



SAPMS; Student Assessment Process Management System Enriched with Quality Factors

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ABSTRACT

Computer's hardware and software development aided education field progresses more rapidly. Not only the computer is used in learning and assessment processes to add more attractiveness, but also it's used for better performance of educational system. But one of more defects was lacking in applying modern educational quality factors to both learning and assessment software. This paper presents a web based Student Assessment Process Management System (SAPMS). SAPMS provides a secured, attractive, easy to use and quality based assessment system. Our system is completely analyzed and designed using the Unified Modeling Language (UML). We also present the implementation of the core components of the SAPMS which performs the most important processes in the system. In addition to that a validation study for the system components is performed.

Indexing terms/Keywords

Process Management System, Software Application, Computer Aided Education, Student Assessment, Quality Standards.

Academic Discipline And Sub-Disciplines

Computer Science and Information System , Software Engineering.

SUBJECT CLASSIFICATION

Information System, Computer Aided Education Software Application.

TYPE (METHOD/APPROACH)

Authors depends on making scientific survey on the Student Assessment Software and educational Quality Standards. and the output system is validated using real experimental approach to measure the system result.

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1. INTRODUCTION

Education is one of the most important sectors that any country needs to develop. In educational sector, the learning experts should design learning programs that must be defined well by specifying the learning outcomes of this course and determining the methodology that will be used to make students earn knowledge and skills needed to satisfy these learning outcomes and prepare students to the next learning stages.

Assessment process has always been as an integral part of learning, and teaching. In recent years it has become a focus of attention for students, parents, practitioners, researchers, policy makers and the media.

In addition to teach students new skills and knowledge, assessment is so important to find ways to measure the knowledge and skills level of students continuously. Before conducting the program, determining whether student has the minimum level of skills and knowledge that enable them to interact with the learning program efficiently or not. During learning program, it helps in determining either student's skills and knowledge progress is satisfied or there is problem in learning process. After learning program, it's important to measure the overall achievement in learning program and suggest recommendations that help all partners in the learning environment.

We use the term assessment to summarize all activities that teachers use to help learners learn and to quantify the learning progress and outcomes [1]. The latter in particular means that assessment measures and documents the knowledge, skills and attitudes of an individual learner, a learning community (e. g., class, course, or workshop), or an educational institution.

However, the student assessment in education system is important, the current student assessment systems didn't provide sufficient security issues to protect Student Assessment's processes and data[2-10]. They also didn't provide the total quality perspectives in student assessment field. Finally, they didn't use management approach which enable Assessment System to be more agility like Business Process Management approach.

The contribution of this paper is two-fold. It presents a system that tries to answer the following question: How to build a secured web enabled process management system that manages all student assessment processes. And at the same time the system meets all quality perspective in student assessment field.

This paper is organized as follows. Section 2 reviews related work. Section 3 displays Then Proposed SAPMS Analysis and Design. After that, the SAPMS Implementation Results are shown in section 4. Finally, the system Validation is shown and illustrated.

2. STUDENT ASSESSMENT RELATED WORK

Xiao Ming et al in [2] proposed a Computer- Assisted Assessment and Diagnosis (CAAD) system for arts students-oriented computer education. This system is used for special diagnostic teaching and self-test exercises and final examination. This system is limited as an assessment system, where it doesn't provide student tailored exams for training and self assessment purposes. It also doesn't added quality ILOs in the questions, and doesn't provide question feedback.

Alexandru Botu et al in [3] developed An interactive on-line e-Learning system with assessment component targeted at training public service administration employees and named it SIIPAL system. The assessment component in SIIPAL system didn't relate the test questions with ILOs and knowledge skills they support. Also the system didn't present the security issues used in the system which provide the system reliability and efficiency. It doesn't provide any feedback or recommendations to students or teachers.

Eugene Essa et al in [4] presented a tool, named ABET Course Assessment Tool (ACAT). It is a web-based application designed to assist in the collecting of data and generation of standardized assessment reports. This tool is very good as an assessment reporting tool but has a significant shortage. It depends on capturing the student scores manually and hasn't facility of integrating with other assessment systems which provide exams management system. But this tool prevents teachers from exporting student scores directly into ACAT.

Fahad T. Alotaiby et al in [5] proposed adaptive learning system with assessment that serves both students and teachers. The system consists of three parts teaching, learning and administration. The adaptive learning system proposed by Alotaiby concentrate on two types of persons in the education system; student and teacher; and don't take other parts in consideration like parents, market companies and research centers. The system lakes feedback feature on individual question, test and overall student progress levels.

