

Utilization of ICTs in Quality Assurance and Accreditation of Higher Education: Systematic Literature Review

Abstract

Numerous studies and surveys have examined the utilization of Information and Communication Technologies (ICTs) in Higher Education (HE). However, the absence of studies that specifically investigate the utilization of ICTs in Quality Assurance and Accreditation (QAA) of HE led us to perform a Systematic Literature Review (SLR). This review mainly benefits QAA agencies and researchers interested in utilizing ICTs for QAA of HE. Several facts regarding ICTs contribute to QAA of HE are identified. 1) Compared to QAA agencies, Higher Education Institutions (HEIs) are more likely to implement ICTs. 2) Most of the ICTs in HEIs are for Quality Assurance (QA) and not Accreditation. 3) Most previous studies were conducted in Europe. These studies demonstrate that efforts have been made to align the QAA agencies and HEI QAA units with European Standards, resulting in ICT diffusion into European HEIs.

1. Introduction

Higher Education (HE) plays a major role in producing professionals and experts in diverse fields. On the one hand, it is evident globally that highly educated individuals are more likely to find employment in the labor market [1]. On the other hand, evolution is a natural part of human society. Thus, the benefits of a static educational system have not been as widely accepted by fast developing markets and societies. Consequently, governments, independent educational organizations, and universities have established practical steps toward assessing their educational services by focusing on quality. This study focuses on evaluating the impact of Information and Communication Technologies (ICTs) on quality assurance (QA). Although the definition and attributes of quality differs based on circumstances and perspectives, this aspect is beyond the scope of this study.

This study uses the definition of some key terms according to United Nations Educational Scientific and Cultural Organization (UNESCO) [2] and we used the

definition of SLR according to Kitchenham [3]. Some key terms and their definitions are:

- QA is an “all-embracing term referring to an ongoing, continuous evaluation process (assessing, monitoring, guaranteeing, maintaining, and improving) the quality of the higher education system, institutions, or programs.” [2] (p. 74).
- Accreditation is “the process by which a (non-)governmental or private body evaluates the quality of a higher education institution as a whole or a specific educational program in order to formally recognize it as having met pre-determined minimal criteria or standards.” [2] (p. 24).
- Assessment is “the process of systematically gathering, quantifying, and using information to determine the instructional effectiveness and the curricular adequacy of a higher education institution (HEI) as a whole (institutional assessment) or of its educational programs (program assessment)” [2] (p. 29).

We used the term ICTs in our Systematic Literature Review (SLR), but the original meaning does not completely satisfy goal of this study. Originally, it had a very wide-ranging term as defined by [4]. Herein we limit our definition according to the goal and scope of the study using the term in ICTs. We refer to these terms as Information Systems (IS), Databases, Portals, and Knowledge Management Systems (KMS). The data is categorized by region based on the continent due to following reasons. 1) Countries are influenced by their neighbors, continent, regional communities, organizations, protocols, and treaties. These groups exist in terms of politics, economy, and education. 2) The analyzed data also supports the above argument that the geographical location affects research in terms of education.

This study addresses the following questions:

