RASED: Spreadsheet-Based Coursework e-Management System Supported by Performance Indicators

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Abstract: Higher education institutions' database management systems are used to maintain and retrieve students' academic records, but in most of the cases they lack further supports regarding coursework tracking or performance indicators. This paper presents the design, implementation and use of a computerized e-management system (named RASED). The system has been developed based-on practice, experience, academic and administrative requirements during the teaching of courses and training sessions. The system is used to manage and measure the performance in educational and training courses using several metrics and indicators. The advantages of this system are accuracy and flexibility in the management of coursework that will assist the staff of the academic colleges to follow-up the duties and activities of the students and trainees. RASED e-management system offers abundant information, and provides assistance in making the right decisions at critical times. Moreover, the system assists to reply precisely instead of speculatively in the cases of inquires or in the situations that require proactive follow-up before getting to the final consequences, which are usually late or too difficult to remedy. The system is developed by attainable tools that are available at relatively low-cost and minimum development effort and time compared with other development techniques. RASED system has been used by a number of staff at some academic and training institutions. It contributed to the effectiveness of the use of electronic systems, to the dissemination of a culture shift towards digital society, and to emphasize importance of the use of modern technology in the management of the educational process. In addition, this paper may serve as a framework for the design and implementation of e-management spreadsheet-based systems that can be used in other educational, training and business disciplines.

Key words: E-management, coursework, performance-indicators, spreadsheets.

1. Introduction

Faculty staff at higher education colleges is obligated to assess and measure the progress of the students and learners in the offered courses and to give fair scores according to their performances. This duty requires that the supervisors of the educational process to continuously follow-up and monitor coursework which may include: assignments, quizzes, home-works, experimental labs, midterm exams and final exam. With the academic duties entrusted to them, monitoring and following-up with this task in a precise manner becomes hard task with exhaustive time and effort, especially with the assorted types of assessments and the multiplicity of their forms.

Higher education institutions have database management systems (DBMS) which are used to maintain students' information and academic records. In most of the cases, the main electronic DBMSs are dedicated

to serve as storage and retrieval database management systems for the students final grades but they lack further supports regarding coursework tracking or performance indicators.

RASED system is a considered as a supporting system for the electronic academic systems of the higher education institutions, since it affords complementary functions to those management systems. Those systems can take advantage of many features in RASED for future developments. Furthermore, the system is compatible with the academic regulations of the higher education and training institutions.

The system is a collection of professionally programmed objects that consists of: e-forms, e-tables, reports, and query. It is characterized by precision, high quality performance and ease of handling, use, design, and low cost. These objects have been designed using spreadsheets, which are distinguished with prevalence and easiness of use. They are exploited to manage works of college courses, in order to save time, cost and effort, and to take advantage of their features and computational power.

The system helps to reduce the burden on faculty staff, and to facilitate follow-up of students and predict their level of performance. It assists in extracting accurate performance indicators instantly with high level of flexibility. Moreover, the system is considered as a tool to support decision-making regarding the situations of students enrolled in a course in quick and efficient manner, especially during tight and critical times for faculty staff.

2. Spreadsheets

An electronic spreadsheet is a collection of cells arranged into a table of rows and columns. Each cell is named by a concatenation of a column alphabetical letter and a row number that represents a reference to the location of the cell in the spreadsheet table. Spreadsheet cells can contain data of assorted types, such as numerical, or text data. A cell can also be formulated to compute simple or complex mathematical or logical formulas and functions.

Modern spreadsheet packages are equipped with several built-in functions related to various applications. These pre-programmed functions save times of programming, testing, and debugging. This feature helps developers to integrate functions with their designs and in turn it saves the effort of entering, verifying and validating formulas and functions required by the problem under investigation.

Spreadsheets are capable of modeling data using charts with wide range of styles. This capability enhances the appearance and the noticing of various relations among data collections. Moreover, they are enabling the representation of the output in diverse formats and structures using just few fingertip keystrokes.

Other features, such as decision-making, sorting, filtering, hyperlinks, conditional formatting, and many others, facilitate implementing numerous powerful and flexible electronic computational spreadsheet based management systems.

