

Development and Implementation of a Web-based Institutional Evaluation System (WIES)

Yousef W. Sabbah

Faculty of Technology and Applied Sciences, Al-Quds Open University (QOU), Palestine

Abstract: *In this research, we propose and implement a web-based system for institutional evaluation of open universities. The purpose of institutional evaluation is to investigate the strengths, the weaknesses and the improvement strategies based on standards for quality assurance and accreditation. The main goal is to improve the educational inputs, processes and outputs in academic and administrative aspects. We developed a web-based institutional evaluation system (WIES), the first of its type, that implements the standards of Open and Distance Learning (ODL) universities issued by the Association of Arab Universities (AAU) in collaboration with Al-Quds Open University (QOU). WIES and its mathematical model for weighting and scoring of qualitative indicators reduce time and efforts. It assists self-evaluation teams, internal and external reviewers and accreditation agencies in performing periodical, short-term and evidence-based institutional evaluation. The evaluation process can be conducted online, including quantitative-indicators collection, response to qualitative indicators and quality criteria and requirements, and self-evaluation report (SER) building. In addition, the proposed mathematical model performs automatic weighting and scoring using weighted and percentage accumulative methods. A beta version of WIES has been developed and tested at QOU in its institutional-evaluation project 2015-2017.*

Keywords: *Institutional evaluation, internal and external review, self-evaluation report, standards of quality assurance and accreditation, web application, weighting and scoring.*

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1. Introduction

Institutional assessment or evaluation is a survey in which an institution evaluates its processes, products and services to find out the strengths and weaknesses. It should provide evidences (e.g. documents or data) for each strength point and an improvement plan to overcome weaknesses [5, 7].

In this paper, we present the development and implementation of a web application for evidence-based institutional evaluation that includes all functions required to complete this process easily and effectively. This paper consists of five sections. After this introduction, we present a literature survey. The third section concentrates on the proposed mathematical model for weighting and scoring. The fourth section describes the developed web application (i.e. WIES), which includes system analysis, design and implementation. The fifth section presents the procedure of conducting institutional self-evaluation using the developed WIES. Finally, the sixth section provides results and conclusion.

1.1. Research Objectives

The main objectives of this research can be summarized in the following three points:

- Assist universities in reducing time and efforts required for institutional evaluation.

- Help Quality Assurance and Accreditation (QAA) agencies in external evaluation of universities that apply for accreditation.
- Provide a short-term evaluation procedure based on an information system that maintains updated quantitative and qualitative data.

1.2. Methodology

We employed a research methodology that consists of three parts. The first part concentrates on surveying of literature review and previous work. We used focus group twice for data collection: at the beginning of the project to measure the importance of our study and the proposed web application, and at the end to measure system applicability and usability.

In the second part, we proposed a mathematical model for weighting and scoring automatically rather than manual use of long tables and statistical computations. In the third part, we developed a prototype of the application to prove the concept and conducted several experiments for testing purposes of its functionality, performance and accuracy. Finally, we developed a beta version and conducted a full institutional evaluation for QOU, which provided us with a real test. The process completed successfully, without any error or bug.

2. Literature Survey

Nowadays, Higher Education Institutions (HEIs) are increasing in number and size, and offer diverse programs, which pose challenges for their efficacy. Therefore, evaluation of HEIs is essential to measure their commitment to quality standards before reaccreditation, which contributes to maintain competitiveness at an international level [4, 17].

2.1. Institutional Evaluation

There are two types of quality evaluation for HEIs based on a variety of quality and accreditation standards. The first is institutional evaluation, where all academic and administrative aspects are inspected against specific criteria, benchmarks and requirements. The second evaluates academic programs more specifically. One of the main objectives of evaluation at strategic or operational level is to prepare an institution or one of its programs for accreditation [3, 6]. Another classification is related to internal or external evaluation, where the former is self-based (i.e. self-evaluation) by a team of reviewers from an institution itself, while the latter is performed by an accreditation body [7, 8], which assigns this task to expert reviewers out of an institution, or even, out of the country. At the end of evaluation, we need some measures for a HEI's performance or achievements that specifies the accreditation period based on its score. Therefore, weighting is required for each domain (i.e. main standard) to find out its share in the total score, and a procedure to compute domains' scores [2, 12].

2.2. Quality Assurance and Accreditation

Different umbrellas were founded to organize the job of Quality Assurance and Accreditation (QAA) bodies, such as the International Network for Quality Assurance Agencies in Higher Education (INQAAHE). INQAAHE was founded in 1991 to control the educational quality of its members. It has worked closely with national governmental or non-governmental QAA bodies, such as the European Association for Quality Assurance (ENQA) in Europe and the Council for Higher Education Accreditation (CHEA) in USA [1, 10].

The accreditation bodies in Europe are generally governmental. In Finland, for instance, universities are accredited only by an act of Parliament. In Spain, there is an authorized national body responsible for higher education quality. In UK, The government recognizes the bodies that can grant UK degrees [14]. The ENQA was established in 2000 and works as a regulator to foster quality assurance for HEIs in the European Higher Education Area (EHEA) member states [10].

Unlike Europe, USA does not have a national ministry of education that regulates academic standards, and institutions that seek accreditation can do so from

private non-profit accreditation organizations [5]. The CHEA is the largest US organization for promoting academic quality through accreditation [6]. Malaysian Qualifications Agency (MQA) is an example of accreditation bodies in Asia. It was set up under the Malaysian Qualifications Act 2007 to accredit academic programs, educational institutions, qualifications and higher education providers [13].