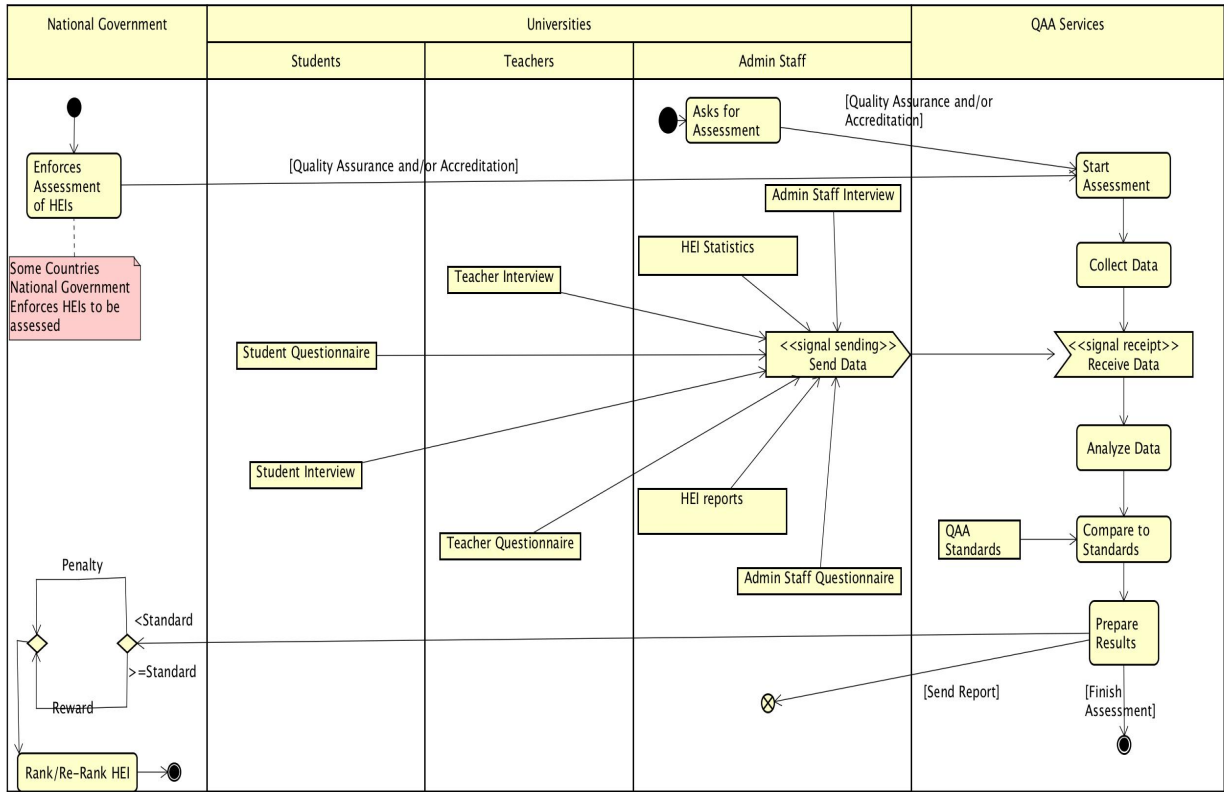
1. Which continents utilize ICTs for QAAs of HE?
2. Which QAA standards support ICT utilization?
3. What are the key attributes of QAA agencies and HEIs who utilize ICTs, and

what are the characteristics of utilized ICTs?

The first question investigates the variations of ICTs for QAA of HE by continent. This should elucidate the root cause of better education in general terms considering geography. The second question examines the standards that have been efficiently supporting ICT utilization for QAA of HE. It aims to determine which QAA agencies and HEIs more efficiently encourage utilization of ICTs. The last question identifies the main characteristics and states of QAA agencies, HEIs, and ICTs. This aims to reveal the adaptability of HEIs and ICTs. Answering these three questions should enormously benefit QAA agencies and researchers interested in further utilizing ICTs for QAA in HE.

This study found that a higher utilization of ICTs for QA has a positive impact and aids universities and QA organizations in improving both the ease of providing educational services and the quality of education. Thus, utilization of ICTs allows universities and QA organizations to better meet the needs of society. Additionally, ICTs allow such organizations to better fulfill their missions while simultaneously maximizing their use of resources (time, money, effort...).

Figure 1. Overview of QAA services



The paper is organized as follows. Related works are described in Section 2. Our SLR approach is detailed in Section 3. Section 4 demonstrates the analysis results. Section 5 addresses potential threats to validity. Section 6 discusses the results. Section 7 explains usages of this SLR, and Section 8 concludes the paper with the future work.

2. Background

The emergence of the digital era and ICTs as well as their significant impact on humans' life has influenced HE. Consequently, QAA agencies in Africa, America, Asia, Australia, and Europe have utilized ICTs for QAA purposes. Additionally, governments, universities, QA agencies, researchers, ICT companies, and other regional and international communities and organizations have introduced various ICTs utilizations. The ICTs have been adopted for QA for HE.

In the past few decades, ICTs have been utilized in HE for QA on a very large scale. Oliver [5] highlighted the various impacts of ICTs on contemporary HE and explored potential future developments. His paper discussed the role of ICTs in transforming teaching and

learning, and explores how this impacts future programs offered and delivered in universities and colleges. Nadira Banu Kamal et al. [6] mainly discussed the role of ICTs in online teaching and learning tools. Their study compiled the role of ICTs in QAA of HE in general but it both do not focus on ICTs utilization in QAA agencies or the QAA unit of HEIs.