Spreadsheets are used in various applications and fields [1], [2]. They are highly flexible programming environment that is widely used in industry and are widely adopted for decision making [3].

Spreadsheets are used in many scientific fields and technological applications. Their features and capabilities make them attractive tools to solve complex problems in attainable manners. Researchers reported their use in wide range of science and technology applications [1], [2], [4]. Some researchers used spreadsheets for computer processing purposes [5]. Other researchers used them for implementing, studying, managing, and analyzing systems and models [6]–[9].

Computerized spreadsheets are used for managing enterprises of all sorts, ranging from one-person projects to multi-institutional conglomerates [10]. They are also used for forecasting resources utilization to aid decision making in medical management [11]. An upgraded system was implemented for a logical spreadsheet management system [4].

Spreadsheets are used for project management [12], for interface to data exploration [13], for inventory simulation [14], and for teaching computational thinking to non-computing majors [15]. Moreover, a sheet-based visual language is defined to use the visible structure of the spreadsheet to specify the computational structure [16].

Modern spreadsheets are equipped with database-like features, such as organization of cells into tables, manipulation and retrieval capabilities [17], [18]. These powerful features with many other features candidate spreadsheets to be used for the design and implementation of computerized e-management systems.

3. RASED Spreadsheet-Based e-Management System

RASED system is a collection of preprogrammed e-objects that include forms, tables, query, reports, and performance indicators. It is characterized by precision, high quality performance, user friendly, and low-cost. These electronic objects have been designed using spreadsheets, which are characterized by their prevalence and easiness of use.

The system is exploited to manage coursework, in order to save time, effort, cost, and utilize the advantage of the spreadsheets computing capabilities, and advanced built-in features. Fig. 1 illustrates the various objects used in implementing the system.

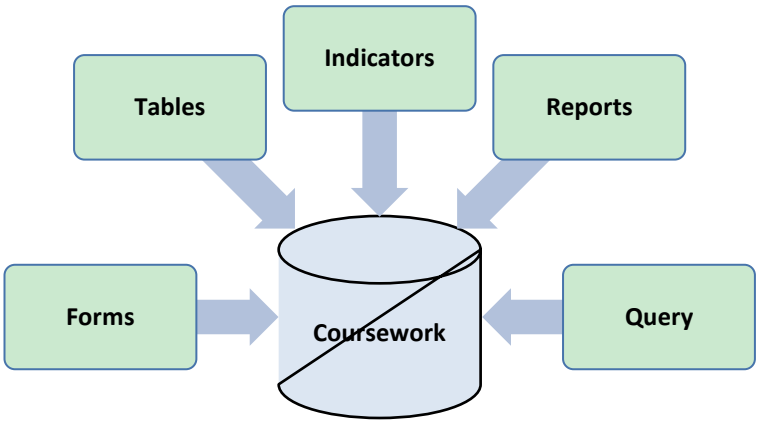

Fig. 1. Objects used in implementing coursework spreadsheet-based e-management system.

3.1. System Objectives

A number of objectives to be achieved for the design and construction of RASED have been set formerly. One of the objectives is to promote and perform complementary tasks to the current management systems which are used to maintain academic records. Second, the system is to be compatible with the academic regulations. Other overall objectives have been taken into consecration, such as accuracy, quality of performance, ease of design, user-friendly interface, low cost, and the freedom from special software use.

3.2. System Features

The main features of RASED System are: precision, quality, high performance, and simplicity in handling and use. The system components have been designed to enter, query, display and extract information and reports in highly effective manners. Moreover, the use of the system objects relies on the users' experience in using spreadsheet software packages.

RASED system is considered as reliable and effective tool, in the hands of instructor, to be able to reply more accurately rather than speculatively to inquiries regarding the performance achieved by enrolled

students. The system supports making suitable decisions regarding the students and assists in future referencing to their records, such as the cases of incomplete students or cases of students requiring to acquire academic recommendations. It also helps to refer to the coursework records and statistics provided by the system for comparison and continuous performance improvement purposes.