The Association of Arab Universities (AArU) is the largest regional accreditation body in the Arab world. It has issued several manuals for institutional and program accreditation and evaluation. They contain specific standards and indicators that measure the extent to which HEIs conform to quality. Some of these manuals are:

- Quality assurance and accreditation manual for member Arab universities [3].
- Self and external evaluation manual for member Arab universities [7].
- Qualitative and quantitative indicators manual for member Arab universities' accreditation [4].
- Standards and weights manual of qualitative and quantitative indicators for quality and accreditation of Arab universities [12].
- Quality and accreditation for open and distance learning universities and programs [8].

The national Accreditation and Quality Assurance Committee (AQAC) is the accreditation body in Palestine. It has been established in 2002 to introduce and develop a culture of quality assurance, and to formulate public policies in education and scientific research in the Palestinian HEIs [1].

2.3. QAA Standards, Requirements and Indicators for ODL Universities

In 2013, Al-Quds Open University (QOU) led an initiative to adapt the AArU standards for traditional system to open learning system. QOU drafted a quality manual for ODL universities and programs [8]. The AArU, in turn, approved and published this quality manual, which covers academic and administrative aspects in 11 domains [8]:

Academic aspect consists of seven domains, which measure academic performance, as follows [8]: a) Faculty Members, b) Student Affairs, c) Admission and Registration, d) Academic Programs and Teaching Methods, e) Scientific Research, f) Continuing Education and Community Service, and finally, g) Assessment.

Administrative aspect consists of four domains, which measure administrative performance, as follows [8]: a) Vision, Mission, Goals and Planning, b) Administration and Leadership, c) Human, Material, Technological and Financial Resources, and finally, d) University Ethics.

Each domain consists of quality criteria and requirements, as well as quantitative and qualitative indicators to measure to which extent these criteria and requirements are met [4, 8]. The indicators are measured based on responses of the relevant reviewers, as shown in table 1 [14], and scoring them using a weighting and scoring manual [12].

Table 1. Sample of qualitative indicators (11th domain) [14].

| # | Scale Statements | Yes | TSE | No |
|---|--|-----|-----|----|
| 1 | University develops an operational plan for promoting educational effectiveness. | | x | |
| 2 | University has documented procedures for the development of educational effectiveness in light of the results of the comprehensive evaluation. | x | | |
| 3 | There are diligent practices at the university to improve and develop the educational effectiveness. | x | | |
| 4 | University discusses the assessment results with administrative and academic leaders. | | x | |
| 5 | University allows the different parties concerned to participate in the comprehensive evaluation process of the teaching effectiveness. | | x | |
| 6 | University takes quick corrective actions in cases which require that. | | | x |
| 7 | University administration takes appropriate decisions to improve educational effectiveness. | | x | |

3. The Proposed Mathematical Model

Usually, quality manuals contain very long tables of indicators that need to be measured. In addition, different domains and subdomains should be weighted for scoring purposes. The AARU has issued a weighting and scoring manual [12], but the procedure is impractical in my view, since it is too complex and time-consuming if performed manually. QOU on the other hand, proposed an easier procedure based on the ratio of domains within an aspect to the total number of domains, and the ratio of qualitative questionnaires within a domain to the total number of questionnaires in order to obtain each domain's weight. *Unfortunately, this procedure lacks to accuracy, since dividing or joining questionnaires affects the weights dramatically. Hence, we used the number of items (i.e. indicators) to improve accuracy, as will be discussed in the mathematical model below.*

Let (a) be the number of domains, (c) be the number of academic domains, and (d) be the number of administrative domains. The academic aspect weights (c/a), whereas the administrative aspect weights (d/a). Therefore, the weight of a domain within the academic (W_i) or the administrative (W_j) aspect is shown in equations (1, 2) respectively [14].

$$W_i = (t_i/n) * (c/a) = c.t_i/a.n \quad (1)$$

$$W_j = (t_j/m) * (d/a) = d.t_j/a.m \quad (2)$$

Where,

t_i, t_j : the number of indicators in an academic or an administrative domain respectively.

n, m : the total number of indicators in an academic or an administrative aspect respectively.

The maximal score of a domain with t_i indicators will not exceed ($2t_i$), when all responses are "Yes". The score S_i of a domain i can be computed using equation (3) [14].

$$S_i = (2y_i + s_i)/2t_i \quad (3)$$

Where,

y_i, s_i : the number of indicators with 'Yes' and 'To Some Extent (TSE)' responses respectively for domain i or j .

Weighted score WS_i of a domain i , can be computed as illustrated in equation (4).

$$WS_i = W_i * S_i \quad (4)$$

Substitute equations (1, 3) in equation (4).

$$WS_i = (2y_i + s_i)/2t_i * (c.t_i/a.n) \quad (5)$$

Simplify equation (5) to obtain equations (6, 7) for academic and administrative domains respectively [14]:

$$WS_i = (c/2a.n) * (2y_i + s_i) \quad (6)$$

$$WS_j = (d/2a.m) * (2y_j + s_j) \quad (7)$$

The last step is to sum the final weighted-scores of all domains to obtain the total score of an institution [14].

$$Total\ Score = \sum_{i=1}^c WS_i + \sum_{j=1}^d WS_j \quad (8)$$

$$Total\ Score = \left(\frac{1}{2a}\right) \left[\frac{c}{n} \sum_{i=1}^c (2y_i + s_i) + \frac{d}{m} \sum_{j=1}^d (2y_j + s_j) \right] \quad (9)$$

Equation (9) computes the total score of an institution in all domains. *Here, we emphasize that equation (9) summarizes more than 300 pages of the standards and weights manual of the AARU [12] in one short-line.* The equations above consider the accumulative score of each indicator, which is computed based on the responses of self-evaluation teams. These responses are scored using a three-point Likert scale with '2' for 'Yes', '1' for 'TSE' and '0' for 'No', as shown in table 1.

