the quality of the HE system in Egypt"* *(Administrative participant 4).* *"The importance of the quality of resources in influencing the quality of the Egyptian higher education system is no less important than the impact of the other variables"* *(Academic participant 13).* *"One of the critical key variables that affect the quality of Egyptian HE system is the quality of resources"* *(academic participant 16).*

From the discussions, the researcher identified two sub-variables that affects the quality of resources. These sub-variables are: *Allocated resources budget* and *desired resources budget*. Where, most of the participants explained this relationship as follows: If we can achieve a match between the desired resources budget and the allocated resources budget, then the quality of Egyptian universities' resources can be significantly increase. These sub-variables are discussed below:

Allocated Resources Budget

The discussions showed that all of participants (20 out of 20) agreed that the quality of resources is highly affected by the allocated resources budget. Where, one of the participants mentioned that *"The allocated resources budget has a 100% effect on the*

quality of resources" (Academic Participant 1). Another opinion was *"There is a positive relationship between the allocated resources budget and the quality of resources" (Administrative participant 3).* Other participant said *"Increasing the allocated resources budget will lead to a high increase in the quality of resources" (Academic Participant 5).*

Desired Resources Budget

It has been concluded from the discussions that more than half of participants (12 out of 20) agreed the idea that the desired resources budget has an effect on the quality of resources. This is apparent in the following opinions of participants: *"The desired resources budget affects the quality of resources. This is a big problem in Egypt, because the allocated resources budget is always very lower than the desired" (Administrative Participant 6). "There is a negative relationship between the desired resources budget and the quality of resources" (Academic participant 13). "We can increase the quality of resources, if the desired resources budget can be covered" (Academic Participant 9).*

From the discussions, the participants argued that the desired resources budget depends on another variable; *demand of resources*. Where, most of them (9 out of 12) confirmed that the desired resources budget can be determined by the sub-sub-variable: demand of resources. The following quotes supports this relationship: *"The desired resources budget can be accurately determined by capturing the demand of resources" (Academic participant 7). "The demand of resources in the HE institutions determines the amount of desired resources budget" (Academic Participant 3).*

Figure (4.6) shows the sub-variables that affect the key variable *"Quality of resources"*.
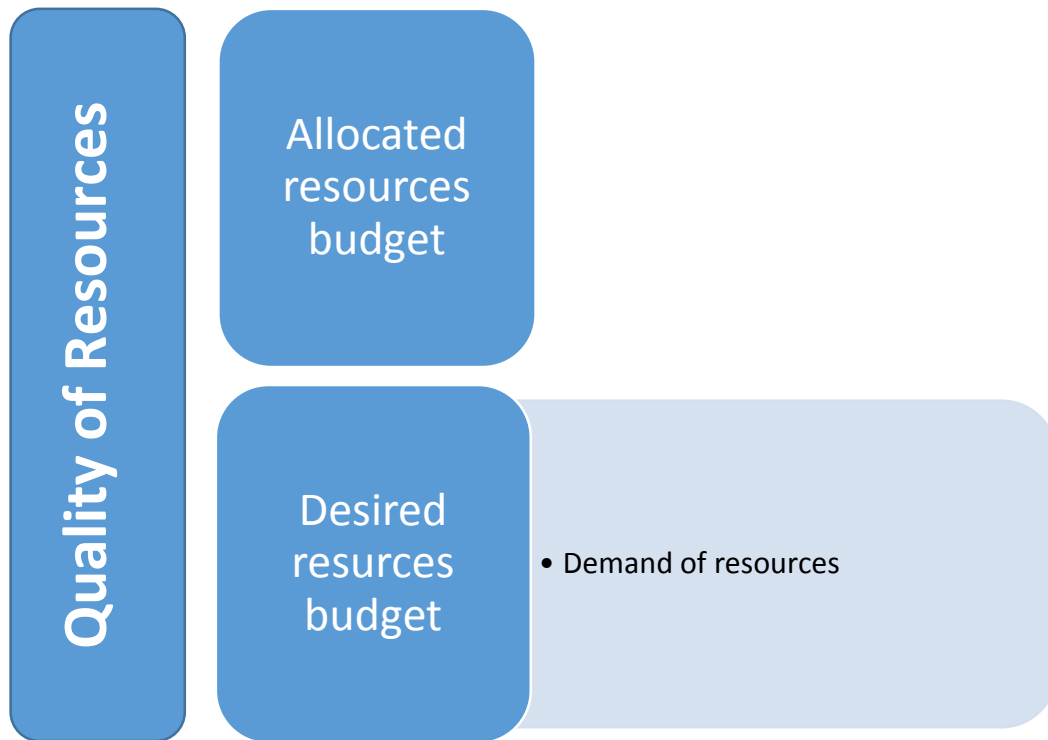
Figure 4-6: Sub-variables That Affect the Key Variable "Quality of Resources"

(Source: This research)

4.1.2.2.6 Key Variable Six: Quality of Facilities

From the interviews' discussions, it has been found that most of the participants (18 out of 24) stated that the quality of facilities is one of the key variables affecting the quality of HE system. This is supported by the following quotes:

"Quality of the Egyptian HE system is affected by an important key variable, which is quality of facilities" **(Academic Participant 5).** "Quality of facilities has a very important effect on the quality of the HE system in Egypt*" (Administrative participant 7). "The quality of facilities is no less important than the quality of resources, concerning increasing the quality of HE system"* **(Academic participant 16).**

The researcher found that, from the discussions, two sub-variables that affect the quality of facilities, which are: *Allocated facilities budget* and *desired facilities budget*. If we can decrease the difference between these sub-variables, as much as possible, then the quality of facilities will increase. These sub-variables are discussed below:

Allocated Facilities Budget

The discussions concluded that all of participants (18 out of 18) supported that the quality of facilities is affected by the allocated facilities budget. The participants' opinions include *"The quality of facilities is totally affected by the allocated facilities budget"* **(Administrative Participant 2).** *"The relationship between the allocated facilities budget and the quality of facilities is direct and in the same direction"* **(Academic participant 11).** *"Any increase in the allocated facilities budget would lead to an increase in the quality of facilities"* **(Academic Participant 2).**

Desired Facilities Budget

The discussions also showed that most of participants (14 out of 18) stated that the desired facilities budget has is another sub-variable that affects the quality of facilities. Where, one participant mentioned: *"The desired facilities budget has a high and direct effect on the quality of facilities"* **(Administrative Participant 6).** *"One of the sub-variables that affect the quality of facilities is the desired facilities budget"* **(Academic participant 13).** *"It is obvious that, when the desired facilities budget is high, it would be difficult to achieve the required level of quality of facilities"* **(Academic Participant 9).**

From the interviews, the researcher found that there is a sub-sub-variable that affects the desired facilities budget; *demand of facilities*. Most of participants (12 out of 14) supported the relationship between the demand of facilities and the desired facilities budget, as appear in the following quotes: *"The desired facilities budget is calculated based on the demand of facilities"* **(Academic Participant 14).** *"There is a relationship between the demand of facilities and the desired facilities budget"* **(Administrative participant 5)**. *"Based on the amount of demand of facilities, the HE management can determine the desired facilities budget"* **(Academic Participant 12).**

Figure (4.7) shows the sub-variables and the sub-sub-variables that affect the key variable *"Quality of facilities"*.
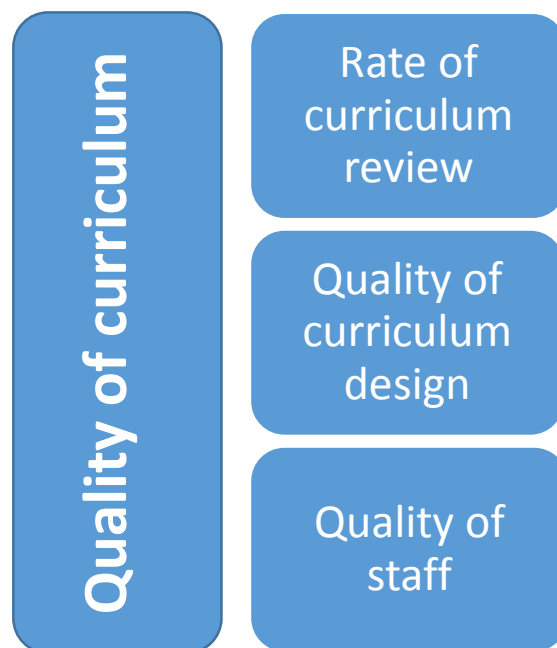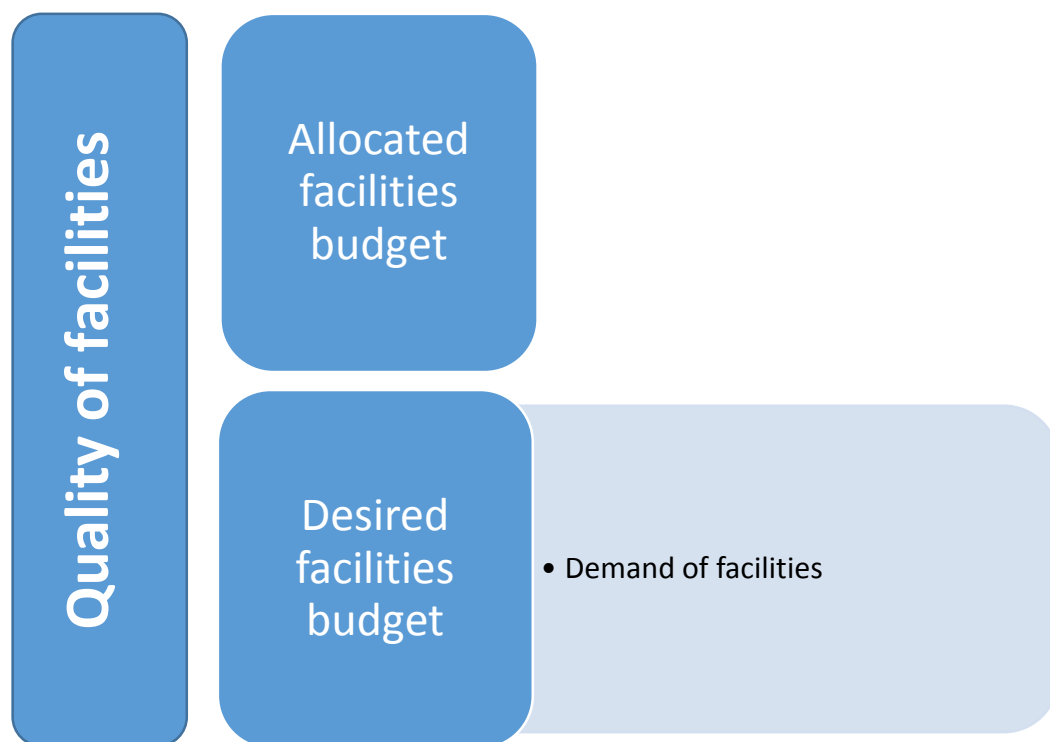

Figure 4-7: Sub-variables That Affect the Key Variable "Quality of Facilities"

(Source: this research)

4.1.2.2.7 Key Variable Seven: Quality of Internship

From the discussions, it was concluded that the quality of internship is another key variable that affects the quality of the Egyptian HE system, as supported by some of the participants (16 out of 24). This key variable is supported by the following attributes:

"*Quality of the Egyptian HE system is also affected by the quality of internship*" *(Academic Participant 15).* "Although there is insufficient attention about internship in Egypt, it still one of the key variables that affect the quality of the Egyptian HE system" *(Academic participant 9). "Quality of internship is considered an important variable when we talk about the quality of the HE system" (Administrative participant 8).*

According to the discussions, the researcher was able to discover three sub-variables that affect the quality of internship. They are: *Effectiveness of trainee, effectiveness of supervisor* and *internship availability ratio*. These sub-variables are more discussed in the following section:

Effectiveness of trainee

More than half of participants (9 out of 16) stated that the effectiveness of trainee plays an important role in affecting the quality of internship. One participant said: *"There is a direct relationship between the effectiveness of trainee and the quality of internship" (Administrative Participant 6). "The effectiveness of trainee has a significant effect on the quality of internship" (Academic participant 13). "If the trainee is highly effective, the quality of internship would be high as well" (Academic Participant 9).*

The researcher discovered other sub-sub-variables that affect the effectiveness of trainee. They are: *Academic preparation*, *self-initiative*, and *positive attitude*. Where, all of participants (9 out of 9) agreed that effectiveness of trainee strongly depends on his/her academic preparation. Less number of participants (7 of 9) stated that the self-initiative of the trainee plays an important role in increasing his/her effectiveness. While, most of them (8 out of 9) mentioned positive attitude as one sub-sub-variable that affects the effectiveness of trainee.

These findings are supported by the following: *"Effectiveness of a trainee depends on the academic preparation of the student, his positive attitude and his self-initiative"* **(Academic Participant 4).** *"The sub-sub-variables that affect the effectiveness of trainee and, consequently, affect the quality of internship include: the positive attitude of the trainee, his academic preparation, and his self-initiative"* **(Administrative participant 6)**. *"There are several variables affecting the effectiveness of trainee. The most important of them are: academic preparation, positive attitude, and self-initiative"* **(Academic Participant 15).**

Effectiveness of Supervisor

Many participants (9 out of 16) mentioned the effectiveness of supervisor as a sub-variable that affects the quality of internship. One participant expressed his opinion by: *"The effectiveness of supervisor and effectiveness of trainee are the pillars that support the quality of internship"* **(Administrative Participant 2).** *"Effectiveness of supervisor has a high effect on quality of internship"* **(Administrative participant 8).** *"If the supervisor is qualified enough, the quality of internship would be improved"* **(Academic Participant 10).**

Effectiveness of supervisor is dependent on one sub-sub-variable: *demand for internship*. Where, all of participants (9 out of 9) confirmed that the effectiveness of supervisor is affected by the demand for internship. This is supported by: *"There is a negative relationship between effectiveness of supervisor and the demand for internship"* **(Academic Participant 14).** *"If the demand for internship increases, the effectiveness of supervisor will decrease, and vice versa"* **(Administrative Participant 7).**

Internship availability ratio

Most of participants (11 out of 16) agreed that the internship availability ratio is considered one of the important sub-variables affecting the quality of internship. The following attributes support this relationship: *"The internship availability ratio affects the quality of internship, which is a problem in Egypt due to the low number of available training opportunities"* **(Academic Participant 13).** *"The quality of internship is directly affected by the internship availability ratio"* **(Administrative participant 4).** *"If the internship availability ratio increased, this would lead to an increase in the quality of internship"* **(Academic Participant 7).**

The internship availability ratio is affected by other sub-sub-variables. The interview discussions enabled the researcher to find them, which are: *available training opportunities* and *demand for internship*. All of participants (11 out of 11) agreed that both of these sub-sub-variables have a strong effect on the internship availability ratio.

These two sub-sub-variables are supported by the following: *"The internship availability ratio is determined through dividing the total available training opportunities by the demand for internship".* **(Administrative Participant 3).** *"The internship availability*

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ratio is an important sub-variable, and can be determined through two sub-sub-variables: the number of available training opportunities and the demand for internship." **(Academic participant 12)**. *"We can increase the internship availability ratio by increasing the available training opportunities, as possible, so that it covers the demand for internship." **(Academic participant 2)***.

Figure (4.8) shows the sub-variables and the sub-sub-variables that affected the key variable *"Quality of internship".*
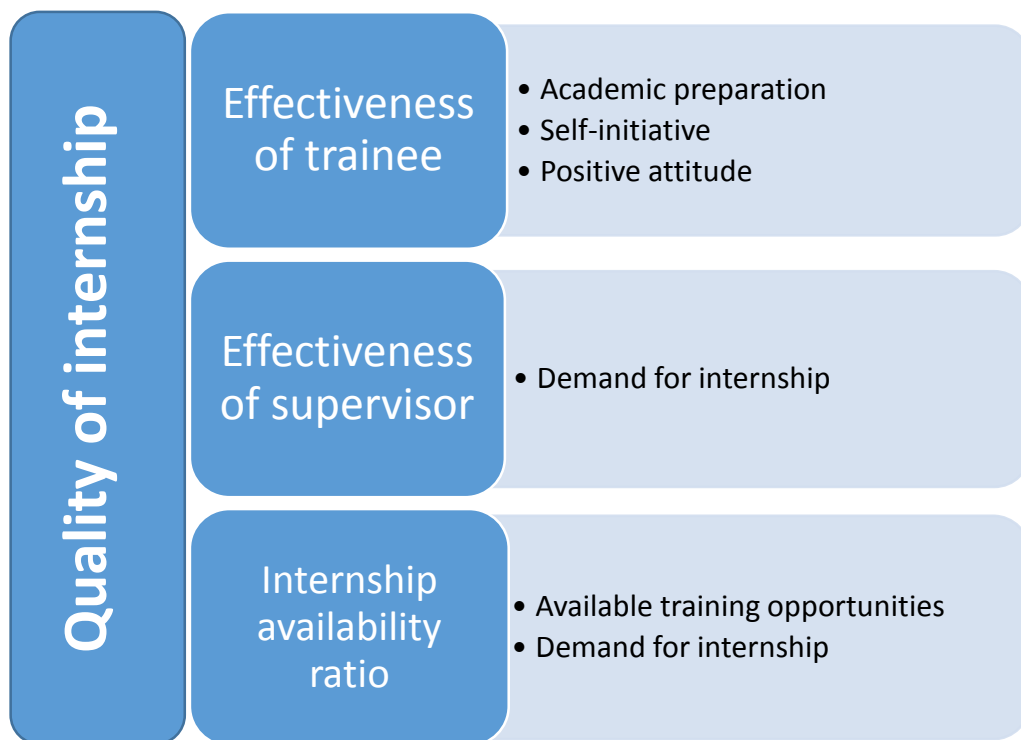
Figure 4-8: Sub-variables That Affect the Key Variable "Quality of Internship"

(Source: this research)

At the end, from the results of the discussion of the interviews. The researcher arranged the seven key variables according to their importance from the participants' perspective, as shown in Table 4.2.

Table 4-2: Frequency of Key Variables According to Their Importance

Key variable	Frequency	Percentage
Quality of staff	24 out of 24	100 %
Quality of teaching	24 out of 24	100 %
Quality of research	24 out of 24	100 %
Quality of curriculum	24 out of 24	100 %
Quality of resources	20 out of 24	83 %
Quality of facilities	18 out of 24	75 %
Quality of internship	16 out of 24	67 %

4.2 Conceptualisation Stage

As mentioned before in Chapter 3, the stage of model conceptualisation is the most important stage in the model building process. This is because all the following stages will be built based upon this stage. The model is formed qualitatively in this stage without the use of any quantitative data. It is called "The mental model" since it represents the concepts of the modeller gained through information that he has obtained about the HE system in Egypt. The model purpose is discussed in the following section as well as the assumptions of the model, the key variables, the time horizon, the reference modes, and the causal loop diagram.

4.2.1 Model Purpose

In order to build a useful model, it is essential to specify the purpose of the model at the beginning. A clear-purpose model helps the modeller to create the most suitable model with the least possible number of variables. The purpose of this model is to explore the gap between skills of graduates and the skills needed by market, which is constantly

changing. It is a dynamic process which includes many factors, all of which feedback to each other. It is therefore very difficult to determine the situation. System dynamics is the ideal tool to be used in such situation (as explained in Chapter 3). This model is being built to replicate the real situation and enable the management of public universities to make decisions that could increase the quality of the HE system and, consequently, bridge the skills gap. The purpose of the model is to find the influencing variables which will have the dominant effect on this gap. When these variables are discovered, they can be manipulated to minimize this gap and therefore increase the compatibility of the graduates.

4.2.2 Model Assumptions

Before defining the variables and writing the equations, we should first define the assumptions that underpin the model. These assumptions were taken in consideration in the model building process so that the model represents the actual Egyptian HE system. These assumptions, which are listed in the following points, will give the reader more understanding of the model building process.

- This research involves graduates of Egyptian public universities; it does not include private university graduates or post graduate students in both public and private universities, where they represent a small percentage of total Egyptian universities graduates. In addition, the research problem is not of great importance for them.
- The officially announced employment rate (by the ministry of manpower and immigration) is the same as the employment rate for Egyptian public universities' graduates.

- The number of reviews of the curriculum does not matter as much as the extent of the impact and effectiveness of the review on the quality of the curriculum.

- Total annual funding for the university is fully expended on the educational process and there is no retained profit. As a result of this, the *"available funding per year"* is equal to the *"total funding per year"*.

- The university does not hire part time staff until the full time staff are fully loaded. The number of part time staff is very small and can be ignored. Therefore, the two variables are aggregated into one variable called *"Total number of staff"*.

- The requirements of the ministry of HE for enrolment are represented only by the average high school grade required for enrolment. This is the actual situation in the Egyptian public universities.

- "Skills needed by market" is assumed to be constant for the five years of simulation, with a value of 90%. This helps the researcher to accurately inspect the effect of quality of HE on the gap by neglecting the effect of skills needed by market. This enables the researcher to focus on the internal aspect of the problem; the HE aspect.

4.2.3 Model Boundary "Key Variables"

In order to set the model boundary, all components that related to the model must firstly be identified. These components were selected after carrying out semi-structured interviews with experienced staff and administrative members in the field of quality of HE in Egypt. After creating the "initial component list" of these variables, unnecessary variables (which are not related to the purpose of the model), were excluded to avoid any unnecessary complications in the model. These unnecessary variables were excluded according to experts' opinions in the interviews. The remaining components were then

divided into two groups; the endogenous and exogenous variables. The model variables and their definitions are shown in **Appendix E**.

The endogenous variables are the variables that can be calculated inside the model using only the variables of the model. They represent the internal variables that are only related to the HE system. On the other hand, the exogenous variables need external data to be identified. They represent the external variables that are related to external systems related to the HE system. After the model boundary chart was completed, more categorisation was needed. The endogenous variables were inspected to know which variables represented stocks and which represented flows; this was helpful in the final stage of conceptualisation. It should be mentioned that, in most cases, the exogenous variables were represented as constants. These variables were used in the next step; drawing the reference modes.

4.2.4 Causal Loop Diagram

The final step in the conceptualisation stage is drawing the causal loop diagram. All the endogenous and exogenous variables are drawn together to show the cause-and-effect relationships. This diagram has been reviewed and modified several times by the researcher with the aid of experts in the field of quality within the HE system in Egypt.

The initial model shown in Figure (4.9) was built after conducting 4 semi-structured interviews. This initial model mainly focused on six key variables that affect "Quality of services provided by universities". All these six key variables have positive effects on "Quality of services provided by university". The model also explained how this variable affects the "Skills gap" and, consequently, the "employment rate".
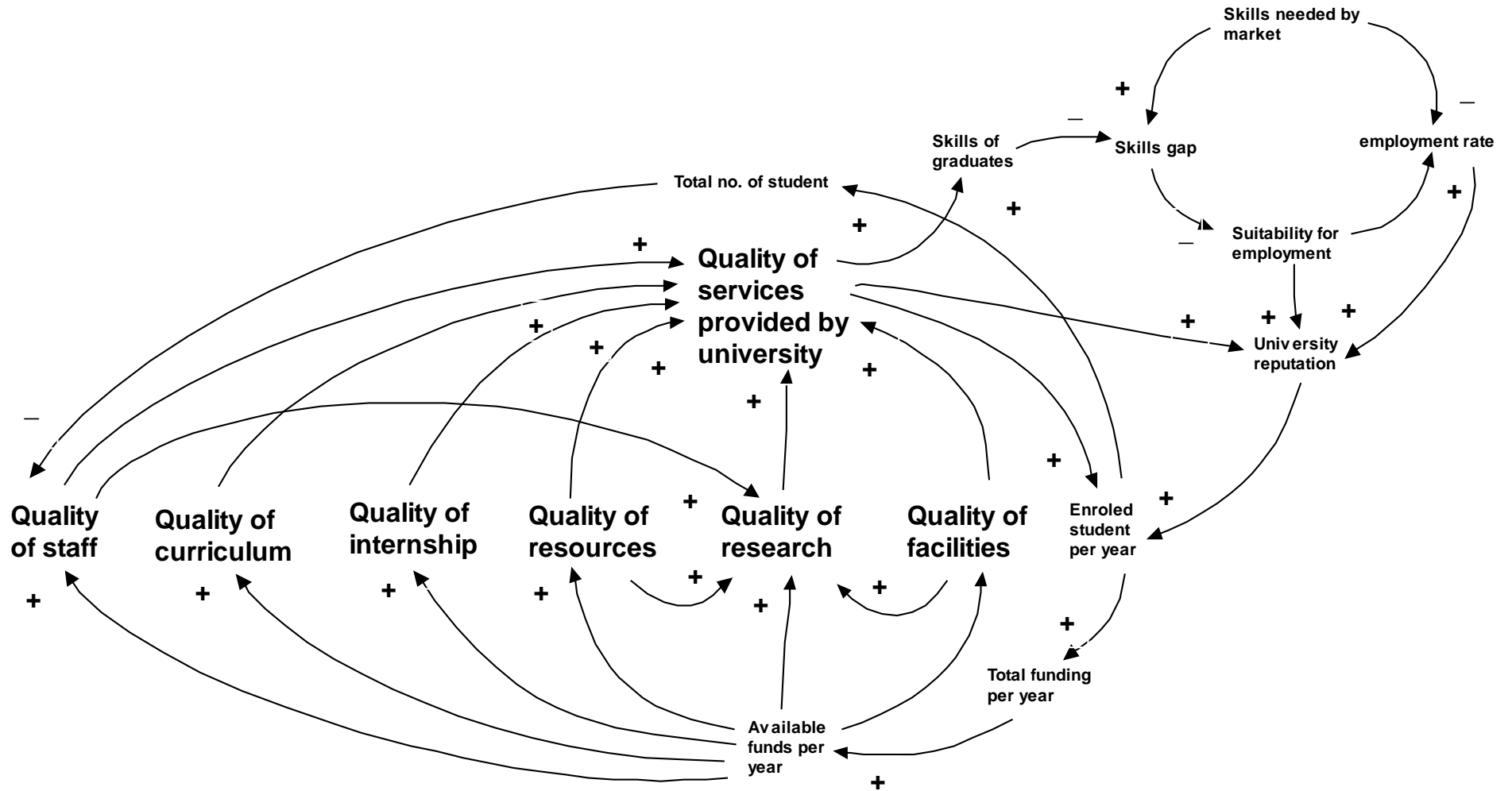
Figure 4-9: Preliminary Causal Model Number (1)

After conducting more interviews, another key variable was added. As shown in Figure (4.10), after the addition of "Quality of staff" the number of key variables increased to seven. The initial model shown in Figure (4.9) indicates that the key variables are affected only by funding. However, in the model shown in Figure (4.10), more sub-variables are included. For example, "Quality of staff" is affected by "Staff motivation" as well as "Available funding". The dynamicity of the complex system of HE is apparent in the model. The key variables are not only affected by the sub-variables but also affect them. For example, the key variable "Quality of staff" affects the sub-variable "Staff performance" but we can say that the sub-variable "Staff performance" indirectly affects the key variable "Quality of staff" through "Student performance" and "Staff motivation".

After conducting larger number of interviews, many sub-variables and sub-sub-variables were added to the model as shown in Figure (4.11). The researcher made sure to include all the variables that contribute to the key variables to make the model as much consistent as it can be. It is obvious that many sub-variables were added to the key variables "Quality of research", "Quality of curriculum", and "Quality of internship". However, both key variables "Quality of facilities" and "Quality of resources" remained affected only by funding through "Available funds per year"
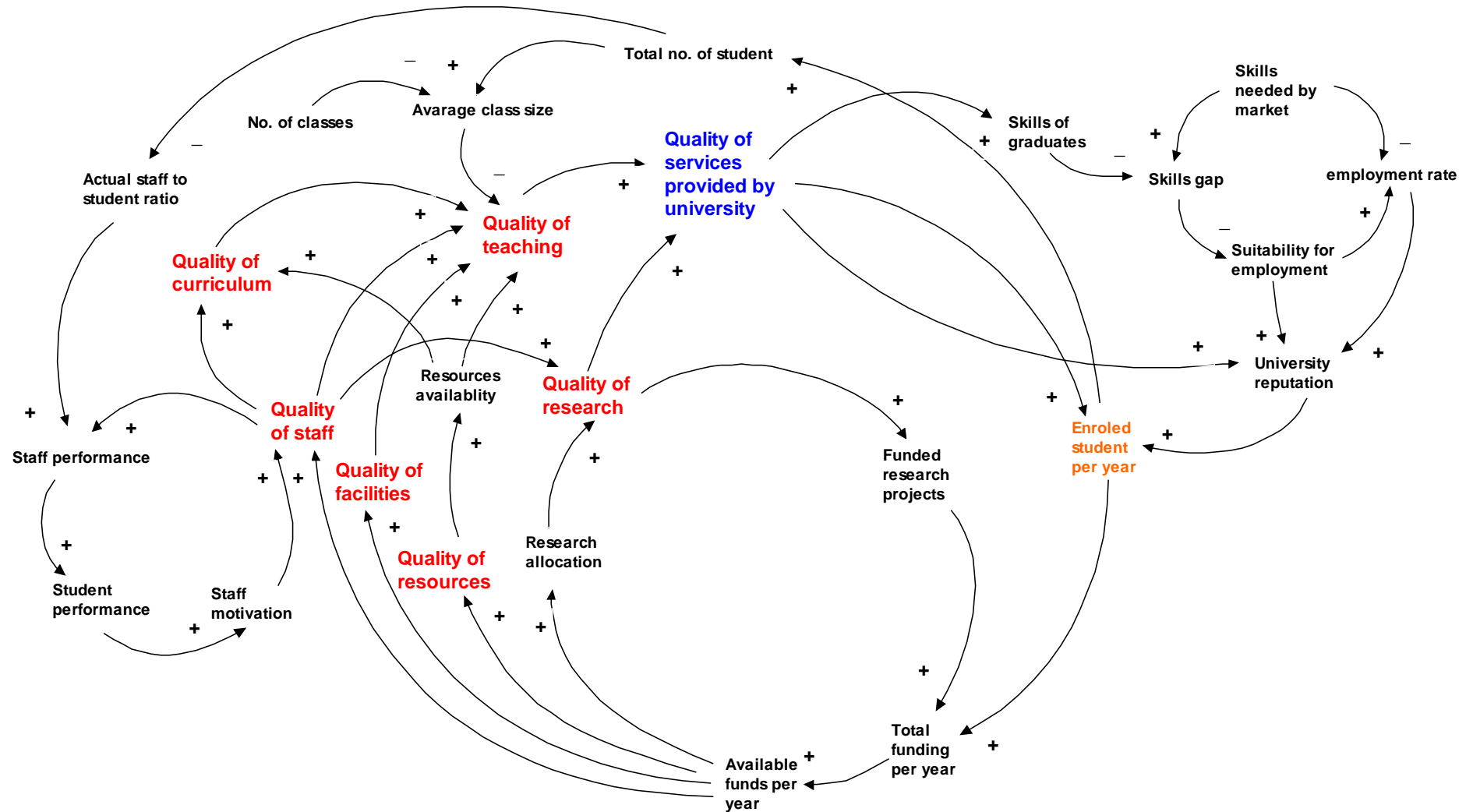
Figure 4-10: Preliminary Causal Model Number (2)
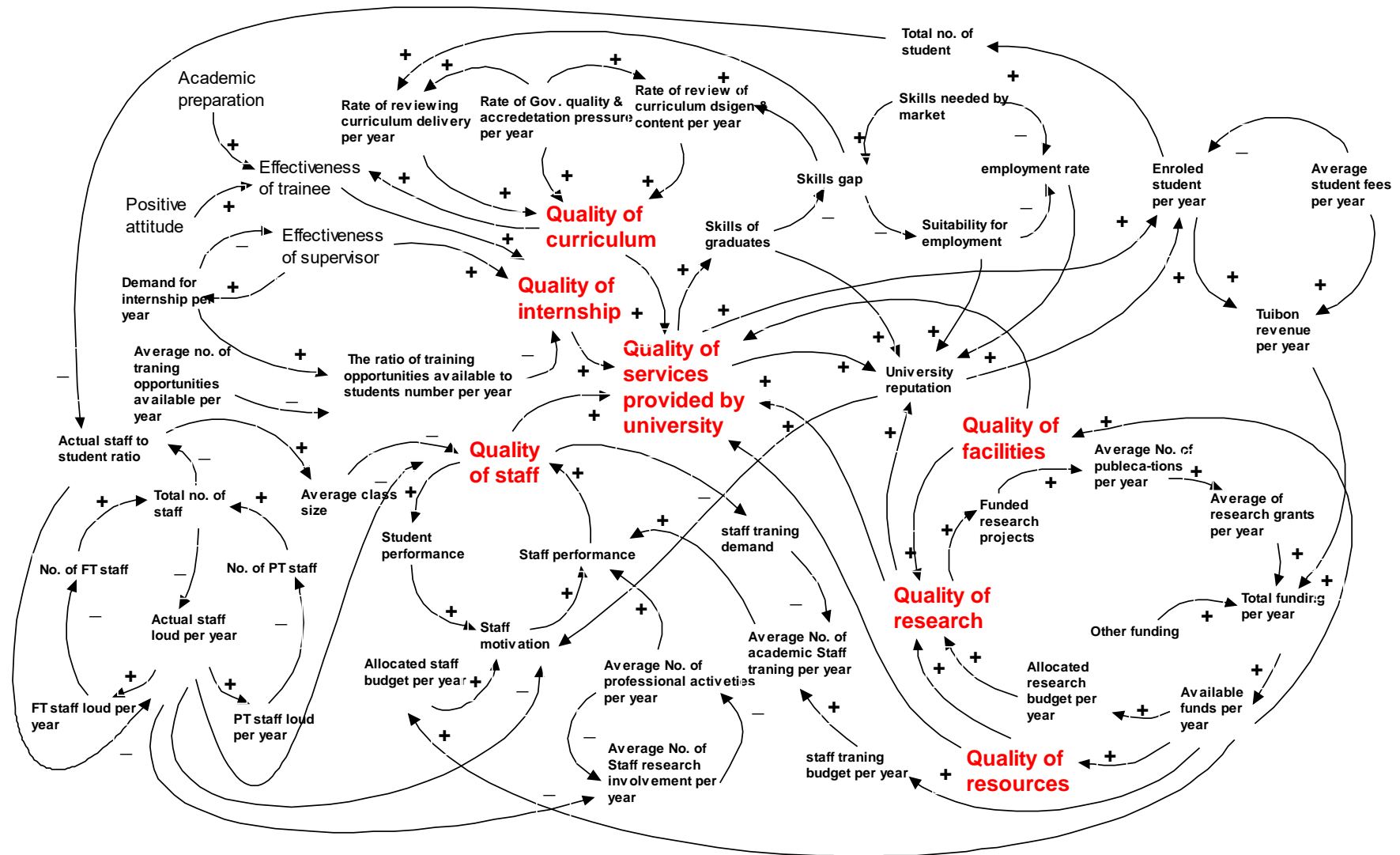
Figure 4-11: Preliminary Causal Model Number (3)

After conducting and analysing all the interviews, the model was improved to reach its final form shown in Figure (4.12). The final model was built after analysing the outputs of all 24 interviews through transcription, coding, and finding themes which are shown in the figures from Figure (4.2) to Figure (4.8). Some variables were excluded from the model such as "Rate of government quality and accreditation pressure" and "Average number of professional activities" because they are of insignificant effect on the key variables. Moreover, some variables were aggregated together for simplification purposes. For example, both "Number of part time staff" and "Number of full time staff" are aggregated together into one variable "Total number of staff". It has been found that saturation was reached after 24 interviews which indicated that no extra interviews were needed.

To conclude the final model shown in Figure (4.11), there are six dominant feedback loops (marked with different colours). These loops control the value of the important key variables (the qualities). These are seven important variables which all affect the "quality of services provided by universities", which in turn affects the skills of graduates. The skills of graduates are not compatible with the skills needed by the market, thus producing a "skills gap", which is the most important variable that represents the purpose of the model. By understanding this causal loop diagram, the cause-and-effect relationships become more obvious. The causal loop diagram is used in the next stage, the formulation stage, in the building of the stock-and-flow diagram.
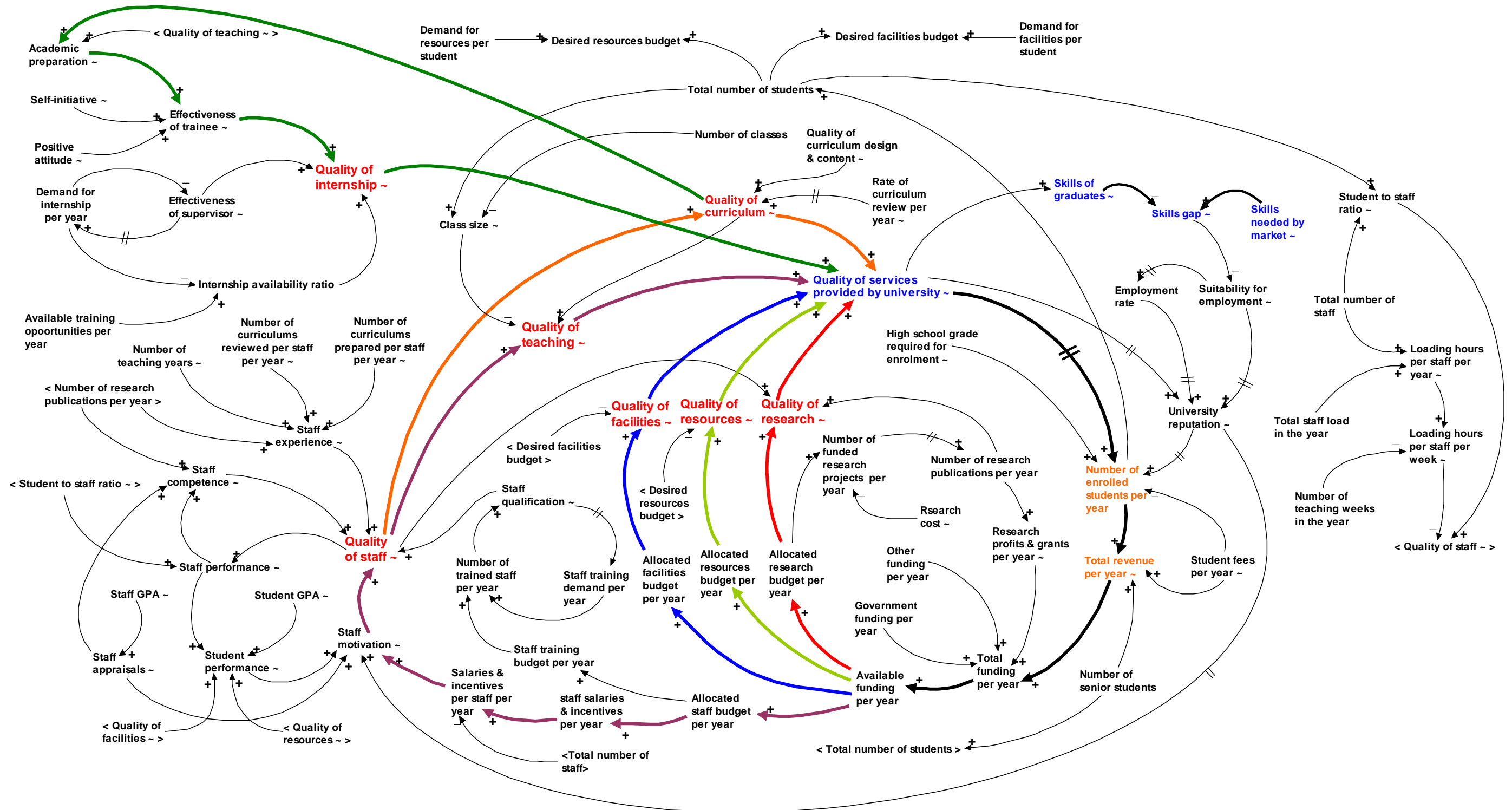
Figure 4-12: Final Causal Model

4.3 Formulation Stage

After the mental model is constructed in the form of a causal loop diagram, the model formulation process begins. With the aid of PowerSim Studio 10 Academic software, the causal loop diagram is redrawn in the software, but in the form of a stock-and-flow diagram. For simplification reasons, the diagram is divided into seven sub-diagrams. All the sub-diagrams are connected, and they together represent the overall stock-and-flow diagram. These sub-diagrams are shown and discussed in the following sections.

4.3.1 Variables Formulation

The stock-and-flow diagram isn't much different than the causal loop diagram. What really matters is the formulating and defining the variables inside the stock-and-flow diagram. Each variable is defined (in the PowerSim Studio 10 Academic) by choosing its type, writing its definition and selecting a proper unit.

The type of variables in PowerSim can be one of three; constant (diamond shape), auxiliary (circle shape), or level (rectangle shape). A constant variable has a constant value which doesn't change for the time of simulation. The value of an auxiliary changes with every time step, according to the value of the variables affecting this auxiliary. The value of the level is accumulated according to the auxiliaries (flows) going in or out of the level. The type of each variable was selected carefully to represent its behaviour in the real system.

4.3.2 Units of Measurement

The units are important to make the simulation more meaningful. They are also important to make sure that the simulation is correct. The PowerSim Studio 10 Academic has a

useful feature; if the units of related variables don't match, an error will appear. This ensures that the model is dimensionally correct. The model deals with different types of variables and as such the units are carefully defined to make sure the equations between different variables are correct. It should be mentioned that all graphs are based on available research, but their shapes reflect trends rather than precise shapes.

4.3.3 Stock-and-Flow Diagram

The sub-models of the stock-and-flow diagram are explained in this section. However, some notes should be first introduced:

- All the sub-diagrams are connected in the software and they all represent one big diagram (i.e., any change in one sub-diagram will affect the other diagrams).

- For simplification reasons, all variables that have average value are marked with the character ($\sim$) after their names.

- All flows are named with the letter (F).

- All auxiliaries that are defined with equations are named with the letter (E).

- All auxiliaries that are defined with graphs are named with the letter (G).

- Variables included in the policy structure are marked with blue colour.

- All the flows contain an (If-statement) with control feedback signal from the stocks in order to avoid extreme conditions.

- All equations used in the model are listed in **Appendix E**.

