ONTOLOGY-BASED CONCEPTUAL MODEL FOR QUALITY ASSURANCE IN
HIGHER EDUCATION

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A thesis submitted in fulfilment of the
requirements for the award of the degree of
Doctor of Philosophy (Information Systems)

School of Computing
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NOVEMBER 2019

DEDICATION

This thesis is dedicated to the soul of my mother, my father, my brothers and sisters. To my wife Elham, my sons Ahmed, Abdullatif and Ayman and my daughter Amna. To all those who have always been a constant source of support and encouragement contributing in many ways to the success of this PhD journey.

ACKNOWLEDGEMENT

While this completed thesis bears my name, I wish to acknowledge my appreciation to the people who dedicated their work and contributed to the process of completing this PhD journey.

I would like to express my sincere gratitude to my supervisor Dr. Nor Hidayati Zakaria for the continuous support during the period of my PhD study, for her guidance, patience and motivation.

Associate Professor Dr. Mohammad Nazir Ahmad, being my first supervisor, has been extremely helpful to me during the entire journey of my study. He worked closely with me during the course of this research, and without his guidance, help and encouragement this thesis would not have been written or ever finished.

I want to acknowledge a special debt to Dr. Kamal Badr Abdalla and Dr. Ahmed Mohammed Arbab, whose assistance, support, cooperation and input made this research possible.

I would also like to thank Mr. Noel Lavin who reviewed several chapters of my thesis and provided me assistance and invaluable comments on my writing and grammar.

Thanks are also due to my colleagues at the Applied Science University (ASU) of Bahrain for taking the time to respond to my online evaluation questionnaire, and domain experts who participated in this research and whose cooperation and input made this research possible.

Thanks must also go to Mrs. Atheer Al-Rashed for her assistance with the statistical analysis of the data collected through survey questionnaire, and Mr. Mohammed Al-Najjar for developing the online evaluation questionnaire employed in evaluating the artifact of this study.

Last but certainly not least, I wish to express my unqualified thanks to my wife and kids for their love, support, and understanding. I would like to thank them here for doing their best to understand a father who had to be confined to his study for such a long time.

ABSTRACT

Quality in higher education is a complex, controversial and continuously evolving area of research. The concept of quality assurance (QA) emerged and is widely used nowadays within a range of processes of managing quality in higher education. A review of a number of existing standards of QA revealed many research gaps such as structure variations, lack of shared knowledge and understanding, lack of standardized use of terminology and the lack of practical and semantic support and guidelines on developing conceptual models of quality assurance in higher education. The Design Science (DS) approach in Information Systems discipline provides clear guidelines for designing, developing, demonstrating and evaluating novel solutions for defined problems with the aim of extending the boundaries of human and organizational capabilities by producing new, advanced and original artifacts. Therefore, to address the highlighted gaps, this research adopts the design science research methodology (DSRM) provided by Peffers (2008) comprising a sequence of six activities: (1) Problem Identification and Motivation, (2) Definition of the Objectives of a Solution, (3) Design and Development, (4) Demonstration, (5) Evaluation, and (6) Communication. This thesis demonstrates the applicability and usefulness of domain models with the phenomenon of quality in the higher education domain to support shared understanding, communication, and domain learning and problem-solving by introducing a universal approach to the domain of quality assurance. The ontology-based conceptual model for quality assurance (OntoQA), which is the main artifact delivered by this research, has been developed to faithfully capture the domain of quality assurance of academic programmes. OntoQA covers its domain to the extent required by intended usage, providing a reference ontology to facilitate design, development, monitoring, evaluation and improvement of quality academic programmes, and to assist in designing quality assurance systems. This research has introduced OntoQA as a new approach to designing, developing, monitoring and evaluating quality academic programmes, as well as the design and development of quality assurance systems. Quality assurance in higher education is a community-based process which requires consensus between stakeholders, therefore, OntoQA enhances communications, and facilitates streamlined collaboration on joint goals. Using OntoQA and getting familiar with the idea of conceptualising quality assurance in higher education facilitates tool developers, which would potentially help higher education providers to integrate quality when designing new programmes, or while reviewing and improving existing ones in conformance with international standards.