3. Methodology

The goal of this SLR is to determine how ICTs are utilized for QA and accreditation purposes in the HE sector. Thus, we started SLR by specifying our scope, and searched only for documents in the domain of HE discussing issues related to QAA supported by ICTs. Topics focusing on online, distance learning, and learning tools and systems are excluded. The lack of information regarding QAA agencies utilizing ICTs in previous research is a limitation of this SLR. Herein data is organized based on geography (continents) and key attributes of QAA.

3.1 SLR Query

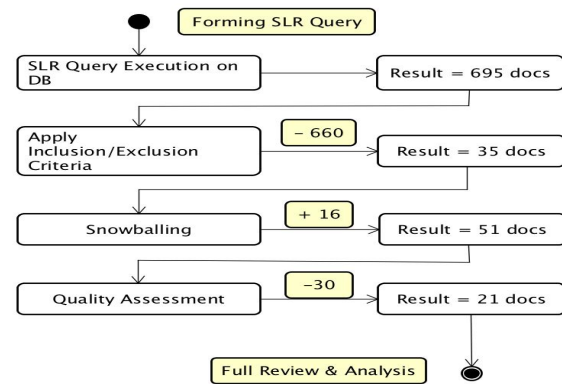
In the SLR query, the keywords must be identified. Thus, we tried to follow the ACM Computing Classification System [7]. However, this was unsuccessful. Most published papers do not follow this system or any other rules for determining the keywords. It is noteworthy that we wrote several queries combining different keywords, which aligned most closely with the scope and goal of our SLR. We compared the results of those several queries prior to determining the final query for this study. We executed the SLR query on titles, abstracts, and keywords of all research papers indexed by Scopus of any time and any subject area. Our query was configured as:

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TITLE-ABS-KEY (("higher education" OR "university")
AND ("quality assurance" OR "qaa")
AND ("information system" OR "information
technology" OR "database" OR "ict" OR "knowledge
management" OR "portal" OR "MIS"))
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We found 695 documents. Next we applied inclusion and exclusion criteria upon reviewing the titles and abstracts. This reduced the number of documents to 35 for full review. We also performed snowballing and identified 16 new relevant documents. Some of which were not indexed by Scopus. However, we simply acquired them from other databases and searched Google.com by title of those papers. We verified that the intended paper was returned in the search using the author name(s), publication date, and publisher. In all, 35 documents were considered. After the initial quality

assessment and crosschecking with the inclusion and exclusion criteria, 21 documents [8]- [28] were selected for a full review (Fig. 1).

Figure 1. Paper Selection Process



3.2 Inclusion and Exclusion criteria

- 1) Inclusion criteria:
 - a) Document must be in the domain of HE.
 - b) Document must target the role of ICTs in QAA explicitly or implicitly.
- 2) Exclusion criteria:
 - a) Remove Non-English documents.
 - b) Remove documents that do not discuss the QA in HE.
 - c) Remove the documents that do not discuss/suggest a conceptual or practical implementation of MIS/Database/Portal/KMS to support QAA in HE.
 - d) Remove documents discussing the role of ICT in QAA of HE regarding Online/distance education.
 - e) Remove documents that discuss the role of ICT focusing on teaching or learning tools and methods only (and not the QA aspect). Example: Using pads and smartphones or simulation software for physics and chemistry.

3.3 Research Questions

The goal is to determine the contribution of ICTs in QAA of HE. Here we address fundamental and important questions.

RQ1: Which continents utilize ICTs for QAAs of HE?

RQ2: Which QAA standards support ICTs utilization?

RQ3: What are the key attributes of QAA agencies and HEIs who utilize ICTs, and what are the characteristics of utilized ICTs?

RQ1 should help elucidate ICTs contribution to QAA of HE and understand their influence and diffusion by

continent. RQ 2 is essential to recognize the most efficient, applicable, and adaptable QAA standards since various standards exist. This question should be most beneficial to QAA agencies. RQ3 should identify the characteristics of utilized ICTs, which will be beneficial in understanding what type of ICTs are attractive for QAA.