Andrea Gorra et al [6] provide an account of the use of integrated assessment with a focus on the area of database teaching at Level 2 in the INN Faculty. Integrated assessments are also known as synoptic assessments. Even though group work and peer assessments are important elements of the curriculum, they could not be considered within the scope of this research. They also did not provide a complete view on the assessment and its persons' types.

Judit Jassó et al in [7] report and analyze the assessment component in blended e-learning system called e-studium project which is based on an open-source platform like Moodle. This assessment component depends on the interaction between only student and teacher in the learning environment and ignore other actors. It also doesn't provide training environment for students to evaluate themselves. Although the system is auto grading, student can't see his test score till teacher deliver it to him after assessing process.



2.1 Student Assessment Software (SAS) Comparison:

In this section we will compare between set of SAS currently exist in the market. Our comparison depends on set of references and web sites of these systems.

Table 1. Student Assessment Systems Comparison

	Conegro[39]	Onyx Test Suite[40]	ASDEL project[41,42]	Respondus [43]	Articulate Quizmaker [44]	TCEExam [45]
Application Type	web-based software for Assessment authoring and delivery system	web enabled software consists of set of independent components used to test and evaluate students	Assessment Delivery Engine	Exams Authoring tool	Flash-based quizzes authoring tool	Web-based software to generate and manage online tests and exams
Multi language Support	Yes	No	No	No	No	Yes
Security issue used	Not presented	Not presented	Not presented	Not Presented	Not used	Support 10 access level with IP
Support ILOs	No	No	No	No	No	No
Question bank management	With 15 type of questions	No	Yes	Support 15 type of questions	supports different graded and survey question types	supports both multiple-answer questions and free-answer questions
Exam management	Yes	Yes	Yes	Yes	Yes	Yes
Exam types	Random exam	static exam	Random Exam	Random Exam	Static exam	Random Exam
Examination platform	No	Yes	Yes	No	Yes	Yes
Feedback methods	On Question level, and overall semester level	Individual test feedback	Exam level feedback	No	Question level feedback	No
Assessment reports	set of reports that analyze students performing	Graphical analysis of individual and group result	Results reports	No	Results and actions reports	Results reports
Import&Export facility	Yes	Yes	Yes	Export exams only	Export results to email or LMS	Export exam to pdf format and results to email
Advertizing facility	No	No	No	No	No	No

From comparison stated (see table 1), we found that all systems are not collaborative assessment systems. The most of these systems lack security issues equivalent with the important and sensitivity of system data. They also didn't support ILOs based assessment, all types of feedback (question level, exam level, time period level, individual and group level, and feedback methods between students and teachers for formative assessment). They don't help teacher in creating balanced exam which covers all important items in the course being tested. These systems also don't provide statistical and graphical reports for all types of users.

3. THE PROPOSED SAPMS ANALYSIS AND DESIGN

In this section, we will present high level abstraction of the SAPMS by representing all entities interact with the SAPMS as shown in figure 1. There are three types of entities which interact with the proposed system. First type is those systems in UIS which have roles in the SAPMS by providing data to the system or receiving data from the system. These systems as follow:

- **Faculty Management System**

This system provides the needed data of college's faculty.

- **Education and Student Management system.**

This system provides student's data to SAPMS and receives student's grades.

- **Graduates Studies and Research Management System.**

This system provides data of post graduate studies' students to SAPMS and receives their grades.

- **Learning Management System.**

This system provides all data about modules, topics and ILO's needed for creating question bank and exams and receives data about the learning modules and techniques need to be improved.

- **Engineering Affairs Management System.**

This system provides data of all colleges' physical resources data including laboratories, ateliers, mechanical, and electrical equipments.