4.3.3.1 Quality of curriculum

Figure (4.13) shows the stock-and-flow diagram of the first key variable, *"Quality of curriculum"*. It is obvious that the *"Quality of curriculum"* depends on three variables;

two are constants; *"Rate of curriculum review per year"* and *"Quality of curriculum design and content",* while the third is another key variable *"Quality of staff"*.
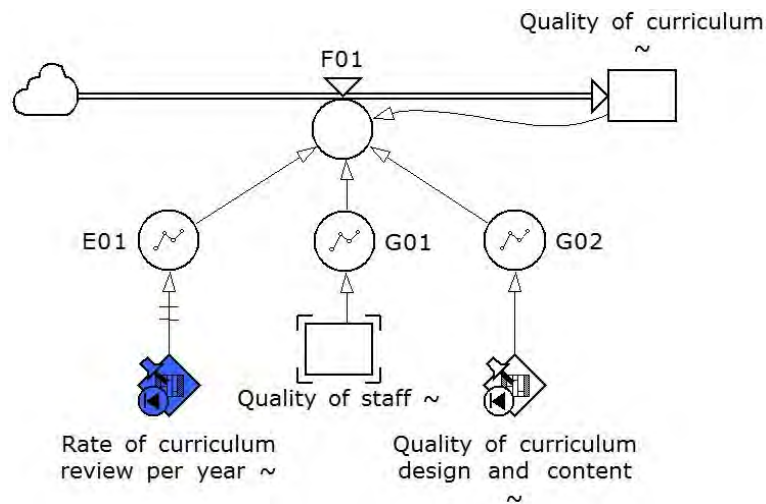
Figure 4-13: Sub-diagram of "Quality of Curriculum" and Related Variables

The effect of *"Rate of curriculum review per year"* is simulated using an equation (E01), which is shown in the equation list in **Appendix E**. The effects of the other two variables are simulated by the graphs (G01 and G02) shown in Figures (4.14) and (4.15) respectively.
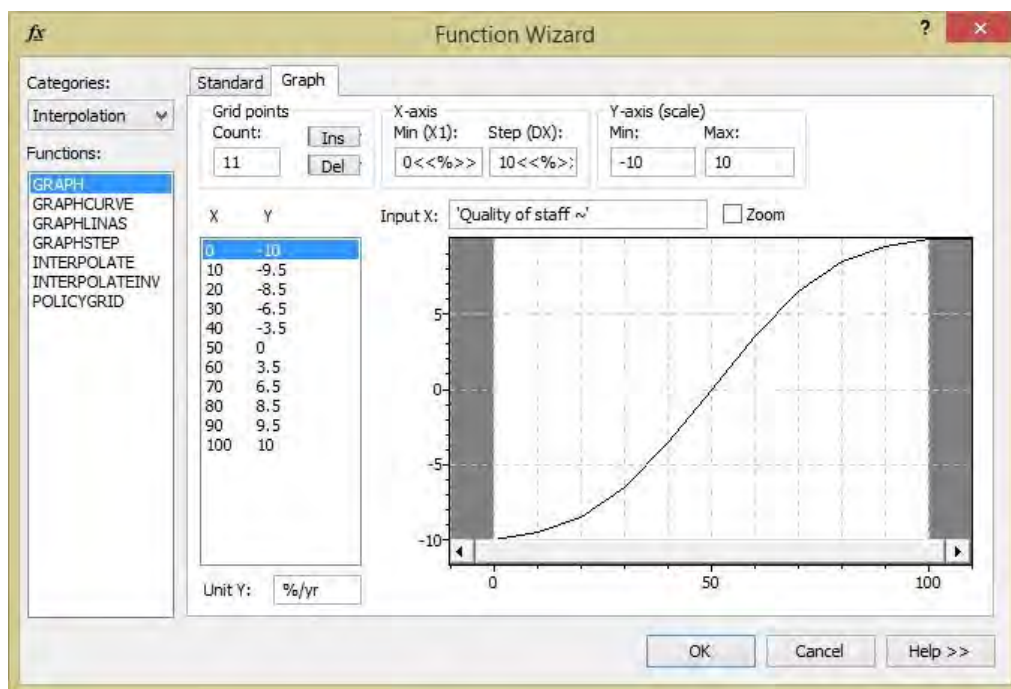
Figure 4-14: Effect of "Quality of staff" on "Quality of curriculum" (G01)

The model monitors the value of *"Quality of staff"* on a scale from 0 to 100 % and determines its effect on *"Quality of curriculum"* based on this value and according to the S-shape curve shown in Figure (4.14). This graph was driven from discussion with experts in the interviews. The point of no-effect is when the *"Quality of staff"* is 50%. Any increase or decrease will lead to a corresponding increase or decrease in the *"Quality of curriculum"*, respectively. The maximum effect is a 10% increase when the *"Quality of staff"* is 100%, while the minimum effect is a 10% decrease when the *"Quality of staff"* is 0%.
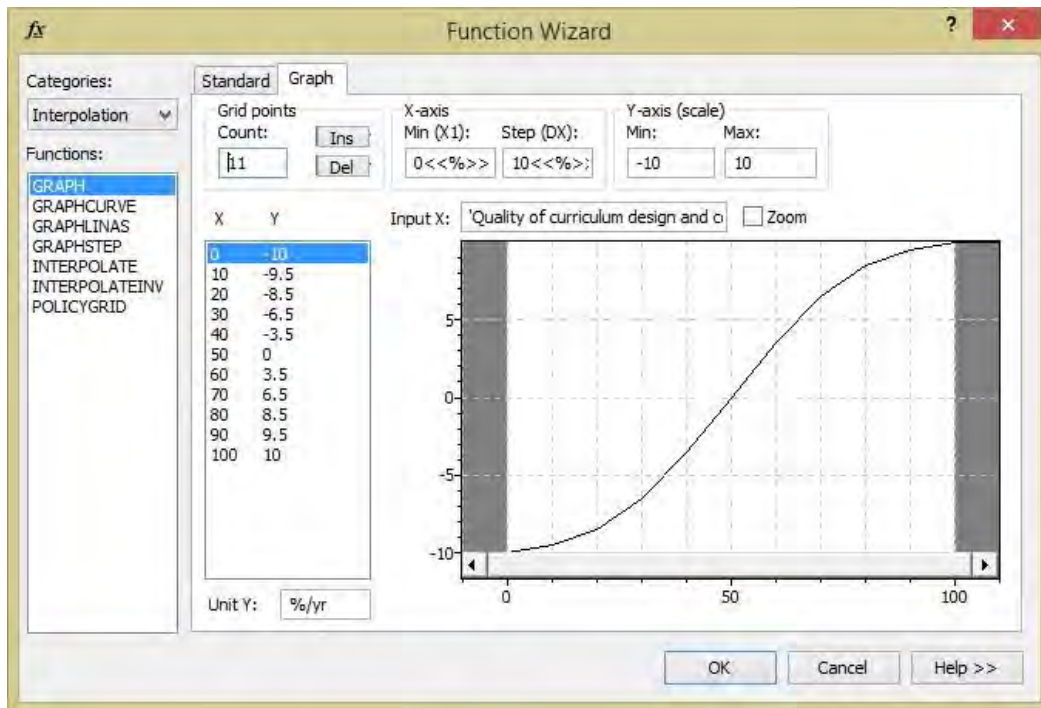
Figure 4-15: Effect of "Quality of curriculum design and content" (G02)

The effect of *"Quality of curriculum design and content"* is similar to the effect of *"Quality of staff"*, with a similar S-shape curve, as shown in Figure (4.15). This graph was drawn this way according to the interviews.

The three effects of the three variables were combined together to get a weighted average. Each variable had a weighting factor depending on its importance; a more important variable has a higher weighting factor. However, the sum of the weighting factors should always equal to unity. The weights of the three variables were defined according to the interviews and the experts' opinions about the importance of each variable. The weights of these variables are shown in the equation list in **Appendix E**. Finally, the weighted average represents the final effect (F01) that changes the value of *"Quality of curriculum"*.

4.3.3.2 Quality of internship

Figure (4.16) shows the stock-and-flow diagram of *"Quality of internship"*. There are three factors affecting *"Quality of internship"*; *"Effectiveness of trainee"*, *"Effectiveness of supervisor"*, and *"Internship availability ratio"*.
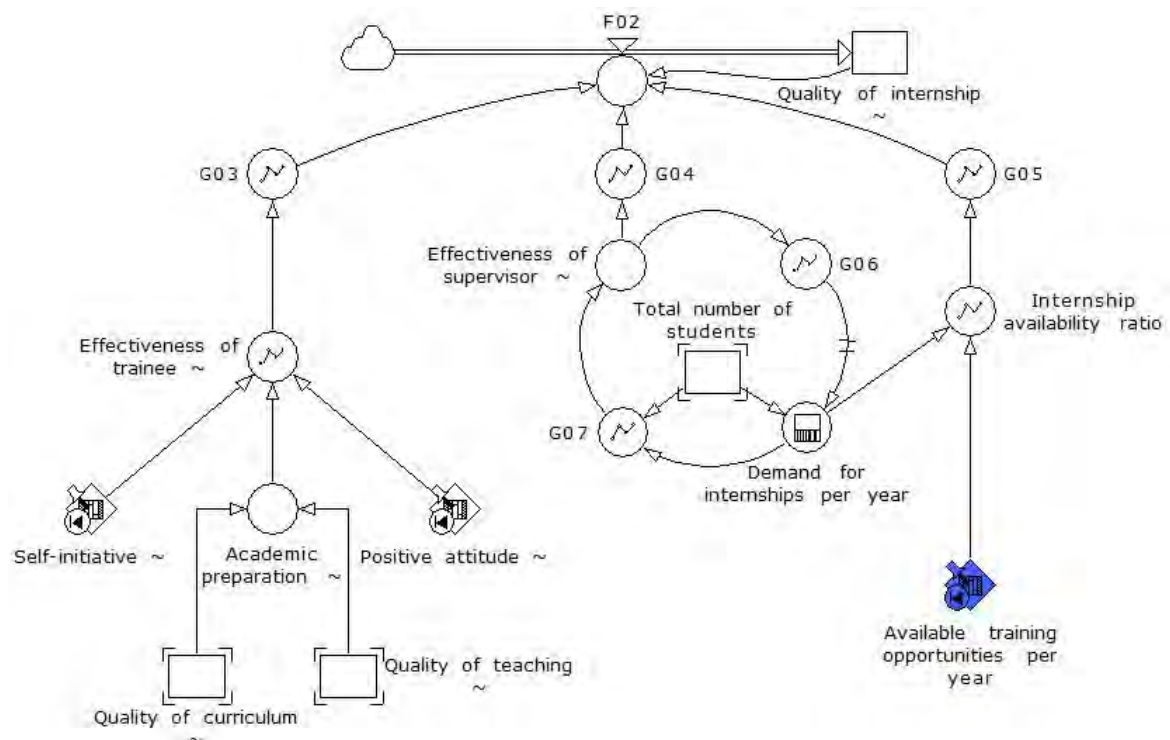
Figure 4-16: Sub-diagram of "Quality of Internship" and Related Variables

The variable *"Effectiveness of trainee"* is calculated from the weighted average of the three variables "Self-initiative", "Positive attitude" and "Academic preparation". The values of these weights are concluded from multiple interviews with experts. The effect of *"Effectiveness of trainee"* on *"Quality of internship"* is calculated from the graph (G03) shown in Figure (4.17).
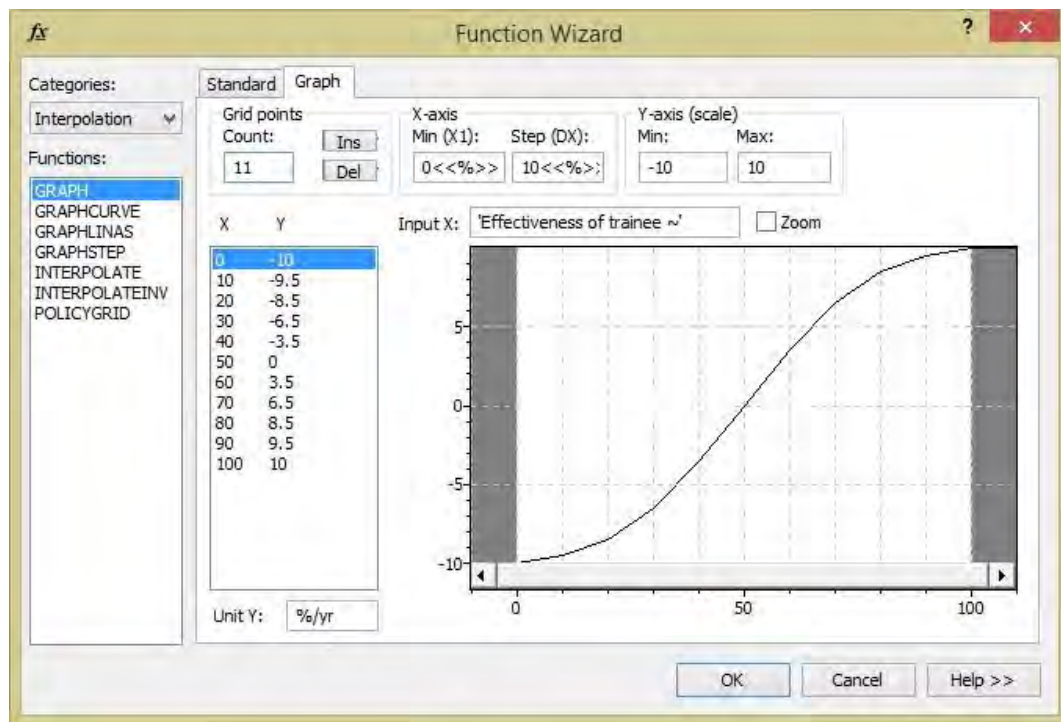
Figure 4-17: Effect of "Effectiveness of trainee" on "Quality of internship" (G03)

In Figure (4.17), an increase of *"Effectiveness of trainee"* over 50% will lead to an increase in the *"Quality of internship"* according to the S-shape curve. The increase (or decrease) does not exceed 10% per year. The effects of "Effectiveness of supervisor" and "Internship availability ratio" are calculated from the graphs (G04) and (G05) respectively. These two graphs are similar to (G03) with the same S-shape curve. All the evidences for these graphs are taken from interviews and discussion with experts.

The *"Demand per internship"* is an important sub-variable, but its effect is not direct; it indirectly affects the quality of internship through the *"Effectiveness of supervisor"* and *"Ratio of training opportunities"* variables. According to interviews, there is a negative (balancing) loop between *"Demand per internship"* and *"Effectiveness of supervisor"*. When the *"Effectiveness of supervisor"* goes higher, the *"Demand per internship"* will be increases (positive relationship). This is shown in the graph (G06) in Figure (4.18).
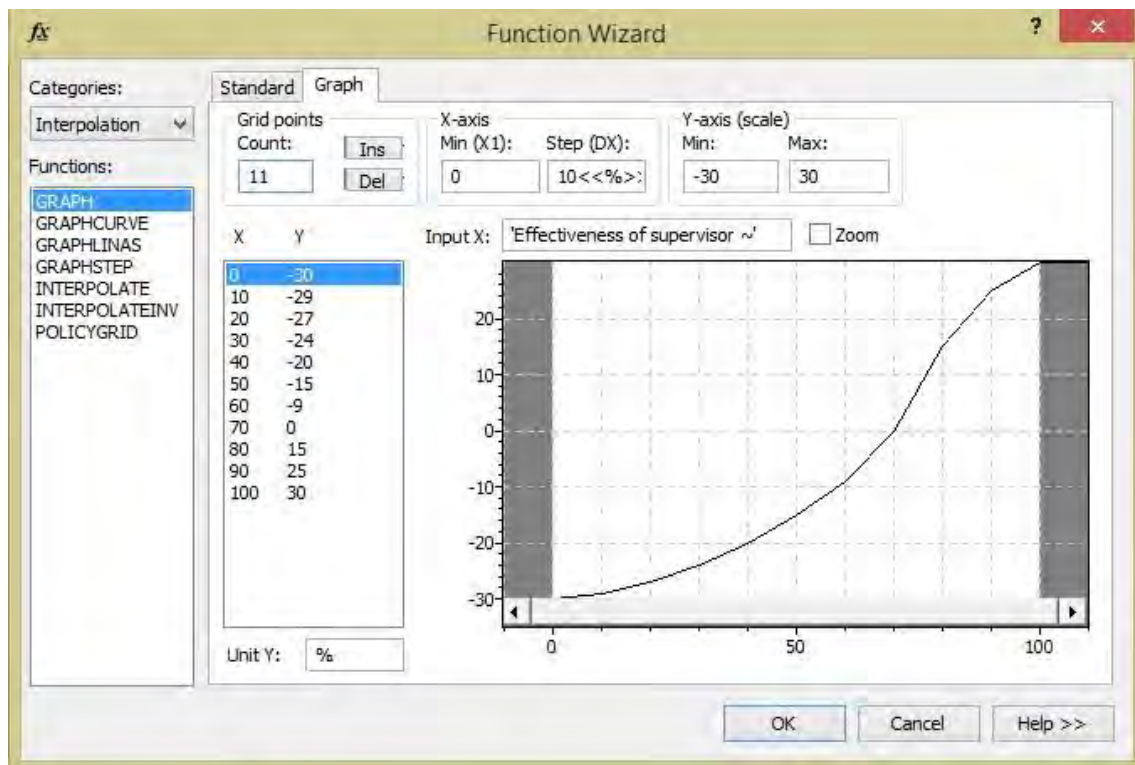
Figure 4-18: Effect of "Effectiveness of Supervisor" on "Demand for internship" (G06)

The balance point in this graph is when *"Effectiveness of supervisor"* is 70%. Any increase above this value will increase the *"Demand per internship"*, and vice versa. However, as shown in Figure (4.19), when the *"Demand per internship"* increases the *"Effectiveness of supervisor"* drops down (negative relationship). The combination of the positive and negative effects produces a balancing loop that causes the two variables to go up and down until a value of equilibrium is reached for both variables.

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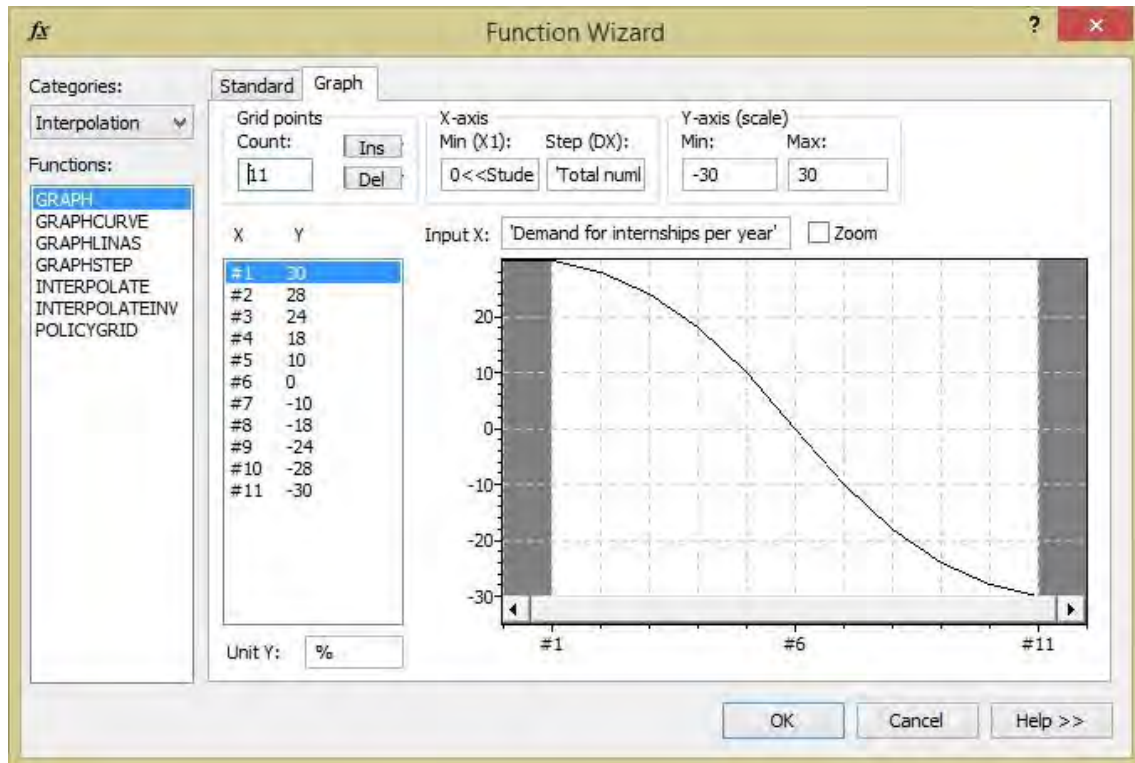
Figure 4-19: Effect of "Demand for internship" on "Effectiveness of trainee" (G07)

The effects of the three variables *"Effectiveness of trainee", "Effectiveness of supervisor"* and *"Internship availability ratio"* are combined together and a weighted average is calculated before adding the final effect (F02) to the *"Quality of internship"*. The weights of the three variables are set according to experts' opinions from interviews.

4.3.3.3 Quality of facilities, resources and research

Three key variables are shown in Figure (4.20); *"Quality of facilities"*, *"Quality of resources"*, and *"Quality of research"*. In the centre of the diagram, there is the *"Available funds per year"*. The *"Available funds per year"* is assumed to be equal to the *"Total funds per year"*.
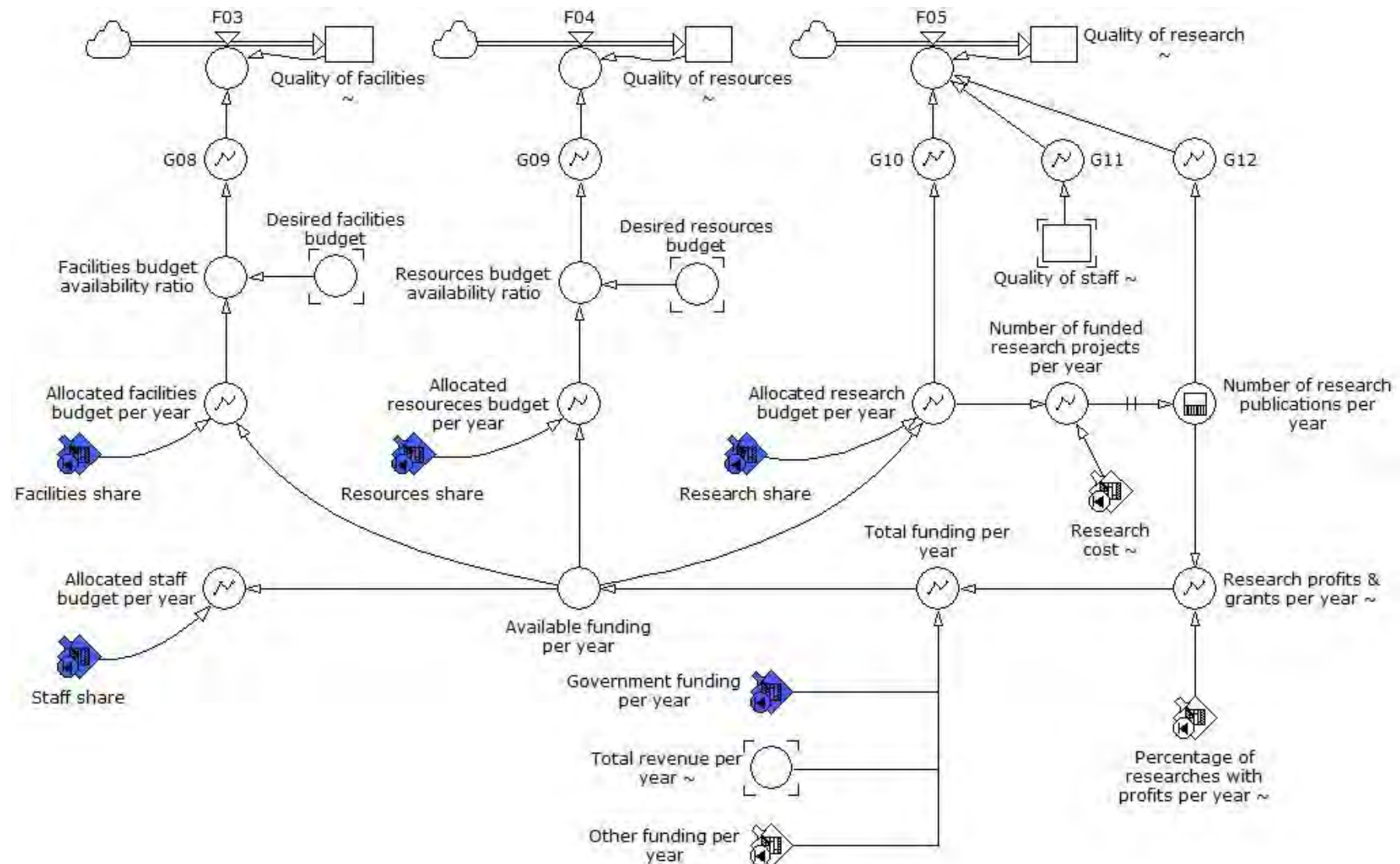
Figure 4-20: Sub-diagram of "Qualities of Facilities, Resources, and Research"

The total funding comes from several sources such as; *"Government funding per year"*, *"Total revenue per year"*, *"Average of research profits per year"*, and *"Other funding per year"*. The available funds are then distributed for each of the allocations depending on the share of each allocation. It is noted that both *"Quality of facilities"* and *"Quality of resources"* are affected by only funding. The allocated budget is compared to the desired budget using the graphs (G08) and (G09) which are drawn with the aid of experts in interviews. Figure (4.21) shows the effect of the graph (G08) which is similar to the effect of the graph (G09).
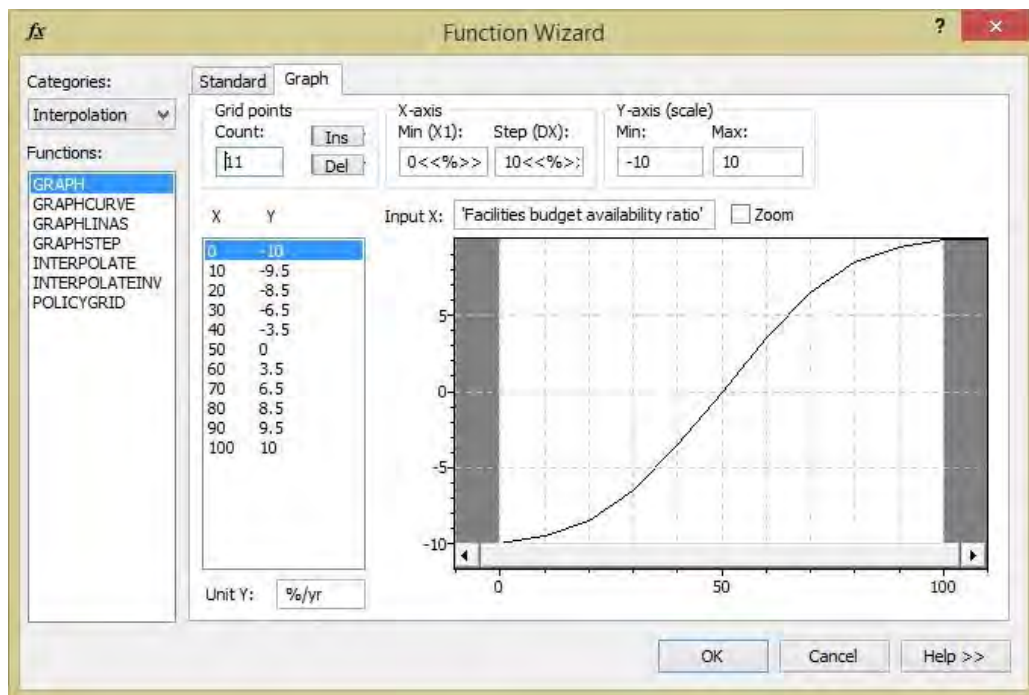
Figure 4-21: Effect of "Facilities budget availability ratio" on "Quality of facilities" (G08)

According to the interviews, and shown within the graph (G08), if the ratio of the *"Facilities budget availability ratio"* is 50% this means that the government provide half of the desired budget for facilities. When the ratio goes higher than 50% a positive effect is produced until the maximum effect is reached (10% increase when the ratio equal to 100%).

"Quality of research" is affected by three variables; *"Allocated research budget"*, *"Quality of staff"* and *"Average number of research publications per year"* through the graphs (G10), (G11) and (G12) respectively. These graphs have been drawn based on information from the interviews. The effect of *"Quality of staff"* (G11) is similar to (G01), while (G10) and (G12) are shown in Figures (4.22) and (4.23) respectively.
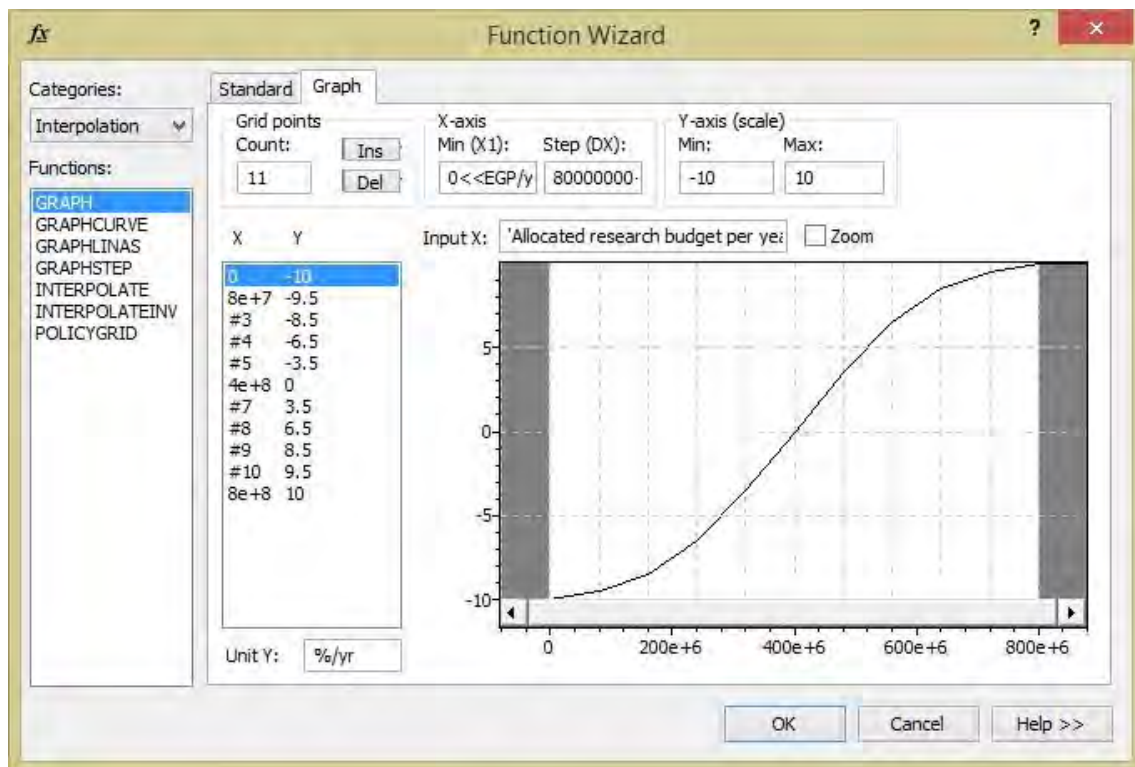
Figure 4-22: Effect of "Allocated research budget" on "Quality of research" (G10)

The graph (G10) simulates the effect of the funding on the *"Quality of research"* through the S-shape curve shown in the Figure. According to the interviews and the MOHESR, the target budget is set to 800 million Egyptian Pounds per year. Depending on the available budget, the effect ranges from -10% to +10% to the *"Quality of research"*.
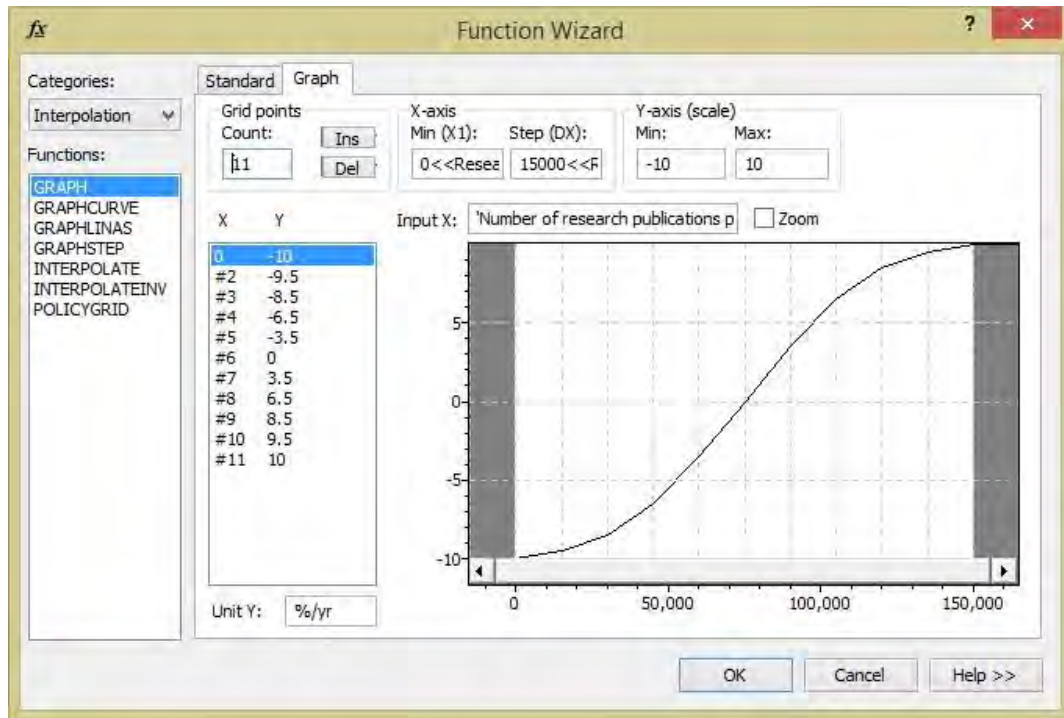
Figure 4-23: Effect of "Number of research publications" on "Quality of research" (G12)

The *"Number of research publications"* affects the *"Quality of research"* through the graph (G12). The approximate number of HE staff members in Egypt is 75 thousand (Ministry of HE). It has been found that each staff member should publish at least two papers in the year to get promoted and to reach the maximum standards set by the Ministry of HE. The minimum standard can be achieved by publishing one paper per year. Therefore, the number of research papers published per year should be more than 75 thousand to produce a positive effect. This effect is set according to the experts in the interviews and the secondary data collected from the Ministry of HE. More research publications will lead to a higher positive increase until the maximum increase of 10% is reached at 150 thousand research publications per year, which means an average number of two publications for each staff member in the year. The three effects (G10), (G11) and (G12) are combined together with a weighting factor for each of them. The weights are also determined from the interviews. The weighted average of the three effects represents the final effect on the "*Quality of curriculum"*.

4.3.3.4 Quality of staff

Many previous studies assured the importance of quality of staff as a main variable that affect the overall quality of HE (Kennedy, 1998; Tsinidou et al., 2010; and Aškerc, 2014). Moreover, these studies and other studies tackled the issue of quality of staff and the sub-variables that affect it. According to these studies, sub-variables that affect quality of staff include; staff motivation (Kennedy, 1998; Oyo, 2010; Buberwa, 2015; Zhang, 2014), staff competence (Oyo, 2010; Sukirno, 2017), staff qualification (Kennedy, 1998; Oyo, 2010), staff experience (Oyo, 2010; Rowley, 1996), student-to-staff ratio (Chindanya, 2002; Zhang, 2014), and loading hours per staff (Chindanya, 2002; Sukirno, 2017). The findings of these previous studies were confirmed by the participants' opinions from the interviews as will be discussed further in Chapter 6 in the discussion section.

Figure (4.24) represents the sub-diagram used in simulating the *"Quality of staff"*. This key variable is changed according to six sub-variables; *"Student to staff ratio"*, *"Loading hours per staff per week"*, *"Staff experience"*, *"Staff competence"*, *"Staff motivation"*, and *"Staff qualifications"*. (G13) and (G14) represent the effects of the first two sub-variables, as shown in Figure (5.25) and (5.26) respectively.
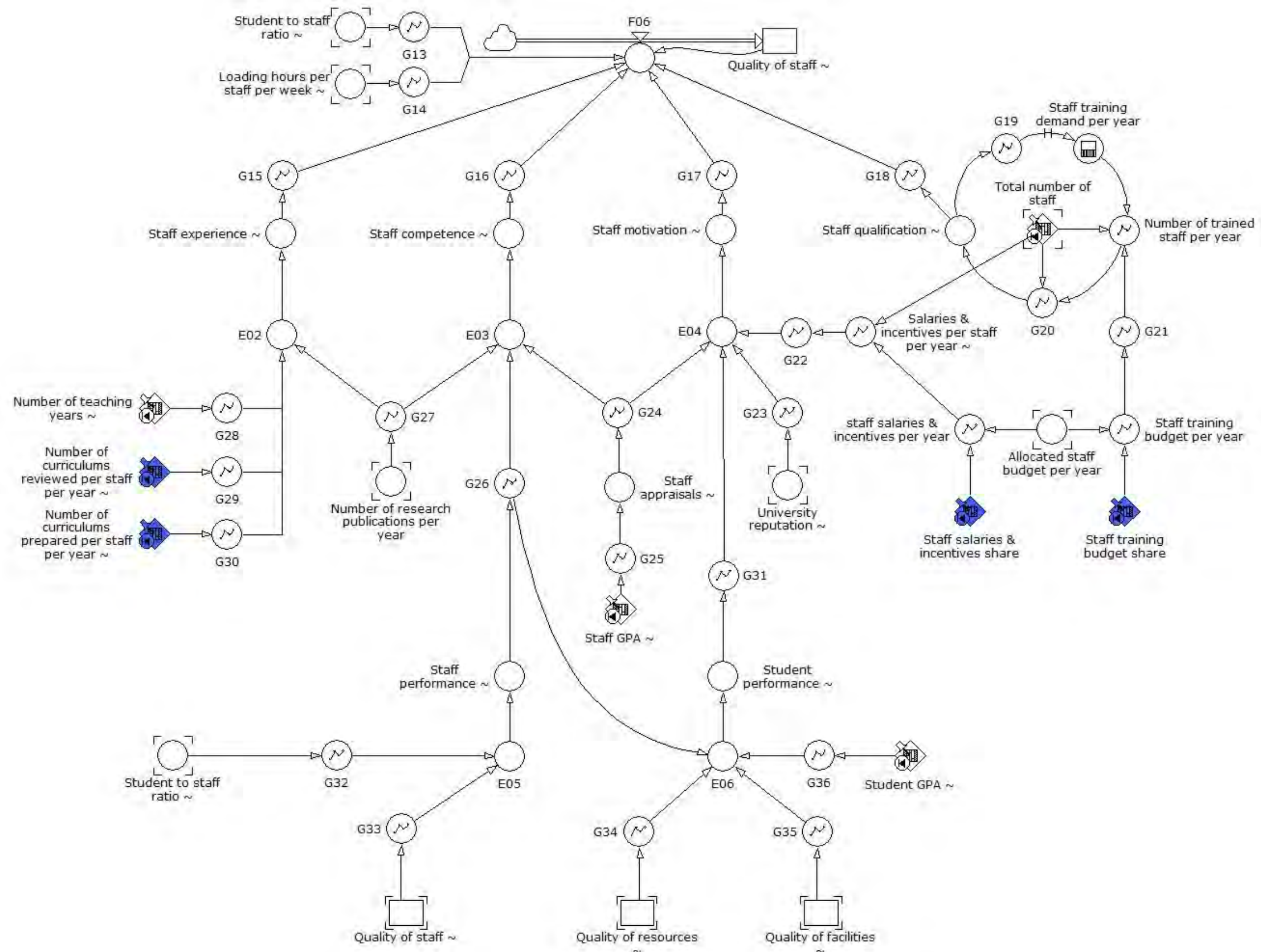
Figure 4-24: Sub-diagram of "Qualities of staff" and Related Variables
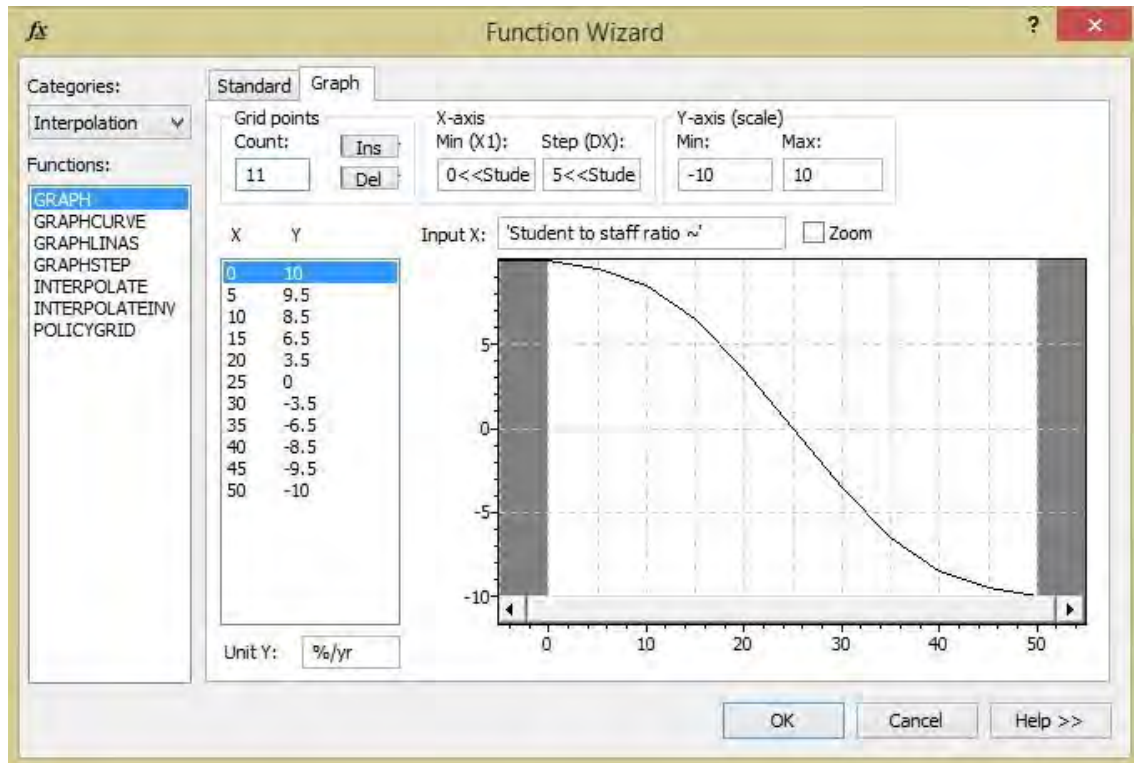
Figure 4-25: Effect of "Student to staff ratio" on "Quality of staff" (G13)

There is a negative relationship between "Students to staff ratio" and "Quality of staff" as shown in Figure (4.25). When the number of students is increased for each staff member, the member of staff will find it more difficult to teach. The number of students changes on a scale from 0 to 50 students per teacher, while the effect changes on a scale from -10% to +10%. The data in this graph was obtained from the experts that were interviewed.
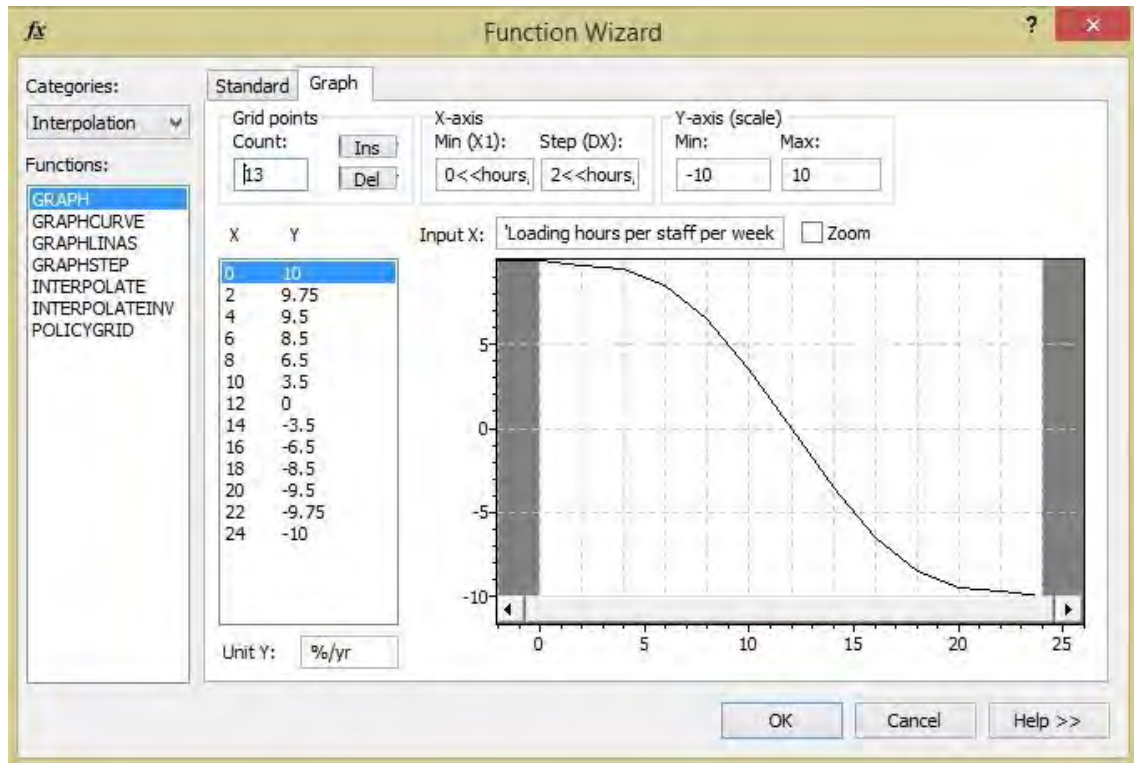
Figure 4-26: Effect of "Loading hours per staff per week" on "Quality of staff" (G14)

A similar negative effect is shown in Figure (4.26). It is the effect of "*Loading hours per staff per week*". It is clear that the *"Quality of staff"* will decrease when the load on a staff member is increased. The data for this graph is obtained from the interviews.

The other four variables - "Staff experience", "Staff competence", "Staff motivation" and "Staff qualification" - affect the "Quality of staff" and this is shown through the four graphs (G15), (G16), (G17) and (G18) respectively. The four graphs are quite similar and were drawn according to the conclusion of the interviews. One of these variables, "Staff experience", is shown in Figure (4.27).
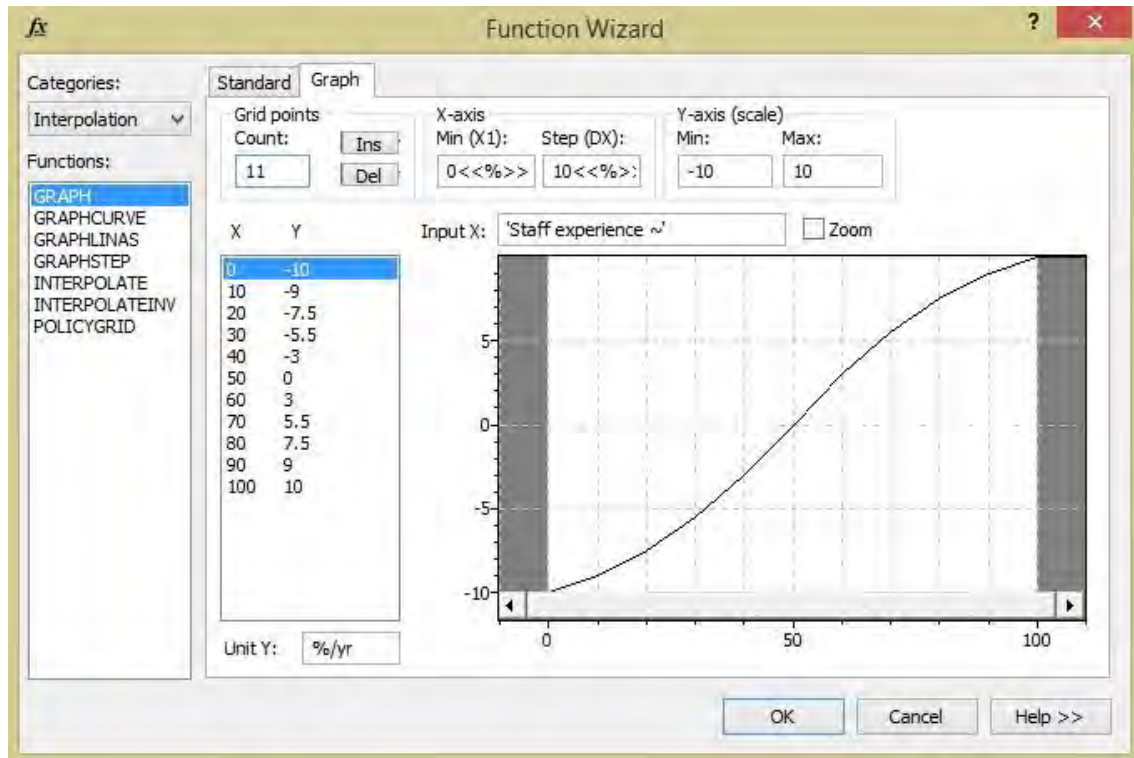
Figure 4-27: Effect of "Staff experience" on "Quality of staff" (G15)

As shown in Figure (4.27), there is a positive relationship between *"Staff experience"* and *"Quality of staff"* according to the S-shape curve. The *"Staff experience"* is of a scale from 0 to 100% while the effect ranges from -10% to +10%.