4. The Developed Web-Application

Universities should perform periodical institutional-evaluation, which might reuse the collected data (i.e. quantitative and qualitative indicators and their evidences). They also repeat weighting, scoring and writing the self-evaluation report (SER) every time. Therefore, automation of the process, i.e. developing an information system will be of a big benefit for universities and accreditation agencies. Our developed WIES can improve institutional evaluation process and provide an efficient communication channel between reviewers and target HEIs. It enables them to respond to all indicators, upload evidences (e.g. documents, images and videos) when required, and generate SERs. In addition, the system automatically performs data

analysis, weighting and scoring. Both internal and external reviewers can benefit from this application.

4.1. System Analysis and Design

In this phase, we describe the developed web application in details, which includes WIES analysis

and design. Figure 1 illustrates a block diagram of this system [14]. It consists of two main components, a core system with a Graphical User Interface (GUI) and a database. Figure 2 depicts its Entity-Relational Diagram (ERD), showing the main entities with their attributes and relations.

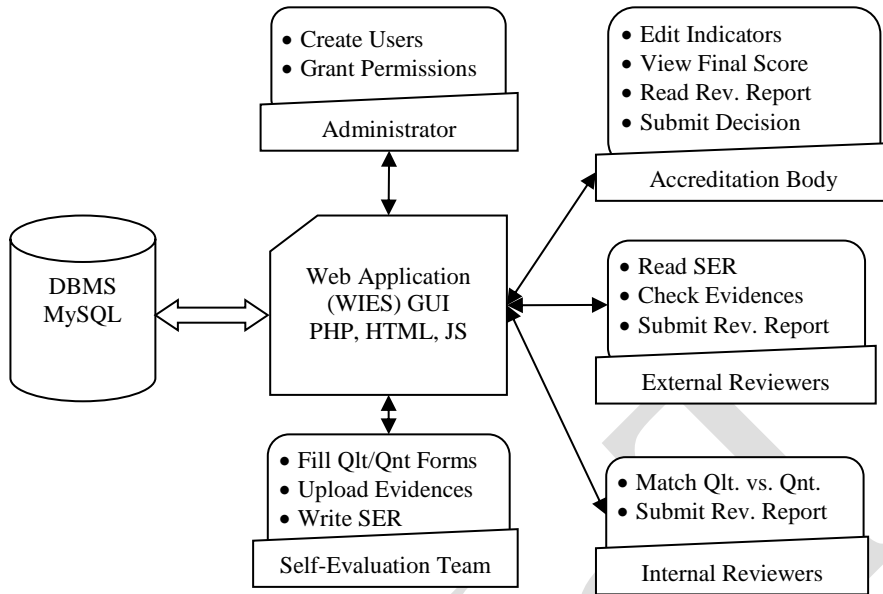


Figure 1. Block diagram of the developed Web-based Institutional Evaluation System (WIES) [14].

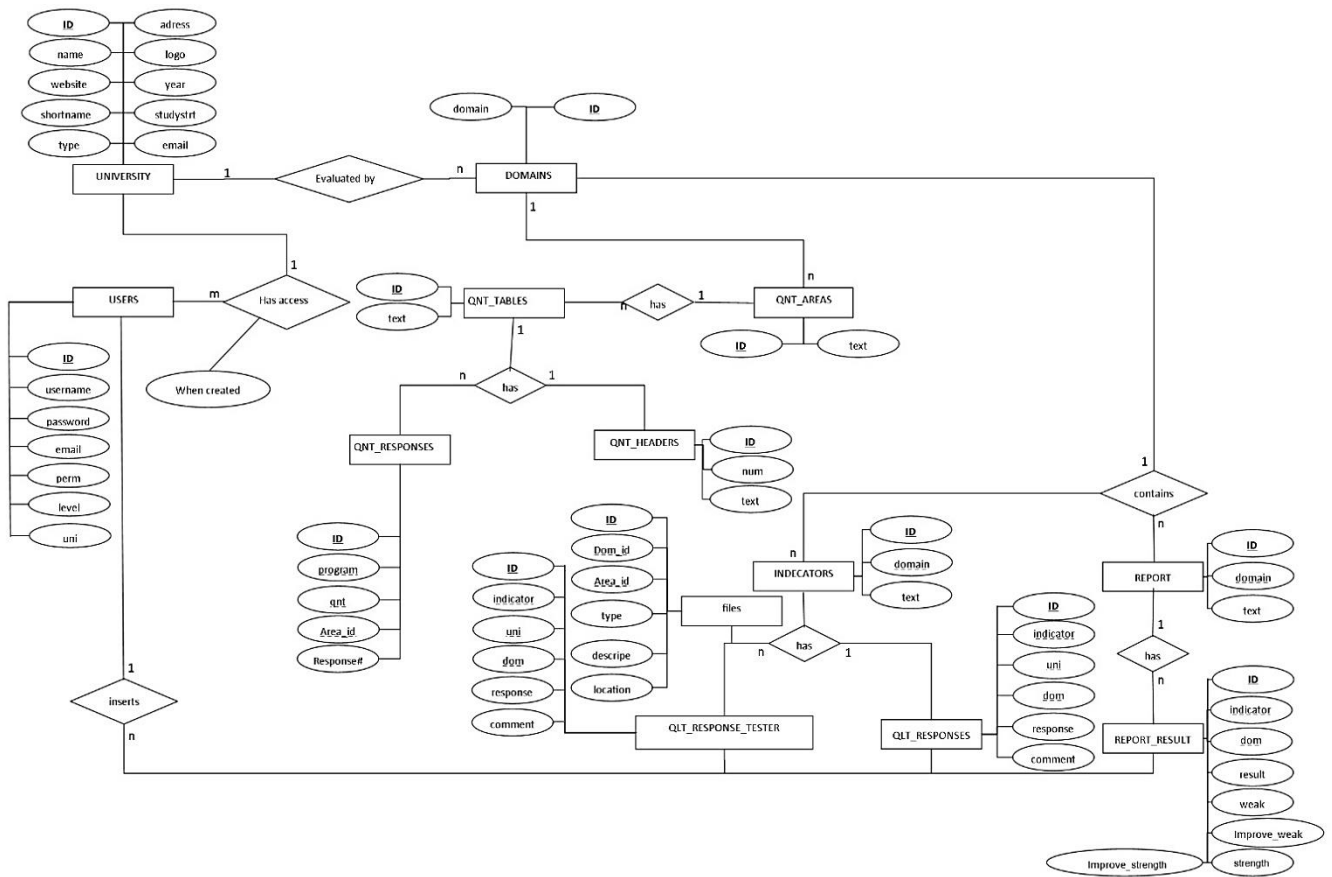


Figure 2. Entity-Relational Diagram (ERD) of the WIES database.