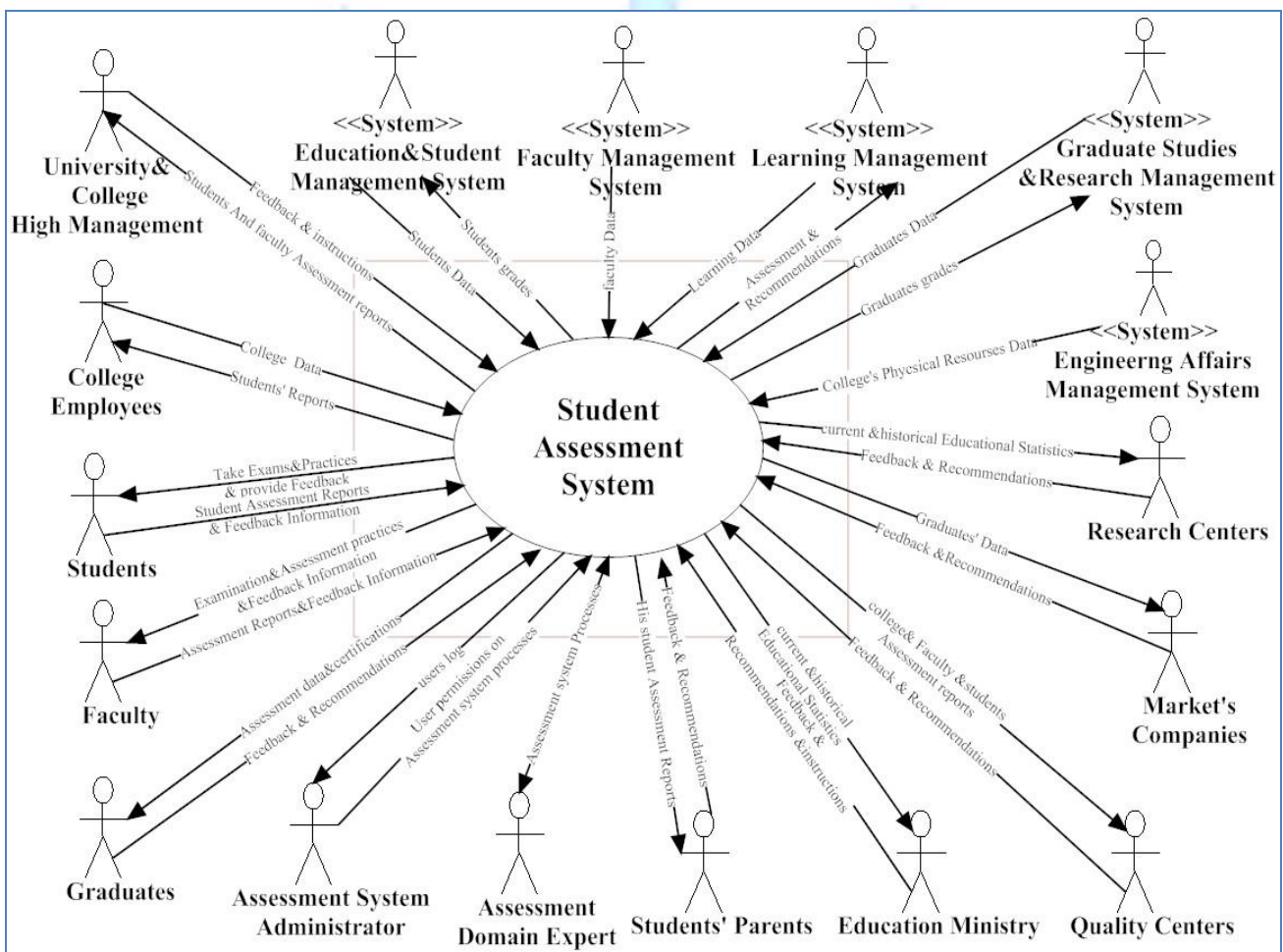


Fig 1: The Use Case Diagram of the SAPMS

The second type is human entities which is the target of the system such as student, faculty and graduates or receive reports from it such as college employee, student's parents, quality center, and university and college high management. The third type of entities is the external entities either governmental such as education ministry, market's companies, or research centers.

To achieve the previous point of view we design an extensive database. Figure 2 represents the general class diagram of the SAPMS database structure.

Fig 4: Manage Students' Data Form

4.2 Quality & Regulations Component

This component automates the college regulations and quality related to assessment processes such as managing courses' topics, defining course Description matrix, defining exam quality matrix for each assessment type (Written, Oral, Practical and Home work)...etc. Figure 5,6, and 7 show the forms which used to manage Quality and Regulations' data.