3.4 Data Extraction Form

Table 1 illustrates and defines the data extraction form as well as its aspects. The following parameters are used:

Table 1. Data Extraction Form

Aspect	Attribute
Title	
Abstract	
Year & Source	
Location	Continent (Derived from country)
Experiment Design	Types (Conceptual, Practical)
QAA Standards/Guidelines	
HE assessment approaches	Type (Internal, External)
Utilized ICTs	Type (IS, KM, Portal...) Technology (Programming languages, Database...) Target Processes/Operations (QA, Accreditation, Both) Aspect of QA and Accreditation (Higher Education Institution, Higher Education Program, Both)

- 1 Location: Is an indicator for the geographical location where the research was conducted. We used the country name to categorize into continents.
- 2 Experiment Design: This attribute defines the type experiment conducted. It is divided into two categories: conceptual (Model, Framework or Has No Tool) and practical (Applied, Implemented or Has Tool). Conceptual experiments involve ongoing tool development, whereas practical experiments involve implementation.
- 3 QAA Standards/Guidelines: These indicate the QAA standards or guidelines being followed. These include local (Governmental/non-Governmental)/international QAA agency or QA unit of HEI.
- 4 Higher Education Assessment: These approaches indicate where the evaluation method of HE is conducted by the HEI itself or

an outside organization such as a government or national/internal QAA agency.

- 5 Utilized ICTs: The type of ICT used (e.g., IS, KM, and Portals) and the aim of the QA. Accreditation or another purpose.

4. Analysis Results

Our analysis was designed to answer the aforementioned research questions. To extract the data and perform the analysis we used tools such as Atlas.ti for coding and extracting the intended data from the selected studies. We also used Microsoft Excel and the R software environment to perform some basic statistical operations and chart drawings. The findings are summarized below:

1. Europe is a hotspot of ICTs utilization for QAA. Figure 2 shows that research on utilization of ICTs for QA began in 2005. Research interest peaked in 2008 and 2009, but was relatively stable until 2015. Now it is on the decline. Figure 2 highlights two facts. **A)** ICTs were utilized for QA purposes between 2005 to 2015. **B)** It is more often utilized in Europe compared to other continents.
2. More tools for QA: Table 3 cross-references two important attributes of this SLR. This answers how many studies have practically developed tools and which aspect of the HE is targeted. Most studies focused on developing tools for the QA aspect of HE.
3. No ICTs for External QAA: Table 2 illustrates the categorization of studies based on the assessment type and continents. The data in the table reveals a very interesting finding. No research has investigated external assessments.
4. ESG is a famous QAA standard: Table 5 categorizes papers based the standards used in the study. Some papers employ European standards (e.g., ESG, EHEA), while others are categorized as “European”. The same concept is applied in the “US”. Additionally, some employ locally developed standards named “Local”, whereas some studies do not mention the QA standards. These are categorized as “NA”.
5. Utilized ICTs in detail: Meanwhile the most common software systems developed are Knowledge Management Systems, Portals, Information Systems, Decision Support Systems, Models and Frameworks. The most common programming languages are Java, PHP, VB.net, Pascal, C++ and Delphi. Databases included Oracle Cloudspace, MySQL, PostgreSQL. The web server is

Apache, deployed on Linux and Win XP platforms. Table 4 shows that distribution of published papers utilizing ICTs considering both levels, program level and institutional level. The aim or purpose is almost balanced. Both HEI and Higher Education Program (HEP) attracted similar attention from researchers. Only 4 studies (20%) focused on both HEI and HEP.

Table 2. Classification of data based on Assessment Type and Continent (RQ1)

Assessment Type	Continents				Total
	Africa	Asia	Europe	America	
Internal	2	2	13	0	17
External	0	0	0	0	0
NA	0	2	1	1	4
Grand Total	2	4	14	1	21

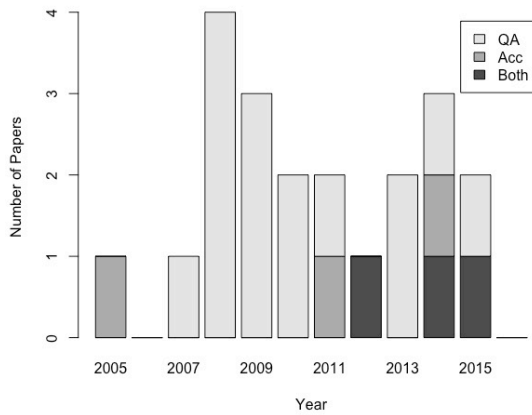


Figure 2. Frequency of published papers

Table 3. Number of studies on tool development and practical experiment design (RQ3)

Target Aspect of QAA	Has Tool?		
	Yes	No	Total
Accreditation	3	0	3
QA	9	6	15
Both	1	2	3
Grand Total	13	8	21

Table 4. Distribution frequency of published papers over QAA standards based on QAA aspects (RQ2)

ICTs target	Higher Education Program	Higher Education Institutions	Both	Total
Counts	8	9	4	21

Table 5. Frequency of published papers categorized by the ICT targets (RQ3)

Standards	QA	ACC	Both	Total
COBIT, ITIL, ISO	0	0	1	1
European	4	1	1	6
European, ISO	2	0	0	2
European, US	0	1	0	1
Local	4	0	1	5
US	0	1	0	1
NA	5	0	0	5
Grand Total	15	3	3	21

5. Threats to validity

The analysis was conducted by a single person, first author of this paper, so there is a possibility that some information was omitted. Moreover, the analysis is limited by the analytical skills of that single person.