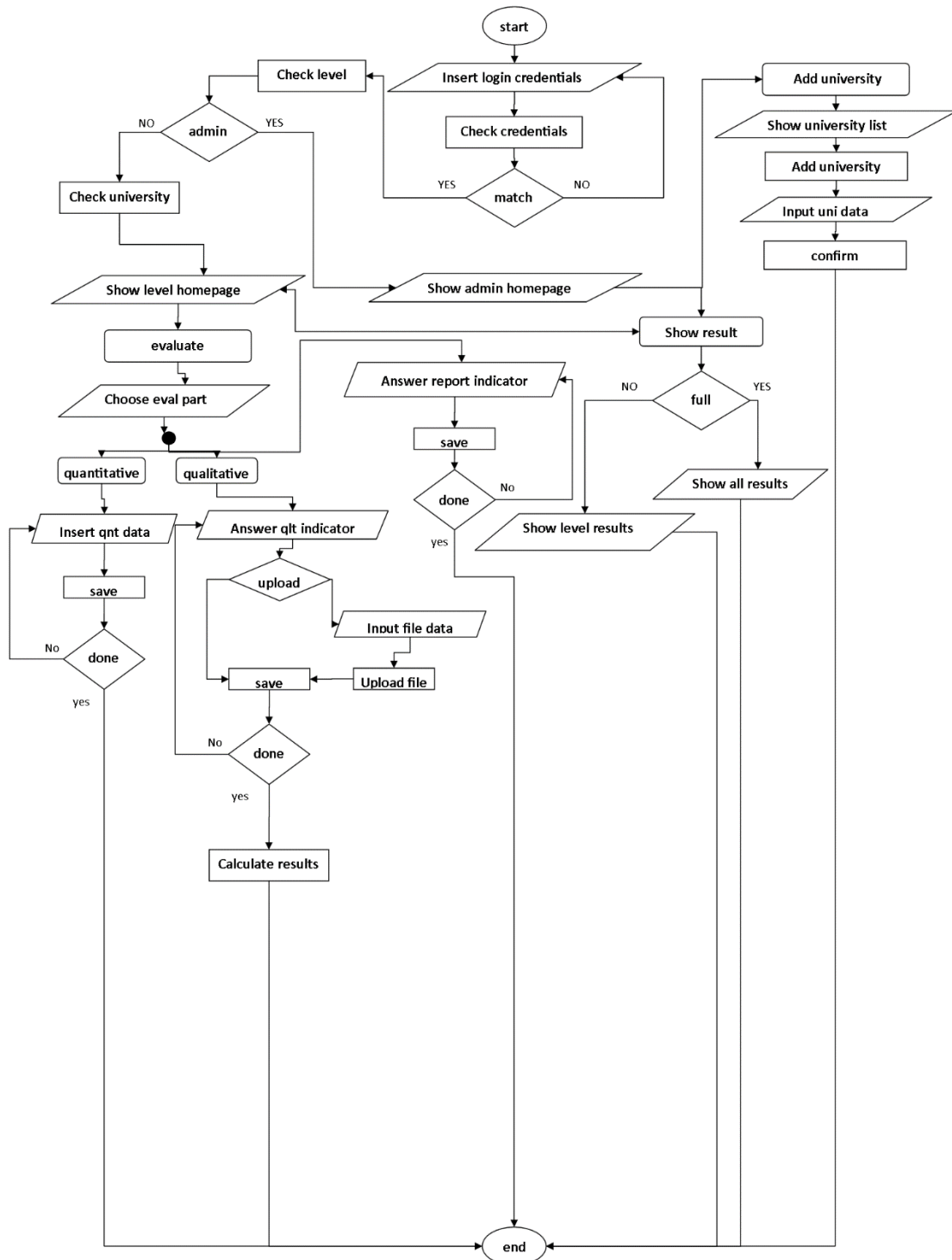


Figure 3. WIES flowchart (workflow diagram).

Other components of WIES and their functions are described according to their users as follows:

- System *administrator* (e.g. the AArU or any accreditation body) creates an account for each institution to be evaluated and/or accredited and grants permissions to other users.
- *Self-evaluation team* at a HEI is responsible for completing its profile information, data entry of the quantitative indicators, responding to the qualitative indicators, uploading evidences of each indicator and preparing the SER. Accordingly, WIES computes the score of each domain and the HEI's total score.
- An institution, then assigns *internal reviewers* from quality unit with 'read-only' permission. These reviewers look at the SER, review responses to the indicators and their evidences, ensure their match and consistency and submit an internal report.
- After a HEI submits the final SER into WIES, the accreditation body assigns *external reviewers*, who review the SER and other data, and conduct field-visits to check the evidences. Accordingly, WIES notifies the HEI with the visit date. Then, the

external reviewers write and submit their external report.

- Finally, the *accreditation body* can edit standards and indicators, and submit reaccreditation decision based on internal and external reports, evidences and scores.

WIES design raised two important features; 1) the whole evaluation procedure can be completed easily online, and 2) the HEI's scores (i.e. for indicators, domains, aspects and the total score) are computed immediately on each response to a single indicator.