Topic Name	Week No.	Cognitive skills								Affective Skills			Enabled	Update
		2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	3.1	3.2	3.3		
topic 2	2	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
topic 3	3	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
topic 4	4	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
topic 5	4	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Topic 6	6	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

Fig 5: Manage Course Description Matrix Form

Fundamentals of Programming's Topic Data											
ILOs Matrix											
Cognitive skills								Affective Skills			
2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	3.1	3.2	3.3	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Fig 6: New Course Topic's data Form

Fundamentals of Programming's Quality Exam Matrix Data Entry									
Assessment Type: Written									
Topic Name	Week No.	Cognitive skills			Affective Skills		Topic Percent		
		remembering	Application	Analysis	Receiving	Valuating			
topic 4	4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	30
topic 5	4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	25
Topic 6	6	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	45
Skill Percent		15	20	25	20	20	100	100	

Fig 7: Exam Quality Matrix Form

4.3 Questions Bank and Exam Generator Component.

This component automates the question bank management and exam generating processes such as creating and managing modules' questions data and generating different types of exams like criteria based random exam and quality based random exam. Figures 8,9, AND 10 show the forms which used to manage question's data and generates different types of exams.

Question Data	
Question Text	what is programming language?
Question image	
Topic Name	topic 4
ILOs Skill	remembering
Question Type	Essay
	Model Answer A programming language is a notation for writing programs, which are specifications of a computation or algorithm.
Question feedback	
Exam Question Enabled	<input checked="" type="checkbox"/>

Update Cancel

Fig 8: Manage Question Data Form

Exam Data						
Exam Name	new exam					
Exam Desc	this trial Exam					
Assessment Type	Written	Assessment Time	Midterm			
Start Date	05/19/2011	End Date	05/21/2011			
Start Time	11:00:00	End Time	22:30:00			
Exam Time	50	No. of Questions	10			
Min Score	25	Max score	50			
Active	<input type="checkbox"/>					
Exam Type	Random Exam	ILOs Skill	Select Question skill	No.Of Questions	Question Score	
		Topic Name	Select Topic Name			
		Question Types	Select Question Type			
		Add Cancel				
Skill Name	Topic Name	Question Type	No. Of Questions	Question score	Update	Delete
remembering	topic 4		5	5		
	topic 5		3	5		
	Topic 6	True / False	2	5		

Update Cancel

Fig 9: Criteria Based Random Exam Form

Exam Data			
Exam Name	quality exam		
Exam Desc			
Assessment Type	Home work	Assessment Time	Midterm
Start Date	05/21/2011	End Date	05/22/2011
Start Time	00:10:00	End Time	23:55:00
Exam Time	20	No. of Questions	10
Min Score	5	Max score	10
Active	<input type="checkbox"/>		
Exam Type	Quality Random Exam		
Topic Name	Cognitive skills		Affective Skills
	remembering	Analysis	Receiving
topic 4	2	1	
Topic 6	3	1	3

Update Cancel

Fig 10:Quality Based Random Exam Form

4.4 Control Management Component

This component automates the control processes such as activating examination, determine examined students, send essay questions to faculty to correct them, show exams' results, and manage special cases such as illness cases...etc. Figure 11 shows the forms which used to manage Control processes.

Exam Control Process			
Exam Name	quality exam		
Active	<input checked="" type="checkbox"/>		
Show Result	<input type="checkbox"/>		
Start Date	05/21/2011	End Date	05/22/2011
Start Time	00:10:00	End Time	23:55:00
Examined Students	<input type="radio"/> All Students <input checked="" type="radio"/> Group Of Students		
Student Name			
<input checked="" type="checkbox"/>	محمد احمد ابراهيم		
<input type="checkbox"/>	تادرس سيقب الدين		
<input type="checkbox"/>	وليد محمد ابراهيم		

Save Process Cancel

Fig 11: Exam Control Form

4.5 Exam Engine component

This component manages all types of examination process such as random exams, quality based exams, written exams, oral exams, practical exams, homework exams...etc. Figures 12 and 13 show the forms which used to manage Examination process.



Current Semester Opened Exams List						
Fundamentals of Programming						
Assessment Time	Assessment Type	Exam Name	Start Date	End Date	Start Time	End Time
Midterm	Written	new quality written exam	2011-05-29	2011-05-31	10:00:00	22:00:00
Human Rights						
There are No Exams !!						
Discrete Mathematics						
There are No Exams !!						
English for Computer Science						
There are No Exams !!						
Fundamentals of Computer Science						
There are No Exams !!						
Physics						
There are No Exams !!						

