An Automated System for Collection and Analysis of ABET Curriculum Requirements

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***Abstract*—To work toward obtaining ABET accreditation, the institution's members need to understand the processes including what they are, how to implement them, in which order to follow, when to apply the processes, etc. On the other hand, ABET evaluators look into several independent variables of students outcomes and course learning outcomes and their relations in order to conclude whether or not a particular program deserves the accreditation. At the same time, the resources of the institution and ABET organization are limited. Hence, automation is needed to minimize preparation and processing time while also ensuring that available resources are effectively managed. The purpose of this work is to provide a robust framework and workflow to facilitate the collection and evaluation of ABET curriculum requirements which are part of the accreditation requirements. A tool called *ABET Automation System (ABETAS)* has been developed to serve this purpose. It is an absolute general tool that can work for any institution that is planning to obtain ABET accreditation while also ensuring effective management of processes.**

Keywords- ABET, accreditation, automation, curriculum management, assessments, continuous improvements.

I. INTRODUCTION

Accreditation is the evaluation of certain processes to determine if an educational degree (program) meet defined standards of quality [1]. Once achieved, accreditation is not permanent. It is renewed periodically to ensure that the quality of the educational program is maintained [1]. The standards for accreditation are set by professional organizations that will do a peer review of the program seeking accreditation. This peer review will be done by faculty members from various accredited colleges and universities.

ABET is an international nonprofit nongovernmental organization that accredits colleges and universities around the world in the disciplines of applied science, computing, engineering, and engineering technology [2]. There are many required steps to achieve ABET accreditation such as keeping track of students' performance and outcomes through set of variant performance indicators. ABET is a credential that many computing programs around the world look forward to achieving it.

Acquiring ABET accreditation is an evidence that an undergraduate program has met standards to produce graduates who have a solid educational foundation and skills needed for the labor market [1]. ABET credential requires keeping track of students' performance and outcomes through set of variant performance indicators. The criteria for accreditation are in two sections: General Criteria and Program Criteria. General Criteria consists of eight criterions [3, 4]: (1) Students, (2) Program Educational Objectives, (3) Students Outcomes, (4) Continuous Improvement, (5) Curriculum, (6) Faculty, (7) Facilities, and (8) Institutional Support. Criterion 2, 3, 4, and 5 are related to the curriculum and organizations spent time preparing for these specific criterions. Evaluation of these criterions consists of collecting data such as students' assessments, analyzing students' performance, and discovering areas for improvements. Next, updates and improvements will be applied to items related to these criterions. Then, a new cycle of collecting data and analyzing the data will start again. These cycles of continuous improvement are done in order to close all loop holes found in the program. We have checked several preparations and practices done by various organizations in the region that are seeking ABET accreditation. We also checked few of these as reported in [5-7]. We realized that organizations are still following the traditional paper work approach which can cause work overhead for both members of the program and ABET evaluators plus spending good amount of time evaluating all the evidences prepared.

A tool called *ABET Automation System (ABETAS)* has been developed to facilitate the collection data needed for the accreditation and provide some analysis of this data. *ABETAS* is a web-based project that aims to automate ABET accreditation processes. The project is composed of two major components. The first component is a client-side website which will be used to specify detail of ABET cycle and identify the rubrics which indicate the status of the performance indicators. It will also display charts that explain the results of analyzing the data collected along with providing an evidence of that results. *ABETAS* can run on desktops, laptops and tablets. The second component is a server side that handles the user requests. *ABETAS* helps detecting whether or not the required students learning outcomes are met based on a threshold set in the system by the program accreditation committee.

The remaining part of this paper is organized as follow: the second section describes the framework and workflow for continuous improvement. Third section describes the tool to

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automate the process and analyze the data to help plan and apply the continuous improvements steps. The paper is concluded in section four.

II. FRAMEWORK AND WORKFLOW

The framework and workflow of the suggested approach is derived from the ABET accreditation processes. The bedrock is the program since ABET considers it as the element to be accredited. The program educational objectives should be set first because student outcomes should be related to these objectives. Students outcomes will be determined, and we link the program educational objectives with the student outcomes as we see in Fig. 1. Courses and their registered students can be added to the system.