The *"Staff experience"* variable is affected by four variables; *"Number of teaching years"*, *"Number of curriculums reviewed"*, *"number of curriculums prepared"* and *"Number of research publications"*. All the effects of these variables are added together to form a weighted average that affects the *"Staff experience"*. The weights and effects are chosen according to the interviews and the opinions of the experts. The effects of these four variables are shown in the next figures.
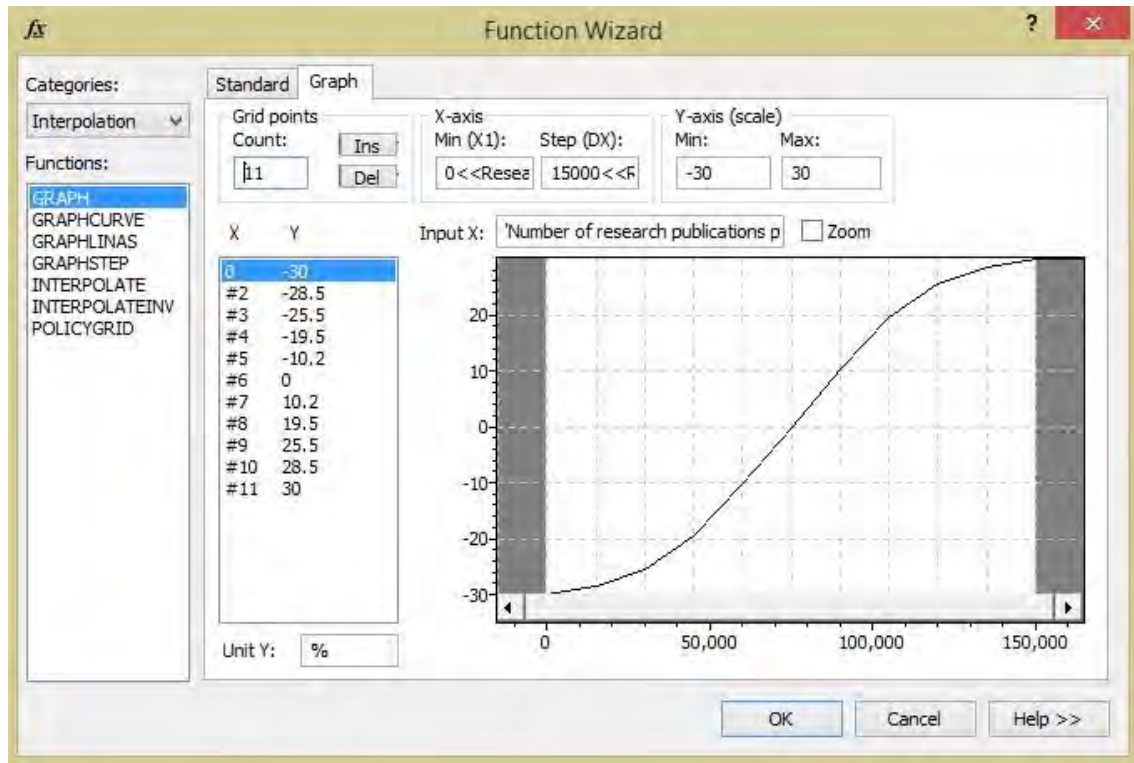
Figure 4-28: Effect of "Number of research publications" on "Staff experience" (G27)

The graph (G27) simulates the effect of *"Number of research publications"* on *"Staff experience"*. The no-effect value is set to 75 thousand research publications per year. A higher number of research publications implies a positive effect, while a lower number implies a negative effect with the maximum and minimum effects equal to +30% and -30% respectively. It should be noted that the number of research publications used in this graph is similar to the number of publications used in (G12). This data was obtained from the Ministry of HE. The drawing of the graph was undertaken based on the opinions of the experts whilst being interviewed.
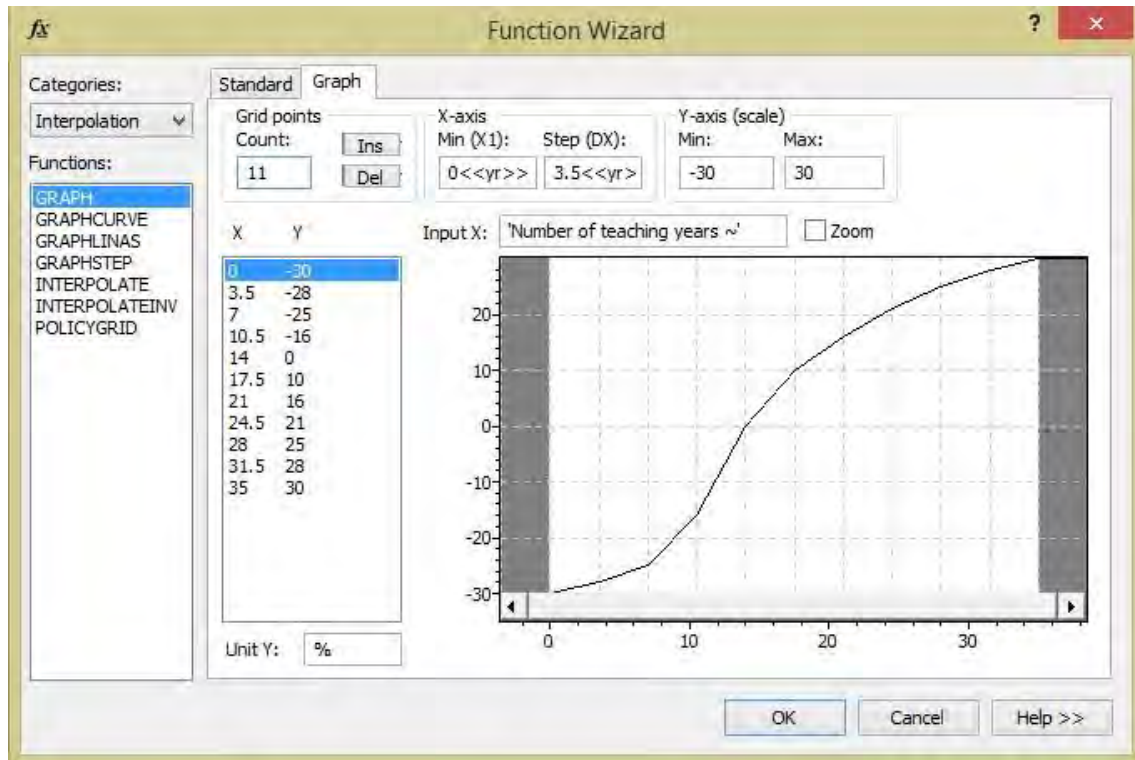
Figure 4-29: Effect of "Number of teaching years" on "Staff experience" (G28)

The second variable that affects *"Staff experience"* is the *"Number of teaching years"*. This variable can be seen as having the most fluctuation among the four variables on the experience so it was given the largest weight. The point of no-effect was set to 15 years. If the staff member has experience of more than 15 years, a positive effect is produced, and vice versa. The maximum and minimum effects are +30% and -30% respectively. The S-shape curve as well as the data was both obtained from the interviews.

Figures (4.30) and (4.31) show the effects of *"Number of curriculums reviewed"* and *"Number of curriculums prepared"* respectively. It has been assumed that, for a positive effect, a minimum number of 2 curriculums revisions per year and a minimum number of 1 curriculum preparations per year are required. Higher numbers would cause a positive effect on the *"Staff experience"* while lower numbers would make it a negative effect, according to the experts' opinions that were captured during the interviews.
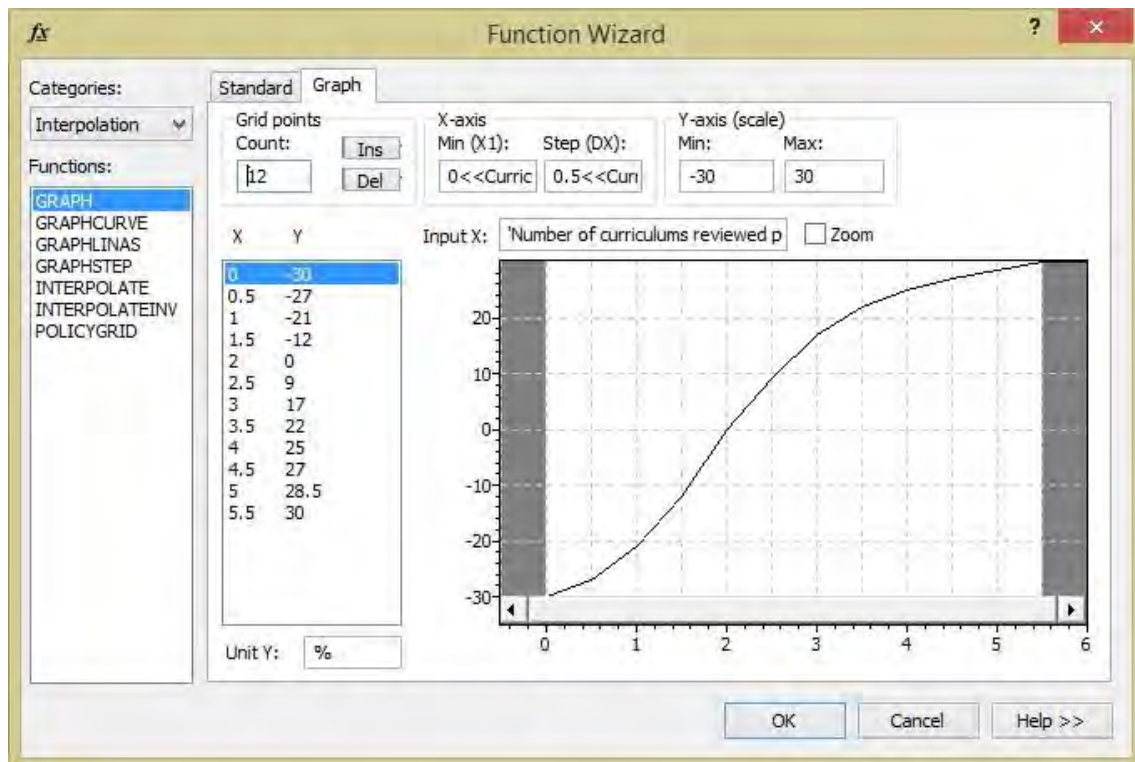
Figure 4-30: Effect of "Number of curriculums reviewed" on "Staff experience" (G29)
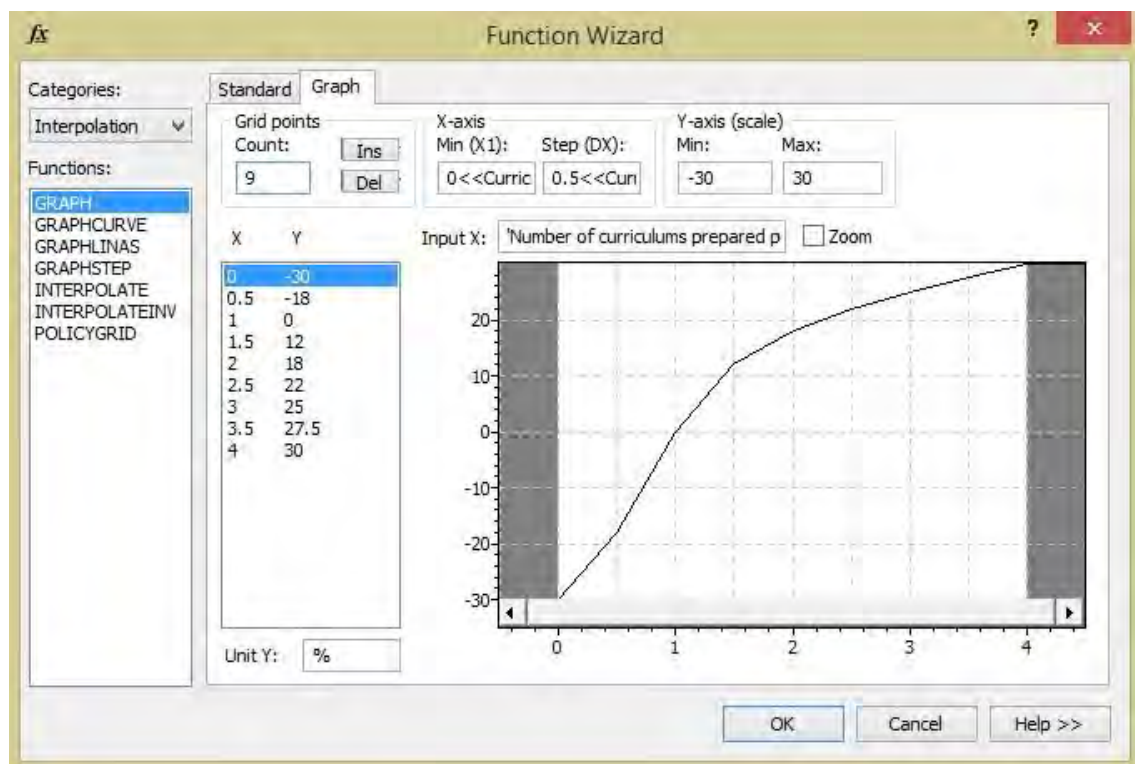
Figure 4-31: Effect of "Number of curriculums prepared" on "Staff experience" (G30)

The *"Staff competence"* variable is affected by three variables; *"Number of research publications per year"*, *"Staff performance"* and *"Staff appraisals"*. The effect of *"Number of research publications per year"* is represented by the graph (G27) which was discussed earlier. The effects of *"Staff performance"* and *"Staff appraisals"* are represented by (G26) and (G24) respectively and they are quite similar. The graph (G26) is shown in Figure (4.32)
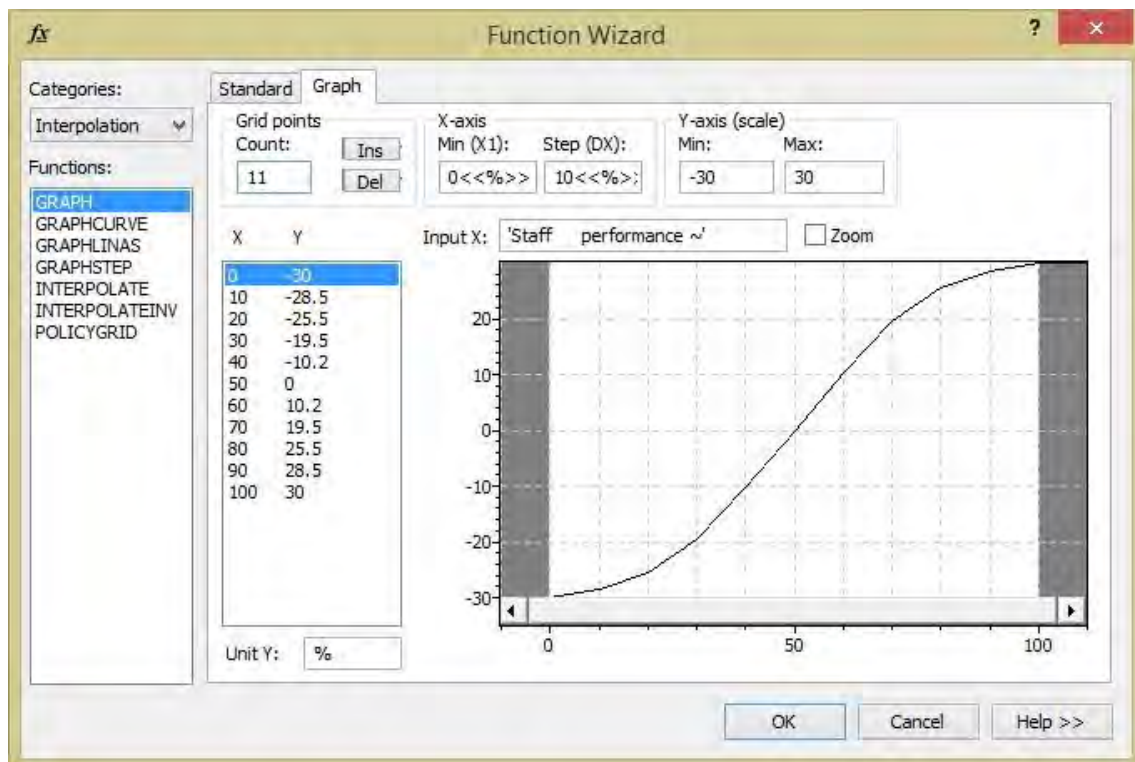
Figure 4-32: Effect of "Staff performance" on "Staff competence" (G26)

As shown in Figure (4.32), there is a positive relationship between *"Staff performance"* and *"Staff competence"* according to the S-shape curve. This relationship is concluded from the interviews' analyses. *"Staff performance"* varies between 0 and 100% while its effect varies between -30% to +30% to *"Staff competence"*.

The two variables "Staff performance" and "Staff appraisals" are affected by other sub-sub-variables. The variable "Staff performance" is affected by both "Student-to-staff ratio" and "Quality of staff" itself, while the variable "Staff appraisals" is affected by "Staff GPA". These findings match with findings of previous studies (Sukirno, 2017; Victor & Babatunde, 2014).

The variable *"Staff motivation"* is affected by four other variables; *"Staff appraisals"*, *"Student performance"*, *"University reputation"* and *"Salaries and incentives per staff per year"*. The first three variables are represented by the graphs (G24), (G31) and (G23) respectively and they are similar to the graph (G26) shown in Figure (4.32). The fourth variable, *"Salaries and incentives per staff per year"* affects *"Staff motivation"* though the graph (G22) shown in Figure (4.33).
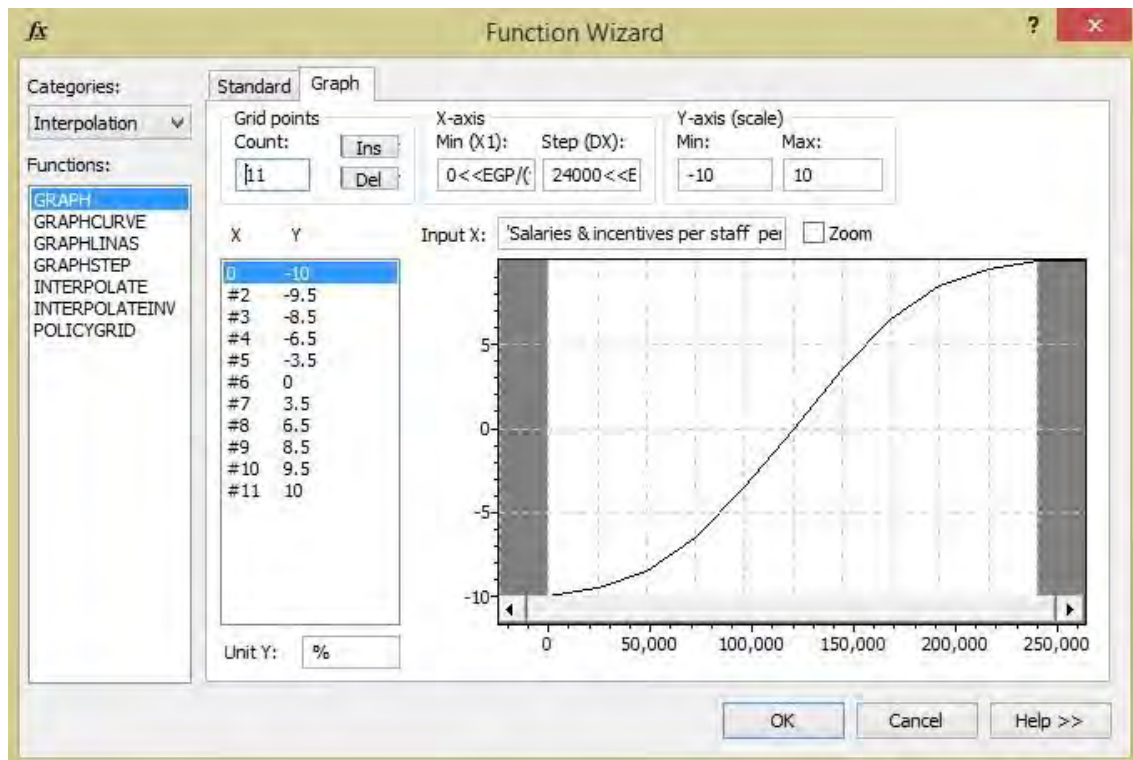
Figure 4-33: Effect of "Salaries and incentives per staff" on "Staff motivation" (G22)

The graph (G22) simulates the effect of *"Staff salaries and incentives"* though the S-shape curve shown in Figure (4.33). The salaries and incentives per member of staff per year varies between 0 to 250 thousand Egyptian Pounds while the effect varies between -10% to +10%. The point of no-balance is set to 125 thousand Egyptian Pounds according to the experts' opinions during the interviews. This means that if the salaries and incentives are higher than this value, a positive effect will be produced, and vice versa. The variable *"Staff qualification"* is part of a balancing loop in the model, along with the two variables *"Staff training demand per year"* and *"Number of trained staff per year"*. When the *"Number of trained staff per year"* increases, the *"Staff qualification"* is improved according the graph (G20) shown in Figure (4.34). As a result, the *"Staff training demand per year"* is decreased following the effect of the graph (G19) shown in Figure (4.35), but this decrease causes the *"Number of trained staff per year"* to decrease as well. This continuous process is repeated and is seen to cause a fluctuating behaviour of the three variables that form the loop until equilibrium is reached. These graphs are drawn according to the interviews.
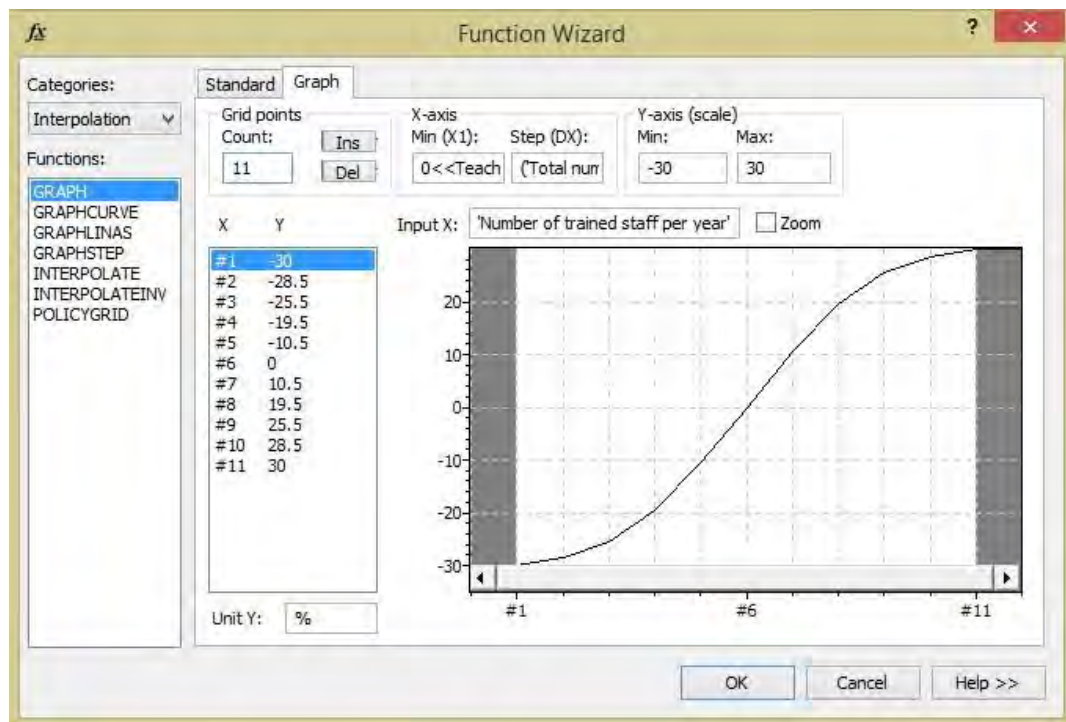
Figure 4-34: Effect of "Number of trained staff" on "Staff qualification" (G20)
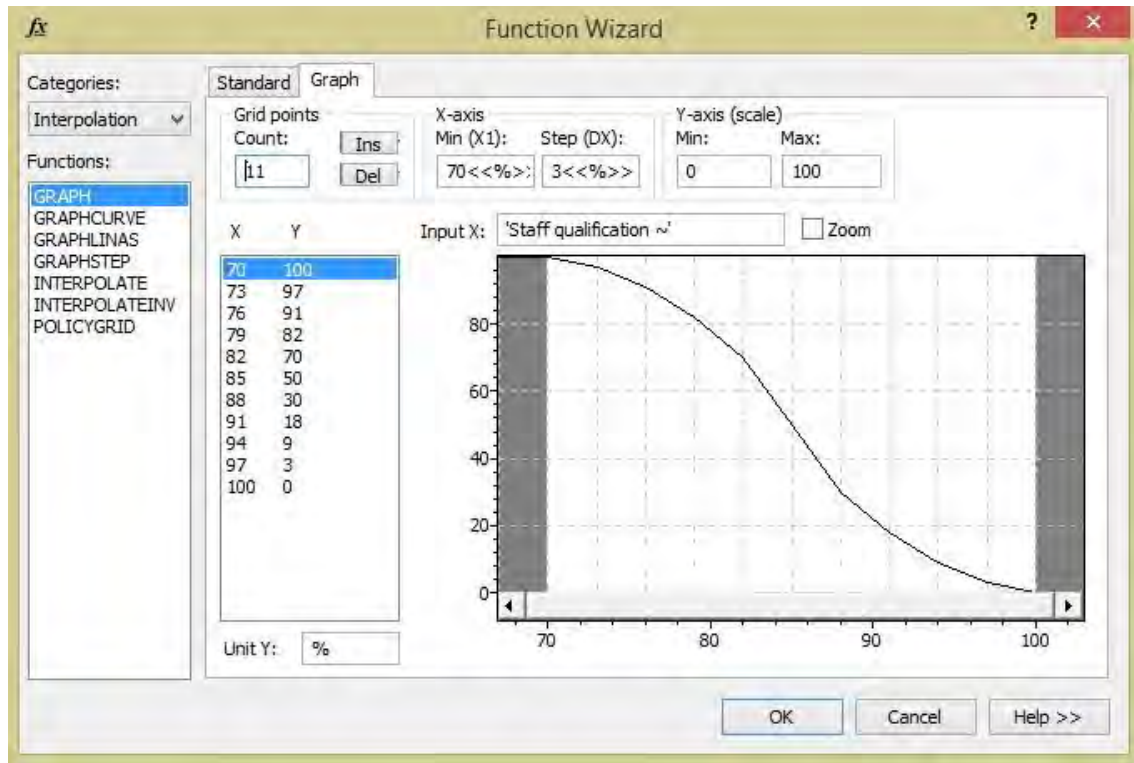
Figure 4-35: Effect of "Staff qualification" on "Staff training demand per year" (G19)

The role of funding in affecting *"Quality of staff"* is apparent in Figure (4.24); the *"allocated staff budget"* is distributed between two allocations; *"Staff training budget"* and *"Staff salaries and incentives"*. The *"Staff training budget per year"* has a positive relationship with the *"Number of trained staff per year"*. If the training budget is increased more staff members can be trained. The other allocation, *"Staff salaries and incentives per year",* is used to calculate the salaries and incentives of each staff member, which has an effect on *"Staff motivation"*.

The *"Staff performance"* variable is affected by the weighted effects of the variables; *"Student to staff ratio"* and *"Quality of staff"* while the *"Student performance"* variable is affected by the weighted effects of the four variables; *"Student GPA"*, "Staff performance", "Quality of resources" and "Quality of facilities". The effects of these variables are similar to the effect in the graph (G26) as I have mentioned before.

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4.3.3.5 Quality of teaching

In Figure (4.36), the sub-model of *"Quality of teaching"* is depicted. It is clear that it is affected by *"Quality of curriculum"*, *"Quality of staff"*, and *"Class size"*. The variable *"Average class size"* is the result of dividing two variables; *"Total number of students"* and *"Number of classes"*. The effects of *"Quality of curriculum"* and *"Quality of staff"* are represented by the graphs (G38) and (G39) respectively and they are the same as the effect of "Quality of staff" as I mentioned earlier (G01). The effect of *"Class size"* is simulated though the graph (G37) shown in Figure (4.37).
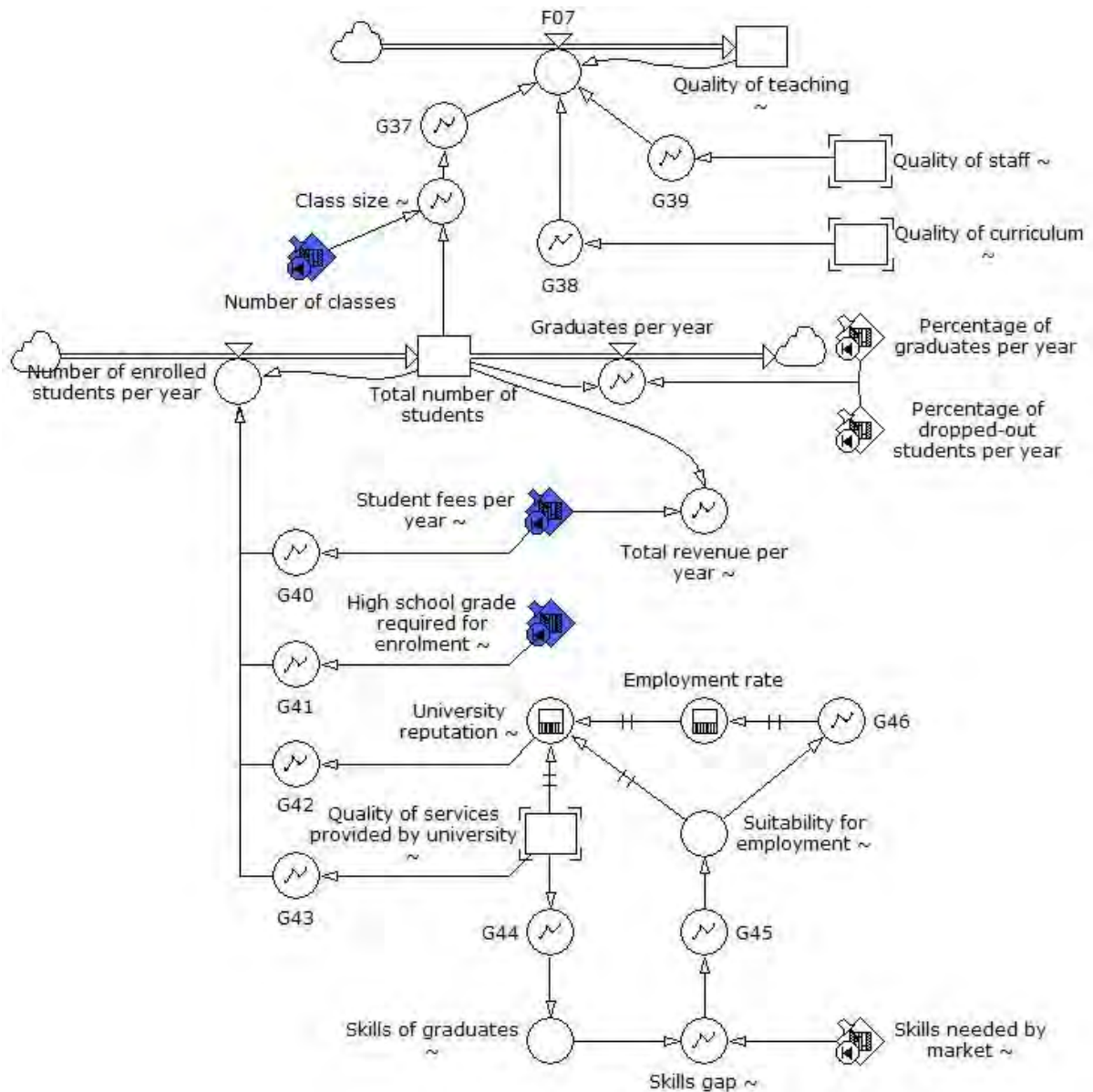
Figure 4-36: Sub-diagram of "Quality of Teaching" and Related Variables
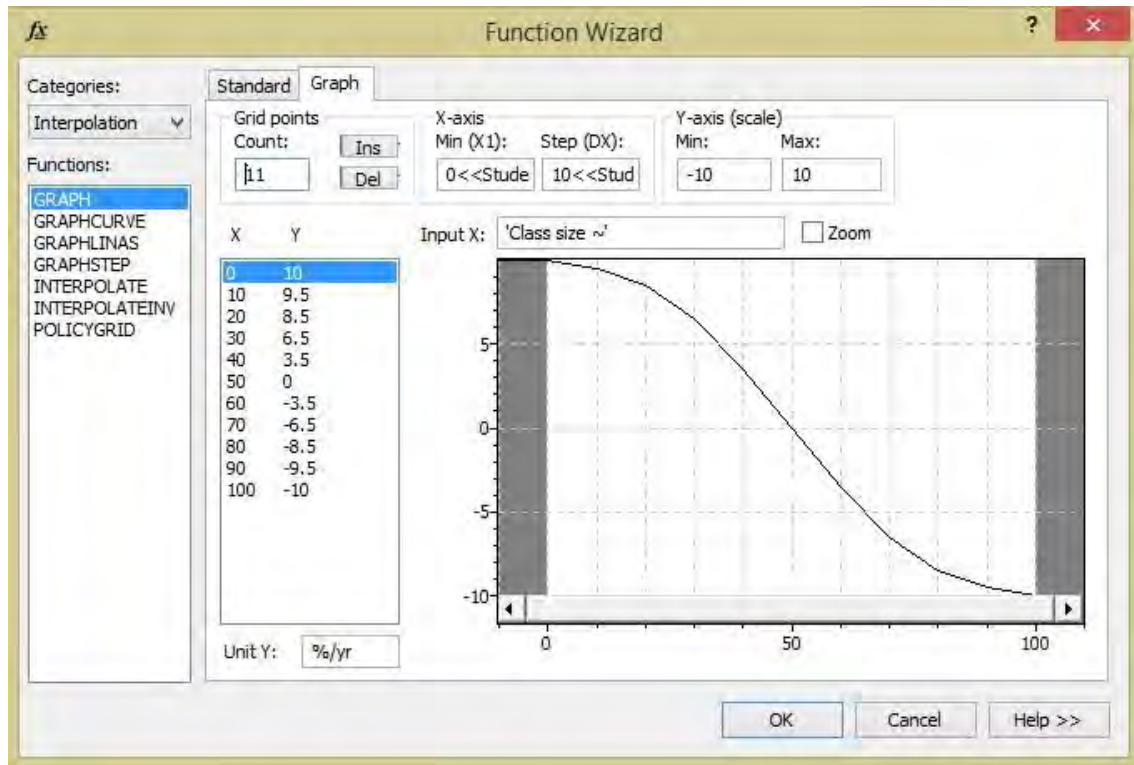
Figure 4-37: Effect of "Class size" on "Quality of teaching" (G37)

As shown in Figure (4.37), there is a negative relationship between *"Class size"* and *"Quality of teaching"*. When the number of students increases within the class, it becomes more difficult for the teacher to impart their knowledge. The number of students in the class ranges from 0 to 100 Student per class, while the effect ranges from -10% to + 10%. The graph was drawn based on information from the interviews that were conducted. It is noted that the value *"Class size"* is an average value and is calculated by dividing the total number of students by the total number of classes.

As shown in Figure (4.36), the number of students is calculated within the stock named *"Total number of students"*. There are two flows that control its value; *"Number of enrolled students"* represents the inflow, while *"Number of graduates"* represents the outflow.

The *"Total number of students"* is used along with the average *"Student fees per year"* to calculate the *"Total revenue per year"*. The inflow to the *"Total number of students"* is represented by the *"Number of enrolled students per year"* which is affected by four variables; *"Student fees per year"*, *"High school grade required for enrolment"*, *"University reputation"* and *"Quality of services provided by university"*. The effects of these four variables are represented through the graphs (G40), (G41), (G42) and (G43) respectively. The next figures can be seen to correlate these findings into graph form.
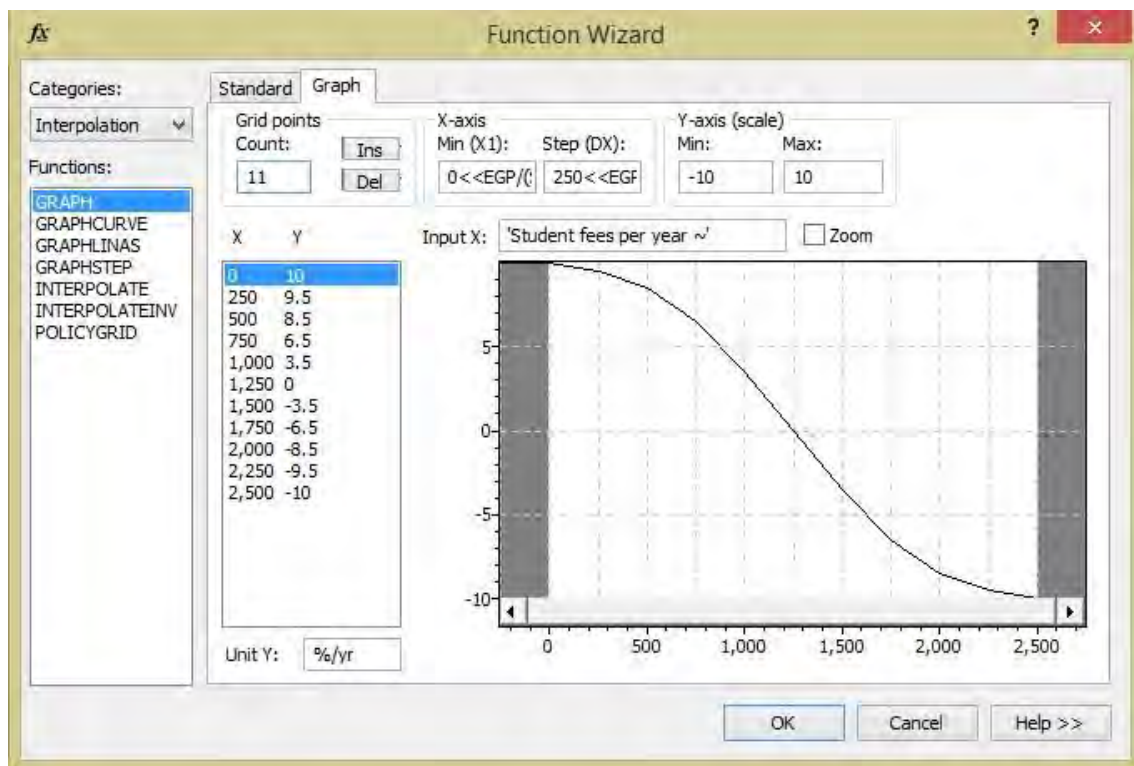
Figure 4-38: Effect of "Student fees per year" on "Number of enrolled students" (G40)

There is a negative relationship between "Student fees per year" and "Number of enrolled students per year". The point of no-effect is when the Student fees are equal to 1250 Egyptian Pounds per year. Any increase above this value will decrease the number of enrolled students and vice versa. The effect ranges from -10% to +10%. This effect has been concluded from information gained during the interviews.
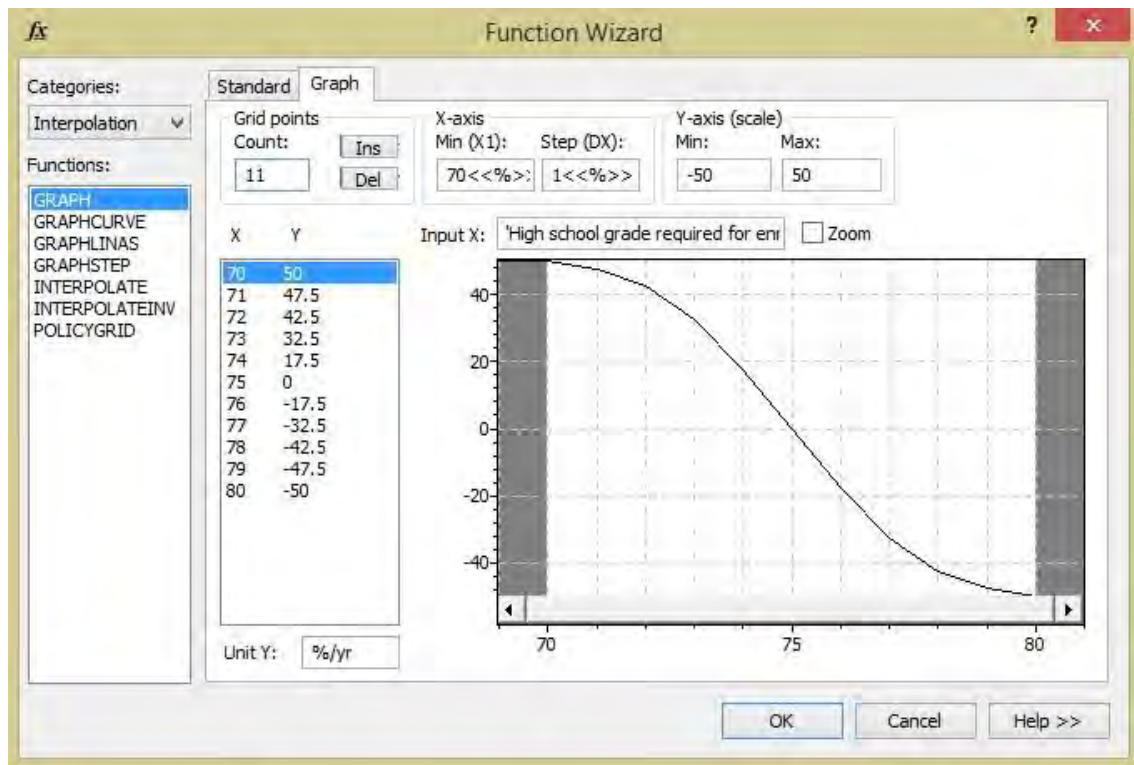
Figure 4-39: Effect of "High school grade" on "Number of enrolled students" (G41)

The graph (G41) has shown in Figure (4.39) represents the effect of *"High school grade required for enrolment"* on the *"Number of enrolled student per year"*. According to the experts' opinions in the interviews, any small change in the *"High school grade required for enrolment"* can cause a high effect on the number of enrolled students. The average *"High school grade"* is simulated between 70% and 80%, while the effect ranges between -50% to +50%.

The other two variables affecting *"Number of enrolled students"* are *"University reputation"* and *"Quality of services provided by university"*. The effects of these two variables are similar to the standard S-shape curve in the graph (G01); they both range from 0 to 100% and their effects ranges from -10% to +10% according to the experts in the interviews.