RASED system is characterized by the immediate response to any alteration and its reflectance on all related data and indicators. The system offers instructors great flexibility in case of subsequent modifications or updates without compromising the accuracy or integrity of the data. This is a useful feature in the case of future emergent alterations, or in the case of a desire to predict the consequences of a particular change on the final results, with the option to accept or reject these changes.

Furthermore, the system can anticipate future situations regarding all students in a course. This can effectively help to remedy certain cases by displaying advance warnings as a result of predictions for certain critical situations before their actual occurrences.

Other advantages of RASED are the freedom from having special packages, plug-in, or add-in software in order to operate or use the system. It also has the advantages of facilitating data entry, cases' follow-up, alerts in cases of errors, and capability to prepare reports for hard printing with flexibility.

4. Design Methodology

RASED system comprised of several forms, tables, reports, and built-in query. The system is fed with the data concerning course and students during a period of time. Afterwards, information regarding course, enrolled students, and performance indicators are automatically extracted and viewed by the system.

In designing and implementation of objects for the purpose of course-works management, several stages have been set to control and enhance the overall system design. Specifically, these design phases can be taken as a guideline for developing e-objects. Fig. 2 illustrates the stages for the methodology that have been applied during the design and implementation of the computational objects for RASED system.

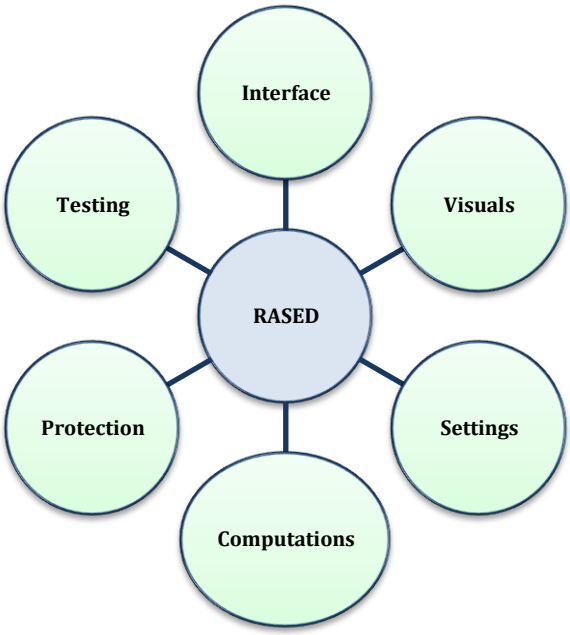

Fig. 2. Development stages for the objects of RASED system.

The interface stage deals with the design of an e-form using spreadsheet table. First, the grid lines of the cells are made invisible by repainting the table using a uniform color. Moreover, to facilitate the use of an object, the object is resized to almost one screen size. Refilling the cells at locations where it is required so

they become visible and resemble input textboxes (look-and-feel). Next, add appropriate labels next to each cell, so it aids the users to enter the proper data types. The overall view of the e-form can be enhanced by adding main explanatory titles and exterior borders. Setting borders and shadows to the input-boxes can also enhance the visual design of the object.

Graphic and image clips are added to the e-form in accordance with the need for the problem under design. For example, logos and other object related images can be added to the forms to enhance its overall appearance and ease their use.

Input textboxes represent the locations for entering input data by the users. These fields are considered as the user interaction to a computational object. On the other hand, the resulted numerical or textual computations are the forwarded to the output textboxes. Setting proper settings to both types of fields is very crucial. Setting properties such as field-size, data-type, number-format, etc., are applied during this stage of the design. Text formats, such as color, font size, etc., are also utilized to assist the user to differentiate and deal with the intended information.

A computational object may include computations using mathematical formulas and/or equations. Precise writing and validation of formulas is vital for accurate operation of the entire object. The integration of spreadsheet built-in functions helps in the development of the targeted object very rapidly and with increased reliability.

The next stage in the design deals with the object's protection. It is obligated to secure the entire object by protecting all the form's components except the input cells. The users can interact through the input fields and they can only observe the other fields of the object. Protecting the object secures it against any alterations or misuse and maintains its overall integrity. This protection enhances the dependability on spreadsheet-based computational objects designed and implemented for e-management systems.