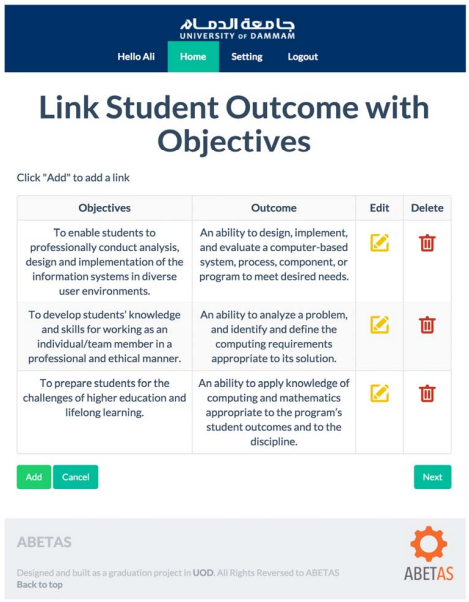

Figure 1. Linking Students Outcomes with Program Educational Objective.

ABET processes are not one-time step. It should be done regularly on many terms using performance indicators. These performance indicators are related to programs and measured by rubrics. In order to manage these regular intervals of ABET processes, we divided them into what is called cycles, where each cycle has its set of terms (semesters) and courses offered in each semester for a certain program as shown in Fig. 2 and 3. This division is important to organize and facilitate the work for both sides; the institution and ABET organization when they visit the institution to evaluate the program, along with maintaining ease of access to the historical data and keep better track of the student outcomes. When it comes to reporting, the student outcomes are the core elements. The report will show the performance indicators (either summative or formative) for a particular student outcome, its terms and cycle along with the option of showing evidence that the instructor uploaded to the system. Evidence can be students' assessments papers.

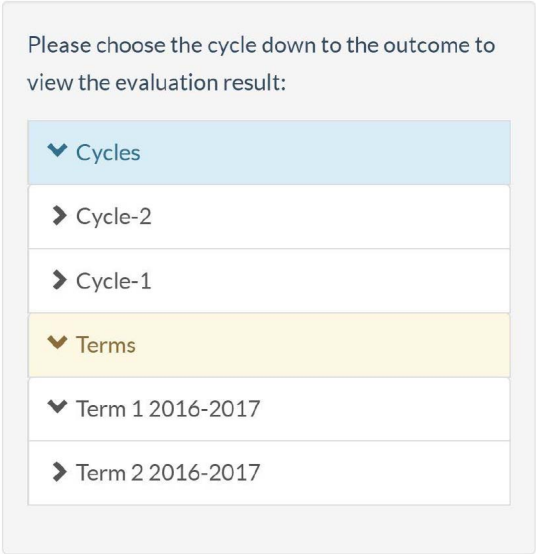

Figure 2. Structuring the data into cycles where each cycle consists of certain academic semesters

Figure 3. An example of list of courses assigned to a cycle which will be evaluated for course improvments

III. AUTOMATION TOOL

ABETAS is the automation tool implemented to collect and analyze data as evidence to meet ABET curriculum requirements. The system requires a server to run on, computers or tablets with an Internet connection in order to be accessible by the users and a compatible browser to work properly. The main system objectives are:

- Reduce paper usage and take one step towards green environment by transferring most of the ABET accreditation required documentation and evidence from paper work into computer-based work.
- Facilitate the program members' work by providing a more convenient way to evaluate students' progress.
- Facilitate ABET evaluators' work during their visit by providing an easier way to evaluate ABET curriculum requirements.
- Facilitate and save time of the whole internal ABET accreditation process by centralizing all the needed data in one location.