Fig 12: Current Semester courses and available Exams list

College Name : Computer Science & Information system
Department Name : General
Class Name : First Class

Fundamentals of Programming Exam
Assessment Time : Midterm
Assessment Type : Written

Total No. of Questions : 10
Exam Time : 20 Mintes
Exam Score : 25
Pass Score : 50

Start Time : 22:10:43 End Time : 22:30:43

Q. 1 2.5 marks

If there is more than one statement in the block of a for loop, which of the following must be placed at the beginning and the ending of the loop block?

parentheses ()
 braces { }
 brackets []
 arrows < >

Q. 2 2.5 marks

..... member function of CWinThread class provides implementation of message loop.

Q. 3 2.5 marks

The parameter list (or argument list) contains all objects used by the function.

Q. 4 2.5 marks

What's wrong? for (int k = 2, k <=12, k)

the increment should always be k
 the variable must always be the letter l when using a for loop
 there should be a semicolon at the end of the statement
 the commas should be semicolons

Fig 13: Examination Form

4.6 Evaluation Component

This is the most important component of the SAPMS. This component used to evaluate students' examination data and provide information and statistics which demonstrates the progress in students' performance and strength and weak points in students' performance. Figure 14 and 15 show the sample of statistical and graphical representation of assessment reports provided by th SAPMS.

Fundamentals of Programming Exam					
Exam Name	new quality written exam				
Exam Description					
Assessment Time	Midterm				
Assessment Type	Written				
Total No. of Questions	10				
Exam Time	60 Mintes				
Exam Max Score	50				
Exam Pass Score	25				
Student Score	25				

Details Result Representation Form					
Per Skill					
Skill Name	No.Of Questions	Correct Answers	Wrong Answers	correct answer per skill Ratio	correct answer per Exam Ratio
remembering	1	1		100 %	10 %
Comprehension	2	2		100 %	20 %
Application	3	1	2	33.3333333333 %	10 %
Evaluation	2	1	1	50 %	10 %
Receiving	2		2		
Valuating	2		2		
Organization	2		2		
Totals	10	5	5		50 %

Details Result Representation Form					
Per Topic					
Topic Name	No.Of Questions	Correct Answers	Wrong Answers	correct answer per skill Ratio	correct answer per Exam Ratio
topic 4	3	1	2	33.3333333333 %	10 %
topic 5	4	2	2	50 %	20 %
Topic 6	3	2	1	66.6666666667 %	20 %
Totals	10	5	5		50 %

Fig 14: Evaluate Student Exam Per Skill &Per Topic Statistical Form

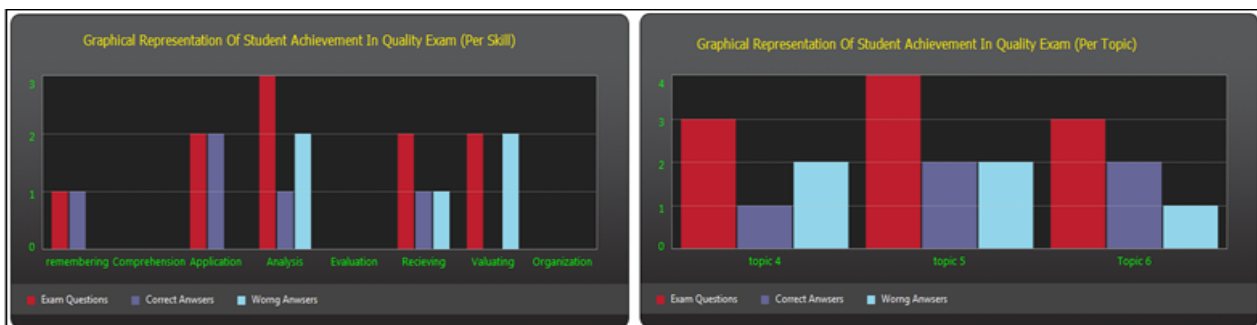


Fig 15: Evaluate Student Exam Per Skill &Per Topic Graphical Form

5 SAPMS VALIDATION

In the following section, we will illustrate the validation study that had been performed in this thesis.

5.1 Study Objective

Measure the effect of using SAPMS on detecting the performance’s strength and weakness of both instructor and students and improve their performance in teaching and learning.