The *"Quality of services provided by university"* is the goal of the model. It affects the *"Skills of graduates"* through the graph (G44) shown in Figure (4.40). It is shown that the *"Quality of services provided by university"* ranges from 0 to 100% while its effect ranges from -40% to +40%. These values were estimated based on information from the interviews.
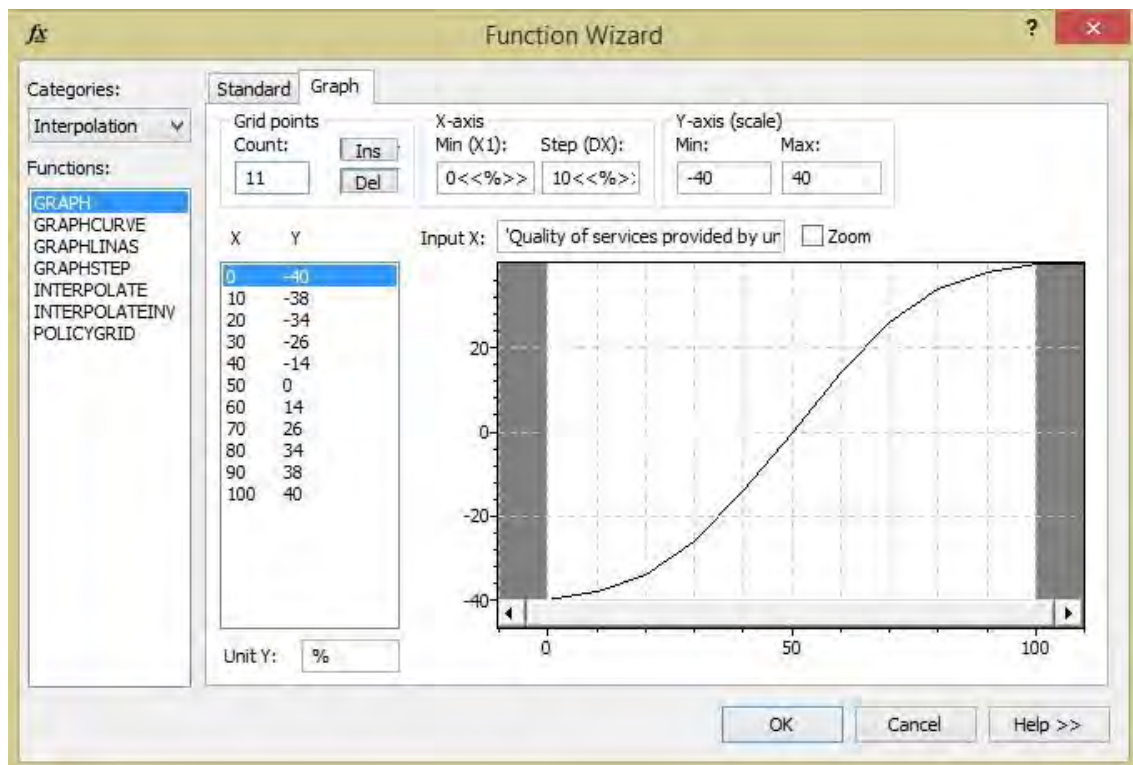
Figure 4-40: Effect of "Quality of services provided" on "Skills of graduates" (G44)

The "Skills of graduates" variable is compared to the "Skills needed by market". The difference between these two variables is the "Skills gap" which poses a problem within the research. As an assumption, the "Skills needed by market" is constant for the five years of simulation for two reasons; the first reason is to investigate the effect of increasing skills of graduates on the gap while the second reason is that "Skills needed by market" doesn't change much in these five years so these changes can be ignored, all its values are close to 90% as measured by NAQAAE.
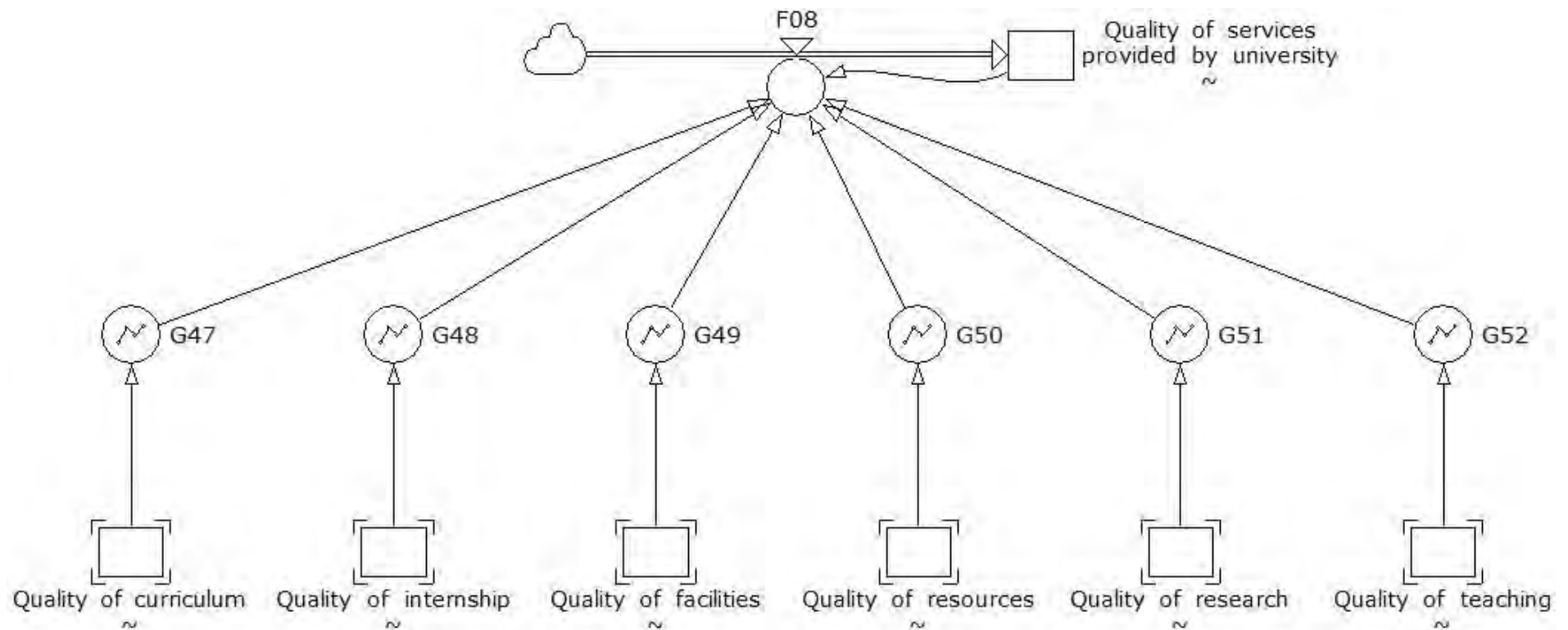
Figure 4-41: Sub-diagram of "Quality of services provided by university"

4.3.3.6 Quality of services provided by university

The final sub-model is shown in Figure (4.41). It contains the six key variables that contribute to the *"Quality of services provided by university"* through six graphs such as (G47) shown in Figure (4.42). However, some key variables have larger effects than others on the *"Quality of services provided by university"*. The weights of the key variables are chosen according to their importance as perceived by experts in the interviews. The key variable *"Quality of staff"* isn't present in this sub-model because it affects the *"Quality of services provided by university"* indirectly through *"Quality of teaching"*, *"Quality of curriculum"* and *"Quality of research"*.
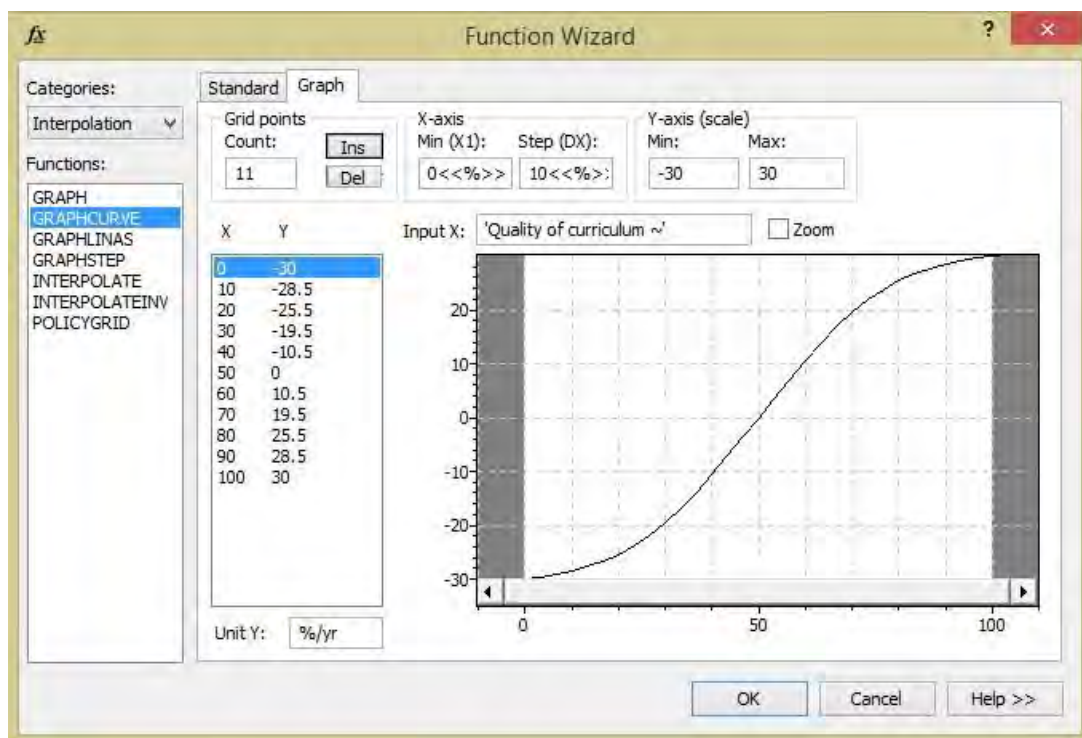
Figure 4-42: Effect of "Quality of curriculum" on "Quality of services provided" (G47)

In Figure (4.43), another sub-diagram is used to calculate the sub-variables; *"Student to staff ratio"*, *"Loading hours per staff per week"*, *"Desired resources budget"* and *"Desired facilities budget"* which are calculated by the equations listed in the **Appendix E**.
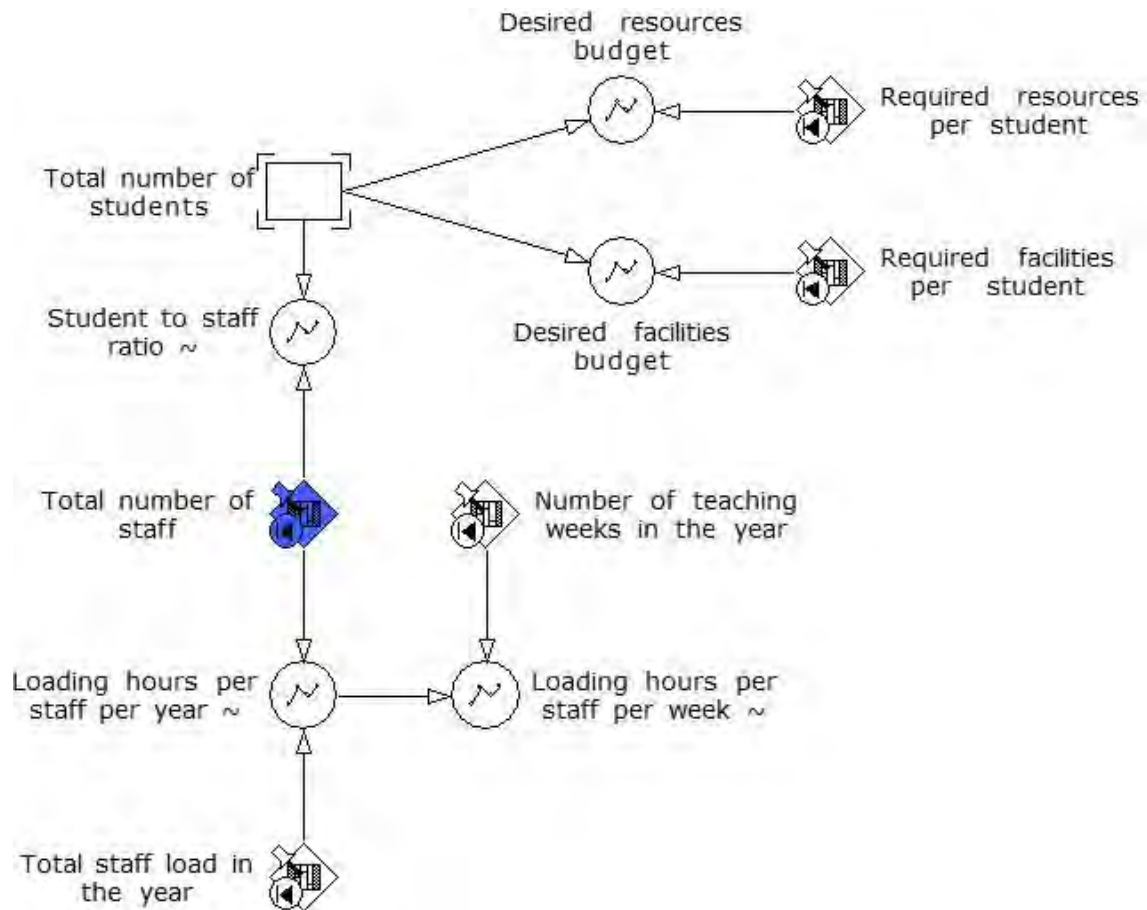
Figure 4-43: Sub-diagram of Other Sub-variables

4.4 Summary

This chapter represents the qualitative phase of this study. First, the outputs of the semi-structured interviews were analysed, both descriptively and in detail. The descriptive analysis showed the characteristics of the participants and their differences. The detailed analysis showed their opinions and thoughts about the research problem. According to this analysis, the researcher moved to the conceptualisation stage where he determined the model purpose, assumptions, boundary, time horizon, and reference modes. After that, the researcher could develop a casual model using the outputs of the interviews. This model represents the variables that affect quality of the real HE system in Egypt.

The researcher has ensured that he has discussed all the parameters of the model that have notable effects on the key variables and by using this information within this model he has made the model more reliable. The researcher then moved to the formulation stage where the variables were identified, formulated, and measured. This enables the researcher to build the stock-and-flows diagram about all the key variables, sub-variables, and sub-sub-variables.. The mental model and the formal model in this chapter gave the reader hugely significant information about the dynamic complexity of the HE system in Egypt.

Modelling is an iterative process, much like learning, as the researcher has gained more experience during the model building process. This experience caused the continuous revision and modification of the model until a suitable and reliable model was obtained. The outputs of the qualitative phase are evaluated in details in the next chapter in the validation stage which makes sure that the outputs of the qualitative phase are valid and represent the real HE system in Egypt. In the next chapter, the quantitative phase of the research is undergone through the validation and implementation stages.

Chapter Five: Quantitative Phase

Quantitative Data Analysis & Results

5.1 Validation Stage

5.1.1 Structure Validation

5.1.1.1 Boundary Adequacy Test

5.1.1.2 Structure Assessment Test

5.1.1.3 Dimensional Consistency Test

5.1.1.4 Parameter Assessment Test

5.1.1.5 Extreme Conditions Test

5.1.2 Behaviour Validation

5.1.2.1 Behaviour Replication Test

5.1.2.2 Behaviour Anomaly Test

5.1.2.3 Behaviour Sensitivity Test

5.1.3 Model Validation

5.2 Implementation Stage

5.2.1 Policy Structure

5.2.2 Simulation Results

5.2.3 Scenarios

5.2.4 Best Predicted Situation

5.3 Summary

CHAPTER 5
QUANTITATIVE PHASE
VALIDATION & IMPLEMENTATION

By the end of Chapter 4, the mental model (causal loop diagram) and the formal model (stock-and-flow diagram) have been constructed and the variables were formulated. This chapter discusses the validation of the model. The model should be first validated before implementation to get improvement policies. This chapter contains two main sections: Quantitative data analysis and results [5.1], which represents the model validation stage and the model implementation stage. Then, section [5.2] provides summary of the chapter.

5.1 Quantitative Data Analysis & Results

5.1.1 Validation Stage

In Chapter 4, a System Dynamics model was created to investigate the effects of different key variables on the quality of public Egyptian universities. After the model building stage comes the model validation stage. The model validation stage is the measure of the model's usefulness. A validated model is proved to be reliable and can be used to develop policies to improve the real system.

There are two stages to the validation process. One is the show that the model is structurally correct i.e. there are no errors in the way the model is assembled. John Sterman has identified several key tests for structural validation which deeply inspecting the equations and graphs of the model and the connections between the variable to ensure that

the model was correctly built The second stage is the behavioural validation which investigates the behaviour of the model in different conditions including extreme of unreal conditions. These tests are discussed in the following sections.

5.1.1.1 Structure Validation

The model was subjected to the following test to check the validity and reliability of the model structure:

5.1.1.1.1 Boundary Adequacy Test

The model boundary chart shown in **Appendix E** contains all the endogenous and exogenous variables used in the model. This list was carefully inspected to make sure that all the variables are related to the model purpose. Variables with minor or no effect on the model purpose were excluded from the model to avoid any unnecessary complication. All the key variables are included endogenously in the model. Furthermore, all the exogenous variables were estimated using historical data.

The interviews carried out with a number of experts in the field of HE system in Egypt helped to make sure that all the variables are taken in consideration. The model boundary chart is large enough to include all the important variables that affect the model purpose. At the same time, any unimportant variables were excluded to avoid any unnecessary complications. However, these variables were included again and the results were obtained. It was observed that the results do not change significantly after including these variables. So, it has been proved that the exclusion of these variables does not affect the model purpose or the resulting policies.

5.1.1.1.2 Structure Assessment Test

This test is to make sure that there aren't any impossible actions or inconsistencies in the model. The model was studied to make sure there are no free lunches, no inappropriate assumptions, and no imaginary decisions. The stock-and-flow structure was inspected to make sure that the aggregation level is suitable. The policy structure was inspected to avoid any impossible or inapplicable decisions. The equations of variables were revised so that no illogic values would appear. Each stock is supplied with a first-order negative feedback control. Any inappropriate assumption that does not agree with the real system is removed.

This test is carried out many times with each simulation run of the model. Each time the model is simulated in the software (with different inputs and scenarios), the values of all the variables are observed to make sure that no value breaks the conservation laws and no value is imaginary. Also the resulting policies at the final stage (implementation stage) were studied. If any policy had an impossible decision, the policy structure was reviewed and modified if necessary.

5.1.1.1.3 Dimensional Consistency Test

The "PowerSim Studio 10 Academic" software has a useful feature to maintain a logic and meaningful simulation. It automatically detects any units' inconsistency. If any variable is defined with a strange unit, or the unit of a variable doesn't agree with the units of related variables, an error would appear to alert the model builder. However, it is possible in the software to add your own units, which are not predefined in the software, such as "student" as a unit of the variable "number of students" or "class" as a unit for the variable "number of classes." Although this test is done automatically by the software during the model building process, each equation is manually inspected to check if there

are any meaningless or strange combinations of units. If there is any, they are reviewed and repaired.

5.1.1.1.4 Parameter Assessment Test

According to Sterman (2000), for the large and complicated models (as the model of this study) it is better to estimate the values of parameters by judgmental methods. This model was formulated using two methods. The primary method is the judgemental method which uses qualitative data obtained from the experts to estimate the overall behaviour, the relationships and the equations. The secondary method is the available secondary data used to estimate the actual values of the inputs for the five years.

To imply this test, each sub-model was subtracted from the main stock-and-flow diagram. Historical data were used as inputs to the sub-model then the equations and graphs were modified so that the outputs of the sub-model can best fit the data. All variables' names and units are shown in **Appendix E**.

5.1.1.1.5 Extreme Conditions Test

This test is used to make sure that all the outputs are realistic regardless how extreme the inputs are. Each equation was inspected to make sure that the output of the equation is realistic. The protection procedures of the equations included a control feedback loop to protect the variable from breaking the conservation laws. Stocks shouldn't fall below zero. Other quantities shouldn't increase above predefined value (for example, the qualities are defined in percentage unit so it can't increase above 100%). After making sure that the output of each equation is reasonable. The whole model was tested by setting all the inputs to extreme values and running the model. The results were realistic and the model was proven to be immune to extreme conditions' errors. The extreme conditions used in this test are shown in Table (5.1).

Table 5-1: Extreme Conditions Used for Validation

Variable	Extremes	Test results	
		Normal	Abnormal
Student-to-staff ratio	Very high versus very low	✓	
Demand for internship	Very high versus very low	✓	
Available funds per year	Very high versus very low	✓	
Average student fees per year	Very high versus very low	✓	
Staff training demand	Very high versus very low	✓	

5.1.1.2 Behaviour Validation

After validating model structure, the model behaviour was investigated for validation. The following tests were carried out to validate the model behaviour:

5.1.1.2.1 Behaviour Replication Test

The model results, obtained from the initial run, were compared to the real data collected about the real system. The difference between the model results and the real data caused the model to be reviewed several times. Some equations were edited, some values of variables were re-estimated, and some feedback structures were slightly changed. After the edition and retesting several times, the behaviour of the final model was similar to the behaviour of the real system along the time horizon of the simulation. Four simulated behaviours were compared to reference modes: Quality of Teaching, Quality of Resources, Student Numbers and Total Revenue.

Because of the lack of the exact historical data for these important variables, the reference modes were approximated. This approximation has been made according to the information that was gathered from the interviews with the experts as well as the secondary data. The reference modes were compared to the simulated behaviour that resulted from the simulation. It is important to mention that the purpose of this comparison is not to reach 100% match between the graphs, but to make sure the overall behaviour of the model is the same as the behaviour of the real system. This means that the curves in both graphs should be the same in shape and direction.

- **Quality of Teaching**

Figure (5.1 A & B) shows the modelling results vs. the reference mode of *"Quality of teaching"* and the sub-variables affecting this key variable. The data used in this figure is taken from Table (5.3). As shown in the figure, both *"Quality of Staff"* and *"Quality of Teaching"* are increasing in a fast rate in the first two years and this rate slows down in the next three years until they become almost constant in the last year. These behaviours agree with the behaviours in the reference modes.

(A)   (B)
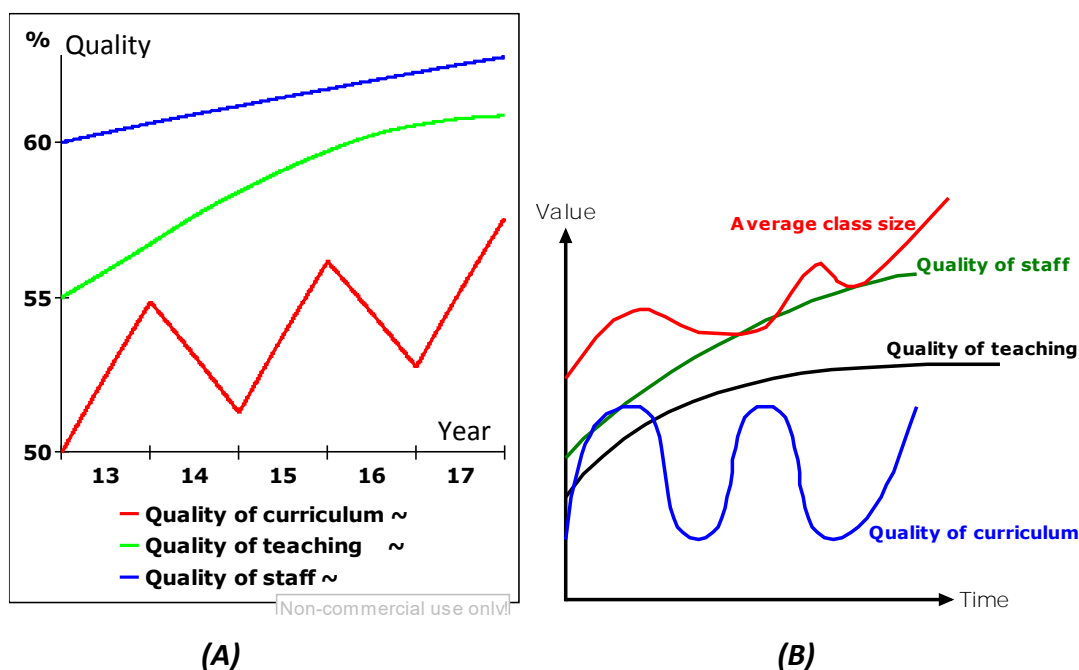
Figure 5-1: "Quality of teaching" and Related Variables:

(A) Simulated Behaviour, (B) Reference Mode

"Quality of Curriculum" is going up and down between 50% and 57% because of the low rate of revision (1 revision each two years), but the overall behaviour has a slight increase with the time.

- **Quality of Resources**

Figure (5.2 A & B) shows the simulated behaviour vs. the reference mode of "Quality of Resources" and the related variables. The data used in this figure is taken from Table

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(5.3).As we can see in the figure, the increase in the allocated resources budget isn't enough to withstand the increase in the total number of students. The total number of students is increasing in a high rate every year causing a very large increase in the demand for resources. This causes the "Quality of resources" to drop. Both simulated behaviour and reference mode have similar behaviours.

(A)   *(B)*
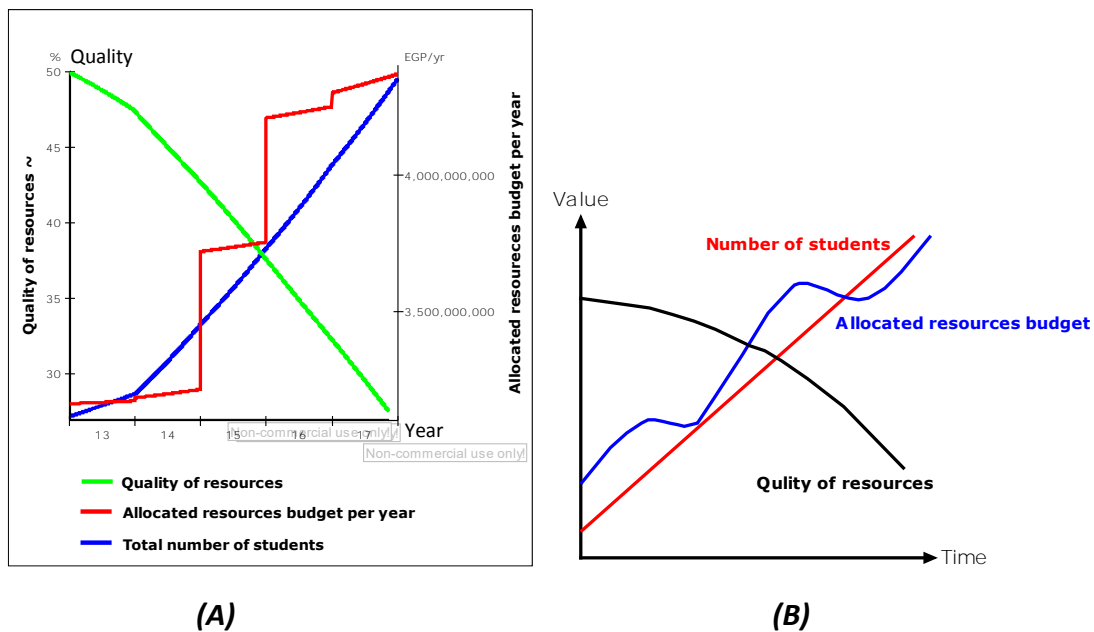
Figure 5-2: "Quality of resources" and Related Variables:

(A) Simulated Behaviour, (B) Reference Mode

- **Student Numbers**

Figure (5.3 A, B & C) shows the simulated behaviour vs. the reference mode of "Number of Enrolled Students", "Number of Graduates", and "Total revenue" in the five years of simulation. The data used in this figure is taken from Table (5.3).The simulated behaviours and the reference modes agree together. It is noted that both the "Number of Enrolled Students" and "Number of Graduates" are increasing. However, the "Number of Graduates" drops dramatically in the second year (2013/2014). This is because of the decision of the Ministry of Education in 2004 to change the period of primary education

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from 5 to 6 years causing a one year gap, which moved forward, and caused the "number

of graduates" in 2014 to drop this way. This phenomenon is also the cause for increasing

the growth rate of the number of students in Figure (5.3 A & C) starting from the second

year.It is obvious that the behaviour of the simulated model is similar to the behaviour of

the reference mode.

(A)   *(B)*

(C)
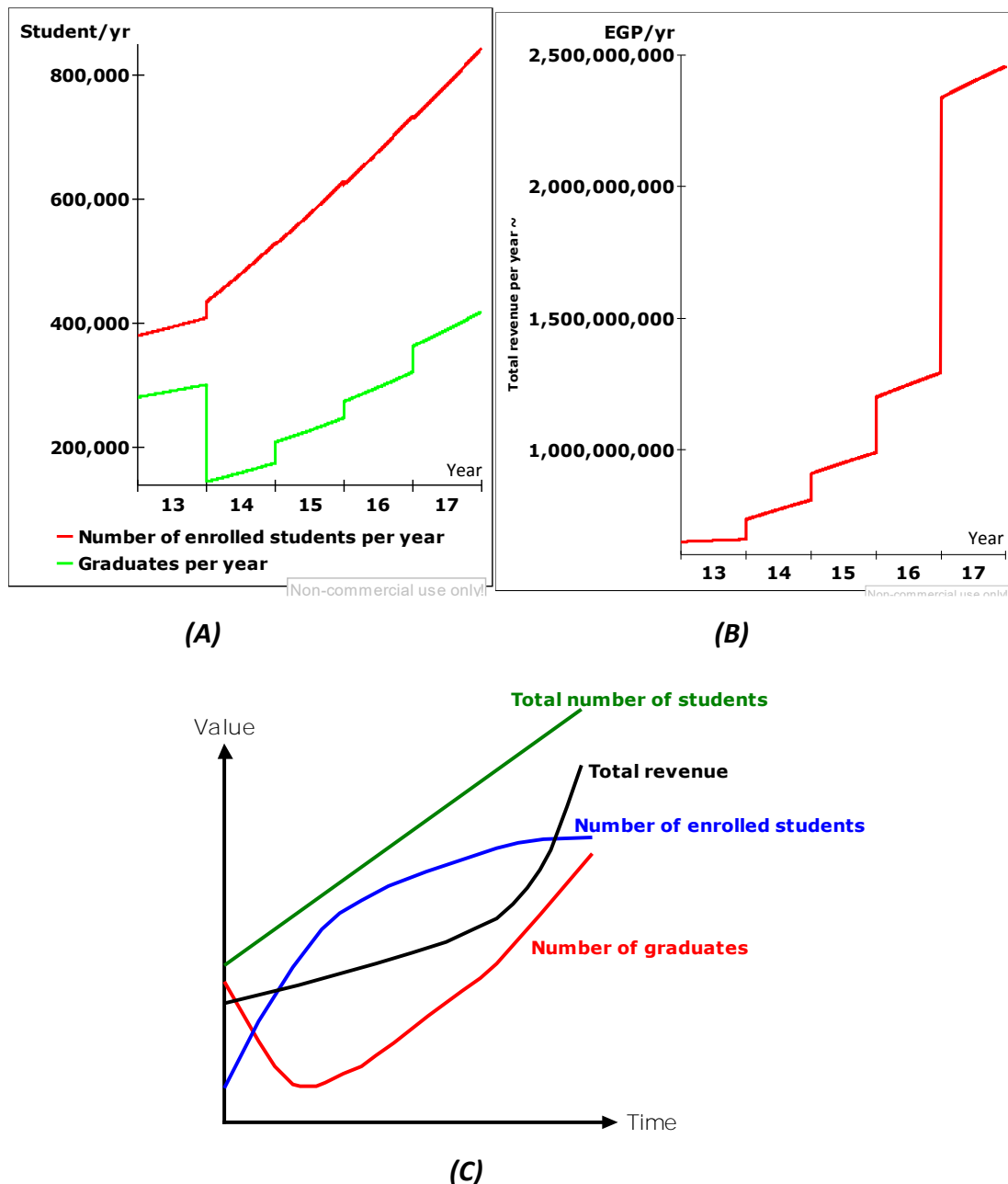
Figure 5-3: "Enrolled students", "Graduates", and "Total revenue":

(A) & (B) Simulated Behaviour, (C) Reference Mode

Total revenue is dependent on two variables: "Total number of students" and "Average student fees per year". There is an increase in the number of student each year as well as an increase in the average student fees which cause the increase in the total revenue shown in the figure. In the last year there was a high increase in the total revenue because of the big increase in the fees in this year. The average student fees in this year almost doubled.

5.1.1.2.2 Behaviour Anomaly Test

This test is used to know the importance of each sub-model. Each of the sub-models is subtracted from the model and the model is simulated to see the difference occurring in the results. Also, another technique called "Loop Knockout Analysis" was used. It was done by setting some values to zero in order to hide the effect of certain loops to study their effects. This test was implemented along with the extreme condition test. This is because the extreme conditions help to reveal the most affecting parameters. After implementing the test, it has been noticed that some key variables have more effect than others. The key variables that have a significant effect on the results are quality of facilities, quality of resources, quality of curriculum, and quality of research. So, the sub-models of these key variables are the most important. The policy structure should be concentrated on these sub-models.

5.1.1.2.3 Behaviour Sensitivity Test

This test shows the sensitivity of the model results to the change of assumptions. There are three types of sensitivity: numerical, behavioural, and policy sensitivity. In this model, the numerical sensitivity is of less concern. What really matters is the behavioural and policy sensitivity. The assumptions were changed and the behaviour and policy sensitivities were observed. Both the behaviour and the policy didn't significantly change

after changing the assumptions which means that the model is neither behaviourally sensitive nor policy sensitive and there is no chaos in the model.

5.1.1.3 Model Validation

In order to prove something, there are two normal methods: deduction and induction. **Deduction** is considered a "general to specific" method. It depends on the truth of general premises (already proven facts that are true or assumed as true) and a conclusion that is driven from the premises using a logical procedure. Here is an example of deduction:

> *Premise 1*   *All human beings are mortal*
>
> *Premise 2*   *Newton is a human being*
>
> *Conclusion*   *Newton is mortal*

This method was invented in the Greek renaissance in the early centuries before Christ. It was investigated by Aristotle who investigated most syllogisms (Bryant, 2009). However, this method can't be used to validate this thesis as it requires to provethe statement: "All correctly structured SD models give valid results". This statement is true and is believed by all SD experts but cannot be proved. The statements beginning with "all" can be proved by examining every single case but can be disproved if one single counterexample exists. An often-quoted example is the statement "All swans are white". This statement can be proved only if every single swan that ever existed is checked. (It has been recently reported that a black swan has been found in Australia!). Thus, this thesis cannot be validated using deduction.

The second method of proof, **induction,** is usually limited to the natural sciences. Induction is considered a "specific to general" method. In this method, if a

property is proved true for one case, then it is true for the next. Consequently, if one can find one true case then it is true for all cases (Vickers et al., 2016). In mathematics, if we can prove that a theorem is true for the value "n" and it is also true for the value "n+1", then we just has to show that the theorem is true for n=1 and then it is true for all values of "n". The difference between induction and deduction is that induction cannot guarantee that the conclusion is true. The commonly quoted case (attributed to Russell, 2013) is the turkey that is very well fed on the days prior to Christmas. This behaviour caused the turkey to inductively conclude that it is favoured and this behaviour will continue. Then comes Christmas! Therefore, this thesis cannot be validated using induction.

Fortunately, there is a third method originated by the American mathematician and philosopher "Charles Saunders Peirce" which is called abduction (Peirce, 1902). Abduction states that if there is a commonly held perception that a process is true and if correct procedures have been followed to install that procedure then one can be reasonably certain that this procedure is correct or true. The difference here from the other two methods is the absence of the need for rigorous proofs.

Therefore, my belief is:

1- I have constructed a System Dynamics model that is structurally correct, which means that the model is structurally valid.

2- I have developed a model and compared the results of this model with existing data about the real Egyptian HE system over the past five years. The model produced good results which verify that the model simulates the real Egyptian HE system.

3- Therefore, I can abductively state that my System Dynamics model is validated and can be used to develop and support decisions.

5.1.2 Implementation Stage

The ultimate advantage of simulation is its ability to investigate the effects of poly changes, which is not feasible in the real world. The model can be used to test different policies that would lead to improvements to the Egyptian HE quality of the HE system in Egypt. The actual situation is firstly investigated, and then different scenarios are taken to change some variables within the system. The different scenarios are investigated to see the most affecting variables. Finally, the best situation is concluded.

5.1.2.1 Policy Structure

In the Egyptian HE system, the management (the Ministry of HE) has the ability to control or change some variables. Other variables cannot be controlled; they can only be measured. The variables that can be controlled are the target of this research and they are called *"Policy Structure"*. These variables are deeply investigated to study their effect on the quality of HE. Table (5.2) shows the policy structure of the HE system in Egypt and the actual values of these variables for the five years of simulation.

Table 5-2: Policy Structure of the Egyptian HE System

Time	13	14	15	16	17
Rate of curriculum review per year ~ (Revision/yr)	0.00	1.00	0.00	1.00	0.00
Available training opportunities per year (Student/yr	100,000.00	120,000.00	150,000.00	195,000.00	220,000.00
Government funding per year (EGP/yr)	14,654,674,533	15,751,200,006	19,723,063,048	23,657,416,099	24,314,694,678
Facilities share (%)	17.28	18.00	18.50	18.59	18.15
Resources share (%)	20.44	19.15	17.86	16.66	15.76
Research share (%)	0.52	0.65	0.49	0.44	0.36
Staff share (%)	61.76	62.20	63.15	64.31	65.73
Number of curriculums reviewed per staff per year ~	2.00	1.00	1.00	2.00	2.00
Number of curriculums prepared per staff per year ~ (	1.00	1.00	1.00	1.00	1.00
Number of classes (Class)	41,578.00	44,160.00	44,970.00	45,934.00	46,753.00
Student fees per year ~ (EGP/(yr*Student))	500.00	500.00	550.00	650.00	1,100.00
High school grade required for enrolment ~ (%)	74.70	74.50	74.50	74.50	74.30
Total number of staff (Teacher)	74,784.00	77,289.00	81,183.00	82,946.00	85,404.00

5.1.2.2 Simulation Results

The initial run with these values represents the HE system in the five years of simulation. The results of the actual situation are shown in Table (5.3). This situation resulted from the simulation of the model when the values of the inputs are set to the real situation in Egypt from academic year 2012/2013 to academic year 2016/2017 as shown in Table (5.2)

Table 5-3: Results of the Initial Run (2012/2013 to 2016/2017)

(%)						
Time	01/2013	01/2014	01/2015	01/2016	01/2017	01/2018
Quality of facilities ~	40.00	38.70	35.83	32.86	30.02	27.33
Quality of curriculum ~	50.00	54.85	51.26	56.11	52.66	57.42
Quality of internship ~	50.00	47.08	44.66	42.18	40.03	37.88
Quality of resources ~	50.00	47.53	42.98	38.05	32.89	27.58
Quality of research ~	60.00	58.68	57.36	56.02	54.65	53.23
Quality of staff ~	60.00	60.20	60.32	60.43	60.49	60.49
Quality of teaching ~	55.00	56.71	58.36	59.61	60.37	60.56
Quality of services provided by university	60.00	61.39	62.56	63.42	63.98	64.21
Skills of graduates ~	64.00	65.67	67.07	68.11	68.78	69.05
Skills gap ~	26.00	24.33	22.93	21.89	21.22	?

It is noted that all the seven key variables are decreasing, except *"Quality of Curriculum"*, *"Quality of Staff"* and *"Quality of Teaching"*. *"Quality of Curriculum"* is going up and down, but the overall behaviour yields a slow increase. *"Quality of Teaching"* is increasing but also in a slow rate while *"Quality of Staff"* is almost constant. The rest four key variables are decreasing. The result of these behaviours is a slight increase in *"Quality of Services provided by universities"* and, consequently, a corresponding slight increase in *"Skills of Graduates"*.

The conclusion of the actual situation is a slow decrease in the *"Skills Gap"*. This is shown in the graphs of Figure (5.4).
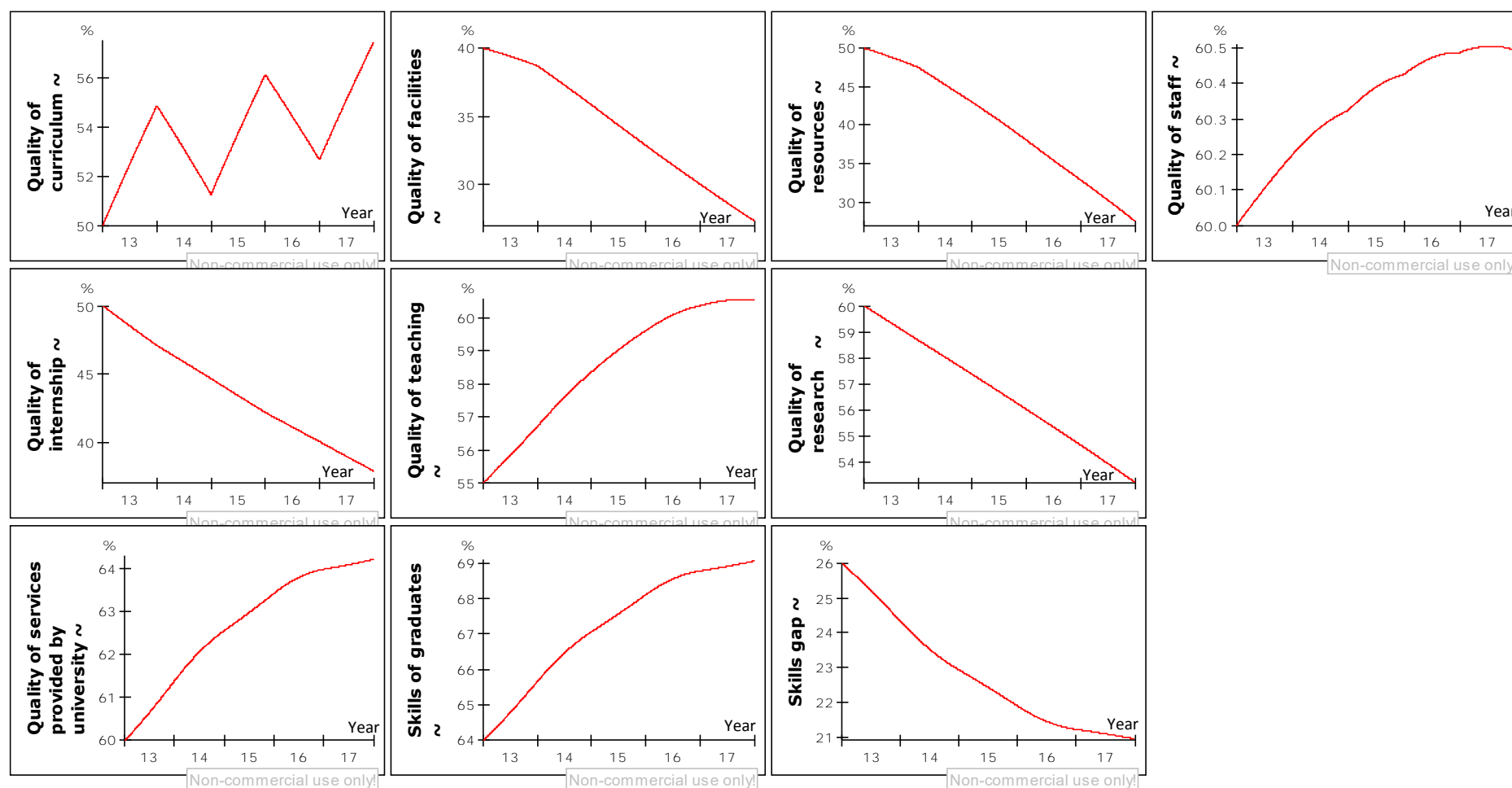
Figure 5-4: Behaviour of the Key Variables for the Real Situation

After obtaining the results shown in Table (5.3) from simulation, they were compared to actual data about the real HE system in Egypt. This comparison is shown in Table (5.4). The actual data were obtained from authorised sources of secondary data for the five years of simulation. The variables that were compared are *"Quality of facilities"*, *"Quality of curriculum"*, *"Quality of internship"*, *"Quality of resources"*, *"Quality of research"*, *"Quality of staff"*, *"Quality of teaching"*, *"Quality of services provided by university"*, *"Skills of graduates"*, and *"Skills gap"*. The aim of this comparison is to test if there is a significant difference between the results of the simulation model and the actual data of the real system as well as the confidence interval of this difference.

Table 5-4: Comparison between simulation model outputs and real system values

Years / Variables	2012/2013		2013/2014		2014/2015		2015/2016		2016/2017	
	Actual	Results	Actual	Results	Actual	Results	Actual	Results	Actual	Results
Quality of facilities (%)	38	40	37	38.7	35.7	35.83	33	32.86	30.2	30.02
Quality of curriculum (%)	53.7	50	56	54.85	51.8	51.26	53.2	56.11	50	52.66
Quality of internship (%)	51	50	49	47.08	45.2	44.66	41.8	42.18	39.4	40.03
Quality of resources (%)	47	50	45.9	47.53	41.2	42.98	39.7	38.05	34.1	32.89
Quality of research (%)	59	60	57	58.68	55.8	57.36	57.1	56.02	52.7	54.65
Quality of staff (%)	57.4	60	58.4	60.2	59	60.32	60.3	60.43	62	60.49
Quality of teaching (%)	54	55	55.4	56.71	57.1	58.36	59.7	59.61	61.2	60.37
Quality of services provided by university (%)	60.1	60	60.2	61.39	61.7	62.56	62.7	63.42	63.5	63.98
Skills of graduates (%)	63	64	64.1	65.67	66.3	67.07	68.1	68.11	70.2	68.78
Skills gap (%)	25	26	24.4	24.33	22.7	22.93	21.3	21.89	20.8	21.22

To compare between the simulation model outputs and the real system values, the Wilcoxon signed ranks test (two related samples) is used, as shown in Table (5.5). The significance levels are all greater than 0.05, therefore, there is no significant difference between the simulation model outputs and the real system values. Also, the 95% confidence interval of the differences, shown in Table (5.6), emphasised the same results since the confidence interval include the zero value (the lower bound is negative and the upper bound is positive). These tests were carried out using SPSS version 25.

Table 5-5: Results of Wilcoxon signed ranks test

Test Statistics[a]		
	Z	Asymp. Sig. (2-tailed)
Quality of Facilities	-.674[b]	.500
Quality of Curriculum	-1.214[b]	.225
Quality of Internship	-.944[c]	.345
Quality of Resources	-.944[b]	.345
Quality of Research	-1.483[b]	.138
Quality of Staff	-1.214[b]	.225
Quality of Teaching	-1.214[b]	.225
Quality of Services Provided by Universities	-1.753[b]	.080
Skills of Graduates	-.944[b]	.345
Skills Gap	-1.753[b]	.080

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

c. Based on positive ranks.

Table 5-6: Results of paired samples test (Confidence interval of the difference)

95% confidence interval of the differences			
		95% Confidence Interval of the Difference	
		Lower	Upper
Pair 1	Quality of Facilities	-2.01823	.61423
Pair 2	Quality of Curriculum	-12.84660	4.77460
Pair 3	Quality of Internship	-.80020	1.78020
Pair 4	Quality of Resources	-3.23117	1.81117
Pair 5	Quality of Research	-2.54304	.49904
Pair 6	Quality of Staff	-2.85779	1.12179
Pair 7	Quality of Teaching	-1.70732	.64732
Pair 8	Quality of Services Provided by Universities	-1.22871	.03129
Pair 9	Skills of Graduates	-1.81921	1.04721
Pair 10	Skills Gap	-.93087	.06287

5.1.2.3 Scenarios

After investigating the results of the real situation, the importance of simulation starts to appear. The variables in the policy structure are varied, one at a time, to study the effect of each single variable and to know the impact of each of them. The goal is to increase the seven key variables as much as possible to increase the *"Quality of Services Provided"* and thus bridging the gap. In the following sections, nine scenarios are investigated and the most advantageous scenario is concluded. Brief tables and figures for the results of each scenario are illustrated in this section. However, the detailed results of the scenarios compared to the real situation are shown in **Appendix F**.