- Provide a more appealing way for the ABET evaluators when they evaluate the continuous improvement evidence by displaying clear and self-descriptive figures and charts.
- The accessibility and availability of the data will be much more convenient and easier since it will be online 24/7 accessed from any location that has an Internet connection and approved credentials to access the system.
- *ABETAS* as any other system has some constraints. The system relies mostly on the input of users to work as planned and produce the desirable outputs. For instance, it's the obligation of the faculty member to enter into the system the correct assessment grades for the students.
- When implementing the system, we went through all the development life cycle phases and detailed documentations using IEEE standards were written including: Software Project Management Plans (SPMP) [8], Software Requirements Specification (SRS) [9], Software Design Descriptions (SDD) [10], Software Test Plan and Test Report [11], user manual and deployment.

The system has many user classes containing the admin, program coordinator (superuser), faculty members and evaluators. Each has his own functional requirements and user interface as shown in Fig. 4.

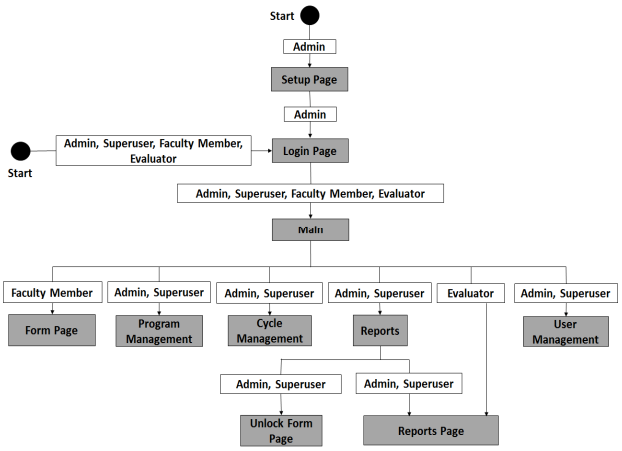

Figure 4. General View of the User Interface Pages

The system is following Model View Controller (MVC) pattern and built using Java Servlet Pages. Due to the complexity of the system, *ABETAS* has been divided into five logical domains. Each domain plays a crustal role in the system processes and is important to provide a rigid output. Each domain has its own important and independent operations that when all put together, *ABETAS* will be formed. As shown in Fig. 5 and 6, these five logical domains are: (1) Program Management, (2) Cycle Management, (3) User Management, (4) Rubric Visualizer, and (5) Form Filling.

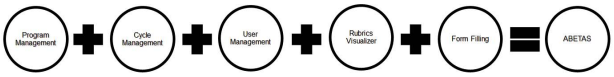

Figure 5. Five logical domains of *ABETAS*

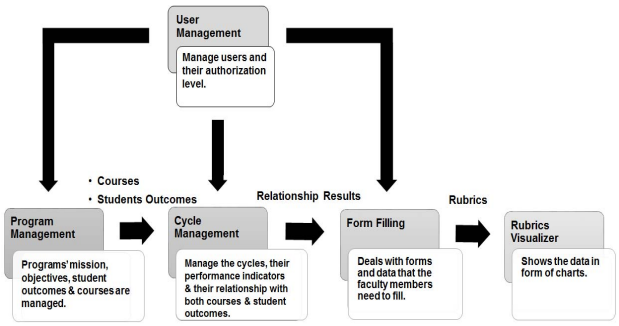

Figure 6. The interaction between the five domains and an abstract discerption of each.

Program management is where the program mission, objectives, student outcomes and courses are managed and controlled. Cycle management is responsible to manage the cycles, performance indicators assigned to each cycle and their relationship with both the courses and student outcomes. User management handles the operations regarding the systems' users. Reports shows the data as charts for summative forms (Fig. 7) and display the formative forms. Fig. 8 shows an example of rubrics result for a particular section in a course (which can be change using the dropdown list as shown in the Fig. 8) with an indicator that the threshold was met. Moreover, it determines the pass or fail based on a pre-set threshold. Form filling deals with the forms and data that the faculty members need to fill.