ABSTRAK

Kualiti adalah bidang penyelidikan yang kompleks, kontroversial, dan terus berkembang dalam pendidikan tinggi. Konsep jaminan kualiti (QA) kini muncul dan digunakan secara meluas dalam pelbagai proses pengurosan kualiti dalam pendidikan tinggi. Tinjauan terhadap beberapa piawai QA sedia ada mendedahkan banyak jurang penyelidikan seperti variasi struktur, kekurangan ilmu dan kefahaman bersama, kekurangan penggunaan terminologi yang piawai, dan kurangnya sokongan praktikal dan semantik dan garis panduan membina model konseptual jaminan kualiti dalam pendidikan tinggi. Pendekatan sains reka bentuk dalam disiplin sistem maklumat menyediakan garis panduan yang jelas untuk mereka bentuk, membangun, mendemonstrasi dan menilai penyelesaian novel untuk masalah yang dirancang dengan tujuan memperluas sempadan keupayaan manusia dan organisasi dengan menghasilkan artifak baharu, maju dan asli. Oleh itu, untuk menangani jurang yang ditekankan, penyelidikan ini menggunakan metodologi penyelidikan sains reka bentuk (DSRM) yang disediakan oleh Peffers (2008) yang terdiri daripada jujukan enam aktiviti: (1) Pengenalpastian Masalah dan Motivasi, (2) Definisi Objektif Penyelesaian, (3) Reka Bentuk dan Pembangunan, (4) Demonstrasi, (5) Penilaian, dan (6) Komunikasi. Tesis ini menunjukkan kebolehgunaan dan kegunaan model domain dengan fenomena kualiti dalam domain pendidikan tinggi untuk menyokong pemahaman, komunikasi, dan pembelajaran domain serta penyelesaian masalah bersama dengan memperkenalkan pendekatan sejagat ke dalam domain jaminan kualiti. Model konseptual berasaskan ontologi untuk jaminan kualiti (OntoQA), yang merupakan artifak utama yang dihasilkan oleh penyelidikan ini, telah dibangunkan untuk mengawasi domain jaminan mutu program akademik. OntoQA melipoti domain setakat yang diperlukan oleh penggunaan yang diperlukan, menyediakan ontologi rujukan untuk memudahkan reka bentuk, pembangunan, pemantauan, penilaian dan penambahbaikan program akademik yang berkualiti, dan membantu dalam mereka bentuk sistem jaminan kualiti. Kajian ini telah memperkenalkan OntoQA sebagai pendekatan baharu untuk mereka bentuk, membangun, memantau dan menilai program akademik yang berkualiti, serta menbantu dalam reka bentuk pembangunan sistem jaminan kualiti. Jaminan kualiti dalam pendidikan tinggi adalah proses berasaskan komuniti yang memerlukan persetujuan antara pihak berkepentingan. Oleh itu, OntoQA meningkatkan komunikasi, dan memudahkan kerjasama yang diperkemas pada matlamat bersama. Menggunakan OntoQA dan membiasakan diri dengan idea untuk mengkonsepsikan jaminan kualiti dalam pendidikan tinggi memudahkan pemaju alatan, yang mungkin berpotensi membantu penyedia pendidikan tinggi untuk mengintegrasikan kualiti apabila mereka merancang program baharu, atau semasa mengkaji semula dan memperbaiki program sedia ada mengikut piawaian antarabangsa.