In each scenario of the nine scenarios, one or more of the variables of the policy structure is chosen and changed. The amount of change of these variables is set and the model is run. After running the model, it is noted that some key variables are increased (the key variables that are related to the changed variables). In all scenarios, three variables are measured and monitored; two of these variables represent the outputs of the Egyptian HE system, which are "Quality of services provided by universities" and "Skills of graduates", while the third variable represents the link between the HE system and the labour market which is "Skills gap". By measuring these three variables in all scenarios, a comparison can be made between scenarios to find the most affecting scenario or the most affecting possible combination of scenarios.

- **Scenario #1**

The first variable to be manipulated is the *"Rate of curriculum review per year"*. Instead of reviewing the curriculums once every two years, as shown in Table (5.2), the first scenario is to increase the rate of review to be one revision every year. The behaviour of "Quality of Curriculum" in this case is shown in Figure (5.5).

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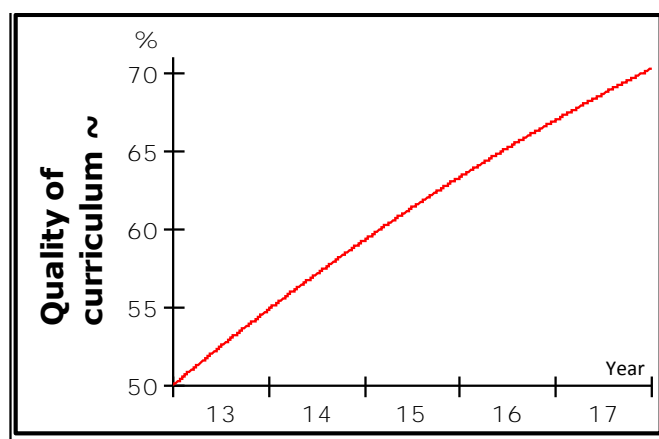
Figure 5-5: Behaviour of "Quality of Curriculum" When Applying Scenario #1

It is obvious that the *"Quality of Curriculum"* increases significantly to more than 70% as a result of this scenario. As a consequence, the *"Quality of Services provided by university"* increases as well as the *"Skills of Graduates."* Both increased by 7% to 8% (compared to 4% to 5% in the real situation) which caused the skills gap to decrease by 7% (compared to 5% in the real situation), as shown in Table (5.7). Noticing that *"Quality of Curriculum"* is just one key variable among seven, this effect is considerably good.

Table 5-7: Results of Scenario #1

(%)						
Time	01/2013	01/2014	01/2015	01/2016	01/2017	01/2018
Quality of facilities ~	40.00	38.70	35.83	32.86	30.02	27.33
Quality of curriculum ~	50.00	54.85	59.29	63.34	66.97	70.30
Quality of internship ~	50.00	47.08	44.67	42.21	40.10	37.98
Quality of resources ~	50.00	47.53	42.63	37.01	30.82	24.19
Quality of research ~	60.00	58.68	57.36	56.02	54.65	53.23
Quality of staff ~	60.00	60.20	60.32	60.42	60.49	60.50
Quality of teaching ~	55.00	56.71	58.49	59.99	61.09	61.72
Quality of services provided by university	60.00	61.39	62.95	64.51	65.96	67.26
Skills of graduates ~	64.00	65.67	67.54	69.41	71.15	72.71
Skills gap ~	26.00	24.33	22.46	20.59	18.85	?

- **Scenario#2**

This scenario targets the key variable *"Quality of Internship"*. The main problem is that the number of *"available training opportunities"* is very low compared to the demand. There should be coordination between the management of Egyptian HE and the

employers to create more training opportunities for students. In this scenario, the number

of *"available training opportunities"* is increased so that it can cover all the training

demand. The assumed values for this scenario for the five years of simulation are shown

in Table (5.8). The resulting behaviour of *"Quality of Internship"* is shown in Figure

(5.6). As shown in the figure, the *"Quality of Internship"* significantly increases to reach

a value near 65%.

Table 5-8: The Changes of Inputs According to Scenario #2

Time	Available training opportunities per year (Student/yr)
13	850,000.00
14	750,000.00
15	1,000,000.00
16	1,150,000.00
17	1,400,000.00
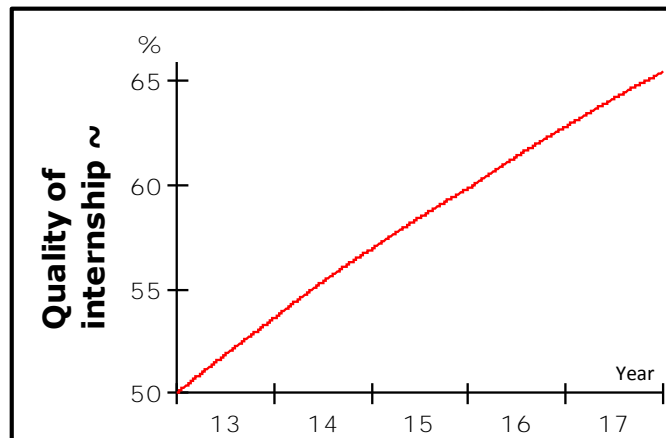
Figure 5-6: Behaviour of "Quality of internship" in Case of Scenario #2

Table (5.9) shows the result of the simulation in the case of scenario #2. The *"Quality of*

Internship" increases to reach 65% at the end of simulation while the other key variables

are almost not changed. The final result is a decrease by 6% in the skills gap (compared

to 5% in the real situation).

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Table 5-9: Results of Scenario #2

(%)						
Time	01/2013	01/2014	01/2015	01/2016	01/2017	01/2018
Quality of facilities ~	40.00	38.70	35.83	32.86	30.02	27.33
Quality of curriculum ~	50.00	54.85	51.26	56.11	52.66	57.42
Quality of internship ~	50.00	53.58	56.91	59.84	62.81	65.45
Quality of resources ~	50.00	47.53	42.98	38.05	32.89	27.57
Quality of research ~	60.00	58.68	57.36	56.02	54.65	53.23
Quality of staff ~	60.00	60.20	60.32	60.43	60.49	60.50
Quality of teaching ~	55.00	56.60	57.97	58.89	59.39	59.50
Quality of services provided by university	60.00	61.45	62.78	63.87	64.72	65.30
Skills of graduates ~	64.00	65.74	67.33	68.65	69.66	70.36
Skills gap ~	26.00	24.26	22.67	21.35	20.34	?

- **Scenario#3**

This scenario deals with the funding. The key variables that are directly affected by funding are *"Quality of Facilities"*, *"Quality of Resources"*, *"Quality of Research"* and *"Quality of Staff"*. In this scenario, the funding is increased while the shares of the four variables are kept without changing. It is required to increase the *"Total funding per year"* and this can be done by increasing any of the funding sources. The increase in this scenario comes from the government, so the variable that needs to be increased is the *"Government funding per year"*, as shown in Table (5.10). It is important to say that most of the funding increase will be consumed by the allocated staff budget because it has the highest share (more than 60%).

Table 5-10: The Changes of Inputs According to Scenario #3

Time	Government funding per year (EGP/yr)
13	29,309,349,066
14	63,004,800,024
15	118,338,378,288
16	189,259,328,792
17	243,146,946,780

These values were estimated after several trials so that the best behaviour of the key variables can be obtained. The behaviours of the four key variables after this increase are

shown in Figure (5.7). It is shown that both *"Quality of Resources"* and *"Quality of Facilities"* are affected instantly. However, the *"Quality of Research"* variable in the first year was still decreasing because there is a one-year delay impeded in the model for this variable. The effect of the funding increase started to take place for *"Quality of Research"* in the second year (year 2013/2014). All the variables increased significantly except *"Quality of Staff"* where the increase was less than 4%. The fluctuating behaviour in *"Quality of Staff"* is because of the balancing loop.
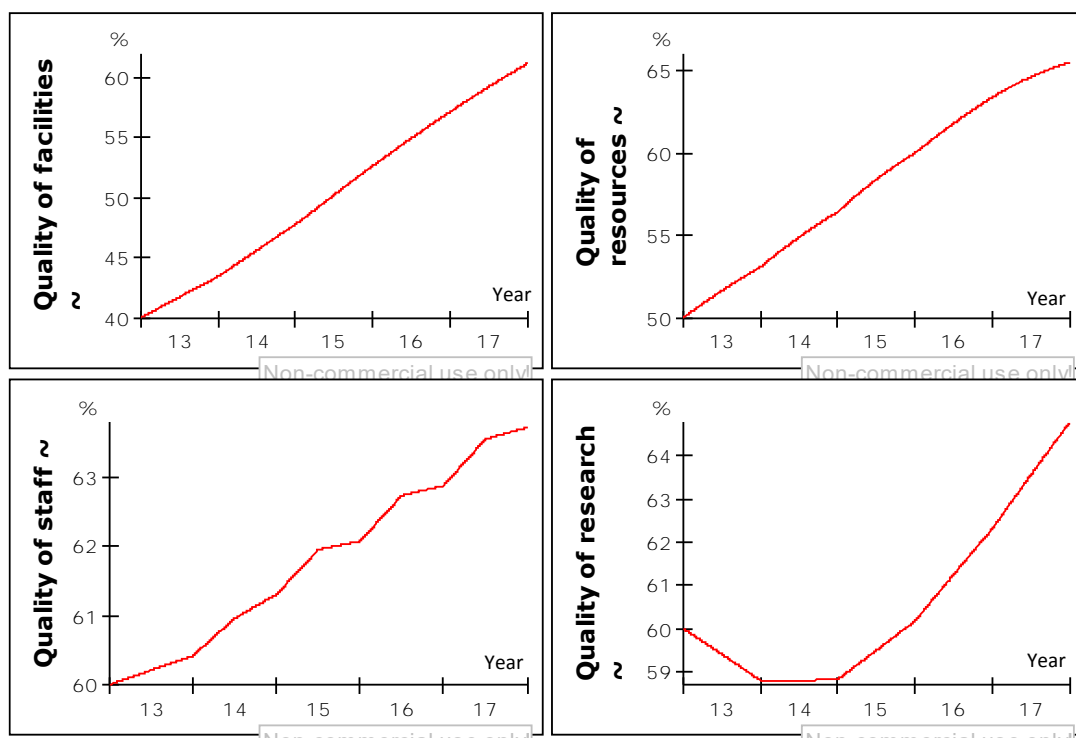
Figure 5-7: Behaviour of Four Key Variables in Case of Scenario #3

The results of this scenario are shown in Table (5.11). The increase in the four key variables resulted in an increase in the *"Quality of Services Provided"* and, simultaneously, an increase in the *"Skills of Graduates"*. The final result was a decrease in the skills gap by 10%. This scenario bridges the gap but also consumes very high amount of funding which may be not available.

Table 5-11: Results of Scenario #3

(%)						
Time	01/2013	01/2014	01/2015	01/2016	01/2017	01/2018
Quality of facilities ~	40.00	43.44	47.79	52.66	57.16	61.18
Quality of curriculum ~	50.00	54.85	51.28	56.17	52.78	57.61
Quality of internship ~	50.00	47.08	44.66	42.18	40.03	37.88
Quality of resources ~	50.00	53.07	56.41	59.98	63.36	65.47
Quality of research ~	60.00	58.80	58.82	60.17	62.30	64.76
Quality of staff ~	60.00	60.42	61.30	62.07	62.87	63.71
Quality of teaching ~	55.00	56.71	58.40	59.73	60.61	60.95
Quality of services provided by university	60.00	61.60	63.53	65.86	68.54	71.42
Skills of graduates ~	64.00	65.92	68.24	71.04	74.25	77.13
Skills gap ~	26.00	24.08	21.76	18.96	15.75	?

- **Scenario#4**

This scenario tries to use another way to increase the key variables without seeking extra funding. It has been found that the *"Quality of Research"* requires very little funding compared to what *"Quality of Facilities"* and *"Quality of Resources"* require. Therefore, the little funding required for increasing *"Quality of Research"* is taken from both *"Quality of Facilities"* and *"Quality of Resources"*. Table (5.12) shows the changes in the funding shares for the three variables.

Table 5-12: The Changes of Inputs According to Scenario #4

(%)			
Time	Facilities share	Resources share	Research share
13	15.75	18.94	3.52
14	16.50	17.65	3.65
15	17.00	16.36	3.49
16	17.09	15.16	3.44
17	16.65	14.26	3.36

As shown in Table (5.12), 1.5% was taken from each of the shares of *"Quality of Facilities"* and *"Quality of Resources"* and 3% was added to the share of *"Quality of Research"*.
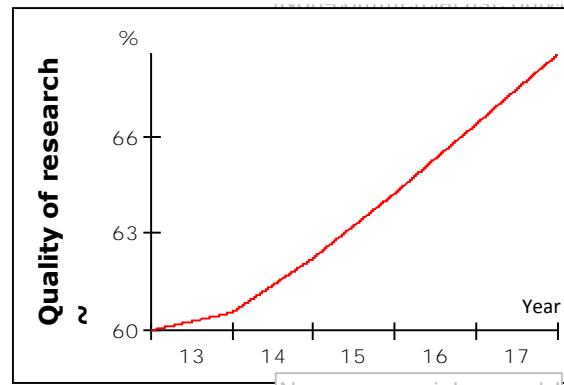
Figure 5-8: Behaviour of "Quality of research" in case of Scenario #3

The results indicated a very little decrease in both "*Quality of Facilities*" and *"Quality of Resources"* but a great increase in *"Quality of Research"*. This causes the skills gap to decrease by 7% (compared to 5% in the real situation).

Table 5-13: Results of Scenario #4

(%)						
Time	01/2013	01/2014	01/2015	01/2016	01/2017	01/2018
Quality of facilities ~	40.00	38.28	35.35	32.37	29.56	26.89
Quality of curriculum ~	50.00	54.85	51.26	56.12	52.69	57.47
Quality of internship ~	50.00	47.08	44.66	42.18	40.03	37.88
Quality of resources ~	50.00	47.11	42.50	37.53	32.34	27.01
Quality of research ~	60.00	60.55	62.24	64.22	66.35	68.50
Quality of staff ~	60.00	60.20	60.54	60.90	61.28	61.63
Quality of teaching ~	55.00	56.71	58.37	59.64	60.43	60.67
Quality of services provided by university ~	60.00	61.46	62.90	64.31	65.66	66.96
Skills of graduates ~	64.00	65.76	67.49	69.17	70.79	72.35
Skills gap ~	26.00	24.24	22.51	20.83	19.21	?

- **Scenario#5**

It is shown from scenario #3 that *"Quality of Facilities"* and *"Quality of Resources"* need a high increase in the funding in order to improve their behaviour. However, the *"Quality of Staff"* didn't improve much when the funding was increased. Consequently, a better solution is focusing the funding increase only on the other three variables. This scenario deals with increasing the funding for *"Quality of Facilities"*, *"Quality of Resources"* and *"Quality of Research"*. As shown in Table (5.14), the funding is increased and the shares are modified to keep the staff budget almost constant.

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Table 5-14: The Changes of Inputs According to Scenario #5

Time	Facilities share	Resources share	Research share	Government funding per year (EGP/yr)
13	24.00	28.30	3.70	20,901,975,085.00
14	33.00	35.00	2.40	34,026,042,044.00
15	38.50	37.20	1.40	56,346,122,994.00
16	42.20	37.80	1.00	82,929,885,330.00
17	43.80	38.00	0.80	99,413,573,142.00
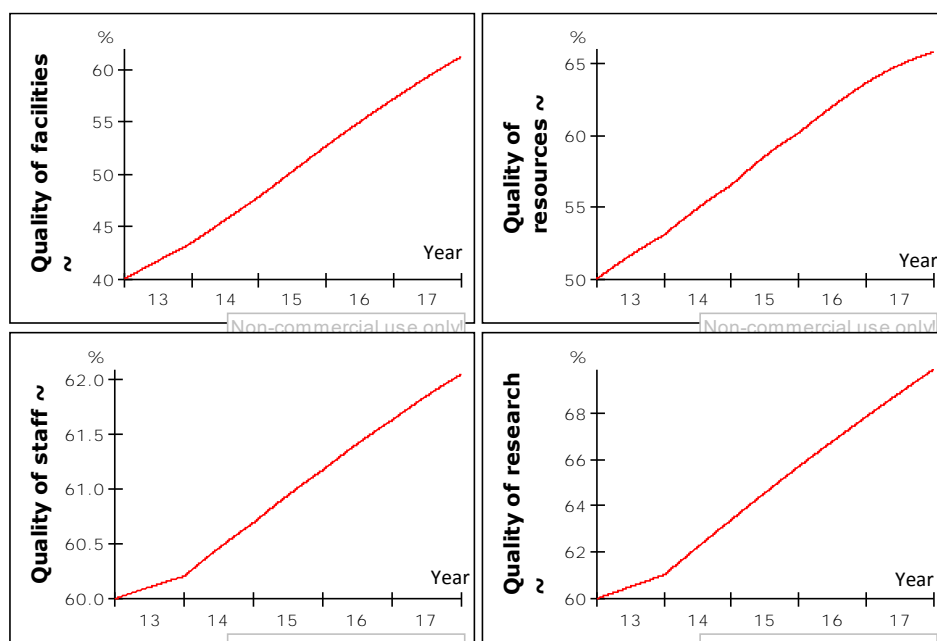
Figure 5-9: Behaviour of Four Key Variables in Case of Scenario #5

As shown in Figure (5.9), *"Quality of Facilities"*, *"Quality of Resources"* and *"Quality of Research"* are increased significantly. *"Quality of Staff"* is increased with a small percentage (1.5%). The final effects of this scenario are shown in Table (5.15). The skills gap is decreased by 12% (compared to 5% in the real situation).

Table 5-15: Results of Scenario #5

(%)						
Time	01/2013	01/2014	01/2015	01/2016	01/2017	01/2018
Quality of facilities ~	40.00	43.45	47.86	52.73	57.23	61.25
Quality of curriculum ~	50.00	54.85	51.26	56.13	52.70	57.50
Quality of internship ~	50.00	47.08	44.66	42.18	40.03	37.88
Quality of resources ~	50.00	53.05	56.53	60.16	63.63	65.79
Quality of research ~	60.00	61.02	63.40	65.69	67.83	69.87
Quality of staff ~	60.00	60.21	60.69	61.17	61.63	62.05
Quality of teaching ~	55.00	56.71	58.37	59.65	60.45	60.69
Quality of services provided by university	60.00	61.71	63.93	66.62	69.62	72.71
Skills of graduates ~	64.00	66.05	68.71	71.95	75.54	78.17
Skills gap ~	26.00	23.95	21.29	18.05	14.46	?

- **Scenario#6**

This scenario seeks another sources of funding increase rather than external sources. It deals with increasing the funding through raising the student fees. The fees were raised by 500 EGP in the year per student. This increase would increase the *"Total revenue per year"* and, consequently, the *"Total funding per year"*. However, the increase in the total funding isn't enough to cover all the demand for facilities and resources; it covers only the funding required for increasing *"Quality of Research"*. Table (5.16) shows the changes involved in this scenario. This scenario has a great effect on "Quality of Research" as shown in Figure (5.10). The "Quality of research" increased to 70%.

Table 5-16: The Changes of Inputs According to Scenario #6

Time	Facilities share	Resources share	Research share	Student fees per year ~ (EGP/(yr*Student))
13	16.50	19.50	4.90	1,000.00
14	17.20	18.40	4.80	1,000.00
15	17.80	17.20	4.30	1,050.00
16	17.90	16.10	4.00	1,150.00
17	17.60	15.20	3.60	1,600.00
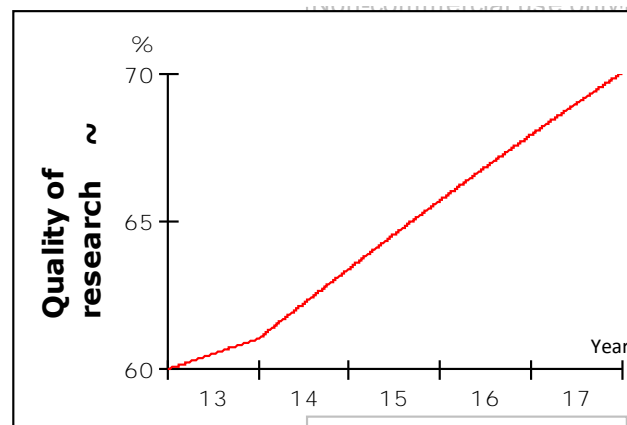
Figure 5-10: Behaviour of "Quality of Research" in Case of Scenario #6

The results of this scenario are close to scenario #4 as the only increased variable is the *"Quality of Research"*. The *"Skills gap"* is decreased by 7% (compared to 5% in the real situation).

Table 5-17: Results of Scenario #6

(%)						
Time	01/2013	01/2014	01/2015	01/2016	01/2017	01/2018
Quality of facilities ~	40.00	38.74	35.98	33.04	30.23	27.55
Quality of curriculum ~	50.00	54.85	51.26	56.13	52.70	57.50
Quality of internship ~	50.00	47.09	44.67	42.20	40.09	37.96
Quality of resources ~	50.00	47.56	43.12	38.24	33.12	27.82
Quality of research ~	60.00	61.02	63.39	65.69	67.90	69.99
Quality of staff ~	60.00	60.20	60.69	61.16	61.62	62.04
Quality of teaching ~	55.00	56.73	58.45	59.86	60.89	61.50
Quality of services provided by university	60.00	61.50	63.05	64.61	66.14	67.62
Skills of graduates ~	64.00	65.80	67.66	69.53	71.37	73.14
Skills gap ~	26.00	24.20	22.34	20.47	18.63	?

- **Scenario#7**

This scenario investigates the effect of increasing the *"Number of Staff"*. This would change both the *"Student to staff ratio"* and *"Loading hours per staff per week"*. These two variables affect *"Quality of Staff"*, so increasing the *"Number of Staff"* would actually increase the *"Quality of Staff"*. However, increasing the *"Number of Staff"* requires increasing the funding as well to pay the salaries and training costs for the new staff added. The changes made in this scenario are shown in Table (5.18). The changes involve increasing both the number of staff and the staff budget by 50%.

Table 5-18: The Changes of Inputs According to Scenario #7

Time	Facilities	Resources	Research	Government funding per year	Total number of staff (Teacher)
13	13.20	15.62	0.40	19,431,732,262.00	112,176.00
14	13.76	14.61	0.50	20,921,339,494.00	115,934.00
15	14.06	13.57	0.37	26,297,825,686.00	121,775.00
16	14.07	12.61	0.33	31,778,475,068.00	124,419.00
17	13.66	11.86	0.27	33,279,825,614.00	128,106.00
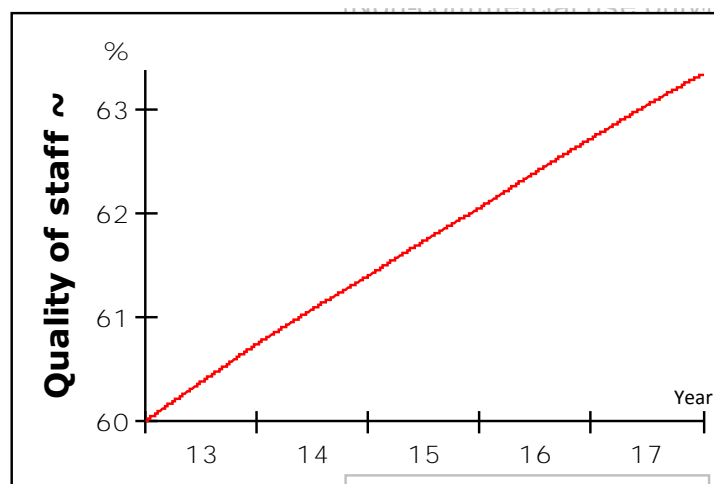
Figure 5-11: Behaviour of "Quality of staff" in case of Scenario #7

The *"Quality of Staff"* increased according to this scenario by 3.5% as shown in Figure (5.11). This effect is very weak and almost has no effect on the *"Skills Gap"* as shown in the Table (5.19). Therefore, this scenario isn't preferable because it would consume much funding without great outcome. The little change in the *"Quality of Staff"* is because this variable has reached its maximum possible value. This means that any extra efforts to increase it would lead to no or little increase. This information is useful because it helps us to know which variables are saturated and which variables have the ability to be increased if they are given the right and enough resources. The latter variables need more attention from the management of HE in Egypt.

Table 5-19: Results of Scenario #7

(%)						
Time	**01/2013**	**01/2014**	**01/2015**	**01/2016**	**01/2017**	**01/2018**
Quality of facilities ~	40.00	39.09	36.20	33.19	30.33	27.61
Quality of curriculum ~	50.00	54.85	51.29	56.17	52.78	57.60
Quality of internship ~	50.00	47.08	44.66	42.18	40.04	37.89
Quality of resources ~	50.00	47.94	43.38	38.45	33.28	27.95
Quality of research ~	60.00	58.70	57.44	56.17	54.91	53.64
Quality of staff ~	60.00	60.74	61.40	62.06	62.73	63.35
Quality of teaching ~	55.00	56.72	58.42	59.75	60.62	60.97
Quality of services provided by university ‹	60.00	61.41	62.61	63.53	64.15	64.47
Skills of graduates ~	64.00	65.69	67.13	68.23	68.98	69.36
Skills gap ~	26.00	24.31	22.87	21.77	21.02	?

- **Scenario#8**

This scenario aims at increasing *"Quality of Staff"* through increasing the "*Number of curriculums reviewed per staff per year"* and the *"Number of curriculums prepared per staff per year"*. These two variables have a positive effect on *"Staff Experience"* and, therefore, they can increase the *"Quality of Staff"*. The changes made to these two variables are shown in Table (5.20).

Table 5-20: The Changes of Inputs According to Scenario #8

(Curriculum/yr)		
Time	Number of curriculums reviewed per staff per year ~	Number of curriculums prepared per staff per year ~
13	4.00	2.00
14	3.00	3.00
15	4.00	2.00
16	4.00	2.00
17	3.00	3.00

[Non-commercial use only]

It is shown in Figure (5.12) that the *"Quality of Staff"* didn't increase much (only a 1% increase). The "*Skills Gap"* didn't change due to this little change in *"Quality of Staff"* as shown in Table (5.21). This means that the *"Quality of Staff"* is saturated and it would be infeasible to try to increase it any further. This conclusion is the same as the one in scenario #7.
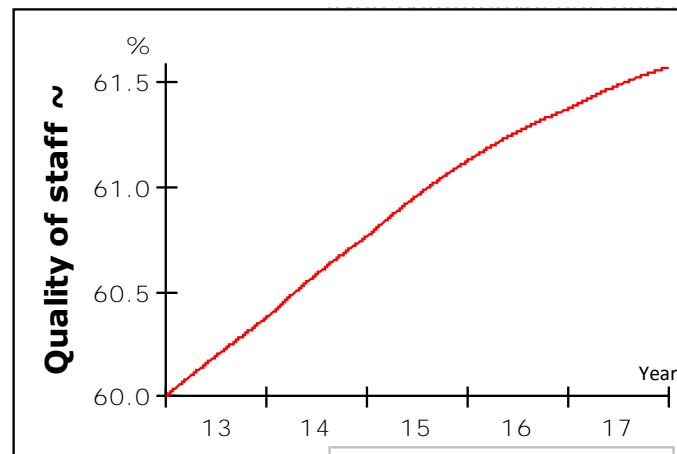
Figure 5-12: Behaviour of "Quality of staff" in Case of Scenario #8

Table 5-21: Results of Scenario #8

(%)						
Time	01/2013	01/2014	01/2015	01/2016	01/2017	01/2018
Quality of facilities ~	40.00	38.70	35.83	32.86	30.02	27.33
Quality of curriculum ~	50.00	54.85	51.27	56.13	52.71	57.49
Quality of internship ~	50.00	47.08	44.66	42.18	40.03	37.88
Quality of resources ~	50.00	47.53	42.98	38.05	32.88	27.56
Quality of research ~	60.00	58.68	57.38	56.08	54.75	53.39
Quality of staff ~	60.00	60.37	60.76	61.13	61.37	61.58
Quality of teaching ~	55.00	56.71	58.38	59.67	60.47	60.72
Quality of services provided by university	60.00	61.39	62.56	63.43	64.01	64.27
Skills of graduates ~	64.00	65.67	67.07	68.12	68.81	69.12
Skills gap ~	26.00	24.33	22.93	21.88	21.19	?

- **Scenario#9**

The final scenario targets the remaining key variable, *"Quality of Teaching*". The variable that directly affects the *"Quality of Teaching"* and can be altered is the *"Class Size"* which indicated the average number of students in class. This variable can be decreased by increasing the *"Number of Classes"*. The changes in *the "Number of Classes"* according to this scenario are shown in Table (5.22). It has been found that an increase by 50% in the *"Number of Classes"* would be suitable. Any increase higher than 50% would make little increase to the *"Quality of Teaching"*.

Table 5-22: The Changes of Inputs According to Scenario #9

Time	Number of classes (Class)
13	62,367.00
14	66,240.00
15	67,455.00
16	68,901.00
17	70,130.00
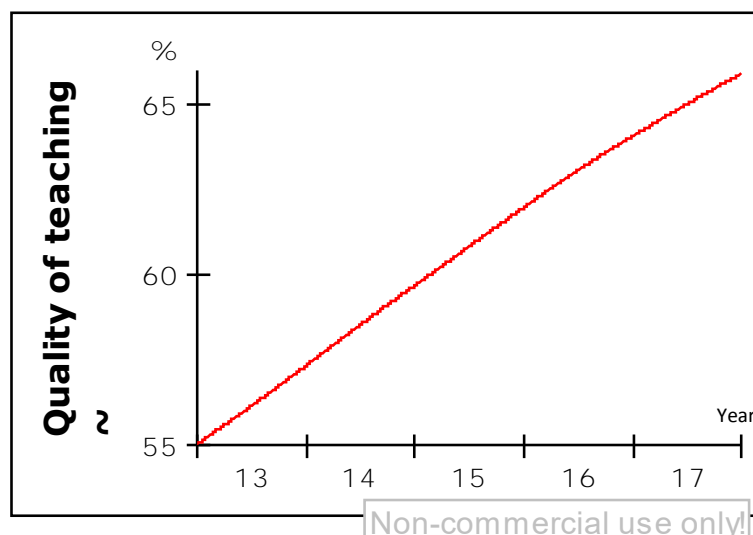
Figure 5-13: Behaviour of "Quality of teaching" in Case of Scenario #9

As shown in Figure (5.13), The *"Quality of Teaching"* increased over 65% which is quite good. The results of this scenario are shown in Table (5.23). The increase in *"Quality of Teaching"* is 11% (compared to 5% in the real situation). This increase yields an increase in the *"Quality of Services provided"* and, therefore, *"Skills of Graduates"*. These changes caused the "Skills Gap" to slightly decrease by 6% (compared to 5% in the real situation). This scenario isn't feasible because its effect isn't noticeable and it requires a high increase in the *"Number of Classes"* which requires a lot of time and money.

Table 5-23: Results of Scenario #9

(%)						
Time	01/2013	01/2014	01/2015	01/2016	01/2017	01/2018
Quality of facilities ~	40.00	38.70	35.83	32.86	30.02	27.33
Quality of curriculum ~	50.00	54.85	51.26	56.11	52.66	57.42
Quality of internship ~	50.00	47.09	44.66	42.18	40.05	37.91
Quality of resources ~	50.00	47.53	42.98	38.05	32.89	27.57
Quality of research ~	60.00	58.68	57.36	56.02	54.65	53.23
Quality of staff ~	60.00	60.20	60.32	60.43	60.49	60.50
Quality of teaching ~	55.00	57.30	59.68	61.97	64.08	65.93
Quality of services provided by university	60.00	61.42	62.68	63.70	64.50	65.08
Skills of graduates ~	64.00	65.70	67.21	68.44	69.40	70.10
Skills gap ~	26.00	24.30	22.79	21.56	20.60	?

5.1.2.4 Best Predicted Situation

The goal of the previous scenarios is to study the effect of different variables. Some variables were proven to be more important than others. Some variables have great effect while other variables have little or even no effect. The best situation could be achieved by applying some of these scenarios together. It has been found that the best situation would be produced by applying Scenario #1, Scenario #2 and Scenario #5 together.

The best situation can be achieved through targeting five of the key variables: *"Quality of Curriculum"*, *"Quality of Internship"*, *"Quality of Facilities"*, *"Quality of Resources"* and *"Quality of Research"*. These variables are all decreasing in the real situation and need more attention. They have the ability to be increased if the right variables are changed by suitable values. The other two key variables, *"Quality of Staff"* and *"Quality of Teaching"*, don't have high ability to be increased easily and it would be very difficult and infeasible to try to improve them.

The changes that should to be made to the HE system in Egypt are shown in Table (5.24). This table represents the recommendations that are presented to the Ministry of HE in Egypt. According to the model of this research, if these changes are applied to the system of Egyptian HE, they can improve the quality of HE. However, the system of HE needs to be monitored during the application of these recommendations. There should be continuous feedback from the system to investigate the effects of these changes. This is essential for complex systems such as the Egyptian HE system.

Table 5-24: The Changes of Inputs for the Best Situation

Time	Rate of curriculum review	Available training opportunities	Government funding	Facilities share	Resources share	Research share	Staff share (
13	1.00	850,000.00	20,901,975,085	24.00	28.30	3.70	44.00
14	1.00	750,000.00	34,026,042,044	33.00	35.00	2.40	29.60
15	1.00	1,000,000.00	56,346,122,994	38.50	37.20	1.40	22.90
16	1.00	1,150,000.00	82,929,885,330	42.20	37.80	1.00	19.00
17	1.00	1,400,000.00	99,413,573,142	43.80	38.00	0.80	17.40
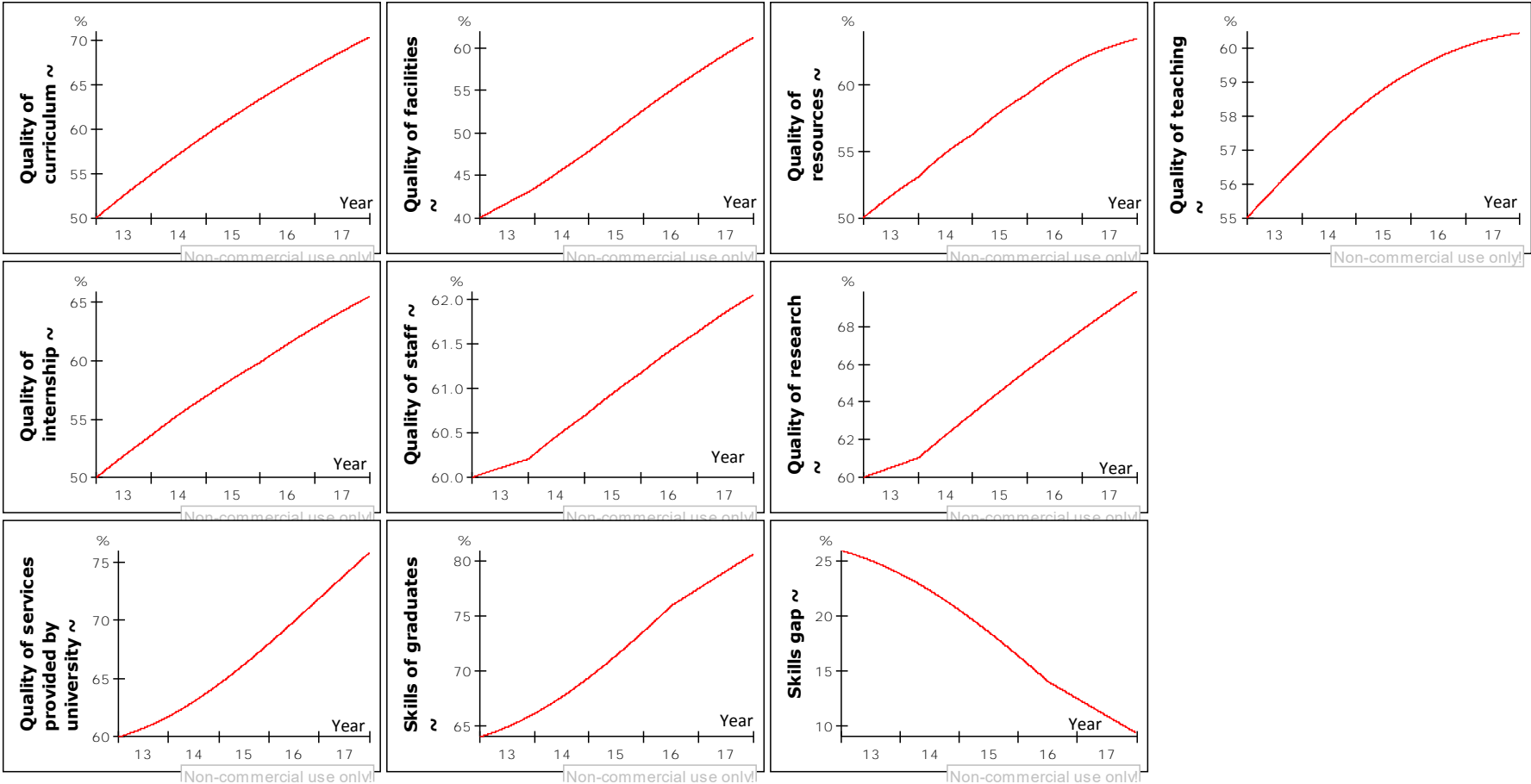
Figure 5-14: Behaviour of the Key Variables in the Best Situation

Figure (5.14) shows the behaviours of the key variables resulting from the changes in Table (5.24). It is clear that all the key variables are increasing. Each of *"Quality of Curriculum"* and "Quality of Facilities" is increasing by 20%. *"Quality of Internship"* and *"Quality of Resources"* are increasing by 15% each. *"Quality of Research"* is increasing by 10%. These five variables have significantly increased due to the changes in Table (5.24). However, the other two key variables haven't increased with high amount. *"Quality of Teaching"* increased by 5% while *"Quality of Staff"* increased by only 2%.

Table 5-25: Results of Best Situation

(%)						
Time	01/2013	01/2014	01/2015	01/2016	01/2017	01/2018
Quality of facilities ~	40.00	43.45	47.86	52.73	57.23	61.25
Quality of curriculum ~	50.00	54.85	59.29	63.35	67.00	70.35
Quality of internship ~	50.00	53.58	56.92	59.87	62.86	65.52
Quality of resources ~	50.00	53.05	56.25	59.28	61.93	63.43
Quality of research ~	60.00	61.02	63.40	65.69	67.83	69.87
Quality of staff ~	60.00	60.21	60.69	61.17	61.63	62.05
Quality of teaching ~	55.00	56.69	58.18	59.30	60.05	60.45
Quality of services provided by university	60.00	61.77	64.53	68.02	71.90	75.81
Skills of graduates ~	64.00	66.13	69.44	73.63	77.52	80.64
Skills gap ~	26.00	23.87	20.56	16.37	12.48	?

The final results of the best situation can be found in Table (5.25). The changes in the seven key variables caused the *"Quality of services provided by university"* to increase by 15%. As a result, the *"Skills of Graduates"* increased by 16%. Finally, the skills gap dropped by more than 16% to reach less than 10% at the end of year 2016/2017. These results are great and reflect a huge improvement in the quality of HE. These results indicate that applying these combinations of scenarios by the management of Egyptian HE would lead to improve the quality Egyptian public universities in Egypt. This is the main purpose of this research.

5.2 Summary

This chapter discussed the validation process of the system dynamics model of the Egyptian HE system. The structural validation tests and behavioural validation tests were applied to the model and the researcher made sure that the model passes all of these tests. The most important thing is that the behaviours resulting from the simulation process were similar to the behaviours in the reference modes generated during the model building process in Chapter 4.

After validating the model and investigating the resulting behaviours of the real situation. These behaviours were studied to identify the importance of each key variable and to decide the most important variables that need to be modified or improved. Different scenarios were carried out regarding different key variables in order to improve the overall quality of the HE system. In every scenario, the values of the inputs were estimated after several trials to find the optimal values. The best situation was predicted and the changes need to be made were concluded. The findings and recommendations of the research will be discussed in Chapter 6.

Chapter Six: Discussion, Conclusion & Recommendations

- 6.1 Summary of the Thesis
- 6.2 Conclusion
- 6.3 Critical Discussion about the Research Findings
- 6.4 How the Research Objectives Where Achieved
- 6.5 Theoretical Contributions
- 6.6 Practical Contributions
- 6.7 Research Recommendations
- 6.8 Research Limitations
- 6.9 Directions for Future Research

CHAPTER 6

DISCUSSION, CONCLUSION & RECOMMENDATIONS

This chapter displays an overview of the contributions of the current study, which is presented in line with the objectives of the study identified in the first chapter of this thesis. The chapter is divided into nine main sections; firstly section [6.1] presents a summary of the whole thesis. Then, section [6.2] provides a conclusion of the study. Next, section [6.3] presents a discussion of the findings of the study and focuses on the key variables, sub-variables, and the relationships between then, which affect the quality of the public HE system in Egypt, which were presented in Chapter 4. Section [6.4] shows how the research objectives are achieved. Next, the theoretical contributions and practical contributions are shown in sections [6.5] and [6.6] respectively. The research recommendations are presented in section [6.7]. Penultimately, section [6.8] displays the research limitations and finally section [6.9] gives directions for future research regarding the research topic.

6.1 Summary of the Thesis

This research had five major objectives. The first objective was to thoroughly explore the dimensions of the Egyptian HE system that contributes to the skills gap. Hence, the current study investigated the dimensions of the Egyptian public universities as a case study of the HE system in Egypt. Among the HE institutions, the current study focuses only on the universities. Moreover, inside the universities the research focuses only on the public universities, excluding the private universities. Inside the public universities,

the research focuses only on the undergraduates excluding the postgraduates. These choices were based on many reasons, which are stated in Chapter 3, pages 131313.

Where, the researcher reviewed the relevant literature. After that, the researcher was able to determine the main dimensions of the Egyptian HE system. The dimensions that were investigated were, roles and purpose of HE, HE systems and the quality of HE, skills of graduates, labour market and its requirements, and the gap between the skills of graduates and the requirements of the labour market (skills gap).

The second objective of this thesis was to identify the factors that affect the quality of the Egyptian HE system. The researcher conducted many personal semi-structured interviews with the experts in the field of Egyptian HE. Through analysing these interviews, the researcher identified the key factors and the sub-factors that affects the quality of Egyptian HE system. Seven key variables that affect the quality of the Egyptian HE system were determined, which are: *"Quality of staff", "Quality of teaching", "Quality of research", "Quality of curriculum", "Quality of resources", "Quality of facilities",* and *"Quality of internship"*. Moreover, this study identifies many of the sub-variables which affect these key variables (see table 6.1).

The third objective of this research was to develop a SD model that simulates the real HE system in Egypt, by using the factors identified in the second objective. Where, the researcher used the key variables, the sub-variables, and the relationships between them (which were determined through the experts' opinions in the field of quality of HE, which emerged in the interviews) to build a SD model that simulated the real HE system in Egypt, which represents the model of this study (see Figure 4.12).

The fourth objective of this study was to validate the model that was developed in the third objective. Then, to use this model to explore and investigate the relative importance of each of the key factors that affect the quality of the Egyptian HE system. Where, the researcher conducted two types of validation test (structural validation tests and behavioural validation tests) to make sure that the model is valid and able to accurately represent the real HE system in Egypt.

Then, the researcher used secondary data to run the model. These secondary data were collected from authorised and trusted sources who are responsible for the HE system in Egypt. These sources are: MOHESR, SCU, CAPMAS, MMI of Egypt, NAQAAE, and QAUs in public universities. The data were collected for the five years of simulation of the model (from academic year 2012/2013 to academic year 2016/2017). After that, the researcher investigated different scenarios by changing the values of the data of some variables in order to know the possible changes that can be made to improve the quality of the Egyptian HE system, and also to know the relative importance of each of the key variables in affecting the quality of the Egyptian HE system. Hence, the researcher was able to reorder the seven key variables according to the relative importance of each of them. The most important key variables were reordered in the following way: "Quality of staff", "Quality of teaching", "Quality of research", "Quality of curriculum", "Quality of resources", "Quality of facilities", and "Quality of internship". This order is according to the relative importance of each of the key variables, and it agrees with the experts' opinions from the discussion of interviews, see table 4.2.

The fifth objective of this research was to make conclusions and recommendations by the necessary changes that must be made by the Egyptian HE management to improve the quality of the HE system. Where, after the researcher investigated the different scenarios

by changing the values of data of some variables, he managed to identify the changes that are required to be made by the management of the Egyptian HE system to improve the quality of this system. Therefore, he was able to derive some recommendations with these changes and present these recommendations to the authorities in the Ministry of HE in Egypt.