The final stage in the design process that precedes releasing and delivering of the system is a thoroughly test for checking and validating the proper operation of the entire product as one integrated object. In the case of presence of any system faults or malfunction, or the obligation to have some system modifications or enhancements, some or all of the design stages are revisited and validated in accordance with the system requirements.

5. System Implementation

RASED system contains several objects that have been designed using the design methodology and stages explained in the previous section. Specifically, the system comprised of 12 objects that all together function to provide various information and services to the staff during managing and tracking of the coursework. These objects are designed to function as one integrated e-management system that reflects the consequences of all changes and indications in various system components. The following subsections will highlight the implementation and use of selected samples of these objects.

5.1. Main Interface

The system's main screen operates as a switchboard that facilitate accessing the various services and functions provided by the system.

The main panel includes several control buttons that enable the user to access all the objects of the system and navigate between the various system's objects. Each control button corresponds to a certain object in the system. Clicking any button in the main switchboard leads to viewing the corresponding object on the screen. Afterward, the user can be able to interact with the enabled components of the displayed object. The user can switch back to the main switchboard from any object. Figure 3 depicts the screen of the main switchboard for RASED system.

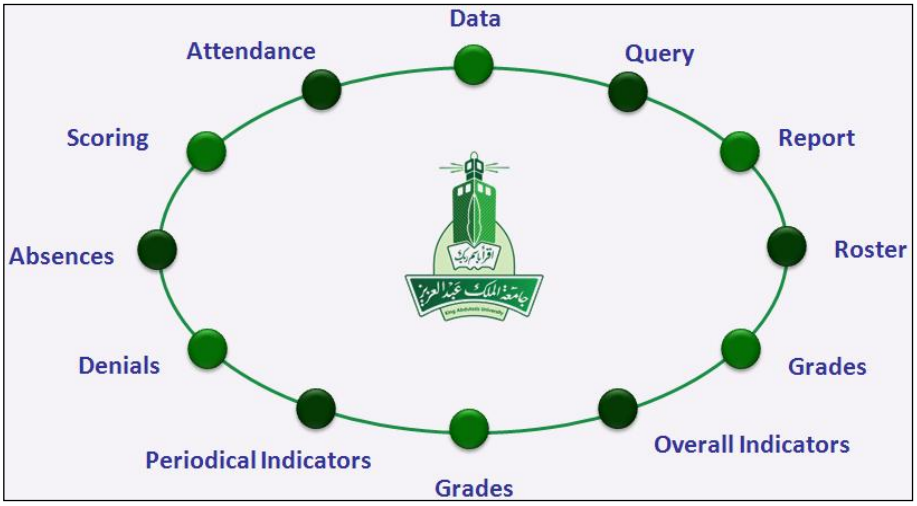

Fig. 3. RASED system main switchboard interface.

5.2. Course Information

This form enables performing the following functions: enter course information, and allocate percentage of warning, and denial that are used to identify students statuses. Fig. 4 illustrates the course information form. Through this form, the distribution of points and weights for the course activities are entered. In the case of a data entry error, an alert message is automatically generated. The form displays: the number of students enrolled in the course, and the number of lectures for warning and denial cases. Remarks on semester-works can be recorded and retained for future reference.