4.2. System Implementation

In this phase, we describe how we have developed WIES and its implementation procedure. We have developed the system over HTML, PHP, and Javascript as well as MySQL Database Management System (DBMS) to hold the data. Figure 3 shows the flowchart that describes WIES operation in several steps.

In the first step, accreditation bodies can create accounts for the HEIs. After login using a HEI's account, you should complete your institution's profile. Each self-evaluation team has permissions on its domain to complete quantitative and qualitative data, and answer the requirements based on relevant evidences. Upon responses to a domain's qualitative indicators, its score is computed, and the HEI's total score is accumulated. A SER can be generated any time during evaluation, which extracts data from indicators and scores and shows weaknesses and strengths as well as improvement plans.

The sequence diagram, shown in figure 4, provides the order at which different steps of the institutional evaluation procedure are implemented. It also shows the interaction between the client and the server.

4.3. System Testing

In this subsection, we present the testing phase of the prototype's development lifecycle. Nevertheless, after the prototype, we have developed a beta version of the system, and intensively tested it during the institutional evaluation process of QOU conducted within the last two years, as we will discuss in section 5.

We have tested WIES prototype in three experiments, to ensure that it operates properly and free of bugs and errors. The first experiment checks the assumption that the total score should be zero if the responses to all indicators are "No". Results of this experiment proved this assumption.

We tested another assumption in the second experiment, which states that when all items have "Yes" responses, the total score should be 100. This assumption was also satisfied.

Results of the third experiment have shown that the system is dynamic, where any change in the responses or the number of indicator in any domain reflects

correctly on the weights and scores of the domains and the total score. We have also proved the effect of variable number of domains per aspect on the weights. In addition, we have tested all functions mentioned in the implementation procedure. Moreover, we have shown that the accumulated responses of multiple users (i.e. domain evaluation teams) provide correct scores.

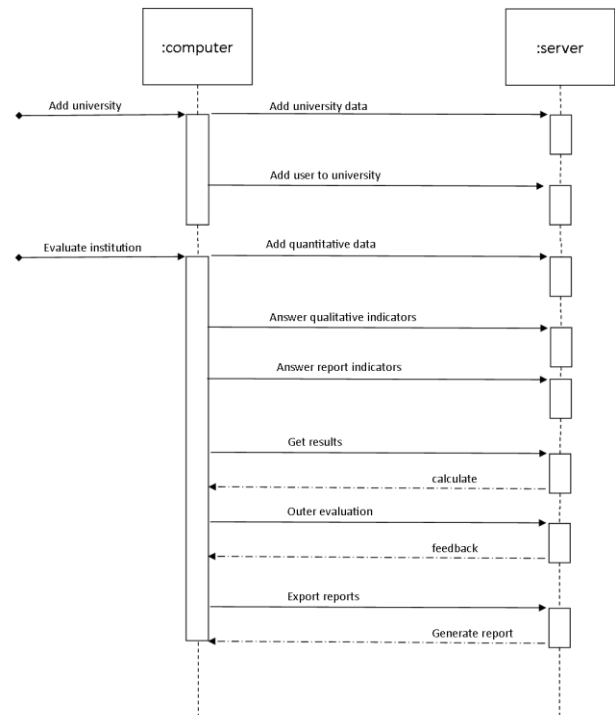


Figure 4. WIES sequence diagram.

For comprehensive testing, and to prove its usability, applicability and accuracy, we applied WIES at QOU in its self-evaluation. Upon the feedback of the evaluation teams (around 100 team-members of senior staff at QOU), WIES has been easy with high usability, flexible, applicable and accurate. Moreover, in a presentation of WIES in a dissemination workshop (February 26, 2017), the MoEHE and AQAC participants have shown admiration of such an application that solves a big issue in HEIs. In addition, a Palestinian HEI has conducted a workshop (April 30, 2017) and invited the researcher to transfer know-how to its technical team in order to develop a similar system. During the preparation of this paper, the AARU announced a workshop (May 8-10, 2018) for member universities based on our developed WIES, where the researcher will be the main trainer.

5. The Conducted Institutional Self-Evaluation

We implemented WIES at QOU in its institutional self-evaluation project 2015-2016. The following procedure summarizes the main steps of this evaluation and its

results. Figures 5-9 show the main screenshots of WIES.

- Self-Evaluation Team: this team consisted of more than 100 members in 11 teams, one team with a coordinator for each domain according to specialty, relevance and experience. The Quality board at QOU (i.e. higher-supervising evaluation-team) approved the formation of these teams.
- Training: we conducted a full-day training for each team, showing the main idea, objectives and benefits of institutional evaluation. We also discussed the evaluation procedure, showing how to use WIES to complete this process transparently.
- Data Collection and Analysis: This included collection and entry of three types of data:
 - a. Quantitative indicators. We asked all QOU departments (i.e. stakeholders) to provide the evaluation teams with the relevant quantitative

data, who in turn entered the data into WIES central database online. See figure 6.

- b. Qualitative indicators. Each domain's team discussed each qualitative indicator transparently until agreement on a suitable response, "Yes: 2", "TSE: 1" or "No: 0". See figure 7.
 - c. Evidence collection and uploading: each team was responsible for collecting evidences, which include supporting data and documents, and uploading them to WIES, in order to prove correct responses.
- Scoring: WIES performed scoring for each domain with respect to its weight. Remember from section 3 that WIES uses equations (1-9) to score different domains and accumulate the total institutional score. Figure 8 shows weighted and percentage scores of all domains, subdomains and the total score.