The researcher started his study by reviewing the relative literature that are related to the topic of his research. With the aim of identifying the dimensions of the HE system in Egypt. After that, he conducted an exploratory research through conducting many semi-structured interviews in order to find out the main factors and the sub-factors that affect the HE system in Egypt. Also, to understand the nature of relationships that link these variables together. Themes that emerged from the discussions of interviews (qualitative discussions) assisted the researcher to determine the key variables and the sub-variables that affect the quality of the Egyptian HE system, and also was able to investigate the different relationships between the variables. Next, the researcher used these variables and relationships to build and validate a SD model that represents the real HE system in Egypt.

Chapter 1 provided an introduction for the study. It was useful in identifying the research aim and objectives. Chapter 2 presented background of the research, which included an overview of the HE system in Egypt and the skills gap facing it. Chapter 3 provided an overview of the methodology that was adopted in this study by the researcher, to achieve the study's objectives. That chapter provided the philosophical assumptions that guided the research methodology. It also detailed the research approaches, strategy, the techniques of data collection, and the procedures of data analysis.

Chapter 4 presented the results of the qualitative phase of the study. Where, it presented a comprehensive discussion of the participants' opinions during the semi-structured interviews, in both ways: descriptive and detailed. The findings of these discussions were useful in developing a SD model that represents the real HE system in Egypt. In doing so, it were useful in the model building stages, conceptualisation stage and formulation stage.

Chapter 5 provided the results of the quantitative phase of the study. Where, this chapter firstly included the validation stage, where the model validation was discussed by using two groups of validations tests: structural validation tests and behavioural validation tests. Then, the chapter presented the implementation stage. In this stage, the policy structure in the model was determined, then the model was run using different data values to experience many scenarios. After that, the scenario that represents the best situation was predicted.

Chapter 6 demonstrated a summary of the thesis, conclusion, how the research objectives were achieved. It also provided a critical discussion about the research findings in both the qualitative phase and the quantitative phase. Moreover, this chapter provided the research contributions (theoretical and practical), the research recommendations, the study's limitations, and finally directions for future research.

6.2 Conclusion

Human resources are considered the most important and critical factor behind the progression of any developing or developed country (Maher, 2018). Seleim and Bontis (2013) defined human resources as the knowledge, skills, experience, education and

competencies belonging to the individuals' of the country who can contribute to realising its goals, and begin to build the intellectual wealth of citizens.

Maher (2018) assured the importance of efficiently and effectively preparing and training the nation's human resources (graduates) to acquire the skills and knowledge which represent the main requirements for employment and which must be in line with the requirements of the Egyptian labour market; thus, HE institutions should provide graduates with the required knowledge, skills and attitudes to meet the country's urgent need for highly trained graduates (Mintzberg, 2004; Wren et al., 2007; Weligamage, 2009; Oyo, 2010; El-Awady, 2013; Al-Nahdi and Katbakhna, 2014).

HE within many developing countries - such as Egypt -are facing unusual challenges during the 21st century which result from the effects of globalisation, the increasing importance of knowledge and the information and communication age (Forest & Altbach, 2006). The most important challenge is the mismatch (gap) between skills of graduates and skills needed by the labour market which is apparent in the fact that many graduates are not getting employment after graduation; thus the skills that the graduates have are not compatible with the skills needed by the labour market and this has resulted in high youth unemployment (Wren et al., 2007; Weligamage, 2009; Loveluck, 2012; and Amin 2014).

According to experts in the field of quality of HE in Egypt, this gap (skills gap) can be bridged by increasing the quality of the Egyptian HE system components; this has been identified through the opinion of these experts and represent the key variables that affect HE system; thus, increasing the quality of services provided by universities will be reflected by the increase of the skills of the graduates. This results in increasing the

compatibility between the skills of the graduates and the skills needed by the labour market which eventually lead to bridging the skills gap (Elsadda, 2008; Maher, 2018). This skills gap bridge can be achieved through continuous coordination between the HE system on one side and the labour market on the other (Kavanagh and Drennan, 2008).

For the previous reasons, the purpose of this research is to firstly identify the key factors in the Egyptian public HE system using a modelling approach. These key factors affect the compatibility between the skills of university graduates and the requirements of the labour market in Egypt. Secondly the research also includes exploring the changes that should be done within these factors by managing HE in order to improve the quality of Egyptian HE system. By doing so, the compatibility can be increasedand the skills gap can be bridged.

In this research the research objectives were achieved using the mixed method. The power of mixed methods lies in their ability to cover all dimensions and details of the research. Neither qualitative nor quantitative research alone is sufficeint when studying this type of research (Bryman, 2016). The research consists of two phases; a qualitative phase followed by a quantitative phase and this mixed method is called exploratory sequential mixed method (Saunders et al., 2016).

The research starts with the qualitative phase that identified the key factors that affect the quality of HE systems in Egypt and to understand the relationships between these variables within the complex HE system. In the qualitative phase, 24 semi-structured interviews were conducted with experts in the field of quality of HE in Egypt. These interviews were very helpful in building the model of this research. This model simulates the behaviour of the real system of HE in Egypt. These interviews were analysed using

thematic analysis. The findings of this analysis helped the researcher to identify the variables and sub-variables of the model and how these varibles affect each other.

During the quantitative phase secondary data was collected about the real HE system and its main variables for the five years of simulation (from academic year 2012/2013 to academic year 2016/2017). This data was collected from many authorised and trusted sources: MOHESR, NAQAAE, SCU, CAPMAS, MMI and QAU in public universities. The secondary data information was used to validate the model of the research. The validation process was achieved by undertaking two groups of tests; the structure validation tests and the behaviour validation tests.

The model has been proved to simulate the behaviour of the real system in the duration of the simulation. This means it can simulate the effects of the changes that can be made to the system.

After the validation process came the implementation process. Several changes were applied to the model and the results of the model were investigated to see the effects of these changes on improving the quality of HE system. The implementations stage was very important in identifying the most important factors that have a major effect on the system. The changes that led to the best results represented the recommendations of this research to those responsible for the management of HE in Egypt (the Ministry of HE in Egypt).

According to the results of the model of this research these changes can actually improve the quality of HE in Egypt. This improvement in the quality of services provided by Egyptian public universities will increase the skills of graduates, increase the

compatibility between the skills of university graduates and the skills needed by the labour market and finally it will bridge the skills gap.

6.3 Critical Discussion about the Research Findings

This section provides a critical discussion of the findings of the study. And focuses on investigating the key variables and sub-variables that affect the quality of HE system in Egypt. In addition, it explores the relationships between these variables, which represents the main reasons of the incompatibility between the skills of Egyptian universities' graduates and the requirements of the current and future labour market. The study focuses on the reasons related to the system of HE in Egypt. In addition, it determines the changes that should be made by the management of the Egyptian HE system in order to improve the quality of the HE system in Egypt.

6.3.1 Findings of Qualitative Phase

Through this study, the researcher attempts to identify the real main dimensions and factors related to the quality of the Egyptian HE system from the points of view of experts in the field of quality of HE in Egypt, in other words, from the Egyptian perspective. This is because when the researcher studied the research problem in the real life, he found that we can't rely on the dimensions of the quality of HE that were determined by previous studies. These previously-derived dimensions can't be applied on the current Egyptian HE system with the aim of improving its quality. Instead, the researcher preferred to directly ask the experts and authorised persons in the field of quality of the Egyptian HE system about the real dimensions of the quality of this system and the real problem that face this system, from their points of view. The researcher believes that this can actually improve the quality of the Egyptian HE system. This is because all of the previously-

derived dimensions from previous studies failed in achieving the desired improvement in the quality of the HE system in Egypt. A strong clue to this fact is the low level of quality of the current Egyptian HE system, and also the incompatibility between the skills of its graduates and the requirements of the labour market (Aasan, 2006). This represents one of the most important contributions of the current study.

This study has undergone two main phases; the first phase was conducting semi-structured interviews with experienced and carefully-chosen administrative and academic staff members in the Egyptian public universities. In the first phase, the researcher conducted 24 semi-structured interviews with academic and administrative staff members who have experience more than 15 years in the field of quality of Egyptian HE. The researcher analysed the semi-structured interviews using thematic analysis. The analysis included transcription, coding, and finding themes and patterns. These interviews had two main purposes:

- To identify the key variables and sub-variables which affect the quality of Egyptian HE system (the second objective).

- To build a system dynamics model that can simulate and predict the behaviours of the real HE system in Egypt (the third objective).

From the discussion of interviews in Chapter 4, and after making the critical analysis for the participants' opinions, the researcher found that there are seven key variables that affect the quality of the Egyptian HE system; *"Quality of curriculum"*, *"Quality of internship"*, *"Quality of facilities"*, *"Quality of resources"*, *"Quality of research"*, *"Quality of staff"*, and *"Quality of teaching"*. Where, each of these key variables is affected by sub-variables and sub-sub-variables. Table (6.1) summarises the key

variables, sub-variables, and sub-sub-variables which affect the quality of the Egyptian HE system.

Table 6-1: Key variables, sub-variables, and sub-sub-variables of the research model

Key variables	Sub-variables	Sub-sub-variables
Quality of staff	Staff qualification	• Staff training
	Staff experience	• Number of curriculums prepared • Number of curriculums reviewed • Number of teaching years • Number of research publications
	Staff motivation	• Salaries and incentives • Staff appraisals • Student performance • University reputation
	Staff competence	• Staff performance • Staff appraisals • Number of research publications
Quality of teaching	Quality of staff	
	Quality of curriculum	
	Average class size	• Number of classes • Total number of students
Quality of research	Number of research publications	
	Allocated research budget	
Quality of curriculum	Rate of curriculum review	
	Quality of curriculum design	
	Quality of staff	
Quality of resources	Allocated resources budget	
	Desired resources budget	• Demand of resources
Quality of facilities	Allocated facilities budget	
	Desired facilities budget	• Demand of facilities
Quality of internship	Effectiveness of trainee	• Academic preparation • Self-initiative • Positive attitude
	Effectiveness of supervisor	• Demand for internship
	Internship availability ratio	• Available training opportunities • Demand for internship

These outputs of the interviews enabled the researcher to articulate the theory of this study (The model of the study, see Figure 4.12) which shows the relationships between each of

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the key variables, sub-variables and sub-sub-variable. These relationships give the model more dynamicity. As a result, the model represents the real HE system in Egypt.

In the beginning, all the participants agreed about the idea of low quality of the Egyptian public HE system, which appears in the low quality of services provided by the Egyptian public universities which lead to incompatibility between the skills that the graduates have and the skills needed by the labour market. Also, all of them stated that graduates from the Egyptian public universities are not qualified enough to directly work in the labour market, which means that there is a skills gap between the skills of graduates and the requirements of the labour market in Egypt. Many previous studies supported the existence of this skills gap (Al-Harthi, 2011). This agrees with the expectations of the researcher. Where, the researcher has been working in the HE academic field more than 20 years. Therefore, he is familiar with the problems that face the Egyptian HE system, especially the problem of skills gap. He published several articles which tackled some reasons behind this gap (Ragheb et al., 2014; Ramy & Abdella, 2020).

The participants believed that all of the key variables have a positive effect on the quality of Egyptian HE system. Which means, increasing these key variables can increase the overall quality of HE system which leads, in the end, to increasing the compatibility between skills of graduates and skills required by labour market and consequently to bridge the skills gap. These findings are supported by the results of previous studies by Kennedy (1998), Zineldin (2007), Tsinidou et al. (2010), Oyo (2010), Hussein and Abo El-Nasr (2013), Noaman et al. (2013), and Hossain (2017). This also agreed with the researcher expectations. Where, the researcher believed that any improve in any of the key variables would improve the quality of the Egyptian HE system (Ragheb et al., 2014; Ramy & Abdella, 2020).

Although all the effects of the key variables are positive, the values of the effects are not the same; some key variables have higher effects than the others. After analysing the participants' opinions, the researcher found that 24 participants (100% of the participants) assured the importance of four key variables; *"Quality of teaching", "Quality of staff", "Quality of research",* and *"Quality of curriculum".* Therefore, it has been concluded that these four key variables have the highest impacts among the seven key variables. After that, 20 participants (83% of the participants) mentioned *"Quality of resources"* as an important key variable. *"Quality of facilities"* comes in the third place with 18 participants (75% of the participants). Finally, *"Quality of internship"* comes in the last place with a16 participants only (67% of the participants) (see Table 4.2). The sub-variables that affect the key variables are determined from interviews (as shown in Chapter 4). These sub-variables (along with the key variables) are used to build the model that represents the real HE system in Egypt. It should be mentioned that these key variables may be similar in many HE systems in different countries. However, the sub-variables and the sub-sub-variables that affect these key variables are highly different from one HE system to another. The key variables, sub-variables, and the relationships between them will be discussed in details in the following section.

6.3.1.1 Key Variable One: Quality of Staff

From the discussions, *"Quality of staff"* is one of the most important key variables that positively affect the quality of the Egyptian HE system. The increase of the quality of staff members would lead to an increase in the overall quality of the Egyptian HE system. Through simulating the real HE system, the current study was able to accurately identify the amount of increase in the quality of HE system resulting from a given increase in the quality of staff. This is considered an important contribution which will be discussed later in this chapter.

This is supported by many previous researches such as (Maher, 2018). This agrees with the expectations of the researcher. Where, the researcher believed that increasing the quality of the staff members have a positive effect on the quality of the HE system in Egypt, and vice versa. What supports this finding is the fact that "Quality of staff" is an important criteria in ranking the universities, both locally and internationally. Which means, if the quality of staff is high in a university, this will increase this university's ranking.

This study identified four sub-variables; *"Staff qualification", "Staff experience", "Staff motivation",* and *"Staff competence"* which affect the *"Quality of staff"*. However, the findings of the current research are in-line with some previous studies. For example, it was found that the "Quality of staff" was affected by these same four sub-variables. Oyo (2010) developed a similar sub-model for "Quality of staff". His model of "Quality of staff" included all the sub-variables of the model in this study. Other previous studies were different from the current study. For example, Kennedy (1998), Tsinidou et al. (2010), and Noaman et al. (2013) included different sub-variables in their models. Kennedy (1998) named his key variable "Staff performance" instead of "Quality of staff", where the sub-variables that affect this key variables are "Staff motivation", "Staff training", "Quality of teaching", and "Student performance". Tsinidou's model and Noaman's model for "Quality of staff" were also different from the current study. They both included four sub-variables; "Academic qualification", "Practical experience", "Communication skills", and "Research activity".

However, these previous studies didn't identify the amount of effect of each of these sub-variables on the quality of staff. Though, the current study presents contribution through identifying the effect of each of these sub-variables on the "Quality of staff", which is

discussed in details in the findings of the quantitative phase. The current study also identified a number of sub-sub-variables that affect each of these four sub-variables, see Figure (6.1), which will be discussed as follows.

Concerning "Staff qualification", the current study found that this variable is affected by the amount of training that the staff members get. This was supported by (Kennedy, 1998) which indicates that the staff qualification can be increased by only increasing the staff training. The researcher disagrees with that, where he believes that the staff qualification isn't effected only by staff training, but also by other sub-sub-variables such as: staff experience and staff competence.

Speaking of "Staff experience", the current study concluded that this sub-variable is affected by four sub-sub-variables: "Number of curriculums prepared", "Number of curriculums reviewed", "Number of teaching years", and "Number of research publications". This is supported by (Askerc, 2014), who assures that the experience of staff members are gained based on these four sub-sub-variables. This agrees with the researcher's expectations.

As for "Staff motivation", the current study identified also four sub-sub-variables that affect this sub-variable, which are: "Salaries and incentives", "Staff appraisals", "Student performance", and "University reputation". There are some previous studies which support this finding, though they differ in some parts. For example, (Kennedy, 1998) agrees with the research findings that these sub-sub-variables affect "Staff motivation", except "University reputation" as he believes that it doesn't affect the sub-variable. However, the researcher supports the research findings regarding "Staff motivation", though he suggests adding another sub-sub-variable, which is: self-esteem of the staff

members. He believes that this is another important variable that affect "Staff motivation".

The final sub-variable that affect "Quality of staff" is "Staff competence". The current study identified three sub-sub-variables affecting "Staff competence" which are: "Staff performance", "Staff appraisals", and "Number of research publications". However, some previous studies (Noaman et al. 2013) don't believe that the "Staff competence" is not affected by "Staff performance". Instead, they claim that "Staff performance" is the one that is affected by "Staff competence". The researcher disagrees with these studies, and partially agrees with the research finding. He suggests that both "Staff competence" and "Staff performance" affect each other.

6.3.1.2 Key Variable Two: Quality of Teaching

The current study stated that *"Quality of teaching"* is one of the key variables that affect the quality of Egyptian HE system. The relationship is positive between "Quality of teaching and the quality of Egyptian HE system. Some previous studies agrees with this finding such as (Douglas & Douglas, 2006) who agrees that "Quality of teaching" is an important variable that has high positive impact on the quality of the Egyptian HE system. The researcher believes that there is a direct and strong effect of "Quality of teaching" on the quality of the Egyptian HE system.

The current study identified three sub-variables; *"Quality of staff"*, *"Quality of curriculum"*, and *"Class size"*. These sub-variables show a big percentage of similarity with previous studies by Oyo (2010). Some differences are that Oyo (2010) added *"Quality of research"* and *"Quality of resources"* to these three sub-variables. Ghonji et al. (2015) and Hubackova (2015) developed different sub-models for "Quality of

teaching". Ghonji's model includes *"Lesson design", "Teaching skill factor",* and *"Communications skill factor"* while Hubackova's model includes *"Teacher experience", "Teacher skills", "Curriculum",* and *"Number of students"*.

The researcher agrees with the research findings, but he suggests adding another two sub-variables affecting "Quality of teaching", which are: "Quality of resources" and "Quality of facilities". He believes that these two variables also affect "Quality of teaching", though their effect can be lower than the three sub-variables mentioned in the current study.

Moreover, from the findings of the research, the researcher found that the "Average class size" can be defined by two sub-sub-variables, which are: "Number of classes" and "Total number of students". Some previous studies supported that we can calculate the average class size by simply dividing the total number of students by the total number of classes in universities (Ghonji, et al., 2015). In addition, if the "Average class size" increases, the "Quality of teaching" decreases, which indicates that there is a negative relationship between them (Douglas & Douglas, 2006). The researcher agrees with the research findings regarding this sub-variable.

6.3.1.3 Key Variable Three: Quality of Research

Indicated from the interviews' discussions, there is a direct and positive relationship between "Quality of research" and quality of the Egyptian HE system. Where, any increase in the "Quality of research" will lead to an increase in the quality of the Egyptian HE system. A clue to this fact is that the "Quality of research" is also one of the criteria used for universities ranking both locally and internationally. Moreover, "Quality of research" is also one of the criteria set by NAQAAE to evaluate quality of HE in Egypt

(EACEA, 2017), which assures the high importance of "Quality of research" and its positive effect on the quality of the Egyptian HE system. The researcher totally agrees with this finding.

The current study indicated that "Quality of research" is affected by funding and another two sub-variables; "Quality of staff" and "Number of research publications". Kennedy (1998) and Oyo (2010) stated that "Quality of research" depend on two sub-variables; "Funding" and "Number of publications". However, they didn't mention the role of "Quality of staff" in enhancing "Quality of research". The "Quality of staff" is very important in increasing "Quality of research", as indicated by the findings of this study.

The researcher agrees with the research findings. He also added that the "Allocated research budget" in the Egyptian universities is still low and insufficient because of the limit of funding of HE in Egypt, which negatively reflects on the number of research publications in Egypt, which in turn decrease the "Quality of research" in Egypt, especially in the Egyptian public universities. The government should increase the 'Allocated research budget" so that the "Quality of research" can be effectively increased and, as a consequence, increase the quality of the Egyptian He system. The current study presents a contribution in this area by identifying the required increase in the "Allocated research budget" which lead to the optimal "Quality of research" which in turn will increase the quality of the Egyptian HE system.

6.3.1.4 Key Variable Four: Quality of Curriculum

The finding of this study showed that the "Quality of curriculum" is one of the most important key variables that affect the quality of the Egyptian HE system in Egypt. The quality of Egyptian universities and their outputs are highly dependent on many key

variables. One of these variables is "Quality of curriculum", which is being taught in these universities (Ragheb et al., 2014). Many previous studies supported the importance of "Quality of curriculum" as one main factor that affect the quality of universities and quality of their outputs (Sheta, 2012). The researcher believes that "Quality of curriculum" is no less important than the member who teach these curriculums "Quality of staff" and also no less important than the methods used to teach these curriculums "Quality of teaching".

From the research findings, the researcher identified three sub-variables that affect "Quality of curriculum"; "Rate of curriculum review", "Quality of staff", and "Quality of curriculum design and content". Where, the "Quality of curriculum" is affected by: the person who prepare these curriculums, the content of these curriculums, and the number of reviewing these curriculums. This means if the quality of the curriculum design is high and, staff members are high qualified, and the rate of curriculum review is high; this will lead to increasing the "Quality of curriculum" (El-temsahi & El-ragal, 2004).

Some previous studies don't support this finding. For example, Kennedy (1998) had a different sub-model of "Quality of curriculum"; it included "Resources available", "staff views", and "Information reached". Oyo (2010) mentioned one sub-variable affecting "Quality of curriculum", which is "Rate of curriculum review". While Kennedy neglected the effect of curriculum reviewing and Oyo neglected the effect of qualified staff members who review the curriculums, this study included both effects. The researcher's expectations agrees with the findings of the current study. He believes that the "Quality of curriculum" depends on all the three sub-variables: "Quality of staff" members who prepare and review the curriculums, "Quality of curriculum design and content", and "Rate of curriculum review". One of the contributions of the current study is the ability

of the model of the study to identify the amount of increase in "Quality of curriculum" against a given increase in one and/or more sub-variables of the three.

6.3.1.5 Key Variable Five: Quality of Resources

The current study indicated that "Quality of resources" is one of the main factors that positively affect the quality of the Egyptian HE system. Any increase that occurs in the "Quality of resources" would lead to increasing the quality of the Egyptian HE system. One contribution of this study is identifying the suitable amount of increase in the "Quality of resources" which would lead to the optimal improvement in the quality of the Egyptian HE system.

Where, it has been shown that "Quality of resources" affects the quality of HE system in Egypt which is represented by the quality of its outputs (EACEA, 2017). This agrees with the researcher's expectations, where "Quality of resources" effectively increase the quality of the Egyptian public universities. Therefore, it affects the quality of the Egyptian HE system, and the quality of its outputs, which represents the skills gap.

The current study identified two sub-variables affecting "Quality of resources", which are: "Allocated resources budget" and "Desired resources budget". Some previous studies agrees that "Quality of resources" is affected by "Allocated resources budget" and "Desired resources budget". The researcher agrees with this finding. The researcher believes that if the "Allocated resources budget" increases, this will make it able to cover the desired resources budget, which leads to an increase in the quality of resources.

From the discussions, one sub-sub-variable was determined to be affecting the sub-variable "Desired resources budget" which is "Demand of resources". Where, "Demand

of resources" greatly helps to determine the "Desired resources budget" (Lagrosen et al., 2004). The researcher declares that the "Demand of resources" is considered important indicator in determining the desired resources budget. Therefore, the management of the Egyptian HE system should increase the "Allocated resources budget" so that it can cover the desired resources budget and the demand of these resources, in a way that reflects on the Egyptian HE system.

6.3.1.6 Key Variable Six: Quality of Facilities

The current study found that "Quality of facilities" is another important factor that affects the quality of the Egyptian HE system. The relationship between "Quality of facilities" between quality of the Egyptian HE system isn't different from the other key-variables, they are all positive (Kennedy, 1998). One contribution of the current study over the previous studies, which makes it more valuable, is that it can identify the amount of increase in the "Quality of facilities" which lead to the best improvement in the quality of the Egyptian HE system.

Some previous study supported that there is a positive relationship between "Quality of facilities" and quality of the Egyptian HE. For example, Kennedy (1998) and Oyo (2010) agree with this finding, where Kennedy (1998) stated that "Quality of facilities" is affected only by funding, while Oyo (2010) mentioned that "Quality of resources" is also affected only by funding. The researcher supports this finding, as he believes that "Quality of facilities" is considered one of the key-variables that affect quality of the Egyptian HE system. The study identified one sub-sub-variable that affect the desired facilities budget, which is "Demand of facilities". Where, "Demand of facilities" is considered a very important indication in determining the desired facilities budget.

The researcher declared that identifying the desired facility budget is done through demand of facilities. Although, always in Egypt, the allocated facilities budget is not sufficient enough to cover the desired facilities budget and the demand of facilities. Therefore, the Egyptian government must increase the allocated facilities budget in order to cover the desired facilities budget and the demand of facilities, even if this desired increase was implemented gradually.

6.3.1.7 Key Variable Seven: Quality of Internship

From the discussions of interviews, "Quality of internship" is one of the key variables that has a direct and positive effect on the quality of the Egyptian HE system. The increase of the quality of internship would lead to an increase in the overall quality of the Egyptian HE system. Through simulating the real HE system, the current study was able to accurately identify the amount of increase in the quality of HE system resulting from a given increase in the quality of internship. This is considered an important contribution which will be discussed later in this chapter. This is supported by many previous researches such as (Krafft & Assaad, 2015).

This agrees with the expectations of the researcher. Where, the researcher concluded that increasing the quality of internship have a positive effect on the quality of the HE system in Egypt, and vice versa. Although this key variable didn't get attention from previous studies, the researcher finds it a very important key variable. This key variable plays a very important role in linking the HE system with the labour market. It helps the students to get more familiar with the requirements of the labour market.

This study identified three sub-variables; *"Effectiveness of trainee", "Effectiveness of supervisor",* and *"Internship availability ratio"* which affect the *"Quality of internship".*

However, this finding is similar to findings of some previous studies. For instance, it was found that the "Quality of internship" was affected by these same three sub-variables, such as (CAPMAS, 2017).

However, these previous studies didn't identify the amount of effect of each of these sub-variables on the quality of staff. Though, the current study presents contribution through identifying the effect of each of these sub-variables on the "Quality of staff", which is discussed in details in the findings of the quantitative phase. The current study also identified a number of sub-sub-variables that affect each of these three sub-variables, see Figure (6.1), which will be discussed as follows.

Concerning "Effectiveness of trainee", the current study found that it is affected by: the academic preparation, self-initiative, and positive attitude. This was supported by (Cleary et al., 2007). The researcher agrees with this finding, where he believes that the Effectiveness of trainee is affected by these three sub-variables.

Speaking of "Effectiveness of supervisor", the current study indicated that this sub-variable is affected by one sub-sub-variable: "Demand for internship". This is supported by (CAPMAS, 2017), who assures that the "Effectiveness of supervisor" is affected by this sub-sub-variable. The researcher disagrees with this finding, because he believes that there are other sub-sub-variables that affect the "Effectiveness of supervisor", including his experience and his qualifications.

As for "Internship availability ratio", the current study identified also two sub-sub-variables that affect this sub-variable, which are: "Available training opportunities" and "Demand for internship". There are some previous studies that support this finding, such

as, (Krafft & Assaad, 2015). The researcher supports the research findings regarding "Internship availability ratio", as this sub-variable is calculated by dividing the "Available training opportunities" by the "Demand for internship".

6.3.2 Findings of Quantitative Phase

This sub-section provides a discussion about the findings of the quantitative phase of the study. The quantitative findings are concluded from two stages. The purpose of the quantitative phase is, firstly, to validate the SD model that was developed in the qualitative phase. Then, to use this model to explore and investigate the relative importance of each of the key variables that affect the quality of the Egyptian HE system. Finally, the quantitative phase enabled the researcher to determine the changes that should be made by the management of the Egyptian HE in order to improve the quality of this system. These changes represents the recommendations of this study.

The first stage of simulation (**validation stage**) where the researcher inserts the real data of the HE system in Egypt to the model (from academic year 2012/2013 to academic year 2016/2017). This simulation is aimed at studying the existing HE system and the dynamic relationships within it. Next, the second stage of simulation (**implementation stage**) starts where some variables are manipulated to try to make improvement to the overall quality of the HE system.

6.3.2.1 Policy Structure

The variables that are changed in the implementation stage represent the variables that can actually be changed in the real life by decisions made by the government or the Ministry of HE (decision makers in the HE sector). These variables together form the

"Policy structure" in the model. The *"Policy structure"* included many variables; *"Rate of curriculum review per year"*, *"Total number of staff"*, *"Available training opportunities per year"*, *"Government funding per year"*, *"Facilities share"*, *"Resources share"*, *"Research share"*, *"Staff share"*, *"Number of curriculums reviewed per staff per year"*, *"Number of curriculums prepared per staff per year"*, *"Staff salaries and incentives share"*, *"Staff training budget share"*, *"Number of classes"*, *"Student fees per year"*, and *"High school grade required for enrolment"* see Table (5.2).

6.3.2.2 Scenarios Findings

The values of these variables have been changed in the model several times. Different scenarios have been developed with different combinations of changes in the "Policy structure" variables. At first, each variable was changed many times until the optimum value was reached; the optimum value is the lowest value of the variable that has the maximum effect. This means that increasing the variable above the optimum value is unfeasible and a waste of effort and resources. After that, several variables in the *"Policy structure"* have been changed together as a *"Scenario"*.

The simulation results show that the improvement of quality of Egyptian HE cannot be achieved by increasing just one or two key variables. Each variable of the seven key variables represents a weakness or a problem that must be solved in order to reach the desired quality level. Different scenarios were tested and the final results obtained. Some scenarios show a great improvement in each of the key variables while within other scenarios there are no noticeable changes, **see Appendix F**. In the following points, each scenario's findings will be discussed.

- **Scenario #1**

The first scenario investigated how to improve the "Quality of curriculum" as a key variable that affects the quality of the Egyptian HE system. The researcher changed the value of the sub-variable "Rate of curriculum review per year" from once every two years to once every year. The resulted in improvement of the "Quality of curriculum" by 20% (from 50% to 70%). This lead to improvement of "Quality of services provided by universities" by nearly 8% instead of just 4% in the real situation (the amount of increase doubled). Consequently, the skills gap decreased by 7% instead of just 5% in the real situation (see table 5.7). This finding shows the importance of the "Quality of curriculum" as a key variable that affects the quality of the Egyptian HE system.

The researcher finds this scenario worthy because it increased an important key variable by a fairly good percent (20%), which would help in improving the quality of the Egyptian HE system.

- **Scenario #2**

The second scenario attempted to improve the "Quality of internship" which represent a problem in the Egyptian HE system, by increasing the "available training opportunities" approximately 7 times the real values. This resulted in improvement of "Quality of internship" by 15% (from 50% to 65%). Which lead, in the end, in decreasing the "Skills gap" by 6%, see table 5.9.

The researcher agrees that the "Quality of internship" represents a point of weakness in the Egyptian HE system. The reason for that is the absence of coordination between universities and employers, which lead to a very low number of "available training opportunities" compared to the demand.

The researcher finds this scenario a worthy scenario as it increased the key variable "Quality of internship" by a considerably high percent (15%). This would be helpful in improving the quality of the Egyptian HE system.

• **Scenario #3**

The variables *"Quality of facilities"* and *"Quality of resources"* represent the main two points of weakness in the HE system in Egypt. This is shown in the results of initial simulation in Table (5.3), where the values of "Quality of facilities" and "Quality of resources" are the lowest among the seven key variables. The funding for the HE system is very low and needs to be increased to at least four times it current value.

This scenario investigated the effect of the funding on the key variables. It has been found that four key variables are directly affected by the funding, these are: "Quality of facilities", "Quality of resources", "Quality of research", and "Quality of staff". In this scenario, the funding to these four key variables is increased. The funding is increased through the five years of simulation exponentially. In this scenario, the funding increased in the five years to reach a value of 8 times the initial value (compare to just 1.5 times the initial value in the real current situation).

This resulted in an improvement in the "Quality of facilities" by 20% (from 40% to 60%) and an improvement in "Quality of resources" by 15% (from 50% to 65%). These are considerably good improvements. However, the "Quality of research" and the "Quality of staff" improved by just 4% (from 60% to 64% approximately). The overall result was an improvement of the "Quality of services provided" by 11% (from 60% to 71% approximately) and, consequently, an improvement in the "Skills gap" by 10%, see Table 5.11.

The researcher finds this scenario infeasible because, despite the high increase in both "Quality of facilities" and "Quality of resources" much of funding has been wasted for a little increase in both "Quality of staff" and "Quality of research". This inspired the researcher to re-distribute the increased funding for certain key variables, as will be shown in the next scenario.

- **Scenario #4**

This scenario investigated another way to increase the quality without increasing the funding, by changing the distribution of the existing funding. The percentage of allocations are changed for each of facilities, resources, and research. Each of the "Facilities share" and "Resources share" was decreased by 1.5%, which allowed to increase the "Research share" by 3%. This resulted in a slight improvement in "Quality of research" by nearly 9% (from 60% to 69% approximately), which lead in the end to decreasing the skills gap by 7% (from 26% to 19% approximately), see Table 5.13.

The researcher finds this scenario unworthy. Although this scenario resulted in a considerably good increase in "Quality of research", but this was on the cost of decreasing both "Quality of facilities" and "Quality of resources". Therefore, the researcher searched for another way to improve "Quality of research" without sacrificing the other key variables.

- **Scenario #5**

It has been found that, from scenario #3 that both "Quality of facilities" and "Quality of resources" needs funding to improve. On the other side, "Quality of staff" showed little improvement against the increase in the funding. Therefore, in this scenario, the funding is increased but this increase is directed towards "Quality of facilities", "Quality of

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resources", and "Quality of research". The researcher excluded "Quality of staff" from the increase by adjusting the shares of these four key variables. The funding increased in the five years to reach a value of 5 times the initial value (compared to just 1.5 times the initial value in the real current situation).

This resulted in a high improvement in "Quality of facilities", "Quality of resources", and "Quality of research". As a consequence, the "Skills gap" decreased by 12% (from 26% to 14%) compared to just 5% decrease in the real situation, see Table 5.15.

The researcher finds this scenario feasible and worthy. This is because this scenario resulted in higher decrease in the "Skills gap" by using approximately half the funding that was used in scenario #3.

- **Scenario #6**

This scenario aims at increasing the funding internally, by increasing the students' fees. The fees were raised by 500 EGP per student each year. This would increase the "Total revenue per year" and also the "Total funding per year". However, the increase in students' fees doesn't provide additional funding for all key variables. The additional funding only covers the required funding for "Quality of research". Therefore, the researcher adjusted the shares allocations to direct the additional funding to cover only "Quality of research".

This resulted in an improvement in "Quality of research" by 10% (from 60% to 70%). Consequently, the "Skills gap" decreased by 7%, see Table 5.17.

- **Scenario #7**

It has been found, from previous scenarios, that "Quality of staff" is not highly affected by increasing the funding. Therefore, this scenario investigates another way to increase this key variable. This can be done by decreasing the two sub-variables "Student to staff ratio" and "Loading hours per staff". This is done by increasing the "Total number of staff". In this scenario, the total number of staff increased by 50% to reach 1.5 times its value in the real situation. However, increasing the staff requires also providing salaries and incentives for them, as well as training funding. Therefore, the staff budget increased also by 50%.

This resulted in an improvement of "Quality of staff" by 3.5% (from 60% to 63.5%). This, consequently, lead to a very low effect on the "Skills gap". The researcher finds this scenario unworthy because it resulted in very little increase in the "Quality of staff" and very little decrease in the "Skills gap".

- **Scenario #8**

In scenario #3 the "Quality of staff" wasn't highly affected by the increase in funding. While in the scenario #7, the "Quality of staff" wasn't also affected by increasing the number of staff members. Therefore, the researcher tried to find another way to increase "Quality of staff". Where, this scenario attempted to increase the "Quality of staff" by increasing the "Number of curriculums prepared per staff" and the "Number of curriculums reviewed per staff". These two variables positively affect the sub-variable "Staff experience", which increases the key variable "Quality of staff". Both "Number of curriculums prepared per staff" and "Number of curriculums reviewed per staff" were approximately doubled.

This resulted in an improvement in "Quality of staff" by just 1%. Which of course didn't have a noticeable effect on the "Skills gap". It is obvious, from this scenario and previous scenarios, that "Quality of staff" has a very low sensitivity to any increase in the sub-variables. Explanation to this phenomenon is that *"Quality of staff"* in the Egyptian HE system is considerably good and stable. Actually, "Quality of staff" is a point of strength in Egypt. Staff members in the Egyptian HE system are highly qualified but they suffer from the poor funding and lack of resources and facilities. Therefore, any attempts to increase the *"Quality of staff"* would consume much funding and much effort to achieve unnoticeable changes. The reasons for this phenomenon are that the HE system in Egypt has highly qualified and highly trained staff members. Therefore, the researcher finds this scenario unworthy, because any extra efforts to increase the "Quality of staff" would lead to very little increase.

- **Scenario #9**

This scenario targeted the "Quality of teaching". The "Class size" is decreased in this scenario by increasing the "Number of classes" by 50%. This resulted in an improvement of "Quality of teaching" by 11% (from 55% to 66%) compared to just 5% increase in the real situation. This caused the "Skills gap" to decrease by 6% (compared to 5% in the real situation), see Table 5.23.

The researcher finds this scenario unfeasible, because increasing the number of classes by this amount would consume a huge amount of funding to just increase "Quality of teaching" slightly.

6.3.2.3 Best Predicted Situation

According to the previous scenarios, the researcher found that some scenarios implied good improvements and effectively decreased the gap. While, other scenarios had nearly no effect, or consumed high funding for little effect. The most effective and suitable scenarios were: scenario #1, scenario #2, and scenario #5. Therefore, the researcher decided to combine these three scenarios together and to investigate the result of applying them to the model at the same time.

This resulted in improvements to five key variables: "Quality of curriculum", "Quality of research", "Quality of facilities", "Quality of resources", and "Quality of internship" by 20%, 10%, 20%, 15%, and 15%, respectively. The other two key variables didn't increase significantly. "Quality of staff" and "Quality of teaching" increased by just 2% and 5%, respectively. The final result was a high increase in "Quality of services provided by universities" (15%) and, consequently, a decrease in the "Skills gap" by 16% (from 26% to 10%).

6.4 How Research Objectives Were Achieved

As the researcher said before in the summary of this thesis, this research had five main objectives. The **first objective** was to thoroughly explore the dimensions of the Egyptian HE system that contributes to the skills gap. Where, the dimensions that were investigated include the roles and purpose of HE, the HE systems, the quality of HE in Egypt, and the labour market in Egypt, with particular emphasis on new employment opportunities in Egypt, skill sets required for employment in both Egypt and abroad, the skills of graduates as perceived by both universities and employers, and the compatibility between skills of university graduates and requirements of labour market represented in the skills gap.

Through reviewing and investigating the literature related to the research problem, and after conducting many semi-structured interviews with the experts in the field of quality of HE in Egypt, the researcher found that most of the new employment opportunities in Egypt are in the informal sector and are characterised by low productivity and low pay. As for the skills set required for employment in both Egypt and abroad, it has been found that, according to the majority of the employers, there are four main types of skills required by the labour market. These skills are what employers demand the most; they are not, however, available within the capabilities of the graduates as much as the employers would like. The skills required are: cultural skills, interpersonal skills, inter-personal skills and technical skills (job specific skills); both graduates and employers agree that the HE system in Egypt is not able to produce these skills. As for the skills of Egyptian university graduates as perceived by both employers and universities, the researcher found that most employers complain that the graduates are not qualified enough to obtain a suitable job because their skills are not compatible with the requirements of the labour market. On the other hand, Egyptian universities claim that the skills of graduates are acceptable considering the available funding and resources for HE sector. They also admit that this quality is not enough for the graduates to compete in the labour market.

The **second objective** of this thesis was to identify the factors that affect the quality of Egyptian HE system. Where, the first phase of the research (The qualitative phase) was to conduct semi-structured interviews with experienced academic and administrative members who are responsible for quality management in four public universities in Egypt and then to find the factors that affect the quality of the Egyptian HE system. The data of the interviews were analysed using thematic analysis. The interviews' transcripts were coded in order to find themes and patterns. This enabled the researcher to determine the key variables and sub-

variables, and also to deeply investigate the relationships between them which affect the quality of Egyptian HE system.

The **third objective** was to develop a system dynamics model that simulates the real HE system in Egypt, by using the factors investigated in the second objective. The current study used the modelling approach in building the SD model, which represents the real system of HE in Egyptian public universities. The study divided the model building process into two main phases; the Qualitative phase and the Quantitative phase. The qualitative phase is based on creating diagrams of cause and effect (known as causal-loop or influence diagrams). These diagrams were built with the aid of system actors (in this thesis: experienced staff and administrative members in the field of quality of HE in Egypt). These mental models helped the researcher in the building of system structure and strategies. The second phase of model building process was the quantitative phase using simulation software (PowerSim Studio 10 Academic) as an appropriate decision support tool. This is the more conventional phase of SD. The calibration of parameters and the identification of simulation equations within the simulator program used were applied in this phase by the researcher.

The **fourth objective** was to validate this model and use it to explore and investigate the relative importance of each of the key factors that affect the quality of the Egyptian HE system. The researcher used two groups of tests to validate the model: the structural validation tests and the behavioural validation tests. The first group aimed at deeply inspecting the equations and graphs of the model and the connections between the variables to ensure that the model was correctly built. In this group of tests, five tests in total were carried out; boundary adequacy, structure assessment, dimensional consistency, parameter assessment and the extreme conditions test. The second group

investigated the behaviour of the model in different conditions, including extreme or unreal conditions. In this group of tests, the study carried out three tests: behaviour replication, behaviour anomaly, and the behaviour sensitivity test. After applying all these tests to the model, the researcher can not only confirm the validity of the model, but also that the model is useful and appropriate for the problem under study.

After the model validation, the researcher applied this model to Egypt by feeding the said model with the necessary secondary data which had been collected in quantitative phase from the many reliable official bodies related to HE in Egypt and whom specialised in providing such data (MHESR, NAQAAE, CAPMAS, SCU…etc.). The study conducted the initial run of the model using the values of those data representing the real HE system in Egypt. The study ran for five years from the academic year 2012/2013 until the academic year 2016/2017. Firstly, the study investigated the actual situation. Secondly, the study applied different scenarios to change the values of some variables within the system; thus the researcher was able to study these scenarios to explore the effect of these variables, which cannot be applied in the real world, in order to find out the relative importance of each of the key variables in improving the quality of the Egyptian public HE system; so that the most affecting variables can be identified and given more attention.

The **fifth objective** of this study was to make conclusions and recommendations by the necessary changes that must be made by the Egyptian HE management to improve the quality of the HE system. The researcher used this model to investigate the changes that are needed to be made by the management of Egyptian HE and the impact of these changes on the quality of the Egyptian HE system. Thus, the researcher was able to identify and formulate many recommendations for the management of Egyptian universities. This will lead to the improvement of the quality of the HE system represented

in the quality of the services provided by the universities, and accordingly increase the skills of graduates. This will lead to an increase in the compatibility between the skills of graduates and the skills needed by the labour market in Egypt. Finally, this will bridge the skills gap.

The researcher started his study by conducting a widespread literature review with the aim of developing a conceptual model for the factors that impact the quality of Egyptian HE system and its impact on the compatibility between the skills of graduates with the requirements of the labour market in Egypt. Following this, the researcher started collecting data by carrying out a qualitative study (using interviews with the experts in the field of HE) with the aim of understanding and determining the key variables affecting the quality of HE system. The topics and ideas that emerged from the qualitative discussions supported the researcher in building and developing a system dynamics model which represents the real HE system in Egyptian public universities. Finally, the model that was created was based on literature review and the results of qualitative discussions. The model was tested through feeding it with secondary data related to the purpose and duration of the study and running it to simulate the Egyptian HE system. The simulation conditions were changed to reach a situation that improved the quality of the HE system in Egypt and the quality of its outputs.

Chapter one displayed an introduction for the research; its purpose. Moreover, it was useful in determining the research aims and objectives. In addition to this, it provided the dynamic hypothesis which represented a summary of the model of the study.

Chapter two provided a literature about the roles and purpose of HE. Then, it presented an overview of HE systems in France, Germany, England focusing on the Egyptian HE

system. Additionally, it displayed the outlines of both the quality of HE in Egypt and the labour market in Egypt.

Chapter three displayed an overview of the methodology that was adopted in this study to achieve the research objectives. This chapter provided the philosophical orientation that guided the methodology of the research. It also presented the research strategy, the techniques of data collection and procedure of data analysis. Additionally, this chapter determined the time horizon and the population of the research.

Chapter four provided the qualitative phase of the study and displayed the analysis procedures of the semi-structured interviews. The findings from this qualitative analysis were used in the process of model conceptualisation. Finally, this chapter had shown the process of model formulation which was carried out before moving to the quantitative phase of the study.

Chapter five discussed the validation of the model where the mental model (causal loop diagram) and the formal model (stock-and-flow diagram) had been constructed and the variables were formulated in previous chapter. Therefore, this chapter displayed the validation tests which were used to validate the model before implementation to obtain the improvement policies. Chapter 5 also provided the model implementation steps.

Chapter six provided an overview of the study ultimately showing how the research objectives were achieved. This chapter displayed a comparison between the findings of the research and the findings of any previous studies. Penultimately, this chapter provided the research conclusions as well as the research recommendations and finally this chapter presented the research limitations and gave directions for future research in this field.

6.5 Theoretical Contributions

The education sector (especially the HE sector) is considered one of the most vital sectors in all developed and developing societies (Yizengaw, 2008; Ramadan et al., 2011). HE sector suffers from man problems in the Middle East region especially in Egypt. Therefore, many previous studies admitted the presence of a skills gap between the skills of university graduates and the requirements of labour market in Egypt (Mintzberg, 2004; Wren et al., 2007; Weligamage, 2009; Loveluck, 2012; and Amin 2014). However, the factors that lead to the existence of this gap are not yet determined. Moreover, previous studies haven't discussed exactly how to bridge this gap. Most of the previous studies focused on how to improve the HE sector in Egypt so that its outcomes match the requirements of the labour market only from an academic perspective without investigating the actual reasons behind the mismatch (gap) between these outcomes and the requirements of the labour market. These studies focused only on the symptoms of the problem not on the actual reasons for the problem.