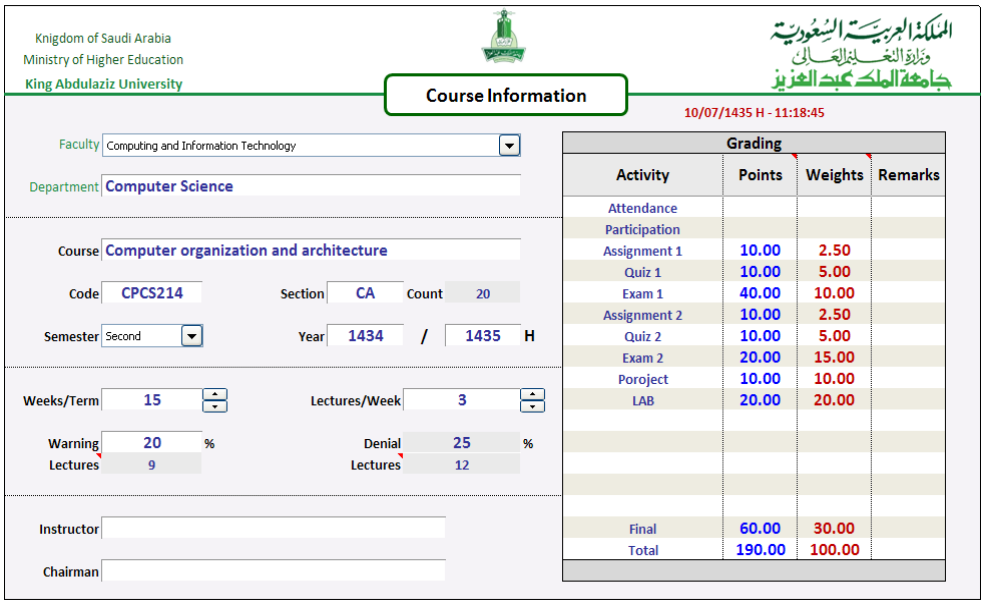

Fig. 4. Course information e-from.

5.3. Electronic Attendance Table

The attendance table enables the user to perform the following functions: displays the enrolled students' information, records the dates of lectures for future reference, and records the attendance state per student. The student cases are distinguished easily using conditional formatting features that automatically highlight various cases. Fig. 5 demonstrates the attendance table.

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وزارة التعليم العالي
جامعة الملك عبد العزيز

Faculty Computing and Information Technology
Department Computer Science
Course Computer organization and architecture - CPCS214
Sec CA Count: 20 Hide Names
Warning: 9 Denial: 12 lectures

Instructor:
Semester Second
Year 1434 / 1435H

			Week	1			2			3			4			5		
			Day															
			Month															
			Attendee	20	20	18	17	17	14	17	17	16	17	16	18	16	17	17
SN	Student No.	Name	Absent	0	0	2	3	3	6	3	3	4	3	4	2	4	3	3
1	350001	Muhammad Fares				A												
2	350002	Omar Salem					A		A	A		A						
3	350003	Khaled Ziad																
4	450004	Rami Waleed							A		A	A	A	A	E	A	A	A
5	350006	Faiz Badr									E							
6	350006	Ali Salem				A		A							E			
7	350007	Saad Bandar								A			A	A	A	A		A
8	350008	Ahmad Saleh					A		A									

Fig. 5. Electronic attendance table.

As can be noticed from Fig. 5, the system automatically detected and highlighted the cases of warning (yellow color highlight) and denial (red color highlight) of students after exceeding threshold values set for both cases.

5.4. Electronic Scoring Table

Fig. 6 shows portion of the scoring table. This table performs the following tasks: displays each individual coursework activity with the corresponding distribution of points and weights, records grades for each activity, discriminates the completion of the entered data, and tracks data entry logical errors.

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جامعة الملك عبد العزيز

Faculty Computing and Information Technology
Department Computer Science
Course Computer organization and architecture - CPCS21
Sec CA Count 20

Instructor:
Semester Second
Year 1434 / 1435H

				Attendance		Participation		Assignment 1		Quiz 1		Exam 1	
			Day/Month										
			Bonus										
			Entered	0		0		20		20		20	
SN	Student No.	Name	Points/Weights	0	0	0	0	10	2.5	10	5	40	10
1	350001	Muhammad Fares						7	1.75	6	3	32	8
2	350002	Omar Salem						10	2.5	9	4.5	37	9.25
3	350003	Khaled Ziad						9	2.25	10	5	18	4.5
4	450004	Rami Waleed						10	2.5	5	2.5	19	4.75
5	350006	Faiz Badr						8	2	2	1	24	6
6	350006	Ali Salem						7	1.75	10	5	25	6.25
7	350007	Saad Bandar						8	2	7	3.5	22	5.5
8	350008	Ahmad Saleh						10	2.5	8	4	29	7.25
9	350009	Yasir Ali						7	1.75	5	2.5	30	7.5
10	350010	Jamal Omar						7	1.75	4	2	32	8

Fig. 6. Electronic scoring e-table.