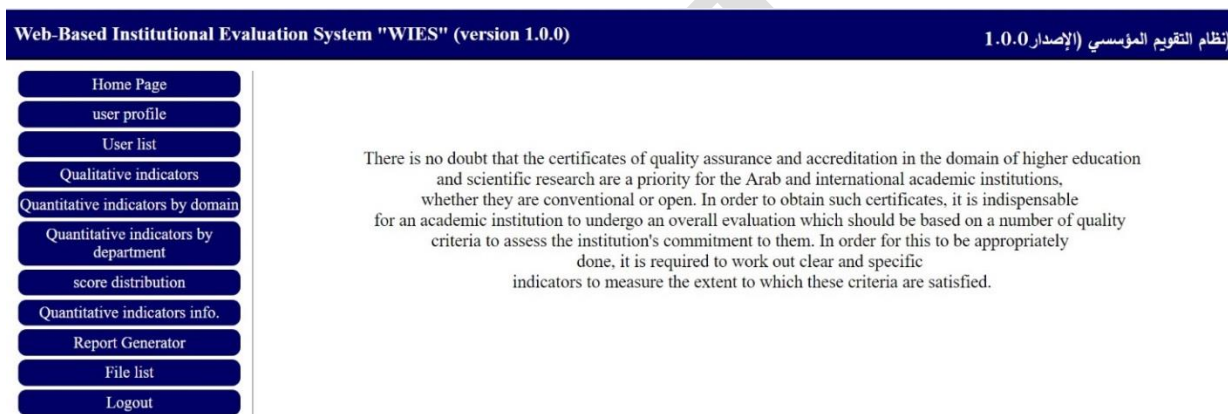


Figure 5. WIES main menu.

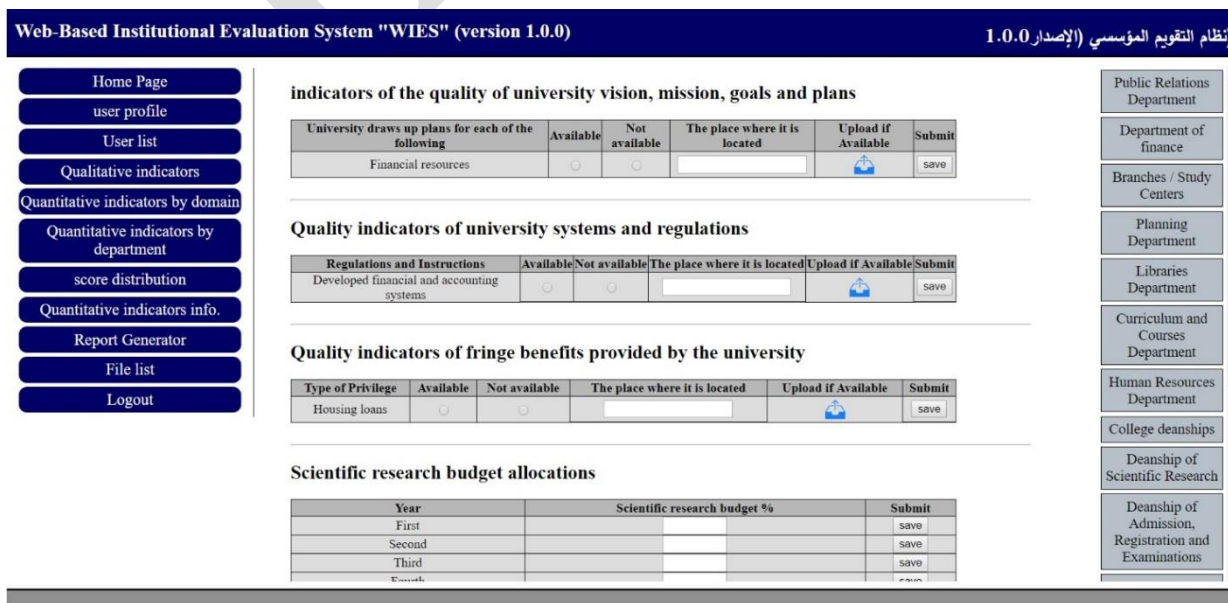


Figure 6. Quantitative-indicators entry forms.

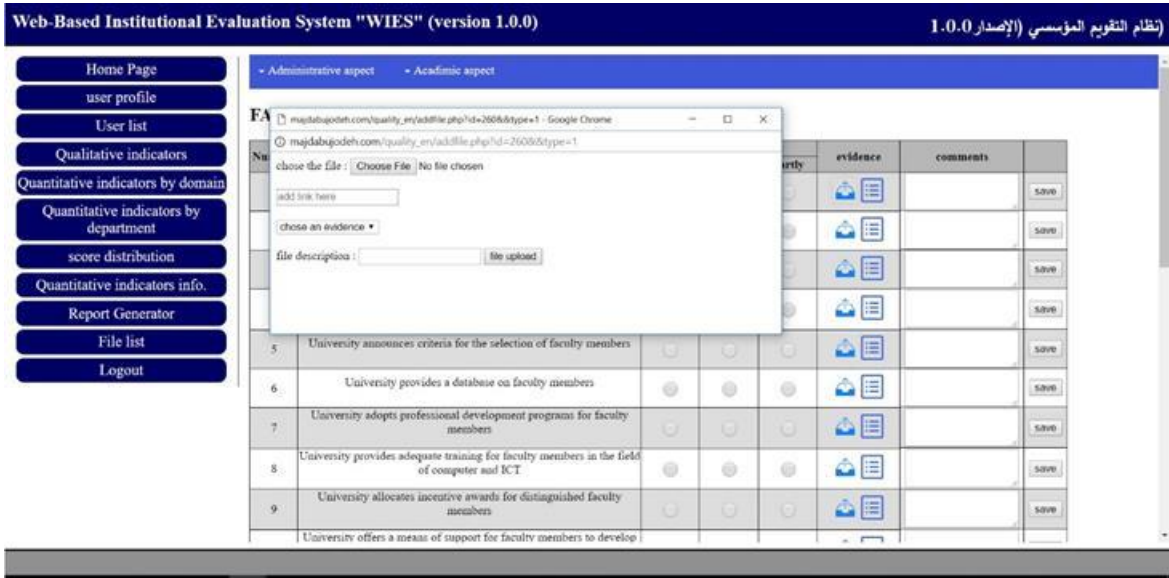


Figure 7. Responses to qualitative-indicators and evidence upload forms.