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LIST OF ABBREVIATIONS

ANOVA	-	Analysis of variance
ASU	-	Applied Science University
AUQA	-	Australian Universities Quality Agency
BS	-	Behavioural Science
BSI	-	British Standards Institute
CM	-	Conceptual Model
COPIA	-	Code of Practice for Institutional Audit
COPPA	-	Code of Practice for Programme Accreditation
DCFR	-	Domain Comparative Formal Relation
DEMO	-	Design Engineering Methodology for Organization
DILIGENT	-	DIstributed, Loosely-controlled and Evolving Engineering of oNTologies
DS		Design Science
DSR		Design Science Research
DSRM		Design Science Research Methodology
EER		Enhanced Entity-Relationship
EHEA		European Higher Education Area
ENQA		European Association for Quality Assurance
EQAR		European Quality Assurance Register for Higher Education
ER		Entity Relationship
ESG		European Standards and Guidelines
ESIB		European Student Information Bureau
ETQA		Education and Training Quality Assurance
EUA		European University Association
EURASHE		European Association of Institutions in Higher Education
GATS		General Agreement on Trade in Services
HCI		Human-Computer Interface
HEP		Higher Education Provider
HERU		Higher Education Review Unit
HOU		Higher-Order Universal
INQAAHE		International Network for Quality Assurance Agencies

IS	Information Systens
ISO	International Standards Organization
LAN	Lembaga Akreditasi Negara
MBNQA	Malcolm Baldrige National Quality Award
MCEETYA	Ministerial Council on Education, Training and Youth Affairs
MQA	Malaysian Qualifications Agency
NEU	National Examinations Unit
NQF	National Qualifications Framework
NS	Narratological Schema
OE	Ontology engineering
OLED	OntoUML Lightweight Editor
OntoQA	Ontology for Quality Assurance
OntoUML	Ontological Unified Modelling Language
ORM	Object-Role Modeling
OTKM	On-To-Knowledge Methodology
OWL	Web Ontology Language
QA	Quality Assurance
QAAET	Quality Assurance Authority for Education and Training
QAD	Quality Assurance Division
QAS	Quality Assurance System
QMS	Quality Management System
SAQA	South African Qualifications Authority
SIMF	Semantic Information Model Federation
SRU	Schools Review Unit
STEM	Science, Technology, Engineering and Mathematics
SUS	System Usability Scale
TEQSA	Tertiary Education Quality Standards Agency
TQM	Total Quality Management
UFO	United Foundational Ontology
UML	Unified Modelling Language
VRU	Vocational Review Unit
W3C	World Wide Web Consortium

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CHAPTER 1

INTRODUCTION

1.1   Overview

This research investigates quality assurance (QA) in higher education, in both the general and quality assurance of academic programmes delivered by higher education providers (HEPs) in particular. Moreover, the research investigates the mechanisms and practices used by international quality assurance bodies to review and accredit academic programmes, ensuring they comply with predefined and sometimes registered sets of standards, while also meeting specific criteria.

Higher education providers (HEPs) are primarily responsible for the quality of the service they provide and their assurance of systems required to be internally deployed by higher education providers, to sustain their quality and assist with their continual quality assurance, review, reporting, and enhancement. The research focuses on developing an ontology as a type of conceptual model for the quality assurance of academic programmes as a reusable artifact, providing comprehensive and unambiguous methods to facilitate assurance, and to support the continuous improvement, recognition and international accreditation of academic programmes.

This chapter offers an overview of the research. It first examines the research background in Section 1.2, followed by Section 1.3 which outlines the background of this study. Section 1.4 presents the problem statement, Section 1.5 presents key research questions, and Section 1.6 contains research objectives. Section 1.7 defines the scope of the study, Section 1.8 presents the significance of the study, and finally, Section 1.9 provides an overview of the thesis structure.

1.2   Research Background

After the last world economic crisis, the influence of an emergent global economy has sped up, and the world is developing at an increasing pace. This makes education in general, and notably higher education an important issue, as the role of science and research in this development is extremely significant (Pucciarelli and Kaplan, 2016). Therefore many countries initiated and implemented on-going education reform projects, leading them to restructure their systems and establish independent bodies responsible for quality assurance and improving higher education, putting specific emphasis on preparing for employment in a global society, and for integrating students into a competitive international environment (Tran *et al.*, 2016).

According to Powell and Snellman (2004) and Leydesdorff (2006), the world is witnessing a paradigm shift from market-based to knowledge-based economies as facilitated by information technology. The result of this paradigm shift has been an emergent super-culture, stipulating societal institutions to generate novel and financially-feasible knowledge, independent from national and cultural borders. This emerging super-culture demands an increased alignment of research with economic interests, as such academia, plays the role of an outer radar for the industry, as outlined by Geuna (2001), and by Philo and Miller (2016).