The following functions are outputted from this table: instantaneous identification for students' performance, highlighting performance declination, computing final scores and grades, and discriminating students cases regarding their current statuses.

5.5. Query e-Form

Through this form, a query about enrolled student in a course can be inquired. The system responds with the following information: course-info, student-info, grades and scores per each coursework activity, level of performance, and student rank among the enrolled students for all the activities. Fig. 7 shows a sample of the student query form.

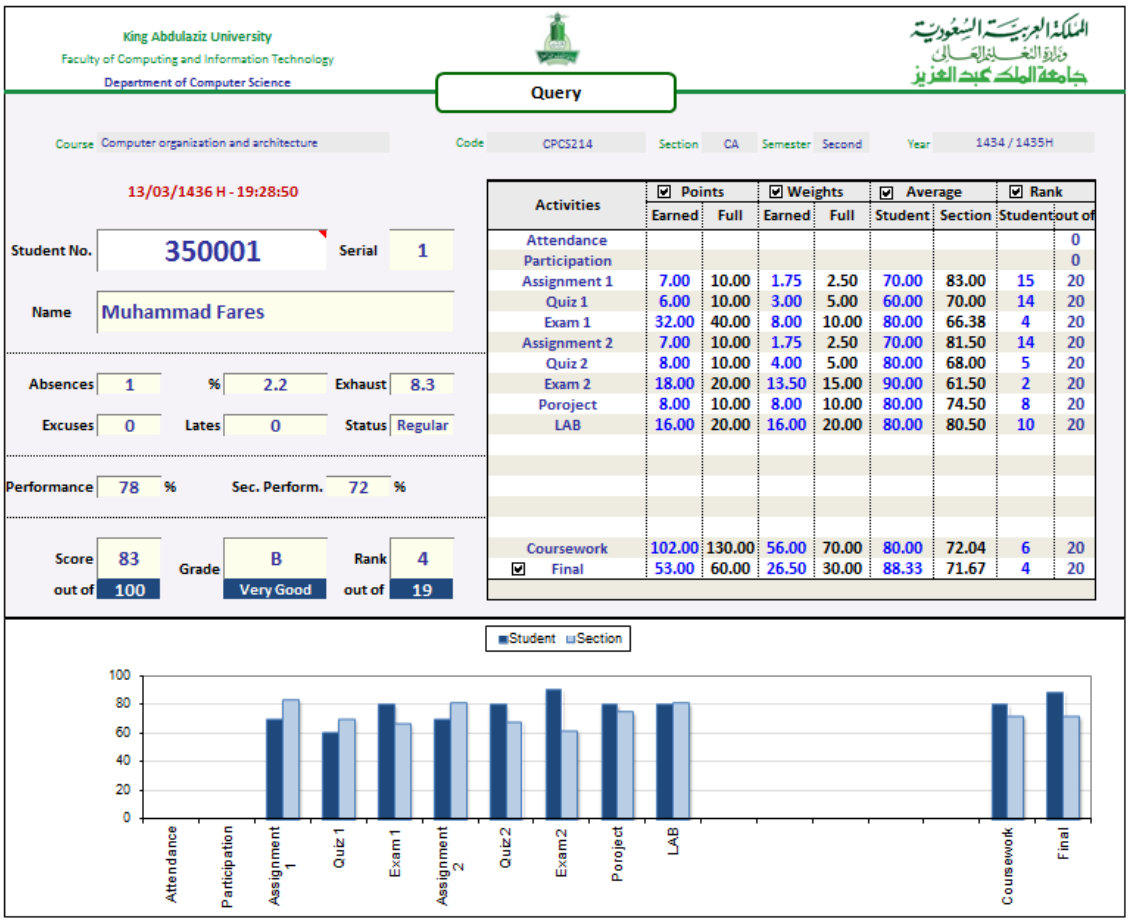

Fig. 7. Query e-form.

In addition, this form displays a bar chart that depicts the performance of the queried student compared with the other enrolled students in the same group. This graph beside other indicators supports the instructor to track student cases and to provide appropriate academic assistance to students according to their needs.