Therefore, the purpose of this study is to identify the main factors that influence the Egyptian public HE system. This purpose also extends to investigate the changes that should be made to these factors by the management of HE in order to achieve a real improvement to the quality of HE system and, finally, bridge the skills gap.

The current study contributes to growing research about the quality of HE in Egypt and increasing the compatibility between the quality of its outcomes (skills of graduates) and the requirements of the labour market. Hence, there are a number of theoretical contributions presented by this research:

Firstly, this study indicates that there are many literatures that tackle the problem of quality of education in Egypt (Altbach and Knight, 2007; El Zanaty et al., 2007; El Badawy et al., 2009; ILO, 2010; OECO, 2010; Osman, 2011; Elassy, 2015). However, most of these studies are in the field of basic education. A very limited number of these studies focus on the public HE in Egypt. So, this study introduces an advancement to the current literature of quality of public HE in Egypt.

Moreover, this study investigated the research problem from the university's perspective (points of views of academic and administrative staff members as internal stakeholders) to obtain more valuable and realistic visions about the quality of the HE system. The experienced academic and administrative members represent the stakeholders who are in direct contact with the problems and issues of the HE system in Egypt. The researcher found that most of the previous studies focused on the perspectives of external stakeholders - especially employers - as the ones who judge the skills of graduates (the outcomes of HE system) and the level of compatibility of these skills with the requirement of the labour market (OECD, 2010; Osman, 2011).

Secondly, this study contributes to identifying the main dimensions of the HE system in Egypt, which affect the quality of this system by interacting with each other. Where, the dimensions of the Egyptian HE system include: roles and purpose of HE, HE system itself, quality of HE, quality of its outcomes (skills of graduates), the labour market who receives these outcomes, and the level of compatibility between the HE outcomes and the requirements of the labour market. In other words, the Egyptian HE system help to achieve its roles and purpose in preparing the human resources through a complete system of activities which lead to preparing the graduates and provide them with the skills required by the labour market. However, the skills gap constrains the HE system from

fulfilling its roles and purpose. Therefore, the contribution of this study lies in helping the real dimensions of the Egyptian HE system and deeply understanding them, because one or more of these dimensions could be causing the skills gap.

In summary, this study shows that there are many previous studies that confirmed the existence of the problem of low quality of HE which lead to producing a gap between the skills of graduates and the requirements of the labour market in Egypt (Angel-Urdinola and Semlali, 2010; Aring, 2012; Barsoum et al., 2014; Van and Agune, 2015). Although most of these studies didn't identify the main factors which represent the actual reasons of this problem. In addition, these previous studies focused on the symptoms of the problem, not the problem itself or the main reasons behind the gap. Therefore, this study is one of the first studies to identify the main factors that influence the quality of the HE system in Egypt.

Thirdly, another contribution of this study is suggesting seven key factors that affect the HE system in Egypt. These factors are: *Quality of staff", "Quality of teaching",* "Quality of research", "Quality of curriculum", *"Quality of facilities"*, *"Quality of resources"*, and *"Quality of internship".* Each one of these key variables is affected by a number of sub-variables. The contribution of this study lies in its ability to determine the relative importance of each of these key variables in affecting the quality of the Egyptian HE system. Where, the previous studies which determined the factors without determining the relative importance of each key variables in affecting the quality of HE.

In summary, this study is considered a base for the future theoretical studies which investigates the factors affecting the quality of the Egyptian HE and the ranking of these factors according to their relative importance. In other words, this study is one of the first

studies that identified the points of strengths and weakness among these factors. The study indicated that both *"Quality of staff"* and *"Quality of teaching"* represent points of strength in the Egyptian HE system, while, *"Quality of facilities"*, *"Quality of resources"*, and *"Quality of internship"* are the points of weakness in the system.

Fourthly, by more deep understanding of the relations between the key variables and sub-variables that affect the quality of the Egyptian HE system, this study contributes in developing a SD model that represents the real HE system in Egypt. This model accurately simulates the effect of all of these variables on the outcomes of this system, which are represented in the "Quality of services provided by universities", which in turn affects the "skills of graduates" and the compatibility.

In summary, this study contributes in building a network of deep and multiple relationships which frame the current model of the Egyptian HE. Moreover, this study clarify the purpose of this network of relationships in affecting the quality of the Egyptian HE system, and the quality of its outcomes (skills of graduates), and finally the skills gap.

Fifthly, this study is considered one of the first attempts to investigate the effect of quality of HE on the compatibility between the skills of graduates and the skills required by the labour market in the Middle East. Through reviewing the literature, the researcher found little number of studies that explored the field of HE and the challenges and problems that faced this field (Aasan, 2006; Ramadan et al., 2011; Arokiasamy, 2012; Noaman et at., 2013; The World Bank, 2014; Sawahel, 2014; Boughzala et al., 2016). Additionally, many of the previous studies related to this field were undertaken in European countries (e.g., Lagrosen et al., 2004; De Oliveira and Ferreira, 2009; Malik et al., 2010; Tsinidou et al., 2010; Kariem, 2010; Arokiasamy, 2012). Moreover, the current study mentions

that most of the previous studies in this field that are undertaken within developing countries such as Egypt are considered relatively weak and do not study the problem from the university's perspective (e.g., Elmahdy, 2001; El Badawy et al., 2009; OECD, 2010; Buckner, 2013; Barsoum et al., 2014; Emira, 2015; Habibi and El Hamidi, 2016).

Sixthly, this study makes a methodological contribution by adopting both methods: qualitative and quantitative. This mixed method was employed to achieve the research objectives. This methodological choice enabled the researcher to make benefit from both methods in the same research. Qualitative phase was very useful in investigating the real main dimensions and variables that affect the quality of the Egyptian HE system from the Egyptian's perspective. Also, the quantitative phase was very useful in testing and validating the model of the study that represents the outcomes of the literature review and the qualitative phase.

In other words, this study is one of the few studies that investigated HE system using sequential exploratory mixed method. This method combines both the quantitative and qualitative data collection techniques and data analysis procedures in order to provide more understanding within the area of quality of HE system in Egypt. Through reviewing previous studies, the researcher found that the majority of these studies applied pure quantitative method such as (El-Zanaty et al., 2007; Malak, 2011; Aring, 2012; Barsoum et al., 2014; Amin, 2014). On the other hand, few studies applied pure qualitative method such as (Abou-Setta, 2014; Elassy, 2015). The studies that apply mixed method to address the problem of HE (in addition to this study) are very few such as (Oyo, 2010; Schomaker, 2015; Hadidi and Kirby, 2015). Moreover, these very few studies where applied in different countries and in a time different than this study.

Seventhly, from the qualitative phase of the study, the researcher managed to determine the dimensions and the key variables that affect the quality of the Egyptian HE system, and also to deeply understand these variables. These variables were examined using SD modelling and by conducting different scenarios that simulate the real HE system. Where, the simulation is the best tool to examine these variables to test the validity of the findings of the research before applying them in the real life, without waiting for a long time to know if these findings are true of false. This saves time, effort, and funding, and also reduces the risks of applying these findings in the case they were wrong. This is very important in the research context. No previous studies implemented the SD modelling and simulation in studying and analysing the reasons of the low quality of the Egyptian public universities. Therefore, this is a very important methodological contribution. As, this study is considered the first one to employ SD and simulation in investigating the HE system in Egypt. Those previous studies tackled this research problem in a mere theoretical way, which is far from the reality in Egypt.

Eighthly, this study is one of the first few studies that has explored the changes that need to be made by the management of HE in Egypt to the main factors and sub-factors which affect the quality of the Egyptian HE system in order to improve the quality of this system and the quality of its outcomes so that these outcomes are compatible with the requirements of the labour market.

In conclusion, the research outcomes have been used to build a SD model that is used by the researcher to investigate the real HE system in Egypt and can be used by other researchers in the future. This is considered a great and effective contribution of this research that helps the Egyptian HE management to understand the main elements (research variables) that form the Egyptian HE system and to understand the impact of

these variables on the quality of this system and the quality of its outcomes. Therefore, this study helps to understand how the quality of the HE system affects the compatibility between the skills of graduates and the requirements of the labour market in Egypt.

6.6 Practical Contributions

In addition to the theoretical contributions of the study (discussed in the previous section), the current study provides a new and objective SD model to the management of HE in Egypt (authorities and decision makers). This model represents the real HE system in Egypt. Also, this study provides an innovative contribution that sheds light on the main elements that form the HE system in Egypt which affect the quality of this system, the quality of its outcomes and consequently affect the compatibility between these outcomes and the requirements of the labour market in Egypt.

So this study includes a number of practical contributions:

Firstly, this study accurately defined the key variables that affect the quality of the Egyptian HE system and identified the relative importance of each of them. Then it sorted them according to this importance in this way: four key variables were the most important which are "Quality of staff", "Quality of teaching", "Quality of research", "Quality of curriculum", "Quality of resources", after that "Quality of resources" comes next, then "Quality of facilities", and in the end of the list "Quality of internship".

Therefore, a contribution of this study is identifying the optimal value of the affecting variables that would lead to the best improvement in the key variables which affect the quality of the Egyptian HE system. This is very helpful for the management of the HE

system in Egypt in making the correct and efficient decisions to improve these factors in the best way that makes use of the available resources.

Secondly, a contribution of this study is helping the authorised organisations that are responsible for the quality of the Egyptian HE system, which are NAQAAE and QAUs in universities: firstly, in identifying the real main dimensions and variables of the Egyptian HE system, which helps those organisations in including these dimensions and variables in the standards of the quality of HE in Egypt, and also to use it to evaluate the quality of Egyptian public universities.

Thirdly, another contribution of this study, this study is the first study in Egypt that used SD modelling and simulation to simulate the real HE system in Egypt. It includes building a SD model that simulates the real HE system in Egypt. This model may act as an important decision support tool which enables the researcher to identify and understand the main changes that should be made within the structures of the Egyptian universities management in a way that could increase their compatibility with the changes within the employment patterns of graduates in Egypt. With the aid of this decision support tool (the model), the researcher manages to produce several decisions that will improve the main factors of the HE system and consequently improve the overall quality of HE system. These decisions can be presented to the management of HE system (as the decision makers) to help them improve the quality of HE system in Egypt.

Fourthly, applying SD as a decision support tool enables the authorities responsible for HE in Egypt to identify the variables inside the HE system, which can be controlled and changed in order to improve the quality of the HE system in Egypt, which represent the policy structure in this system. This is done through conducting many scenarios that

simulates the reality, changing the values of the variables, and study the effects of these changes on the quality of the Egyptian HE system. This also helps the authorities to evaluate their decisions before applying them in real life, through using SD modelling as an important decision support tool. This leads to reducing the risks of wrong decisions, and also reduces the used money, time, and effort.

Fifthly, another important contribution of the current study is that using SD and simulation enables the authorities responsible for quality of HE in Egypt (NAQAAE and QAUs) to quantitatively assess their standards of HE quality, instead of just being qualitative standards. This helps in not only makes sure to apply these standards qualitatively, but also expressing these standards by numbers or percentages that actually measure the quality of each key variable from the variables that affect the quality of the Egyptian HE system.

Sixthly, another contribution is showing that there are some factors are not affected by funding while others are highly affected by funding. According to the model, these variables can be increased without the need to increase the funding. The variables that do not depend on the funding include *"Quality of curriculum", "Quality of internship",* and *"Quality of teaching"*. The HE system in Egypt suffers from the lack of sufficient funding. Therefore, authorities responsible for HE in Egypt should pay more attention to the variables that are not affected by funding, and work on improving their quality in a way that leads to improving the overall quality of the Egyptian HE system with the minimum possible cost.

Seventhly, a contribution of this study is the identification of the points of strengths and weakness of each of the factors that affect the quality of the Egyptian HE system. The

points of strengths are identified as *"Quality of staff"* and *"Quality of teaching"*, while the points of weakness in the system are *"Quality of facilities"*, *"Quality of resources"*, and *"Quality of internship"*. Therefore, this study advices the authorities of HE system in Egypt to concentrate more on the variables that represent weaknesses areas in the HE system in Egypt, in order to overcome these weaknesses which would lead to improve the quality of the Egyptian HE system.

In conclusion this study can enable the management of Egyptian HE to identify and understand the problems and deficiencies that face the HE system and their sources (which represent the reasons of the skills gap). The model of this study gives the HE management several advantages; it enables them to deeply study the HE system and to identify the factors that affect the quality of this system. It can also underline the most important factors that need special attention. The model can be used to simulate the real HE system in past years to determine the real reasons behind the problems that faced the system during these years. It also can be used to evaluate the results of future decisions before applying them to the real system.

These contributions would increase the ability of the management to make correct decisions that lead to improve the quality of the Egyptian HE system and the quality of its outcomes and consequently to increase the compatibility between the skills of graduates and the requirements of the labour market.

6.7 Research Recommendations

The results of this study included the recognition of the main reasons behind the low quality of the Egyptian HE system which leads to the incompatibility between the skills

of university graduates and the requirements of labour market in Egypt. These are concluded in seven factors; *"Quality of curriculum", "Quality of internship", "Quality of facilities", "Quality of resources", "Quality of research", "Quality of staff"*, and *"Quality of teaching"*. The research recommends that the Egyptian HE management focus on these factors as the main reasons of the problem instead of just focusing on the symptoms of the problem. This enables the HE management to deal efficiently with the problem and minimise its consequences. The management should measure these factors continuously to detect any changes that could cause a problem in the future. Among these seven key variables, some variables need more attention than others from the HE management. They are *"Quality of curriculum", "Quality of internship", "Quality of facilities", "Quality of resources",* and *"Quality of research"*. These variables represent the weaknesses in the Egyptian HE system. Moreover, the Egyptian HE sector should be given more importance due to its vital role in the development of the country.

Regarding *"Quality of curriculum"*, this research recommends increasing the "Rate of curriculum review" in order to increase *"Quality of curriculum"*. The curriculums should be reviewed and improved at least once per year in order to achieve significant increase in *"Quality of curriculum"*.

"Quality of internship" needs more attention in Egypt. To do so, this research recommends increasing the *"Training availability ratio"*. The government should provide much more training opportunities for students so that they can acquire more experience about the labour market. This can be achieved through continuous coordination between universities from one side and the employers from the other side in order to provide the required number of training opportunities for students each year.

To improve both *"Quality of facilities"*, *"Quality of resources"*, and *"Quality of research"*, this research recommends increasing the funding for their allocations. Where, the Egyptian government doesn't provide enough funding for the educational sector (especially HE). The expenditure on public HE in 2017 was just 3.34% of the total state public expenditure (EACEA, 2017). This percentage needs to be increased in order to make real and effective improvement to the quality of the public HE system in Egypt. According to the results of this study, it is recommended to increase the amount of allocated budget for *"Quality of facilities", "Quality of resources", and "Quality of research"* at least five times the current amount in order to achieve an effective improvement in the quality of each of them.

Regarding *"Quality of staff"* and *"Quality of teaching"*, they are among the most important four key variables which affect the quality of the Egyptian HE system. Any improvement in their qualities requires huge amount of funding. So, because of the lack of sufficient funding in Egypt, this research recommends increasing these two qualities through other ways rather than funding. This can be achieved through many ways such as; creating more classes to decrease the *"Average class size"* which would increase *"Quality of teaching"*. Also, this can be achieved through ensuring to train high number of staff members each year to increase *"Staff qualification"* which would increase *"Quality of staff"* and, indirectly, *"Quality of teaching"*.

This research has developed a simulation model of the public HE system in Egypt as a decision support tool. This model should be used by the Egyptian HE management to develop decisions that can make improvements to the HE system and that will also test the consequences of these decisions. This will enable the management to predict the

results of their decisions and to detect undesired effects early and to take the correct actions to avoid them.

As mentioned before in Chapter 3, complex systems (such as the HE system) are best studied using SD simulation in order to understand the relationships and effects inside the system. However, continuous feedback must exist between the real systems and the simulation model. Therefore, this research suggests that the HE management should create a department that is responsible for applying and evaluating future decisions. This is supported by (Sterman, 2000) who mentions the importance of "System improvement test" after applying the simulation results to the real system. It is important to monitor the real system and investigate any changes that may result from applying these decisions. Feedback should be given to the simulation model continuously to make sure that the real system is changing for the better as the simulation model predicted.

6.8 Research Limitations

Although this research provides a number of important theoretical and practical contributions, it isn't clear from limitations. The limitations of this research are shown in the following points:

(1) This study was applied in universities only. It did not include other HE institutions. Accordingly, the generalisability of the sample may be limited to universities only. Therefore, the results of the study may not be generalised to other HE institutions. When generalising the findings to other countries and contexts, the economic, geographic, and cultural features in Egypt should be taken into consideration when the results are interpreted.

(2) Among Egyptian universities, this study targeted public universities only (excluding private universities). There are many reasons for choosing public universities only; the number of public universities is higher than the number of private ones. Also, the public universities have a higher number of students, graduates, staff members, administrators and majors. The public universities are present in all regions in Egypt. They are also the oldest universities known and are higher in rank than the private ones. Accordingly, the generalisability of the sample may be limited to public universities only. Therefore, the results of the study may not be generalised to private universities.

(3) This study concentrates on undergraduate students only (excluding post graduate students) because the number of post graduate students is very low compared to the number of undergraduate ones and the research problem is not apparent for the post graduate students. Accordingly, the generalisability of the sample may be limited inside the public universities to undergraduates only. Therefore, the results of the study may not be generalised to postgraduates.

(4) This study investigates the perspectives of one group of the internal stakeholders; staff members. The participants were academic and administrative staff members who have more than 15 years of experience in the field of quality of HE system in Egypt. The study didn't explore perspectives of other internal or external stakeholders.

(5) In the qualitative phase, thematic analysis was used to analyse the findings of the interviews. This analysis procedure includes transcription of interviews, coding, and searching for themes and patterns. Although this method is suitable for the purpose

of this research, it is subjective as it depends on the researcher's understanding of the opinions of the interviewees. However, the researcher attempts to reduce the bias by recording a summary of the interviewee's opinions after each interview. These summaries help the researcher to avoid any biased information. Also, these summaries were shown to the interviewees after each interview to give them the chance to evaluate their answers and to make corrections where necessary. This technique of reducing bias was supported by Saunders et al. (2016).

(6) Additionally within the qualitative phase a judgmental sampling technique was used to collect the data. This sampling technique is the most suitable for the purpose of this study among the different non-probability sampling techniques (Bryman and Bell, 2015; Sekaran and Bougie, 2016; Saunders et al., 2016). The researcher attempted to reduce the bias by choosing the sample for this phase from four public Egyptian universities; Cairo University, Alexandria University, El-Mansoura University, an Ein-Shams University. These universities were chosen because theyare the highest ranking in the Egyptian public universities according to the world ranking (Ranking Web of Universities, 2017). Also, they contain the largest number of students, graduates, staff and administrative members and have all the specialisations in Egyptian HE. They also are the oldest universities known.

(7) The model of this study focuses on the effect of quality of HE system on the compatibility between the skills of graduates and the skills needed by the market. Which means that the study focused only on studying the research problem from the internal perspective (HE system), and didn't focus on the external perspective (labour market). Therefore, the variable "Skills needed by market" is assumed to be constant for the five years of simulation in order to ignore its effect on the gap and focus more

on the effect of the "skills of graduates", which is the purpose of this study. In other words, the model of this study focuses only on one aspect of the research problem; the HE aspect. This constant value (90%) was estimated as an average value from the data obtained from NAQAAE.

6.9 Directions for Future Research

Because the research problem was investigated regarding universities only future research can consider a much wider study by including other HE institutions. Also, this research excluded the private universities and focused only on the public universities so future research can investigate the dimensions of the problem within the private HE institutions. This research also excluded post-graduate students and pre-HE student and focused only on undergraduate students within the HE level. The post graduate students and pre-HE students can be investigated in future research to study their impact on the research problem.

The research problem (skills gap) was produced by two main factors; the skills of the graduates and the skills needed by market. This research investigated the compatibility between them from the perspective of HE outcomes (Skills of graduates). The research did not deeply investigate the perspective of employers (Skills needed by market). Future research can focus more on the perspectives of employers and include their thoughts and opinions.

Moreover, the research focused on one group of the internal stakeholders; the academic and administrative staff members because they are more experienced and they interact more with the HE system and its problems. Future research can address the other internal stakeholders such as students and parents, or external stakeholders, such as employers.

The study used one strategy (System Dynamics) to achieve the research objectives. Future research can integrate more than one strategy to study the effect of the quality of the HE system in Egypt on the compatibility between skills of graduates and the requirements of the labour market. Similar integration has been used by Oyo (2010) who integrated SD and Action Research to study HE quality management.

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Appendix A

Ethical Approval and Documentation

for Data Collection in the First Phase

(Semi-Structured Interviews)

Appendix A

Ethics approval for semi-structure interview

● **CSM Research** <csmresearch@cardiffmet.ac.uk>
To:abdella13@yahoo.com
Cc:amoscardini@cardiffmet.ac.uk,nerminek@gmail.com,raghebmm67@gmail.com,aaragab@hotmail.com
Apr 29, 2016 at 3:03 PM

29.04.2016
csm/ethics/approved
Osama Abdella
Cardiff School of Management
Llandaff Campus
Cardiff, CF5 2YB

Dear Osama,

Re: Application for Ethical Approval: *The Effect of quality of higher education systems on compatibility between the skills of graduates and the requirements of the labour market in Egypt*

Ethics Committee Application Reference Number: 2015S0032

Your ethics application, as shown above, was considered at the meeting of the School Research Ethics Committee on 13.04.2016. Further to requested committee amendments, I am pleased to inform you that your application for ethical approval was *APPROVED* by the Chair of the Committee subject to the conditions listed below – *please read carefully*

Conditions of Approval

- Your Ethics Application has been given a reference number as above. This <u>MUST</u> be quoted on all documentation relating to the project (E.g. consent forms), together with the full project title.
- Any changes in connection to the proposal as approved, must be referred to the Panel/ Committee for consideration.
- A full Risk Assessment must be undertaken for this proposal, and be made available to the committee if requested.
- Any untoward incident which occurs in connection with this proposal must be reported back to the panel *without delay*

Yours sincerely,
On behalf of the Chair of the Ethics Committee
Louise
Louise Ballantyne
Research Administrator – Gweinyddwr Ymchwil
Cardiff Metropolitan University / Prifysgol Fetropolitan Caerdydd
Cardiff School of Management/Ysgol Reoli Caerdydd
Llandaff Campus/Campws Llandaf
Cardiff/Caerdydd
CF5 2YB
02920 416 934
CSMResearch@CardiffMet.ac.uk

#cardiffmet150

Appendix A

PARTICIPANT CONSENT FORM

Cardiff Metropolitan University Ethics Reference Number: 2015S0032

Title of the Project: The Effect Of Quality Of Higher Education System On Compatibility Between The Skills Of Graduates And The Requirements Of The Labour Market In Egypt

Name of Researcher: Osama Ahmed Abdella Ahmed   Student Number: 10004543
Research Supervisors: Prof. Alfredo Moscardini, Prof. Mohamed A. Ragheb and Prof. Aiman A. Ragab

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I understand that Mr Osama A. Abdella, who is a PhD student at Cardiff Metropolitan University, is conducting an oral interview as part of his studies in order to identify the key factors in HE system which affecting public universities in Egypt, and investigating changes that must be made by the Egyptian HE Management (ministry of HE) in these factors to achieve the significant and real effect in quality of Egyptian higher education system.

I agree to take part in this research. And I confirm that I have read and understand the information sheet for this research. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

1. This consent is given on the understanding that Mr Osama A. Abdella will use his best efforts to guarantee that my identity is protected and my confidentiality maintained and that this information will shared with the supervisors in the Cardiff Metropolitan University and Arab Academy for Science & Technology and Maritime Transport. I do this freely and understand that I may terminate the interview at any point and can withdraw from the research process at any time without giving any reason.

2. I understand and agree that the information I have given to Mr Osama A. Abdella in our interview of the following date ×× / × × / ×××× will be treated in the following manes:

   a) I agree to the interview consultation being audio recorded.
   b) I agree to the use of an onymised quotes in publications.
   c) Hand written notes will be taken during our discussion.
   d) This data will be stored securely by Mr Osama A. Abdella.
   e) The data will be used only by Mr Osama A. Abdella and for his PhD thesis.

Name of the participant:	Date:
Signature of the participant:	
Researcher name:	Date:
Researcher Signature:	

Appendix A

PARTICIPANT INFORMATION SHEET

Cardiff Metropolitan University Ethics Reference Number: 2015S0032
Title of the Project: The Effect Of Quality Of Higher Education System On Compatibility Between The Skills Of Graduates And The Requirements Of The Labour Market In Egypt
Name of Researcher: Osama Ahmed Abdella Ahmed   Student Number: 10004543
Research Supervisors: Prof. Alfredo Moscardini, Prof. Mohamed A. Ragheb and Prof. Aiman A. Ragab

Project summary

The purpose of this research project is explore the main factors for the higher education system which affecting public universities in Egypt, in order to increase the quality of educational services provided by the universities, and thus increase the quality of graduates or the perception of employers about the quality of graduates. The purpose of this research extends to investigating the changes that must be made by the Higher Education Management (Ministry of Higher Education) in these factors to achieve the significant and sincere effect in quality of Egyptian higher education system and thus, bridge the skills gap. Where, bridge skills gap has a direct effect on the quality of service provided by public universities, the quality of graduates and their skills, the compatibility between the skills of graduates and the requirements of the labour market in Egypt and the employment rate(Assaad, 2007; Zaytoun, 2008; Aring, 2012). Your participation will enable the collection of data which will form part of a study being undertaken at Egypt.

Why have you been asked to participate?

You have been asked to participate because you fit the profile of the population being studied; that is you have an experience in higher education sector or in the quality of HE system.

 However, since the participating in this research is involved you must be
• 	Working in HE sector for more than 10 years
• 	Participate in developing HE system
• 	Participate in implementing the quality Procedures in HE system
• 	Participate in building the model of HE system
During the interview you will be asked about the key factors that affect the HE system in Egyptian public universities. Your participation is entirely voluntary and you may withdraw at any time.

Project risks

The research involves the completion of participation in interviews and which will be recorded for later analysis. We are not seeking to collect any sensitive data on you; this study is only concerned with determined the key factors that affect the quality of HE system and the quality of graduates. We do not think that there are any significant risks associated with this study. However, if you do feel that any of the questions are inappropriate then you can stop at any time. Furthermore, you can change your mind and withdraw from the study at any time – we will completely respect your decision.

How we protect your privacy

All the information you provide will be held in confidence. We have taken careful steps to make sure that you cannot be directly identified from the interviews form; there is no information on these interviews that will identify you. Your personal details (e.g. signature on the consent form) will be kept in secure locations by the researcher. When we have finished the study and analysed all the information, all the documentation used to gather the data will be destroyed. The recordings of the interview will also be held in a secure and confidential environment during the study and destroyed when it is complete.

YOU WILL BE OFFERED A COPY OF THIS INFORMATION SHEET TO KEEP

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SEMI STRUCTURED INTERVIEWS GUIDE

Order of semi structured Interview	Discussed	Related to question
1) Is it possible to use the system to record the interview? Is it possible to sign and acknowledge consent form?		√
2) **Background questions:** Confirm information about; • What is the Name of university that you are working in?		√
• What is your position in the university?		√
• How many years you are working at the university/higher education sector?		√
• What is your Level of study?		√
3) **Experience** • How many times have participated in the preparation of the organizational structure of the University?		√
• How many times have participated in the application and control of quality Systems in University?		√
• How much research involving or published?		√
• How many workshops that participated or managed?		√
• How many training courses that you received or contributed to?		√
4) **Discuss about skills gap** • Are graduates of the Egyptian public universities qualified to work directly in the labour market?	√	
• Are graduates skills consistent with the skills needed by the labour market?	√	
• Are there skills gap between the skills of graduates and the skills needed by the labour market?	√	
5) **Egyptian higher education factors** • What are the main factors that affect the Egyptian higher education system?	√	
• Is the quality of these factors affecting the quality of the Egyptian Higher Education System? • Is the quality of these factors affecting the quality of the Egyptian higher education system outputs (graduates)?	√	
• What are the sub-factors that affecting the main factors which affect the Egyptian higher education system? • Does the quality of these factors affect the skills gap between the skills of graduates and the skills needed by the labour market	√	

6) quality of Egyptian Higher Education System		
• Does the increase the quality of Egyptian higher education system components increase the quality of service provided by universities?	√	
• Does the increase the quality of service provided by universities increase the quality of universities graduates?	√	
• Does the increase the quality of Egyptian higher education system components increase the Compatibility between the Skills of Graduates and the Requirements of the Labour Market in Egypt?	√	
7) change the structures of key factors		
• What changes are to be made in the key factors of the Egyptian higher education system to increase their quality?	√	
• What changes are to be made in the key factors of the Egyptian higher education system to increase the quality of its outputs (graduates)?	√	
• What changes are to be made in the key factors of the Egyptian higher education system to increase Compatibility between the Skills of Graduates and the Requirements of the Labour Market in Egypt?	√	
• What changes are to be made in the key factors of the Egyptian higher education system to bridge the skills gap?	√	

LETTER TO AN ORGANIZATION

Dear Prof. xxxxxxxxxxx

President of xxxxxxx University

I am a PhD student at Cardiff Metropolitan University. The title of my thesis is "The Effect Of Quality Of Higher Education System On Compatibility Between The Skills Of Graduates And The Requirements Of The Labour Market In Egypt" Its aim is develop a system dynamic model of the factors that contribute to the gap between skills of university graduates and the requirements of the labour market in Egypt, with a focus on Identification of the key structural changes that need to be made to reduce this gap, and using a public Egyptian universities as a case study. As part of my research I would like to undertake research with experienced academic and administrative staff members from various public universities in Egypt. I am writing to you because my research fits the profile of this type of university and also employs a sufficient number of experienced academic and administrative staff members so as to provide a large enough number of potential participants. This research project has received approval from Cardiff Metropolitan University and all data collection will be in accordance with the university's ethics code of practice.

My purpose in writing is to ask if you would permit me to conduct interviews to your staff members. Their participation would be entirely voluntary, neither they nor the university would be identified in the research and it would only take one hour for each staff member to complete the interview. I would hope to conduct 6-7 interviews with your staff members.

Be covered by the interviews include:

- quality of services provided by university
- quality of graduates
- key factors of the higher education system
- skills gap between skills of university graduates and the requirements of the labour market in Egypt

I shall be very happy to make the results of my research available to your university as a participant in the research when it is complete. If you would like to participate in this project and or are interested in discussing it further please contact me on:

Arab Academy for Science, Technology & Maritime Transport
College of Management and Technology
P.O Box 1029 – Miami
Tel: (+203) 5565429 / 5481163
Fax: (+203) 5487786 / 5506042
Ext: 2424
Mail: abdella13@aast.edu
Thank you in anticipation.
Yours sincerely

Appendix B

Ethical Approval and Documentation for Data Collection in the Second Phase (Secondary Data)

Ethics approval for secondary data collection

- **CSM Research** <csmresearch@cardiffmet.ac.uk>

To: Osama Abdella

Cc: Nermine Khalifa, Moscardini, Alfredo, Mohamed Ragheb, Aiman Ragab

Jul 11, 2017 at 5:19 PM

Hello Osama,

I have had an email from the Chair of the committee to advise as your application is for secondary data collection only I can issue you with an approval number as reference for your thesis.

This is: - 2015S0064

With kindest regards – Louise

Louise Ballantyne

Louise Ballantyne
Research Administrator – Gweinyddwr Ymchwil
Cardiff Metropolitan University / Prifysgol Fetropolitan Caerdydd
Cardiff School of Management/Ysgol Reoli Caerdydd
Llandaff Campus/Campws Llandaf
Cardiff/Caerdydd
CF5 2YB
02920 416 934
CSMResearch@CardiffMet.ac.uk

Appendix B

رقم القيد : 70 / 050 /2018

التاريخ : 13 فبراير 2018

سعادة الأستاذ الدكتور/ أحـمد الشـيـخ

مدير عام مكتب وزير التعليم العالى والبحث العلمى

تحية طيبة   وبعد،

تهدى الأكاديمية العربية للعلوم والتكنولوجيا والنقل البحرى – إحدى منظمات جـامعة الدول العربية المتخصصـة – أسمى تحياتها لسعادتكم.

وفى إطــار التــعــاون الدائـم والمســـتمر بين وزارة التعليم العالى والبحث العلمى الموقرة والأكاديـمية.

يرجى تفضل سعادتكم بتسهيل مهمة الباحث / أسامه عبد اللاه أحمد المدرس المساعد بقسم التسويق والأعمال الدولية بكلية الإدارة والتكنولوجيا بالأكاديمية فى الحصول على بيانات خاصة بموضوع بحث "تأثير جودة التعليم العالى المصرى على الفجوة بين مهارات الخريجين والمهارات التى يحتاج إليها سوق العمل" وذلك بالتطبيق على الجامعات الحكومية وذلك لقيام سيادته بإعداد رسالة الدكتوراة فى هذا الموضوع.

وتغتنم الأكاديمية العربية للعلوم والتكنولوجيا والنقل البحرى هذه المناسبة لتعرب لسعادتكم عن خالص تقديرها.

وتفضلوا سعادتكم بقبول فائق الإحترام،،،

ا.د/ إسماعيل عبد الغفار إسماعيل فرج

مع خالص تقديرى واحترامى لسعادتكم

رئيس الأكاديمية

Arab Academy for Science, Technology & Maritime Transport

President of the Academy

Record No.2018/050/70
Date: **13 Feb. 2018**

Letter

Attn/ **Dr. Ahmed Elshiekh**

General Director of the Office of the Minister of Higher Education and Scientific Research

Greetings,

The Arab Academy for Science, Technology & Maritime Transport, one of the Arab League specialized organizations, extends its sincere greetings.

In light of the continuous cooperation between the esteemed Ministry of Higher Education and Scientific Research and the Academy,

Kindly take necessary action to facilitate the mission of Researcher/

Osama Ahmed Abdella Ahmed – Teaching Assistant at the Marketing and International Business Department of the College of Management and Technology of the Academy – to obtain data for his research topic **"the Impact of the quality of Egyptian higher education on the gap between the skills of graduates and the skills required by the labor market"**, as applied on governmental universities, in preparation for his PhD thesis.

The Arab Academy for Science, Technology & Maritime Transport would like to use this opportunity to express its sincere appreciation.

Regards,

President of the Academy/
Prof. Dr. Ismail Abdelghaffar Ismail Farag (signed on 13 Feb. 2018)

> *Seal Affixed*
> **Arab League**
> **Arab Academy for Science, Technology & Maritime Transport**

P.O. Box: 1029 – Alexandria – Egypt – Tel: (+203) 5520614/5520615 – Fax: (+203) 5497882

Arab Academy for Science, Technology & Maritime Transport

رئيس الأكاديمية

President

رقم القيد : 70 / 051 /2018

التاريخ : 13 فبراير 2018

سعادة الأستاذة الدكتورة/ يوهـانسن عيـد

رئيس الهيئة القومية لضمان جـودة التعليم والإعتـماد

تحية طيبة وبعد،

تهدى الأكاديمية العربية للعلوم والتكنولوجيا والنقل البحرى – إحدى منظمات جـامعة الدول العربية المتخصصـة – أسمى تحياتها لسعادتكم.

وفى إطـــار التـــعاون الدائــم والمسـتمر بيــن هيئتكم الموقــرة والأكاديمـيـة.

يرجى تفضل سعادتكم بتسهيل مهمة الباحث / أسامه عبد اللاه أحمد المدرس المساعد بقسم التسويق والأعمال الدولية بكلية الإدارة والتكنولوجيا بالأكاديمية فى الحصول على بيانات خاصة بموضوع بحث "تأثير جودة التعليم العالى المصرى على الفجوة بين مهارات الخريجين والمهارات التى يحتاج إليها سوق العمل" وذلك بالتطبيق على الجامعات الحكومية وذلك لقيام سيادته بإعداد رسالة الدكتوراة فى هذا الموضوع.

وتغتنم الأكاديمية العربية للعلوم والتكنولوجيا والنقل البحرى هذه المناسبة لتعرب لسعادتكم عن خالص تقديرها.

وتفضلوا سعادتكم بقبول فائق الإحترام،،،

ا.د/ إسماعيل عبد الغفار إسماعيل فرج

بخالص تقديرى واحترامى لسعادتكم

رئيس الأكاديمية

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Arab Academy for Science, Technology & Maritime Transport

President of the Academy

Record No.**2018/051/70**
Date: **13 Feb. 2018**

Letter

Attn/ **Dr. Johansen Eid**

President of the National Authority for Quality Assurance and Accreditation of Education

Greetings,

The Arab Academy for Science, Technology & Maritime Transport, one of the Arab League specialized organizations, extends its sincere greetings.

In light of the continuous cooperation between your esteemed Authority and the Academy,

Kindly take necessary action to facilitate the mission of Researcher/

Osama Ahmed Abdella Ahmed – Teaching Assistant at the Marketing and International Business Department of the College of Management and Technology of the Academy – to obtain data for his research topic "**the Impact of the quality of Egyptian higher education on the gap between the skills of graduates and the skills required by the labor market**", as applied on governmental universities, in preparation for his PhD thesis.

The Arab Academy for Science, Technology & Maritime Transport would like to use this opportunity to express its sincere appreciation.

Regards,

President of the Academy/
Prof. Dr. Ismail Abdelghaffar Ismail Farag (signed on 13 Feb. 2018)

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كلية الإدارة والتكنولوجيا

التاريخ : 2018/1/2

السادة الأفاضل/ وحدة ضمان الجودة – جامعة القاهرة

تحية طيبة وبعد...

نحيط سيادتكم علماً بأن الأستاذ/ **أسامة أحمد عبد اللاه أحمد** يعمل مدرس مساعد بكلية الإدارة والتكنولوجيا بالأكاديمية العربية للعلوم والتكنولوجيا والنقل البحرى وهو حالياً يقوم بإعداد رسالة الدكتوراه فى موضوع "تأثير جودة التعليم العالى المصرى على الفجوة بين مهارات الخريجين والمهارات التى يحتاج اليها سوق العمل" وذلك بالتطبيق على الجامعات الحكومية.

لــذا نرجــوا مــن ســيادتكم التكــرم بتسـهيل مهمــة الباحـث فــى الحصــول علــى البيانــات الخاصـة بموضــوع البحــث علمــاً بــأن هــذه البيانــات ســوف تعامـل بسرية تامة ولن تستخدم إلا لأغراض البحث العلمى.

وتفضلوا سيادتكم بقبول فائق الإحترام والتقدير،،،

عميد الكلية

أ.د./ أشرف لبيب

رئيس القسم

د/ أيمن حسن فريد متولى

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Arab Academy for Science, Technology & Maritime Transport

College of Management and Technology
Date: **02 Jan. 2018**

Letter

ᴀᵗᵗⁿ/ **Quality Assurance Unit – Cairo University**

Greetings,

Kindly be advised that Mr. **Osama Ahmed Abdella Ahmed** – Teaching Assistant at the College of Management and Technology of the Arab Academy for Science, Technology & Maritime Transport – is preparing his PhD in "**the Impact of the quality of Egyptian higher education on the gap between the skills of graduates and the skills required by the labor market**", as applied on governmental universities.

Kindly take necessary action to facilitate his mission in obtaining data regarding the subject of his research. Please know that this data will be strictly confidential and will not be used for any other purpose except academic research.

Regards,

Head of Department/ Dr. Ayman Hassan Farid Metwally (signed)
Dean of the College/ Prof. Dr. Ashraf Labib (signed)

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> **Arab League**
> **Arab Academy for Science, Technology & Maritime Transport**
> Date: 03 Jan. 2018

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كلية الإدارة والتكنولوجيا

التاريخ : 2018/1/2

السادة الأفاضل/ وحدة ضمان الجودة – جامعة عين شمس

تحية طيبة وبعد...

نحيط سيادتكم علماً بأن الأستاذ/ **أسامة أحمد عبد اللاه أحمد** يعمل مدرس مساعد بكلية الإدارة والتكنولوجيا بالأكاديمية العربية للعلوم والتكنولوجيا والنقل البحرى وهو حالياً يقوم بإعداد رسالة الدكتوراه فى موضوع "تأثير جودة التعليم العالى المصرى على الفجوة بين مهارات الخريجين والمهارات التى يحتاج اليها سوق العمل" وذلك بالتطبيق على الجامعات الحكومية.

لـذا نرجـوا مـن سـيادتكم التكـرم بتسـهيل مهمـة الباحـث فـى الحصـول علـى البيانـات الخاصـة بموضـوع البحـث علمـاً بـأن هـذه البيانـات سـوف تعامـل بسرية تامة ولن تستخدم إلأ لأغراض البحث العلمى.

وتفضلوا سيادتكم بقبول فائق الإحترام والتقدير،،،

عميد الكلية

رئيس القسم

أ.د./ أشرف لبيب

د/ أيمن حسن فريد متولى

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Arab Academy for Science, Technology & Maritime Transport

College of Management and Technology
Date: **02 Jan. 2018**

Letter

Attn/ **Quality Assurance Unit – Ain Shams University**

Greetings,

Kindly be advised that Mr. **Osama Ahmed Abdella Ahmed** – Teaching Assistant at the College of Management and Technology of the Arab Academy for Science, Technology & Maritime Transport – is preparing his PhD in "**the Impact of the quality of Egyptian higher education on the gap between the skills of graduates and the skills required by the labor market**", as applied on governmental universities.

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Regards,

Head of Department/ Dr. Ayman Hassan Farid Metwally (signed)
Dean of the College/ Prof. Dr. Ashraf Labib (signed)

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> **Arab League**
> **Arab Academy for Science, Technology & Maritime Transport**
> Date: 03 Jan. 2018

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كلية الإدارة والتكنولوجيا

التاريخ : 2018/1/2

السادة الأفاضل/ وحدة ضمان الجودة – جامعة حلوان

تحية طيبة وبعد...

نحيط سيادتكم علماً بأن الأستاذ/ **أسامة أحمد عبد اللاه أحمد** يعمل مدرس مساعد بكلية الإدارة والتكنولوجيا بالأكاديمية العربية للعلوم والتكنولوجيا والنقل البحرى وهو حالياً يقوم بإعداد رسالة الدكتوراه فى موضوع "تأثير جودة التعليم العالى المصرى على الفجوة بين مهارات الخريجين والمهارات التى يحتاج اليها سوق العمل" وذلك بالتطبيق على الجامعات الحكومية.

لـذا نرجـوا مـن سـيادتكم التكـرم بتسـهيل مهمـة الباحـث فـى الحصـول علـى البيانـات الخاصـة بموضـوع البحـث علمـاً بـأن هـذه البيانـات سـوف تعامـل بسرية تامة ولن تستخدم إلاً لأغراض البحث العلمى.

وتفضلوا سيادتكم بقبول فائق الإحترام والتقدير،،،

عميد الكلية

أ.د./ أشرف لبيب

رئيس القسم

د/ أيمن حسن فريد متولى

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Arab Academy for Science, Technology & Maritime Transport

College of Management and Technology
Date: **02 Jan. 2018**

Letter

Attn/ **Quality Assurance Unit – Helwan University**

Greetings,

Kindly be advised that Mr. **Osama Ahmed Abdella Ahmed** – Teaching Assistant at the College of Management and Technology of the Arab Academy for Science, Technology & Maritime Transport – is preparing his PhD in "**the Impact of the quality of Egyptian higher education on the gap between the skills of graduates and the skills required by the labor market**", as applied on governmental universities.

Kindly take necessary action to facilitate his mission in obtaining data regarding the subject of his research. Please know that this data will be strictly confidential and will not be used for any other purpose except academic research.

Regards,

Head of Department/ Dr. Ayman Hassan Farid Metwally (signed)
Dean of the College/ Prof. Dr. Ashraf Labib (signed)

Seal Affixed **Arab League** **Arab Academy for Science, Technology & Maritime Transport** Date: 03 Jan. 2018

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Appendix B

كلية الإدارة والتكنولوجيا

التاريخ : 2018/1/2

السادة الأفاضل/ وحدة ضمان الجودة – جامعة مدينة السادات

تحية طيبة وبعد...

نحيط سيادتكم علماً بأن الأستاذ/ أسامة أحمد عبد اللاه أحمد يعمل مدرس مساعد بكلية الإدارة والتكنولوجيا بالأكاديمية العربية للعلوم والتكنولوجيا والنقل البحرى وهو حالياً يقوم بإعداد رسالة الدكتوراه فى موضوع "تأثير جودة التعليم العالى المصرى على الفجوة بين مهارات الخريجين والمهارات التى يحتاج اليها سوق العمل" وذلك بالتطبيق على الجامعات الحكومية.

لـذا نرجـو مـن سـيادتكم التكـرم بتسـهيل مهمـة الباحـث فـى الحصـول علـى البيانـات الخاصـة بموضـوع البحـث علمـاً بـأن هـذه البيانـات سـوف تعامـل بسرية تامة ولن تستخدم إلا لأغراض البحث العلمى.