6. Discussion

It is still unclear how QA organizations utilize ICTs for their internal operations or their internal departments and inter-department operations.

6.1 RQ1: Which continents utilized ICTs for HEIs or QAA agencies?

Referring to RQ1, one of the main causes behind the wide utilization of ICTs for QAA in Europe is the commitment of the European countries to common guidelines.

6.2 RQ2: Which QAA standards support ICTs utilization?

Developed countries and developing countries who are members of regional or global communities utilize better and more effective QAA standards. Developing

countries mostly rely on locally developed standards, indicating that this gap has a significant impact. We believe that developing countries will undergo the same transitional phases as developed countries. However, developing countries have a big advantage over developed countries because they can learn from past experiences and have they have additional support from developed countries. It should be mentioned that the achievements of developed countries at the country and continent level are due to regional and global communities and organizations, such as European Union, facilitating opportunities.

We identified COBIT and ESG standards for utilization of the latest ICTs. The key difference in this standard is that ESG gives customer autonomy of ICTs utilization for QAA, whereas COBIT has developed complex tools (COBIT 5) to meet the standards. COBIT 5 is described in [29]. We speculate that QAA agencies avoid utilizing ICTs due to political reasons, corruption, or monetary constraints.

6.3 RQ3: What are the key attributes of QAA agencies and HEIs who utilized ICTs, and what are the characteristics of utilized ICTs?

Utilization of ICTs in QAA is influence by the academic developments in countries and continents. We assert that the continents practicing up-to-date technologies design better standards for QAA. We discuss this issue by focusing on both the dimension of QAA, which accommodate ICTs utilization. Firstly, to accommodate ICT utilization, both program and institutional level assessment are necessary. Experimental designs were practical and mostly supported by a tool. Secondly, utilized ICTs from technical perspective are mainly information systems deployed at the HEIs, which is where the data collection process starts. We believe that QAA agencies can also add new services according to the available ICTs. However, based on analysis results in 4.5, ICT has not been utilized in QAA such as Artificial Intelligence (AI) and Machine Learning (ML).

7. Usage

This section describes usage by key stakeholders.

7.1 QAA agencies

Firstly, QAA agencies can use this SLR as a report that clearly represents the utilization of ICTs in QAA agencies at the continent and global levels. QAA can reassess their goals, policies, and strategies to enhance the efficiency of their operations. They can improve the

accuracy and reliability of their decisions at the strategic level as well as at the operational level. Such improvements will conserve resources such as time, money, and human power. Secondly, this SLR indirectly encourages QAA agencies to consider adding new or enhancing existing services according to the available up to date ICTs to improve HEIs and HEPs. Such services will result in an improved educational system and better students being delivered to society.

7.2 Researchers

This study also acts as a literature review for researchers interested in in this topic. It provides a clear picture of the contribution of ICTs in QAA, allowing researchers to incorporate state-of-the-art technologies for QAA.

8. Conclusion and Future Work

ICTs are utilized for QA at both QAA agencies and QAA unit of HEIs with the goal of improvement assessments of HEIs and HEPs. ICTs are important in collecting and processing various input data related to students, teachers, HEIs, and HEPs. ICTs utilization is more common in internal assessments performed by QAA unit of HEIs than external assessments conducted by QAA agencies. Because HEIs QAA units are responsible for data collection, they have easy and direct access to stakeholders (HEIs, Students, Teachers). QAA Standards and HEIs by geographical location have been identified as the key drivers of efficient ICTs utilization in the QAA unit of HEIs. QAA agencies and HEIs in developed countries are utilizing up-to-date technologies compared to developing countries.

In the future, we plan to elucidate other dimensions of ICTs utilization in QAA agencies. This should provide solutions for existing problems as well as simplify and enhance current operations and services of QAA agencies. We are looking forward to conducting a survey on well-known and globally recognized QAA agencies.

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