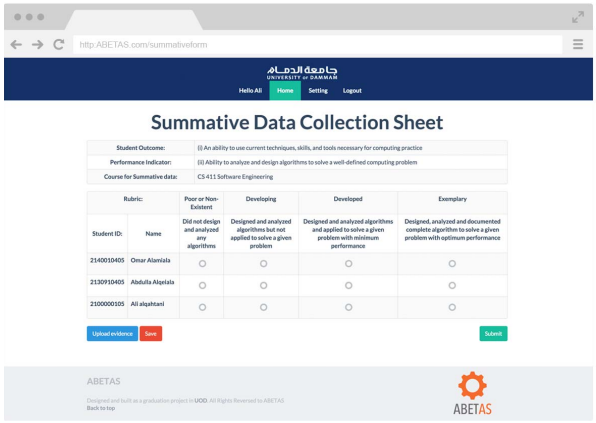

Figure 7. Summative form to be filled by the faculty member and validated by higher privileged system user containing the performance indicator, linked student outcome, rubrics, students' data and evidence.

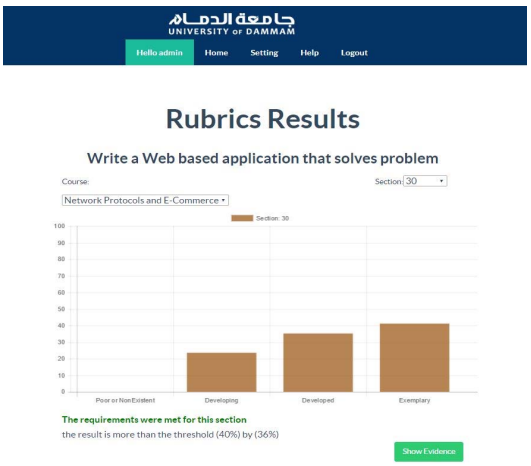

Figure 8. Rubrics result for a particular section in a course with an indicator that the threshold was met and a way to show related evidence.

The system keep track of un-submitted necessary forms in order to send reminders to the responsible faculty members to upload the missing data. *ABETAS* has several other features such as doing scheduled backup of the data and keeping the logs of anything done by any of the system users. The database has around twenty-two tables. All the data of all types can be added to the system manually (one by one) or by importing excel sheets for the user convenience, usability and user-friendly aspect. *ABETAS* is fully dynamic and general so that it can be suitable for any institution seeking ABET accreditation. All the data are changeable such as the program name, courses, performance indicators, student outcomes, rubrics, term's duration, and number of terms in a cycle. An institution can prepare the system to reflect its intuition's brand such as setting the system to reflect its name, logo and brand colors. Fig. 9 shows the homepage of *ABETAS* where the most important aspects of the system can be accessed directly for the optimal user experience.

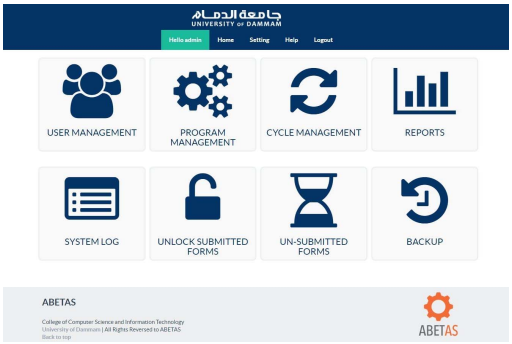

Figure 9. The homepage of *ABETAS*

IV. Conclustion and Recommendation

Computing programs work hard to prepare students with knowledge and skills needed for the job market. This requires them to do continuous assessments and improvements to their curriculum. To continue offering the highest level of quality of education, organizations need to have an achievable assessments and continuous improvement plan. International accreditation agencies such as ABET requires certain criteria to be met and achieved as an evidence of quality of education provided to students before the accreditation is granted.

In this paper, we present an automated system that will facilitate the collection and analysis of criterions 2, 3, 4 and 5 of ABET accreditation requirements criteria. We have presented a detailed description of the system. It will facilitate the assessment methods and analysis of data which will help in the continuous improvement actions needed to close the loop holes found in various aspects of the curriculum.

The accreditation of a program is an indication of the suitability of the methods applied in the accredited program. *ABETAS* will support the work done toward the preparation of getting the accreditation. The experiences and practice gained throughout this project hopefully will guide new candidates for accreditation and provide insight to the work involved.

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