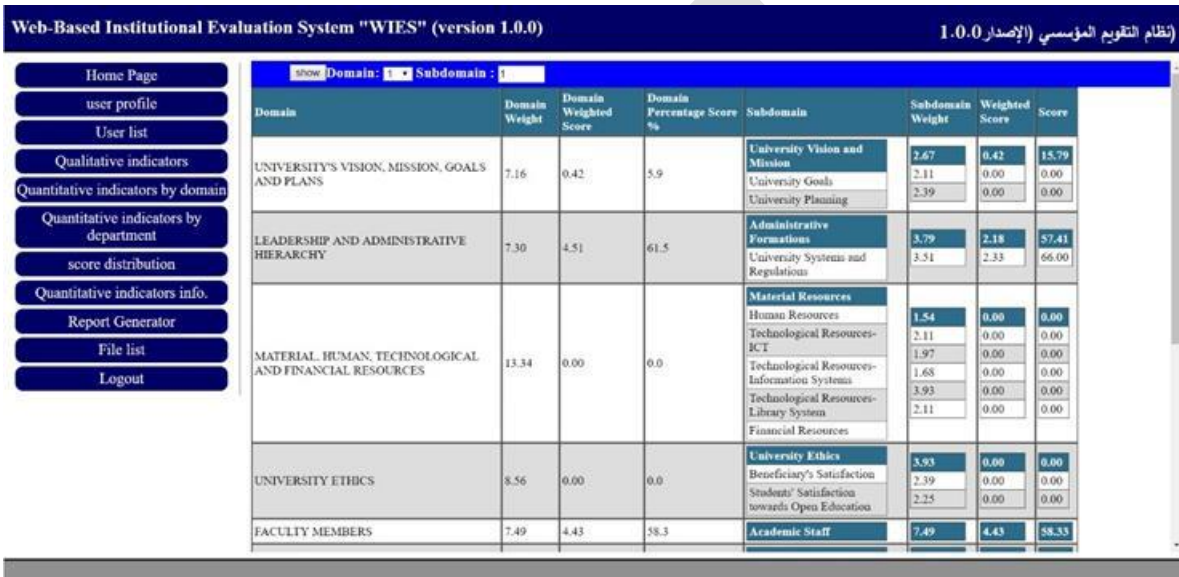


Figure 8. Domains, subdomains and institutional weighted and percentage scores.



Figure 9. Self-Evaluation Report (SER) builder wizard.

- **Draft-SER Generation:** each team asked WIES to generate partial SER that includes domain's strengths, weaknesses and improvement plans. After revision of partial SERs, we generated the master SER from WIES, which combined them into a full SER. Figure 9 illustrates the SER-builder wizard.
- **Dissemination:** after finishing the evaluation, QOU conducted a workshop under the auspices of the General Secretary of the AArU, the Palestinian MoEHE, AQAC and QOU's Board of Trustees. We invited all stakeholders, and each team's coordinator presented his domain's results (i.e. the main weaknesses and strengths, and how to improve).
- **Internal review:** we constructed a team of internal reviewers, who in turn reviewed the SER online, prepared revision reports, and distributed them to the evaluation teams for modification or defense.
- **Final SER Generation:** The evaluation teams responded to the internal reviewers' comments, and generated the final SER to Quality Board, University Board and the Board of Trustees for approval.
- **External Review:** In general, accreditation bodies ask universities for periodical institutional-evaluation. After completing self-evaluation, each university submits its SER. Then, the accreditation body assigns external reviewers who evaluate the SER, conduct field visits to decide whether a HEI deserves the reported score for accreditation, and submit external evaluation reports. Unfortunately, this is not the case in Palestine. Therefore, we offered the AQAC to customize WIES, and evaluate the Palestinian HEIs.

6. Results and Conclusion

6.1. Results

The efforts and hard work of the evaluation teams and quality department all contributed in the success of WIES implementation. They proved teamwork, transparency, and integrity in data entry and analysis. They responded to the indicators, uploaded their evidences (e.g. documents, links, etc.), and generated the SER report. Consequently, the evaluation results were characterized by their transparency and objectivity.

Table 2 shows the distribution of responses on the number of qualitative indicators, which count 457.

Table 2. Distribution of responses on the number of qualitative indicators.

| Response | Number of Indicators | Percentage |
|-------------------------|----------------------|-------------|
| Yes (2) | 295 | 64.6% |
| To Some Extent: TSE (1) | 123 | 26.9% |
| No (0) | 39 | 8.5% |
| Total | 457 | 100% |

Responses with "Yes" (i.e. a score of '2') is given if an evidence was fully present, "TSE" (i.e. a score of '1') if an evidence was partially available, and "No" (i.e. a score of '0') if no evidence was available. Note that most indicators got '2', with a percentage of 64.6%. Table 3 shows the scores of QOU's in all domains, with an accumulative score of 75%.