وتفضلوا سيادتكم بقبول فائق الإحترام والتقدير،،،

عميد الكلية

رئيس القسم

د/ أيمن حسن فريد متولى

أ.د/ أشرف لبيب

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TRANSLATION SERVICES
71, Sidi Gaber Street, Sidi Gaber, Alexandria, Egypt.
Tel: +2-03-5439537   Mobile: +2-01210504674   Email: info@albritannia.com

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Arab Academy for Science, Technology & Maritime Transport

College of Management and Technology
Date: **02 Jan. 2018**

Letter

Attn/ **Quality Assurance Unit – University of Sadat City**

Greetings,

Kindly be advised that Mr. **Osama Ahmed Abdella Ahmed** – Teaching Assistant at the College of Management and Technology of the Arab Academy for Science, Technology & Maritime Transport – is preparing his PhD in "**the Impact of the quality of Egyptian higher education on the gap between the skills of graduates and the skills required by the labor market**", as applied on governmental universities.

Kindly take necessary action to facilitate his mission in obtaining data regarding the subject of his research. Please know that this data will be strictly confidential and will not be used for any other purpose except academic research.

Regards,

Head of Department/ Dr. Ayman Hassan Farid Metwally (signed)
Dean of the College/ Prof. Dr. Ashraf Labib (signed)

Seal Affixed
Arab League
Arab Academy for Science, Technology & Maritime Transport
Date: 03 Jan. 2018

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Tel: (+3) 5439537 - Mobile: 01210504674   Email: **info@albritannia.com**

General Director /

Mr. Tamer Sami Ahmed

Certified Translator

Authorized by the Egyptian Translators & Linguists Association – Accreditation No. (17-051)
Approved by the Real Estate & Notarization Offices of the Egyptian Ministry of Justice.
Instructor of English Language and Literature at Alexandria University (Formerly)

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لدى السفارات والحكومات الأجنبية
مكاتب الشهر العقاري والتوثيق بوزارة العدل المصرية
مكاتب النيابة العامة والمحاكم المصرية وهيئات القضاء والتحكيم الدولي

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Appendix C

Sample Interview Transcript

(Academic Participant 1)

Introduction

Researcher: I want to thank you in advance for your contribution in this research. In this research, I investigate the effect of quality of public higher education on the compatibility between skills of graduates and the requirements of the labour market in Egypt. I want to assure that your participation is voluntary and confidential, and you can withdraw anytime you like without any responsibility. Your responses will not be able to be identified from the published results. Additionally, all the raw data will only ever been seen by the researcher.

Ethical questions

Researcher: Do you allow me to record the interview?

Participant: Ok.

Researcher: This participant consent needs signing by you as part of the paper work required by the university. Do you agree to sign it?

Participant: Sure, no problem.

Descriptive questions

Researcher: Which university do you work in?

Participant: Alexandria University.

Researcher: What is your current position in this university?

Participant: I am the president of the quality assurance unit in Alexandria university, which is under supervision of NAQAAE.

Researcher: How long have you been working in academic field?

Participant: More than 25 years.

Researcher: What is your current scientific degree?

Participant: I am a professor doctor since 1999.

Questions related to "experience of participant"

Researcher: How many times have you participated in developing of the organisational framework of the university?

Participant: As for my position and the number of years I have been in this field, I participated in developing and improving the organisational framework of the university.

Researcher: How many times have you participated in developing and applying quality assurance system in the university?

Participant: Although I am the president of the quality assurance unit in the university just from a short time, I have participated in developing the quality assurance unit 6 times.

Researcher: How many researches have you published or contributed to publish?

Participant: More than 20 researches. Most of them are in the field of quality of education, especially quality of higher education.

Researcher: How many workshops have you participated in or organised?

Participant: About 25 workshops with an approximate rate of one workshop each year along my work duration in the university.

Researcher: How many training courses have you got (or given) along your academic career?

Participant: I have got more than 15 training courses, and contributed to preparing and lecturing more than 12 training courses.

Questions related to "skills gap"

Researcher: Do you believe that graduates from Egyptian public universities are qualified enough to work directly in the labour market just after graduation?

Participant: No, they aren't. Most of the graduates are not qualified enough to work in the labour market without further training. Their skills do not match with the skills required by the labour market.

Researcher: Please explain more the skills mismatch issue.

Participant: As I said, the skills of graduates do not match with the skills that the labour market requires. This is a strong evidence of the absence of coordination between universities from one side and the labour market from the other side concerning the skills that the graduates should have. Universities must know exactly the skills required by the labour market then work to produce graduates with these skills.

Researcher: Does this mean that there is a gap between skills of graduates and skills needed by labour market?

Participant: According to my experience and my relationship with many employers in various fields of business and industry in Egypt, most of employers complain about the low level of qualification of Egyptian universities' graduates, especially graduates of Egyptian public universities. They agree that the skills of graduates are not consistent with the requirements of the labour market. As a result, these employers have to train the low-qualified graduates before they can benefit from them, which consumes a lot of money and time.

Questions related to "Factors that affect Egyptian higher education"

Researcher: In your opinion, what are the main factors that affect the system of higher education in Egypt?

Participant: Many factors affect the Egyptian higher education but the most affecting, in my point of view, are quality of curriculums in universities, quality of the teaching process itself, quality of staff and the teaching methods they use to teach these curriculums, and finally quality of research in universities.

Researcher: Is there a relationship between quality of these factors and the overall quality of the system of higher education in Egypt? In other words, do the qualities of the previous mentioned factors affect the overall quality of the system of higher education in Egypt?

Participant: Yes, no doubt. Any increase in any quality of these factors will lead to an increase in the quality of the system of Egyptian higher education.

Researcher: Does each of these factors equally affect the quality of Egyptian higher education?

Participant: Of course they don't. They all affect the quality of higher education positively but the effect of each of them is different according to its importance.

Researcher: Do the qualities of these main factors consequently affect the quality of the outputs of the Egyptian higher education system?

Participant: Of course. Any change in any quality of these factors will reflect on the quality of higher education system and, as a consequence, the quality of its outputs.

Researcher: Are these the only factors that affect the quality of Egyptian higher education system or there are other factors that affect it (directly or indirectly)?

Participant: If we look closer at these main factors, we will be able to see other sub-factors that affect them. For example, quality of curriculum is dependent

on three factors; quality of staff who prepare the curriculum, review rate of the curriculum and quality of curriculum design. Each of these three sub-factors affect the overall quality of curriculums in universities.

Researcher: I see. What about the sub-factors that affect quality of teaching?

Participant: I believe quality of teaching (or the quality of the educational process itself) is one of the most important main factors. Average class size is a very important factor that affects the quality of teaching as well as quality of staff and quality of curriculum. If these sub-factors are measured, quality of teaching can be measured.

Also, quality of staff members is one of the main factors that directly affect the quality of HE. It strongly and directly affect quality of Egyptian HE system. Many sub-factors affect quality of staff including staff qualification level, their competence, their motivation, and their practical experience.

Researcher: Could you talk more about each of these sub-factors?

Participant: I believe that staff qualification is highly dependent on the amount of training they get. The more they are trained the more they get qualified. It's a positive relationship.

Competence of the staff member is determined by several factors such as: his performance, his appraisals and the number of researches he publishes.

The motivation of the staff members is highly affected by their salaries and incentives. It is also affected by their appraisals, the students' performance and the reputation of the university.

Finally, staff experience depends on three sub-factors: the number of working years of the staff and the number of curriculums that the staff prepared or reviewed. These three sub-factors have a positive effect on the experience of staff, which in turn affects quality of staff.

Researcher: I see. What about quality of research? What are the related sub-factors?

Participant: Quality of research is determined by two sub-factors: the number of published researches and the allocated research budget. Increasing the research budget gives the ability to publish more researches which, in return, increases the quality of research. These two sub-factors affect quality of research positively.

Researcher: Are there any other factors that contribute to quality of Egyptian HE?

Participant: All the previous mentioned key factors or sub-factors contribute to quality of Egyptian HE. In addition, these key factors highly depend on the available funding of universities and the allocations for each of them.

Researcher: Do you believe that qualities of these key variables affect the skills gap between skills of graduates and skills needed by labour market?

Participant: Of course. Qualities of the key variables positively affect quality of the Egyptian HE system, which in turn affects the skills gap between skills of university graduates and skills required by labour market.

Questions related to "The Egyptian HE system"

Researcher: Do you believe that increasing qualities of components of the Egyptian HE system can lead to increasing quality of services provided by universities?

Participant: I believe that any increase in any component of these components will lead to increasing quality of the Egyptian HE system, which reflects positively on quality of services provided by HEIs.

Researcher: Does increasing the quality of services provided by Egyptian universities increase quality of graduates from these universities?

Participant: Sure. In my point of view, there is a positive relationship between quality of services provided by universities and quality of graduates. Therefore, increasing quality of services provided by universities will

lead to increasing quality of university graduates and their skills, and vice versa.

Researcher: Does increasing quality of components of the Egyptian HE system increase the compatibility between outputs of this system (represented in skills of graduates) and requirements of the labour market?

Participant: Absolutely. Quality of components of the Egyptian HE system has a significant effect on quality of services provided by universities and, as a consequence, quality of graduates (or skills of graduates). This leads in the end in increasing the compatibility between skills of graduates and skills needed by labour market.

Questions related to "Structural changes in key variables"

Researcher: In your point of view, what are the changes that should be done to these key variables of the Egyptian HE system, which would increase the quality of this system and the quality of its outputs, which consequently would increase the compatibility between skills of graduates and labour market requirements and bridge the skills gap?

Participant: I believe that there are variables that can be changed and others cannot be changed. For example, the variables that can be changed by the government (MOHESR) or by the university include: the funding allocations for the components of the Egyptian HE system (the amount of funding from the government that is allocated for universities), educational fees, number of enrolled students, and number of staff members. These variables can be manipulated by the government or the universities in a way to generally increase and improve the quality of Egyptian HE system.

Researcher: In the end, I want to thank you again for your time, effort, and the valuable information that you provided which will help me in my study.

Appendix D

Coding Sheet Sample

Raw Data	Code
Most of the **graduates are not qualified enough** to work in the labour market without further training. Their **skills do not match** with the skills required by the labour market.	Skills Mismatch
This is a strong evidence of the absence of **coordination** between **universities** from one side and the **labour market** from the other side concerning the skills that the graduates should have.	*"Coordination"*
Universities must know exactly the **skills required by the labour market** then work to produce graduates with these skills.	*"Skills required by labour market"*
According to my experience and my relationship with many employers in various fields of business and industry in Egypt, most of employers complain about the **low level of qualification** of Egyptian universities' graduates, especially graduates of Egyptian public universities.	Skills Mismatch
They agree that the **skills of graduates are not consistent** with the requirements of the labour market. As a result, these employers have to train the **low-qualified graduates** before they can benefit from them, which consumes a lot of money and time.	Skills Mismatch
Many factors affect the Egyptian higher education but the most affecting, in my point of view, are **quality of curriculums** in universities, **quality of the teaching** process itself, **quality of staff** and the teaching methods they use to teach these curriculums, and finally **quality of research** in universities.	Key Variables

Quality of curriculum is dependent on three factors; **quality of staff** who prepare the curriculum, **review rate of the curriculum** and **quality of curriculum design**. Each of these three sub-factors affect the overall quality of curriculums in universities.	Sub-variables: Quality of curriculum
I believe quality of teaching (or the quality of the educational process itself) is one of the most important main factors. **Average class size** is a very important factor that affects the quality of teaching as well as **quality of staff** and **quality of curriculum**. If these sub-factors are measured, quality of teaching can be measured.	Sub-variables: Quality of teaching
Also, quality of staff members is one of the main factors that directly affect the quality of HE. It strongly and directly affect quality of Egyptian HE system. Many sub-factors affect quality of staff including **staff qualification** level, their **competence**, their **motivation**, and their **experience**.	Sub-variables: Quality of staff
I believe that staff qualification is highly dependent on the amount of **training** they get. The more they are trained the more they get qualified. It's a positive relationship.	Sub-sub-variables: Staff qualification
Competence of the staff member is determined by several factors such as: his **performance**, his **appraisals** and the **number of researches he publishes**.	Sub-sub-variables: Staff competence
The motivation of the staff members is highly affected by their **salaries and incentives**. It is also affected by their **appraisals**, the **students' performance** and the **reputation of the university**.	Sub-sub-variables: Staff motivation

Finally, staff experience depends on three sub-factors: the **number of working years** of the staff and the **number of curriculums that the staff prepared** or **reviewed**. These three sub-factors have a positive effect on the experience of staff, which in turn affects quality of staff.	Sub-sub-variables: Staff experience
Quality of research is determined by two sub-factors: the **number of published researches** and the **allocated research budget**. Increasing the research budget gives the ability to publish more researches which, in return, increases the quality of research. These two sub-factors affect quality of research positively.	Sub-variables: Quality of research
All the previous mentioned key factors or sub-factors contribute to quality of Egyptian HE. In addition, these key factors highly depend on the **available funding** of universities and the **allocations** for each of them.	Funding
I believe that there are variables that can be changed and others cannot be changed. For example, the variables that can be changed by the government (MOHESR) or by the university include: the **funding allocations** for the components of the Egyptian HE system (the amount of funding from the government that is allocated for universities), **educational fees**, **number of enrolled students**, and **number of staff members**. These variables can be manipulated by the government or the universities in a way to generally increase and improve the quality of Egyptian HE system.	Policy Structure

Appendix E

Model Variables, Units, and Equations

Stocks			
No.	Name	Unit	Initial value
1	Quality of curriculum ~	%	50
2	Quality of facilities ~	%	40
3	Quality of internship ~	%	50
4	Quality of research ~	%	60
5	Quality of resources ~	%	50
6	Quality of services provided by university ~	%	60
7	Quality of staff ~	%	60
8	Quality of teaching ~	%	55
9	Total number of students	Student	1,417,624

Constants							
No.	Name	Unit	2012/ 2013	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017
1	Available training opportunities per year	Student/yr	100,000	120,000	150,000	195,000	220,000
2	Facilities share	%	17.28	18.00	18.50	18.59	18.15
3	Government funding per year	EGP/yr	14,654, 674,533	15,751, 200,006	19,723, 063,048	23,657, 416,099	24,314, 694,678
4	High school grade required for enrolment ~	%	74.7	74.5	74.5	74.5	74.3
5	Number of classes	Class	43,578	44,160	44,977	45,934	46,753
6	Number of curriculums prepared per staff per ear	Curriculum /yr	1	1	1	1	1

No.	Name	Unit	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017
			Constants (Continued)				
7	Number of curriculums reviewed per staff per ear	Curriculum /yr	2	1	1	2	2
8	Number of teaching weeks in the year	Week/yr	32	32	32	32	32
9	Number of teaching years ~	yr	20	19	17	15	15
10	Other funding per year	EGP/yr	46,260,000	33,144,000	20,753,000	50,281,000	53,578,000
11	Percentage of dropped-out students per year	%	0.7	0.4	0.5	0.2	0.2
12	Percentage of graduates per year	%	19.10	9.10	10.80	12.30	13.90
13	Percentage of researches with profits per year ~	%	10	13	8	16	10
14	Positive attitude ~	%	45	47	50	48	51
15	Quality of curriculum design and content ~	%	57	59	61	60	63
16	Rate of curriculum review per year ~	Revision/yr	0	1	0	1	0
17	Required facilities per student	EGP/(yr *Student)	4,500	7,500	10,500	13,500	16,500
18	Required resources per student	EGP/(yr *Student)	6,000	10,000	14,000	18,000	22,000
19	Research cost ~	EGP/ Research	5250	5250	5250	5250	5250
20	Research share	%	0.52	0.65	0.49	0.44	0.36
21	Resources share	%	20.44	19.15	17.86	16.66	15.76
22	Self-initiative ~	%	35	38	36	40	37
23	Skills needed by market ~	%	90	90	90	90	90

	Constants (Continued)						
No.	Name	Unit	2012/ 2013	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017
24	Staff GPA ~	GPA	3.2	3.2	3.3	3.1	3.3
25	Staff salaries and incentives share	%	97.6	97.8	98.2	98.3	98.5
26	Staff share	%	61.76	62.20	63.15	64.31	65.73
27	Staff training budget share	%	2.4	2.2	1.8	1.7	1.5
28	Student fees per year ~	EGP/(yr *Student)	500	500	550	650	1100
29	Student GPA ~	GPA	2.4	2.5	2.6	2.5	2.5
30	Total number of staff	Teacher	74,784	77,289	81,183	82,946	85,404
31	Total staff load in the year	Hours/yr	35,000,000	35,100,000	35,250,000	35,500,000	35,800,000

	Auxiliaries		
No.	Name	Unit	Definition
1	Academic Preparation ~	%	$\dfrac{\text{Quality of curriculum}}{2} + \dfrac{\text{Quality of teaching}}{2}$
2	Allocated facilities budget per year	EGP/yr	Available funding per year× Facilities share
3	Allocated research budget per year	EGP/yr	Available funding per year× research share
4	Allocated resources budget per year	EGP/yr	Available funding per year× resources share
5	Allocated staff budget per year	EGP/yr	Available funding per year× staff share
6	Available funding per year	EGP/yr	Total funding per year
7	Class size ~	Student/ class	$\dfrac{\text{Total number of students}}{\text{Number of classes}}$

No.	Name	Unit	Definition
	Auxiliaries (Continued)		
8	Demand for internship per year	Student/yr	$(0.6 \times Total\ number\ of\ students) + (G06 \times Total\ number\ of\ students)$
9	Desired facilities budget	EGP/yr	$Required\ facilities\ per\ student \times Total\ number\ of\ students$
10	Desired resources budget	EGP/yr	$Required\ resources\ per\ student \times Total\ number\ of\ students$
11	E01	%/yr	$If\ "Rate\ of\ curriculum\ review\ per\ year = 1$ $Effect = +15\%$ $If\ "Rate\ of\ curriculum\ review\ per\ year = 0$ $Effect = -15\%$
12	E02	%	$0.4 \times G28 + 0.2 \times G29 + 0.3 \times G30 + 0.1 \times G27$
13	E03	%	$.2 \times G27 + .5 \times G24 + .3 \times G26$
14	E04	%	$0.4 \times G22 + 0.3 \times G24 + 0.2 \times G31 + 0.1 \times G23$
15	E05	%	$0.6 \times G33 + 0.4 \times G32$
16	E06	%	$0.5 \times G36 + 0.3 \times G26 + 0.1 \times G34 + 0.1 \times G35$
17	Effectiveness of supervisor ~	%	$70\% + G07$
18	Effectiveness of trainee ~	%	$0.3 \times Positive\ attitude + 0.3 \times Self\ initiative + 0.4 \times Academic\ preparation$
19	Employment rate	%	$65\% + G46$ _"The effect G46 is delayed one year"_
20	Facilities budget availability ratio	%	$\dfrac{Allocated\ facilities\ budget\ per\ year}{Desired\ facilities\ budget\ per\ year} \times 100$
21	Internship availability ratio	%	$\dfrac{Available\ training\ opportunities\ per\ year}{Demand\ for\ internship\ per\ year} \times 100$
22	Loading hours per staff per week ~	Hours/(week *Teacher)	$\dfrac{Loading\ hours\ per\ staff\ per\ year}{Number\ of\ teaching\ weeks\ in\ the\ year}$
23	Loading hours per staff per year ~	Hours/(yr *Teacher)	$\dfrac{Total\ staff\ load\ in\ the\ year}{Total\ number\ of\ staff}$

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Appendix E

No.	Name	Unit	Definition
24	Number of funded research projects per year	Research/yr	$$\dfrac{Allocated\ research\ budget\ per\ year}{Research\ cost}$$
25	Number of research publications per year	Research/yr	$80\% \times Number\ of\ funded\ research\ projects$
26	Number of trained staff per year	Teacher	$Staff\ training\ demand\ per\ year \times G21 \times Total\ number\ of\ staff$
27	Research profits & grants per year	EGP/yr	$Number\ of\ research\ publications\ per\ year Per\ year \times 50000$
28	Resources budget availability ratio	%	$Allocated\ resources\ budget\ per\ year \times Desired\ resources\ budget \times 100$
29	Salaries & incentives per staff per year ~	EGP/ (Teacher *yr)	$$\dfrac{Staff\ salaries\ \&\ incentives\ per\ year}{Total\ number\ of\ staff}$$
30	Skills gap ~	%	$Skills\ needed\ by\ market - Skills\ of\ graduates$
31	Skills of graduates ~	%	$50\% + G44$
32	Staff appraisals ~	%	$60\% + G25$
33	Staff performance ~	%	$70\% + E05$
34	Staff competence ~	%	$40\% + E03$
35	Staff experience ~	%	$65\% + E02$
36	Staff motivation ~	%	$30\% + E04$
37	Staff qualification ~	%	$70\% + G20$
38	Staff salaries & incentives per year	EGP/yr	$Allocated\ staff\ budget\ per\ year \times Staff\ salaries\ \&\ incentives\ share$
39	Staff training budget per year	EGP/yr	$Allocated\ staff\ budget\ per\ year \times Staff\ training\ budget\ share$
40	Staff training demand per year	%	$G19$

Appendix E

	Auxiliaries (Continued)		
No.	**Name**	**Unit**	**Definition**
41	Student performance ~	%	$55\% + E06$
42	Student to staff ratio ~	Student/ Teacher	$\dfrac{Total\ number\ of\ students}{Total\ number\ of\ staff}$
43	Suitability for employment ~	%	$60\% + G45$
44	Total funding per year	EGP/yr	$Government\ funding\ per\ year$ $+ Other\ funding\ per\ year$ $+ Research\ profits\ \&\ grants\ per\ year$ $+ Total\ revenue\ per\ year$
45	Total revenue per year	EGP/yr	$Total\ number\ of\ students$ $\times Student\ fees\ per\ year$
46	University reputation ~	%	$\dfrac{1}{3}(Employment\ rate$ $+ Quality\ of\ services\ provided\ by\ university$ $+ Suitability\ for\ employment)$

	Flows		
No.	**Name**	**Unit**	**Definition**
1	F1	%/yr	$0.2 \times G02 + 0.2 \times G01 + 0.6 \times E01$
2	F2	%/yr	$0.7 \times G05 + 0.2 \times G04 + 0.1 \times G03$
3	F3	%/yr	$G08$
4	F4	%/yr	$G09$
5	F5	%/yr	$0.3 \times G10 + 0.2 \times G12 + 0.5 \times G11$
6	F6	%/yr	$0.15 \times G15 + 0.1 \times G16 + 0.1 \times G17 + 0.15 \times G18 + 0.25 \times G13 + 0.25 \times G14$
7	F7	%/yr	$0.4 \times G39 + 0.4 \times G37 + 0.2 \times G38$
8	F8	%/yr	$0.25 \times G47 + 0.25 \times G51 + 0.25 \times G52 + 0.12 \times G50 + 0.08 \times G49 + 0.05 \times G48$
9	Graduates per year	Student/ yr	$(Percentage\ of\ graduates\ per\ year$ $+ Percentage\ of\ droppedout\ students\ per\ year)$ $\times Total\ number\ of\ students$
10	Enrolled students	Student/ yr	$(21.5\% + 0.2 \times G43 + 0.1 \times G42 + 0.4 \times G41 + 0.3 \times G40)$ $\times Total\ number\ of\ students$

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Appendix F

Detailed Results of Scenario Trials

- **Scenario #1**

Increasing the rate of curriculum review per year up to 1 revision every year		Real Situation						Scenario #1					
Variable	Unit	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017		2012/2013	2013/2014	2014/2015	2015/2016	2016/2017	
Rate of curriculum review per year	Revision/yr	0	1	0	1	0		1	1	1	1	1	
Quality of curriculum	%	50.00	54.85	51.26	56.11	52.66	57.42	50.00	54.85	59.29	63.34	66.97	70.29
Quality of services provided by university	%	60.00	61.39	62.56	63.42	63.98	64.21	60.00	61.39	62.95	64.51	65.96	67.26
Skills of graduates	%	64.00	65.67	67.07	68.11	68.78	69.05	64.00	65.67	67.54	69.41	71.15	72.71
Skills gap	%	26.00	24.33	22.93	21.89	21.22		26.00	24.33	22.46	20.59	18.85	

- **Scenario #2**

Increasing the number of available opportunities to cover the all demand		Real Situation						Scenario #2					
Variable	Unit	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017		2012/2013	2013/2014	2014/2015	2015/2016	2016/2017	
Available training opportunities per year	Student/yr	100,000	120,000	150,000	195,000	220,000		850,000	750,000	1,000,000	1,150,000	1,400,000	
Quality of internship	%	50.00	47.08	44.66	42.18	40.03	37.88	50.00	53.58	56.90	59.84	62.80	65.44
Quality of services provided by university	%	60.00	61.39	62.56	63.42	63.98	64.21	60.00	61.45	62.78	63.87	64.72	65.30
Skills of graduates	%	64.00	65.67	67.07	68.11	68.78	69.05	64.00	65.74	67.33	68.65	69.66	70.36
Skills gap	%	26.00	24.33	22.93	21.89	21.22		26.00	24.26	22.67	21.35	20.34	

- **Scenario #3**

Increasing the total funding per year without changing the share of each allocation		Real Situation						Scenario #3					
Variable	Unit	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017		2012/2013	2013/2014	2014/2015	2015/2016	2016/2017	
Government funding per year	EGP/yr	14,654,674,533	15,751,200,006	19,723,063,048	23,657,416,099	24,314,694,678		29,309,349,066	63,004,800,024	118,338,378,288	189,259,328,792	243,146,946,780	
Total revenue per year	EGP/yr	708,812,000	760,403,389	1,012,969,795	1,424,007,724	2,827,980,727		708,812,000	760,430,718	1,013,305,509	1,425,940,766	2,838,483,747	
Other funding per year	EGP/yr	46,260,000	33,144,000	20,753,000	50,281,000	53,578,000		46,260,000	33,144,000	20,753,000	50,281,000	53,578,000	
Research profits & grants per year	EGP/yr	60,000,000	79,676,561	65,864,384	124,380,631	84,668,020		60,000,000	155,155,113	253,377,794	714,564,866	641,813,720	
Total funding per year	EGP/yr	15,469,746,533	16,624,423,956	20,822,650,227	25,256,085,454	27,280,921,425		30,124,421,066	63,953,529,856	119,625,814,592	191,450,115,424	246,680,822,247	
Allocated facilities budget per year	EGP/yr	2,673,172,201	2,992,396,312	3,852,190,292	4,695,106,286	4,951,487,239		5,205,499,960	11,511,635,374	22,130,775,699	35,590,576,457	44,772,569,238	
Allocated resources budget per year	EGP/yr	3,162,016,191	3,183,577,188	3,718,925,331	4,207,663,837	4,299,473,217		6,157,431,666	12,247,100,967	21,365,170,486	31,895,589,230	38,876,897,586	
Allocated research budget per year	EGP/yr	80,442,682	108,058,756	102,030,986	111,126,776	98,211,317		156,646,990	415,697,944	586,166,491	842,380,508	888,050,960	
Allocated staff budget per year	EGP/yr	9,554,115,459	10,340,391,701	13,149,503,619	16,242,188,555	17,931,749,653		18,604,842,450	39,779,095,570	75,543,701,915	123,121,569,229	162,143,304,463	
Total expenditures per year	EGP/yr	15,469,746,533	16,624,423,956	20,822,650,227	25,256,085,454	27,280,921,425		30,124,421,066	63,953,529,856	119,625,814,592	191,450,115,424	246,680,822,247	
Facilities share	%	17.28	18	18.5	18.59	18.15		17.28	18	18.5	18.59	18.15	
Resources share	%	20.44	19.15	17.86	16.66	15.76		20.44	19.15	17.86	16.66	15.76	
Research share	%	0.52	0.65	0.49	0.44	0.36		0.52	0.65	0.49	0.44	0.36	
Staff share	%	61.76	62.2	63.15	64.31	65.73		61.76	62.2	63.15	64.31	65.73	
Quality of facilities	%	40	38.7	35.83	32.86	30.02	27.33	40	43.44	47.79	52.65	57.16	61.18
Quality of resources	%	50	47.53	42.98	38.05	32.88	27.57	50	53.06	56.4	59.97	63.34	65.42
Quality of research	%	60	58.68	57.36	56.02	54.65	53.23	60	58.8	58.82	60.17	62.3	64.76
Quality of staff	%	60	60.2	60.32	60.42	60.48	60.49	60	60.42	61.3	62.07	62.86	63.7
Quality of services provided	%	60	61.39	62.56	63.42	63.98	64.21	60	61.6	63.53	65.86	68.54	71.41
Skills of graduates	%	64	65.67	67.07	68.11	68.78	69.05	64	65.92	68.24	71.03	74.25	77.13
Skills gap	%	26	24.33	22.93	21.89	21.22		26	24.08	21.76	18.97	15.75	

- **Scenario #4**

Increasing research share by 3% & decreasing each of facilities and resources share by 1.5%		Real Situation						Scenario #4					
Variable	Unit	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017		2012/2013	2013/2014	2014/2015	2015/2016	2016/2017	
Government funding per year	EGP/yr	14,654,674,533	15,751,200,006	19,723,063,048	23,657,416,099	24,314,694,678		14,654,674,533	15,751,200,006	19,723,063,048	23,657,416,099	24,314,694,678	
Total revenue per year	EGP/yr	708,812,000	760,403,389	1,012,969,795	1,424,007,724	2,827,980,727		708,812,000	760,412,785	1,013,087,479	1,424,696,452	2,831,781,036	
Other funding per year	EGP/yr	46,260,000	33,144,000	20,753,000	50,281,000	53,578,000		46,260,000	33,144,000	20,753,000	50,281,000	53,578,000	
Research profits & grants per year	EGP/yr	60,000,000	79,676,561	65,864,384	124,380,631	84,668,020		60,000,000	539,349,030	380,080,678	899,267,960	682,277,452	
Total funding per year	EGP/yr	15,469,746,533	16,624,423,956	20,822,650,227	25,256,085,454	27,280,921,425		15,469,746,533	17,084,105,820	21,136,984,205	26,031,661,511	27,882,331,166	
Allocated facilities budget per year	EGP/yr	2,673,172,201	2,992,396,312	3,852,190,292	4,695,106,286	4,951,487,239		2,441,126,003	2,818,877,460	3,593,287,315	4,448,810,952	4,642,408,139	
Allocated resources budget per year	EGP/yr	3,162,016,191	3,183,577,188	3,718,925,331	4,207,663,837	4,299,473,217		2,929,969,993	3,015,344,677	3,458,010,616	3,946,399,885	3,976,020,424	
Allocated research budget per year	EGP/yr	80,442,682	108,058,756	102,030,986	111,126,776	98,211,317		544,535,078	623,569,862	737,680,749	895,489,156	936,846,327	
Allocated staff budget per year	EGP/yr	9,554,115,459	10,340,391,701	13,149,503,619	16,242,188,555	17,931,749,653		9,554,115,459	10,626,313,820	13,348,005,526	16,740,961,518	18,327,056,276	
Total expenditures per year	EGP/yr	15,469,746,533	16,624,423,956	20,822,650,227	25,256,085,454	27,280,921,425		15,469,746,533	17,084,105,820	21,136,984,205	26,031,661,511	27,882,331,166	
Facilities share	%	17.28	18	18.5	18.59	18.15		15.78	16.5	17	17.09	16.65	
Resources share	%	20.44	19.15	17.86	16.66	15.76		18.94	17.65	16.36	15.16	14.26	
Research share	%	0.52	0.65	0.49	0.44	0.36		3.52	3.65	3.49	3.44	3.36	
Staff share	%	61.76	62.2	63.15	64.31	65.73		61.76	62.2	63.15	64.31	65.73	
Quality of facilities	%	40	38.7	35.83	32.86	30.02	27.33	40	38.28	35.34	32.37	29.55	26.88
Quality of resources	%	50	47.53	42.98	38.05	32.88	27.57	50	47.11	42.5	37.52	32.33	27
Quality of research	%	60	58.68	57.36	56.02	54.65	53.23	60	60.55	62.24	64.22	66.36	68.51
Quality of staff	%	60	60.2	60.32	60.42	60.48	60.49	60	60.2	60.54	60.9	61.28	61.63
Quality of services provided	%	60	61.39	62.56	63.42	63.98	64.21	60	61.46	62.9	64.3	65.66	66.96
Skills of graduates	%	64	65.67	67.07	68.11	68.78	69.05	64	65.76	67.48	69.17	70.79	72.35
Skills gap	%	26	24.33	22.93	21.89	21.22		26	24.24	22.52	20.83	19.21	

- **Scenario #5**

Increasing the total funding per year & Changing the share of the allocations		Real Situation						Scenario #5					
Variable	Unit	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017		2012/2013	2013/2014	2014/2015	2015/2016	2016/2017	
Government funding per year	EGP/yr	14,654,674,533	15,751,200,006	19,723,063,048	23,657,416,099	24,314,694,678		20,901,975,085	34,026,042,044	56,346,122,994	82,929,885,330	99,413,573,142	
Total revenue per year	EGP/yr	708,812,000	760,403,389	1,012,969,795	1,424,007,724	2,827,980,727		708,812,000	760,443,969	1,013,454,742	1,426,688,167	2,841,840,965	
Other funding per year	EGP/yr	46,260,000	33,144,000	20,753,000	50,281,000	53,578,000		46,260,000	33,144,000	20,753,000	50,281,000	53,578,000	
Research profits & grants per year	EGP/yr	60,000,000	79,676,561	65,864,384	124,380,631	84,668,020		60,000,000	795,878,068	521,004,004	988,182,780	650,628,855	
Total funding per year	EGP/yr	15,469,746,533	16,624,423,956	20,822,650,227	25,256,085,454	27,280,921,425		21,717,047,085	35,615,508,082	57,901,334,740	85,395,037,276	102,959,620,963	
Allocated facilities budget per year	EGP/yr	2,673,172,201	2,992,396,312	3,852,190,292	4,695,106,286	4,951,487,239		5,212,091,300	11,753,117,667	22,292,013,875	36,036,705,731	45,096,313,982	
Allocated resources budget per year	EGP/yr	3,162,016,191	3,183,577,188	3,718,925,331	4,207,663,837	4,299,473,217		6,145,924,325	12,465,427,829	21,539,296,523	32,279,324,090	39,124,655,966	
Allocated research budget per year	EGP/yr	80,442,682	108,058,756	102,030,986	111,126,776	98,211,317		803,530,742	854,772,194	810,618,686	853,950,373	823,676,968	
Allocated staff budget per year	EGP/yr	9,554,115,459	10,340,391,701	13,149,503,619	16,242,188,555	17,931,749,653		9,555,500,717	10,542,190,392	13,259,405,655	16,225,057,082	17,914,974,048	
Total expenditures per year	EGP/yr	15,469,746,533	16,624,423,956	20,822,650,227	25,256,085,454	27,280,921,425		21,717,047,085	35,615,508,082	57,901,334,740	85,395,037,276	102,959,620,963	
Facilities share	%	17.28	18	18.5	18.59	18.15		24	33	38.5	42.2	43.8	
Resources share	%	20.44	19.15	17.86	16.66	15.76		28.3	35	37.2	37.8	38	
Research share	%	0.52	0.65	0.49	0.44	0.36		3.7	2.4	1.4	1	0.8	
Staff share	%	61.76	62.2	63.15	64.31	65.73		44	29.6	22.9	19	17.4	
Quality of facilities	%	40	38.7	35.83	32.86	30.02	27.33	40	43.45	47.85	52.72	57.22	61.24
Quality of resources	%	50	47.53	42.98	38.05	32.88	27.57	50	53.05	56.53	60.15	63.6	65.74
Quality of research	%	60	58.68	57.36	56.02	54.65	53.23	60	61.02	63.4	65.69	67.83	69.87
Quality of staff	%	60	60.2	60.32	60.42	60.48	60.49	60	60.21	60.69	61.17	61.62	62.04
Quality of services provided	%	60	61.39	62.56	63.42	63.98	64.21	60	61.71	63.93	66.62	69.62	72.71
Skills of graduates	%	64	65.67	67.07	68.11	68.78	69.05	64	66.05	68.71	71.94	75.54	78.17
Skills gap	%	26	24.33	22.93	21.89	21.22		26	23.95	21.29	18.06	14.46	

- **Scenario #6**

Increasing student fees to increase revenue & changing share to incresae research only	Unit	Real Situation						Scenario #6					
Variable	Unit	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017		2012/2013	2013/2014	2014/2015	2015/2016	2016/2017	
Student fees per year	EGP/yr	500	500	550	650	1100		1000	1000	1050	1150	1600	
Government funding per year	EGP/yr	14,654,674,533	15,751,200,006	19,723,063,048	23,657,416,099	24,314,694,678		14,654,674,533	15,751,200,006	19,723,063,048	23,657,416,099	24,314,694,678	
Total revenue per year	EGP/yr	708,812,000	760,403,389	1,012,969,795	1,424,007,724	2,827,980,727		1,417,624,000	1,498,196,801	1,877,037,377	2,408,060,189	3,867,120,739	
Other funding per year	EGP/yr	46,260,000	33,144,000	20,753,000	50,281,000	53,578,000		46,260,000	33,144,000	20,753,000	50,281,000	53,578,000	
Research profits & grants per year	EGP/yr	60,000,000	79,676,561	65,864,384	124,380,631	84,668,020		60,000,000	785,199,374	528,610,456	1,161,053,802	831,293,290	
Total funding per year	EGP/yr	15,469,746,533	16,624,423,956	20,822,650,227	25,256,085,454	27,280,921,425		16,178,558,533	18,067,740,181	22,149,463,881	27,276,811,090	29,066,686,708	
Allocated facilities budget per year	EGP/yr	2,673,172,201	2,992,396,312	3,852,190,292	4,695,106,286	4,951,487,239		2,669,462,158	3,107,651,311	3,942,604,571	4,882,549,185	5,115,736,861	
Allocated resources budget per year	EGP/yr	3,162,016,191	3,183,577,188	3,718,925,331	4,207,663,837	4,299,473,217		3,154,818,914	3,324,464,193	3,809,707,787	4,391,566,585	4,418,136,380	
Allocated research budget per year	EGP/yr	80,442,682	108,058,756	102,030,986	111,126,776	98,211,317		792,749,368	867,251,529	952,426,947	1,091,072,444	1,046,400,721	
Allocated staff budget per year	EGP/yr	9,554,115,459	10,340,391,701	13,149,503,619	16,242,188,555	17,931,749,653		9,561,528,093	10,768,373,148	13,444,724,575	16,911,622,876	18,486,412,746	
Total expenditures per year	EGP/yr	15,469,746,533	16,624,423,956	20,822,650,227	25,256,085,454	27,280,921,425		16,178,558,533	18,067,740,181	22,149,463,881	27,276,811,090	29,066,686,708	
Facilities share	%	17.28	18	18.5	18.59	18.15		16.5	17.2	17.8	17.9	17.6	
Resources share	%	20.44	19.15	17.86	16.66	15.76		19.5	18.4	17.2	16.1	15.2	
Research share	%	0.52	0.65	0.49	0.44	0.36		4.9	4.8	4.3	4	3.6	
Staff share	%	61.76	62.2	63.15	64.31	65.73		59.1	59.6	60.7	62	63.6	
Quality of facilities	%	40	38.7	35.83	32.86	30.02	27.33	40	38.73	35.98	33.03	30.23	27.55
Quality of resources	%	50	47.53	42.98	38.05	32.88	27.57	50	47.56	43.11	38.23	33.11	27.82
Quality of research	%	60	58.68	57.36	56.02	54.65	53.23	60	61.02	63.39	65.69	67.9	69.99
Quality of staff	%	60	60.2	60.32	60.42	60.48	60.49	60	60.2	60.69	61.16	61.62	62.04
Quality of services provided	%	60	61.39	62.56	63.42	63.98	64.21	60	61.5	63.05	64.61	66.14	67.62
Skills of graduates	%	64	65.67	67.07	68.11	68.78	69.05	64	65.8	67.66	69.53	71.37	73.14
Skills gap	%	26	24.33	22.93	21.89	21.22		26	24.2	22.34	20.47	18.63	

- **Scenario #7**

Increasing number of staff by 50 % & increasing the staff budget by 50 %	Real Situation						Scenario #7					
Variable	**Unit**	**2012/2013**	**2013/2014**	**2014/2015**	**2015/2016**	**2016/2017**		**2012/2013**	**2013/2014**	**2014/2015**	**2015/2016**	**2016/2017**
Total number of staff	Teacher	74784	77289	81183	82946	85404		112176	115934	121775	124419	128106
Government funding per year	EGP/yr	14,654,674,533	15,751,200,006	19,723,063,048	23,657,416,099	24,314,694,678		19,431,732,262	20,921,339,494	26,297,825,686	31,778,475,068	33,279,825,614
Total revenue per year	EGP/yr	708,812,000	760,403,389	1,012,969,795	1,424,007,724	2,827,980,727		708,812,000	760,403,505	1,012,972,249	1,424,026,667	2,828,107,851
Other funding per year	EGP/yr	46,260,000	33,144,000	20,753,000	50,281,000	53,578,000		46,260,000	33,144,000	20,753,000	50,281,000	53,578,000
Research profits & grants per year	EGP/yr	60,000,000	79,676,561	65,864,384	124,380,631	84,668,020		60,000,000	80,215,910	66,423,171	123,577,910	83,917,707
Total funding per year	EGP/yr	15,469,746,533	16,624,423,956	20,822,650,227	25,256,085,454	27,280,921,425		20,246,804,262	21,795,102,909	27,397,974,106	33,376,360,646	36,245,429,172
Allocated facilities budget per year	EGP/yr	2,673,172,201	2,992,396,312	3,852,190,292	4,695,106,286	4,951,487,239		2,673,172,201	2,992,363,691	3,852,196,637	4,695,085,873	4,951,076,418
Allocated resources budget per year	EGP/yr	3,162,016,191	3,183,577,188	3,718,925,331	4,207,663,837	4,299,473,217		3,162,016,191	3,183,542,482	3,718,931,456	4,207,645,543	4,299,116,493
Allocated research budget per year	EGP/yr	80,442,682	108,058,756	102,030,986	111,126,776	98,211,317		80,442,682	108,057,578	102,031,154	111,126,293	98,203,169
Allocated staff budget per year	EGP/yr	9,554,115,459	10,340,391,701	13,149,503,619	16,242,188,555	17,931,749,653		14,331,173,188	15,510,587,551	19,724,255,428	24,363,282,833	26,897,624,479
Total expenditures per year	EGP/yr	15,469,746,533	16,624,423,956	20,822,650,227	25,256,085,454	27,280,921,425		20,246,804,262	21,794,551,302	27,397,414,675	33,377,140,541	36,246,020,559
Facilities share	%	17.28	18	18.5	18.59	18.15		13.20	13.73	14.06	14.07	13.66
Resources share	%	20.44	19.15	17.86	16.66	15.76		15.62	14.61	13.57	12.61	11.86
Research share	%	0.52	0.65	0.49	0.44	0.36		0.40	0.50	0.37	0.33	0.27
Staff share	%	61.76	62.2	63.15	64.31	65.73		70.78	71.17	71.99	72.99	74.21
Quality of facilities	%	40	38.7	35.83	32.86	30.02	27.33	40	38.7	35.83	32.86	30.02	27.32
Quality of resources	%	50	47.53	42.98	38.05	32.88	27.57	50	47.52	42.97	38.04	32.86	27.54
Quality of research	%	60	58.68	57.36	56.02	54.65	53.23	60	58.69	57.42	56.16	54.89	53.62
Quality of staff	%	60	60.2	60.32	60.42	60.48	60.49	60	60.72	61.38	62.03	62.7	63.32
Quality of services provided	%	60	61.39	62.56	63.42	63.98	64.21	60	61.39	62.56	63.45	64.05	64.35
Skills of graduates	%	64	65.67	67.07	68.11	68.78	69.05	64	65.67	67.08	68.14	68.86	69.22
Skills gap	%	26	24.33	22.93	21.89	21.22		26	24.33	22.92	21.86	21.14

- ## Scenario #8

Increasing the number of curriculums reviewed and prepared by each staff member in the year		Real Situation						Scenario #8					
Variable	Unit	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017		2012/2013	2013/2014	2014/2015	2015/2016	2016/2017	
Number of curriculums reviewed per year	Curriculum/yr	2	1	1	2	2		4	3	4	4	3	
Number of curriculums prepared per year	Curriculum/yr	1	1	1	1	1		2	3	2	2	3	
Quality of staff	%	60.00	60.20	60.32	60.42	60.48	60.49	60.00	60.79	61.60	62.39	63.10	63.77
Quality of services provided by university	%	60.00	61.39	62.56	63.42	63.98	64.21	60.00	61.39	62.57	63.46	64.06	64.37
Skills of graduates	%	64.00	65.67	67.07	68.11	68.78	69.05	64.00	65.67	67.08	68.15	68.88	69.25
Skills gap	%	26.00	24.33	22.93	21.89	21.22		26.00	24.33	22.92	21.85	21.12	

- ## Scenario #9

Increasing number of classes by 50 %		Real Situation						Scenario #9					
Variable	Unit	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017		2012/2013	2013/2014	2014/2015	2015/2016	2016/2017	
Number of classes	Class	41,578	44,160	44,970	45,934	46,753		62,367	66,240	67,455	68,901	70,130	
Quality of Teaching	%	55.00	56.71	58.36	59.60	60.35	60.53	55.00	57.31	59.72	62.08	64.27	66.24
Quality of services provided by university	%	60.00	61.39	62.56	63.42	63.98	64.21	60.00	61.42	62.68	63.72	64.55	65.19
Skills of graduates	%	64.00	65.67	67.07	68.11	68.78	69.05	64.00	65.70	67.22	68.47	69.46	70.22
Skills gap	%	26.00	24.33	22.93	21.89	21.22		26.00	24.30	22.78	21.53	20.54	