5.6. Periodical Indicators e-Form

This form presents the following information: attendance statistics, periodical statistics for all completed coursework activities. The form provides graph of attendance percentage and graph of the ratio of the performance of the performed coursework activities. Moreover, the form discriminates incomplete coursework activities for the entire students enrolled in a certain course. Fig. 8 shows a sample of the periodical performance indicators form.

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Faculty of Computing and Information Technology
Department of Computer Science

Periodical Indicators

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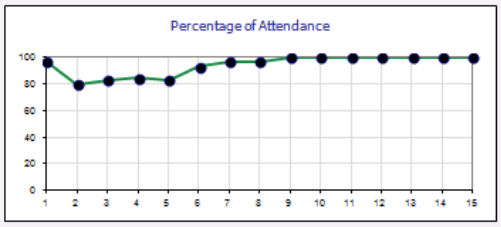
جامعة الملك عبد العزيز

Course: Computer organization and architect | Code: CPCS214 | Section: CA | Count: 20 | Sem.: Second | Year: 1434 / 1435 H | M Lev %: 70.0 | Perf.: 70.8 %

Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Avg.
Absences	2	12	10	9	10	4	2	2	0	0	0	0	0	0	0	3
% Attending	97	80	83	85	83	93	97	97	100	100	100	100	100	100	100	94

Coursework	1 Attendance	2 Participation	3 Assignment 1	4 Quiz 1	5 Exam 1	6 Assignment 2	7 Quiz 2	8 Exam 2	9 Poroject	10 LAB	11	12	13	14	15	Total
Recorded			20	20	20	20	20	20	20	20						11
% Recorded			100	100	100	100	100	100	100	100						53
Points			10.0	10.0	40.0	10.0	10.0	20.0	10.0	20.0						9
Weights			2.5	5.0	10.0	2.5	5.0	15.0	10.0	20.0						5
Average (%)			83.0	70.0	65.0	81.0	66.5	61.0	74.0	80.0						39
Min			7.0	2.0	16.0	5.0	3.0	0.0	0.0	10.0						3
Max			10.0	10.0	37.0	10.0	9.0	19.0	10.0	20.0						8
Std. Dev.			1.2	2.0	5.4	1.5	1.5	5.2	2.8	2.7						1



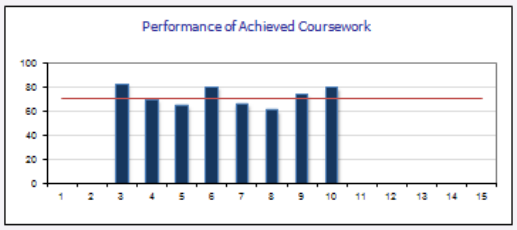


Fig. 8. Periodical indicators e-form.

Moreover, this form enables manual setting of the performance measuring level in order to discriminate performance of the various coursework activities using a specified threshold value. Performance indicators are adjusted in accordance with the set threshold value.

5.7. Overall Indicators e-Form

The overall indicators form demonstrates the following information: students statistics with respect to their statuses in the course, grades statistics, and scores statistics. The form also discriminate statistics using automatic color highlighting based on the magnitudes of the indicators. Fig. 9 depicts the overall indicators form. Moreover, the form displays graphs for the actual grades distribution for all students enrolled in a course using the normal distribution. The distribution of final grades is plotted in order to manifest the disparity levels for all students. The form offers the possibility of manual determination of the performance measurement level for better discrimination of grades and performance using specified threshold value. Furthermore, this form provides a support for an overall scores' curve-up. Consequently, it instantaneously echoes the reflections of the change on all the related objects' components.

5.8. Reports

The coursework e-management system could generate several detailed reports. Specifically, roster, denials, absences, and grades can be outputted as hardcopy reports. These reports are intended for monitoring purposes. All the printed system's reports include detailed information regarding a designated course and the current statuses of the enrolled students.