The accumulation of knowledge works in parallel with the accumulation of capital in society, and the practice of creating and accumulating knowledge should be firmly associated with power mechanisms (Olssen, 2016). Therefore, the focus is on professional knowledge, driving the production and research that is either marketed or can expedite marketability.

In the globalized world, there is a great interest in the so-called knowledge-based economy, putting a demand on the scientific community to produce knowledge to help sustain global development. Therefore globalization in higher education and science is inevitable, due to the international nature of science as presented by Altbach (2004). Globalization is defined by Giddens (1987) as being one single social system, resulting from ties of interdependence which virtually affect everyone, and impacting

economic, social and political links that cross-cut borders. According to Research and Innovation (1996) globalization basically refers to businesses and the economy, due to the increasing significance of what are termed knowledge-based economies. However, higher education and research institutions are most likely deal with globalization's impact.

According to Knight (2007), public and private education providers have started to exploit commercial opportunities in cross-border education, due to the inclusion of education as a tradable service in regional and world trade agreements. In the last decade, the education and research landscape has changed dramatically when moving across national borders (Knight, 2008, Vincent-Lancrin, 2007). The latest wave of cross-border education is the transformation of some countries which have developed education hubs, which are centres for recruiting students and providing education and training, along with research and innovation.

Exporting higher education is a profitable business expanding aggressively and steadily, with the possibility of dissatisfying receiving countries and leaving them wanting (Powell and Snellman, 2004, Binsardi and Ekwulugo, 2003). The United Arab Emirates have been recognized as a country whose capacity to transform into an education hub has been observed. However, while western higher education institutions are formidable within their national boundaries, they have sometimes failed to deliver education of comparable quality when exporting education to the UAE (Shabandri, 2010).

In this contemporary global higher education landscape, the quality assurance and continuous quality improvement of academic programmes delivered by higher education providers, which are the largest producers of knowledge, has become more important. Likewise, the mechanisms to ensure the quality and validity of knowledge has become significant.

The use of academic and professional external points of reference are essential for effective quality assurance in higher education and are the responsibility of the higher education institution for starting their internal quality assurance, which should

be ideally integrated into an internal system of quality assurance. Then an independent external body for quality assurance is required to evaluate the higher education provider's quality assurance processes and outcomes and to judge their suitability and efficacy (Michelsen *et al.*, 2016).

High-quality learning generates knowledge which provides people with an adaptive-toolbox to assist them in problem-solving (Gigerenzer, 2001). The responsibility of maintaining standards of academic awards, and the quality of academic programming, lies within institutions of higher education. Therefore, internal systems and processes must be developed and deployed internally within these institutions, supporting continuous quality assurance, quality review, reporting, and enhancement. Therefore, higher education institutions are urged to adopt proper internal quality management systems (QMS), and to develop an appropriate and effective quality assurance system (QAS) to ensure the quality of their provided academic programmes, and to assure compliance with internationally agreed-on sets of standards, which are the primary concern of this thesis, or of their performance as a whole.

Quality assurance in higher education is a community-based approach involving different kinds of stakeholders, who define the aspects of systems they need to ensure quality. There is a lack of conceptual models supporting quality assurance in the higher education domain, as a means of guiding stakeholders to develop systems of quality assurance. Such conceptual models are needed, and appropriate development methodologies are required to develop them.

Ontology has been identified as having an enormous capability for uses in requirement elicitation, and as a domain model. It can, therefore, be used for the conceptual modelling of quality assurance in the higher education domain (Falbo *et al.*, 2002, Omoronyia *et al.*, 2010, Carvalho *et al.*, 2017, La-Ongsri and Roddick, 2015, Sales and Guizzardi, 2015, Barcelos *et al.*, 2016). Ontology has emerged in the discipline of computer and information science as a technical concept, defined as "specifications of a conceptualization in a certain domain" (Gruber, 2009).