Table 3. QOU scores in its institutional evaluation using WIES.

| ID | Domain | Score (%) | Aspect |
|----------------------------------|--|-------------|-----------------------|
| 1 | Faculty Members | 79.2 | Academic Aspect |
| 2 | Student Affairs | 73.5 | |
| 3 | Admission and Registration | 76.3 | |
| 4 | Academic Programs and Teaching Methods | 78.0 | |
| 5 | Scientific Research | 72.4 | |
| 6 | Continuing Education and Community Service | 89.1 | |
| 7 | Assessment | 52.6 | |
| 8 | Vision, Mission, Goals and Planning | 79.4 | Administrative Aspect |
| 9 | Administration and Leadership | 89.4 | |
| 10 | Human, Material, Technological and Financial Resources | 80.9 | |
| 11 | University Ethics | 66.9 | |
| Total Institutional-Score | | 75.0 | |

It is important to stress that the implementation of WIES in the evaluation has improved transparency and objectivity in preparation of SER that lists the answers to the requirements, the strengths, the weaknesses and the improvement plans. As a result, subsections 6.1.1 and 6.1.2 present the main strengths and weakness.

6.1.1. Strengths

Institutional evaluation results using WIES have shown the most important strengths of QOU as follows:

- The geographical widespread of QOU's branches, which gave a chance for various community sectors to join QOU to address the needs of the labor market.
- The Mobile Computer Lab Project raised the awareness and sharpened students' IT skills in marginalized areas.
- QOU's satellite channel with its intellectual and academic programs contributed in building a good image of the University and its academic programs.
- The complaint box for students has contributed in finding efficient solutions for various problems to sustain an appropriate studying environment.
- Financial support for top students to continue their graduate studies in majors needed by the University.
- QOU gives a special attention to students with disabilities through providing grants, special computer labs, and printing textbooks in Braille.
- Students have representatives in QOU Boards and have a vote in decision-making process.
- QOU is keen on keeping close contact with its alumni regarding their work performance. It established a database of all sectors of the labor

market and partners to benefit its alumni in landing jobs.

6.1.2. Weaknesses and Challenges

The institutional evaluation using WIES, on the other hand, has shown weaknesses and challenges that QOU should address in its strategic plan, such as:

- Lack of a comprehensive manual for organizational structure, which includes job titles and descriptions.
- Lack of assessment of the teaching staff by students. Consequently, QOU had to apply e-assessment via its academic portal.
- Most of the scientific research focus on theoretical aspects. Consequently, applied research that would bring profitability to QOU and have a major impact on science and society is insufficient.
- Lack of a monitoring system to monitor and manage publications and arbitration inside and outside QOU.

6.2. Conclusion

Information and Communication Technology (ICT) have initiated a new trend towards web services, web and mobile applications. This provides integrated and efficient solutions for long procedures, reducing efforts and cost. For instance, institutional evaluation is a hard and time-consuming process that requires a lot of paperwork. In addition, accreditation bodies and external reviewers need to have an idea about the target HEIs before conducting field visits. It will be easier and helpful if they can do that from distance (e.g. online). Our developed web-based WIES provides such an effective and efficient solution. It provides automatic weighting and scoring of standards and indicators and an easy SER builder.

According to the users of WIES (e.g. the self-evaluation teams at QOU), flexibility and efficiency in the procedure of institutional evaluation is the main advantage of the developed system. WIES makes it easier to perform periodical evaluation, with reduced efforts and cost. In addition, the proposed mathematical model for WIES has several features. For instance, with some slight changes, it would be suitable for any quality standards, regardless of the number of aspects, domains or subdomains. It computes weights and scores for any number of indicators within the domains. So, it can be customized for any evaluation model for HEIs or their academic programs. Another reported strength point of WIES is that it reduces the long and effort-consuming weighting and scoring processes into one mouse-click. The quantitative data are treated as supportive measures (i.e. evidences) linked to the corresponding qualitative indicators. In addition, WIES enables evaluation teams to upload all evidences, such as documents and reports besides each indicator. One more important feature that WIES users mentioned is that the whole evaluation process is completed online.

This makes the task of the accreditation bodies (e.g. AArU) as well as the internal and external reviewers so easy, simple and effective.

Finally, we have developed a prototype of WIES at the beginning to prove the concept and tested it against several scenarios in three experiments. Then, we have upgraded it into a beta version and implemented it at QOU for institutional self-evaluation in a comprehensive testing approach. In both testing, WIES proved usability, accuracy, applicability, efficiency and effectiveness. Evaluations teams, internal reviewers and the AQAC staff, who practiced WIES, indicated that it is one of the most innovative and important web-applications, which serves the educational improvement in HEIs.

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Yousef W. Sabbah was born in Qaffin, Palestine, 1974. He is assistant Professor of ICT. He earned his PhD in ICT at Cairo University, Cairo, Egypt, 2012. Before that, he earned M.Sc. in computing at Birzeit University, Ramallah, Palestine, 2005, and B.Sc. in computer engineering at Baghdad University, Baghdad, Iraq, 1997.

Currently, he is the President's assistant for Quality Affairs at Al-Quds Open University (QOU), secretary of the Board of Trustees, and member of University, Quality and Academic Boards. Formerly, he was director of Open Learning Center (OLC), head of Research and Development Department, Director Assistant of ICTC, Head of Training Department, IT Manager, and Network-System Engineer. He has experience in process engineering and development of ISO-based procedures and workflow diagrams. This experience has been extended in two main projects; Self-Evaluation project 2014-2016 and Procedure Manual Development project 2014-2016. He is a reviewer for QIF projects, the World Bank. Also, he was the lead researcher of e-learning action research for the Palestinian MoEHE in the PEI, funded by the Belgium Agency (BTC).

Dr. Sabbah joined the Human and technology Development Foundation (**HDF**), Cairo, Egypt, 2011. He is also a member of the founding body of the Palestinian Association for Academic Development (**PAAD**), 2016. In December 2015, he won a research fellowship to the Open Polytechnic of New Zealand through Zamala program on "Cheating-Free Online Exams". In December 2013, he also conducted a fellowship through the Staff Exchange 2013 by the AAOU at WOU, Malaysia in developing a "Self-Evaluation Model Based on the AArU and MQA Standards". His current research interests include but not limited to university governance, quality assurance, e-learning, e-assessment and computer networks and security.