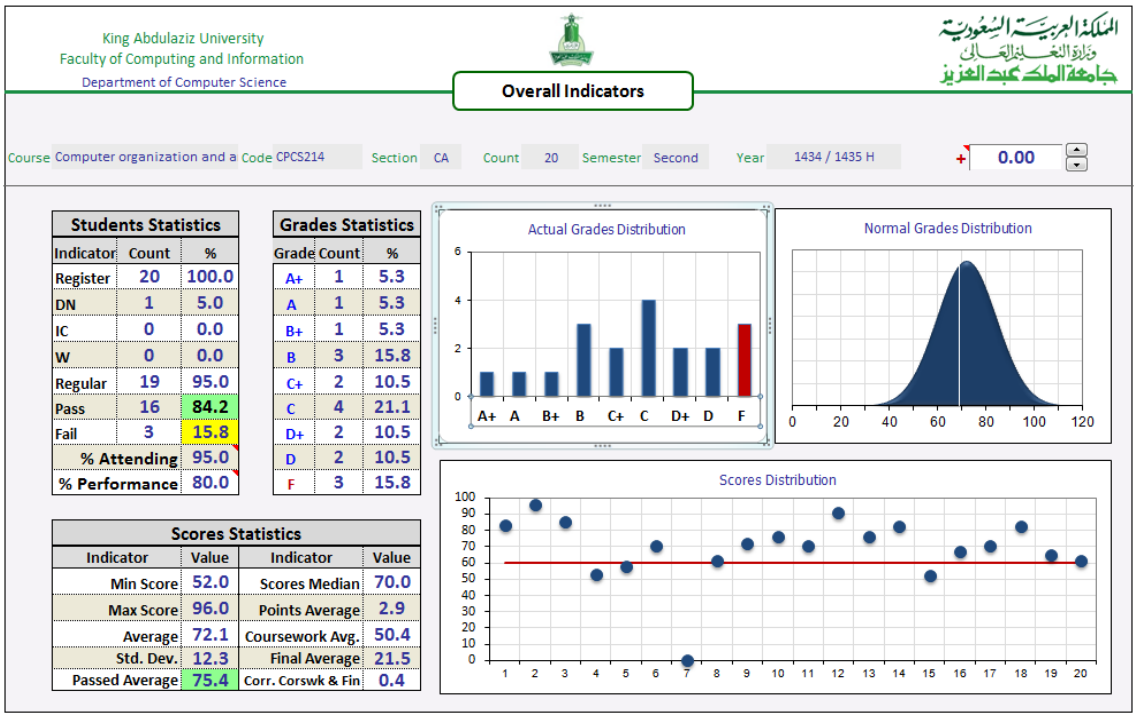


Fig. 9. Overall indicators e-form.

6. Conclusion

This paper demonstrated an e-management system (named RASED) for college level coursework. RASED is a supportive computerized e-management system for the use of faculty staff during the conduction and evaluation of coursework during the process of education and training. The system helps in saving time and effort with high accuracy, efficiency and instant retrieval of information and preciseness in decisions making. The system consists of several objects programmed using electronic spreadsheets. The objects are intended to track and manage coursework. RASED can provide statistics, queries, and various reports. Moreover, it provides a quick and substantive rather than discretionary tool and supports with increased and reliable decision making.

RASED system has been used by a number of faculty staff at some academic and training institutions. The system also has been used by staff who have no means of supporting tools to monitor and manage coursework.

Some of the expected outcomes of adopting this system are: facilitating tasks and saving valuable efforts for faculty staff which can be devoted towards the educational and research duties. In addition, it is expected to have increased accuracy in monitoring and tracking errors in data entry by using computer capabilities in performing required computations. The system supports in distinguishing and highlighting the cases needed to be investigated and sorted out for remedying purposes. RASED supports future referrals and follow-up, such as the cases of incomplete students or students who are obligated to obtain academic recommendations. Performance indicators for students and courses can also be generated by the system at partial or overall periods.

Some for future enhancements for RASED system may include: modifications and improvements through feedbacks and proposals collected from the users. Finally, it is recommended to get advantage of the ideas in this system and integrate them with the online e-systems for the purposes of upgrading and raising efficiency of their use, and to provide important information to users that saves time, and effort and to support in making the right decisions with high precision and flexibility.

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