As there is no conceptual model pertaining to the quality assurance of academic programmes, a well-designed reusable artifact using a conceptual modelling based on domain ontology, will provide for and facilitate the development of necessary processes and activities needed to assure, enhance and promote the quality of academic programmes. This uses international standards and good practice, helping enhance transparency, comparability, benchmarking and the exchange of expertise, leading to automatic international recognition and the accreditation of academic programmes.

1.3 The Background of the Study

Effective international collaborations are vitally important for the quality assurance of academic programmes delivered by higher education providers through today's higher education (Dent, 2017). The recognition and accreditation of academic programmes as knowledge has become increasingly international, without a doubt, expanding and strengthening the links between providers which has emerged as one of the positive aspects of contemporary higher education. For this international recognition and accreditation to be achieved, a common shared understanding and agreement is required between the different stakeholders involved (Beerkens and Udam, 2017).

The current practices of accrediting academic programmes used worldwide have been comprised of a legitimate body responsible for developing and setting standards, sometimes called threshold standards, against which the accredited programme is compared to identify whether it meets standards specifications (Humphries and Gaston, 2016). In some countries, the body developing standards are independent of those accrediting or evaluating the programme (Brady and Bates, 2016).

Standards are long-established to attain a shared understanding between parties in a domain, to facilitate interoperability among them. In higher education standards are known to provide means for benchmarking and guidance for developing and

implementing the quality assurance of academic programmes, and should not be envisaged as rigid compliance instrument.

Moreover, the current standards in use have been developed by groups of stakeholders spanning different geographical areas, with their main limitation between their locales. This has naturally led to different understandings and a lack of clarity and inconsistencies in the specifications of standards, causing unfavorable effects on the quality assurance and international accreditation of academic programmes delivered by higher education providers worldwide. The European Association for Quality Assurance (ENQA) has stressed that developing an agreed-to set of standards is not an easy task, as the word 'standards' itself can be interpreted differently in the local contexts of higher education systems. For instance, its use is diverse across Europe, ranging from simple statements that define regulatory requirements, to more elaborate descriptions of good practice.

The state-of-the-art lacks an international system for quality assurance, providing a commonly-accepted set of standards, guidelines, and procedures for the quality assurance of academic programmes. This affects providers who wish to move across borders when providing their service, and to operate in regions other than their home countries, in so-called 'overseas universities', as they have to maintain their local home standards and meet standards defined for providers in the destination country. Nonetheless, this stifles the delivery of programmes through specific arrangement with entities other than the provider as the transparency of achieved outcomes, with the outcomes of similar programmes delivered by providers themselves being an issue of concern. The mobility of staff and students, the decisions made by parents and students when selecting a programme of study, and the development of education hubs, are all affected without no exceptions.

Moreover, one of the quality requirements of academic programmes is to be responsive to changing environments. Since their development is connected to a predefined set of standards, this means standards themselves need to be responsive to change.

For all of these reasons, the capturing, modelling and representing of concepts pertaining to quality assurance in higher education domain related to general and particular standards, in a clear, precise and unambiguous way, has become a necessity. This research has proposed that using ontology would, however, lead to the formalizing of quality concepts and the specifications of existing standards. This will provide a common shared understanding which can facilitate the process of re-engineering existing standards when standards need to be updated or improved, the integration of different sets of standards currently in use, and improving the development of new standards in response to higher education's changing dynamics.

Ontologies have been adopted by various communities, and have been applied in many areas to create mutual understanding between developers, analysts, and stakeholders, to facilitate knowledge sharing between domains, and much more (Gómez-Pérez *et al.*, 2004). Therefore, this research has focused on tackling the above issues by using ontology, and proposes an ontology-based conceptual model for the quality assurance of academic programmes. Exploiting the convergence between ontology and standards, by blending the specification of standards with the formal agreement of domain experts, alongside involving the community of domain experts in this process, which would eventually lead to one internationally unified set of standards and a standardized domain. This would help assure the quality of the academic programmes of higher education, which is the ultimate motivation and goal of this research.

1.4   Problem Statement

Over the last two decades, in response to the ongoing demands for quality reforms in higher education, many quality standards have been developed to assess, assure and improve the quality of higher education. However, existing standards demonstrate variations in their structure and coverage, lack of knowledge sharing and understanding, lack of standardize use of terminology as well as the lack of practical and semantic support and guidelines to engage a wide range of stakeholders on developing conceptual models of quality assurance in higher education. A single view

of all these standards is essential, serving as a common framework of understanding among stakeholders (Beerkens and Udam, 2017). The main challenge is how to design and develop such a common framework, which is this research's principal motivation. Therefore, this research will follow the design science research approach in IS which provides clear guidelines for designing, developing, demonstrating and evaluating novel solutions for defined problems with the aim of extending the boundaries of human and organizational capabilities by producing new, advanced and original artifacts such as conceptual models.

1.5   Research Question

Main Research Question Is:

How can one design an ontology-based conceptual model for quality assurance in higher education, facilitating the quality assurance and accreditation of academic programmes delivered by higher education providers (HEPs)?

To answer the main question above, the sub-questions have been divided as follows:

Question (1): What is the state-of-the-art of the quality assurance of academic programmes in higher education?

Question (2): How can one propose a list of ontological concepts for the quality assurance of academic programmes in the domain of higher education?

Question (3): What design and methodological issues are raised in the development of a conceptual domain model based on ontology?

Question (4): How can the usefulness of the improved model be evaluated in the real settings of a higher education environment?

1.6   Research Objectives

Objective (1): To provide a systematic review of the current status of the quality assurance of academic programmes in higher education.

Objective (2): To provide a list of common ontological concepts for developing a conceptual domain model that can facilitate the design of a unified quality assurance model for academic programmes in the higher education domain.

Objective (3): To develop an ontology for QA as a conceptual domain model for higher education.

Objective (4): To demonstrate and evaluate the practical adequacy of the proposed ontological model.

1.7   Scope of the Research

In light of the questions raised and objectives defined in this thesis, this research has been limited in scope to the development of an ontology as a kind of conceptual model for quality assurance in higher education. The proposed ontology covers the European Standards and Guidelines (ESG) and QA standards of four countries: Australia, Malaysia, South Africa and Bahrain. The proposed ontology does not cover all aspects of quality assurance in the higher education domain since quality in higher education has many dimensions.

The study mainly focuses on how domain models can be well-designed and developed, based on the ontology for the domain of quality assurance in higher education. This facilitates the quality assurance of academic programmes delivered by higher education providers. One significant point to emphasize here is that the artifact developed in this work can be used and reused in the future.

1.8   Significance of the Study

This research contributes to theory and practice by introducing conceptual domain modelling to the domain of quality assurance in higher education. The ontology for quality assurance (OntoQA) that has been designed and developed in this research, is the first conceptual model design based on the domain ontology as a reusable artifact for quality assurance.

With regards to practice, OntoQA can be used by higher education providers to design and develop high quality academic programmes, while it can also be used as a reference model for monitoring, reviewing and evaluating the quality of existing programmes. OntoQA can be used as a tool for domain learning to create a clear understanding of the domain, to improve the quality of provided services. OntoQA facilitates tools developers and enables the integration of quality when designing new programmes, or while reviewing and improving existing ones in conformance with international standards. Developing tools based on OntoQA conceptual model may provide economic value, offering resources to save time, effort and money.

With regards to theory, there are four key communities who would benefit from this new approach. The first is higher education providers who can utilize modelling and reuse it for delivering high-quality academic programmes. The second is standard generating bodies which are provided with an opportunity to share a common understanding of domain knowledge, facilitating interoperability between standards in the international higher education domain. The third is quality practitioners who can be provided with a reference model for attaining goals and objectives. The fourth is academia, which can be provided with an opportunity to research interconnected fields of design science research (DSR), standards, quality, conceptual modelling and ontology.

1.9   Thesis Overview

This thesis has been organized as shown in Figure 1.1 to achieve the stated research objectives, and is explicated in the following:

Chapter 2 thoroughly reviews the fields of quality, quality assurance in higher education, quality standards and guidelines, ontology, conceptual modelling and design science research, all of which are deemed necessary for conducting this research. This review aimed to attain a profound understanding of the current practices in the fields under study, while at the same time learning ways in which ontology can be utilized to facilitate the quality assurance of academic programmes, and to develop systems of quality assurance, alongside quality standards. This review helps with identifying gaps in the domain of quality assurance in higher education and draw the map for conducing this research.

Chapter 3 illustrates the strategy of the research, demonstrate the DOGMA-based ontology development methodology and presents the application of the adopted design science research methodology (DSRM) in designing and developing an ontology-based conceptual model for quality assurance in higher education. Finally, it provides a detailed illustration of the research design for this thesis.

Chapter 4 demonstrates the application of the different phases and activities of the DOGMA-based ontology development methodology to design and develop the artifact. It further introduces OntoQA which stands for Ontology for Quality Assurance as this research's main artifact.

Chapter 5 overviews the existing ontology evaluation approaches, evaluating the syntactical and semantic correctness of OntoQA, and demonstrating its usefulness through experts' judgement, and three different application scenarios in real-world settings.

Chapter 6 summarizes the thesis, providing articulation of the research's values and contributions. It further explains the implications, limitations, and

challenges surrounding this work. Finally, it elaborates on recommendations for future research.

		Problem: There is no single view of QA standards which can play as a common framework of understanding among stakeholders to facilitate quality assurance of academic programmes in higher education. **Questions:** 1. What is the state-of-the-art of the quality assurance of academic programmes in higher education? 2. How can one propose a list of ontological concepts for the quality assurance of academic programmes in the domain of higher education? 3. What design and methodological issues are raised in the development of a conceptual domain model based on ontology? 4. How can the usefulness of the improved model be evaluated in the real settings of a higher education environment? **Objectives:** 1. To provide a systematic review for the current status of the quality assurance of academic programmes in higher education. 2. To provide a list of common ontological concepts for developing a conceptual domain model that can facilitate the design of a unified quality assurance model for academic programmes in the higher education domain. 3. To develop an ontology for QA as a conceptual domain model for higher education. 4. To demonstrate and evaluate the practical adequacy of the proposed ontological model.
	Chapter 1 Research Problem, Questions and Objectives	

Chapter 2 — Literature Review (Answered Question 1 and Achieved Objective 1)

Quality, Higher Education, Quality Standards and Guidelines, Ontology, Ontology Engineering, Domain Engineering, Conceptual Modeling, Unified Foundational Ontology (UFO), Conceptual Modeling Languages, Design Science Research (DSR) and Design Science Research Methodology (DSRM)

Identified Gaps:
- Variations in structure of standards and topic coverage
- Lack of knowledge and understanding
- Lack of standardized use of terminology
- The state-of-the-art lacks an international system for quality assurance which engages a wide range of stakeholders
- Lack of practical and semantic support and guidelines on developing conceptual models of quality assurance in higher education

Solution Domain:
Ontologies have been identified for the capability to support mutual understanding among communities and support knowledge sharing among many other capabilities. They have been adopted and applied in various areas, and are therefore considered to cater to a more solid ground for international collaboration, in order to mutually agree on unifying terminology for using and developing one comprehensive system of quality assurance in higher education.

Chapter 3 — Research Methodology (Answered Question 2 & 3)

Research Strategy
Application of Design Science Research Methodology (DSRM)
DOGMA-based Ontology Development Methodology
Research Design

Chapter 4 — Development (Answered Questions 2 & 3 and Achieved Objectives 2 & 3)

Design and Development of OntoQA

Chapter 5 — Evaluation (Answered Question 4 and Achieved Objective 4)

The syntactical and semantic correctness of OntoQA is demonstrated and its usefulness and usability have been evaluated, using expert's judgement and application scenarios at the Applied Science University (ASU) of Bahrain.

Chapter 6 — Conclusion

Research Contribution:
Phases for developing ontology based on DOGMA
OntoQA as an ontology-based conceptual domain model for QA in higher education

Figure 1.1   Thesis overview

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