5.2 Study Sample

- 100 students in 1st year in Electrical Engineer Department (EED) - Faculty of Engineering – Mansoura University.
- 100 students in 2nd year in EED- Faculty of Engineering – Mansoura University.
- Study had been performed using 2 courses of Electrical Engineer Program of 1st and 2nd year. These courses were taught by one instructor “Dr. Ahmed Elsayed Hassan”.

5.3 Study Procedures

- Data of courses had been entered (ILOs, Course Description, Topics, and Exam Quality Matrix).
- The question bank of the 2 courses had been built by saving 50 questions of different types, skills, and topics for each course.
- Students’ data had been recorded and accounts data sent to each one of them.
- One Quality Based Exam was built for each course. Each exam composed of 10 questions which are randomly selected. Each exam’s time was 30 minutes.
- “First Time Exam” had been made for all students in each course.
- Display results for each student and expose his strength and weakness points in his performance to improve his performance.
- Display these results to instructor as follow:
 1. Overall students result is displayed exposing the strength and weakness points in their overall performance to guide instructor to improve his teaching methods and concentrate on shortage points.
 2. Show results for each individual student which can be used by instructor as recommendation feedback to students.
- Another Quality Based Exam “Last Time Exam” with the same characteristics of the first time exam.
- Compare the results of the “First Time Exam” and “Last Time Exam” and display the comparison results for each student and for all students.

5.4 Study Results:

- **For Overall Students**

1. Fundamental of Programming Course of 1st Year of EED:

Fundamental of Programming

Skill Name	No.Of Questions	First Time Exam		Last Time Exam	
		Correct Answers	correct answer per skill Ratio	Correct Answers	correct answer per skill Ratio
remembering	300	250	83.33333333 %	263	87.66666667 %
Analysis	100	43	43 %	65	65 %
Evaluation	100	19	19 %	49	49 %
Reclieving	200	176	88 %	180	90 %
Valuating	100	52	52 %	64	64 %
Organization	200	135	67.5 %	143	71.5 %
Totals	1000	675	67.5 %	764	76.4 %

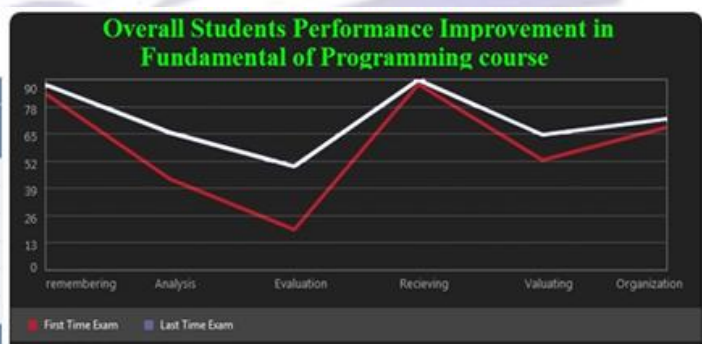


Fig 16: Students Performance improvement in Fundamental of Programming Course



2. Matlab Course of 2nd Year of EED:

Matlab Course

Skill Name	No.Of Questions	First Time Exam		Last Time Exam	
		Correct Answers	correct answer per skill Ratio	Correct Answers	correct answer per skill Ratio
remembering	200	120	60 %	147	73.5 %
Comprehension	100	64	64 %	72	72 %
Application	500	316	63.2 %	375	75 %
Analysis	100	51	51 %	69	69 %
Organization	100	70	70 %	76	76 %
Totals	1000	621	62.1 %	739	73.9 %

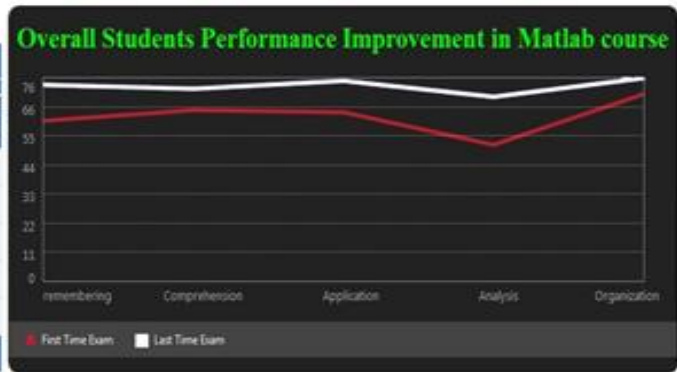


Fig 17: Students Performance improvement in Matlab Course

3. 2 Courses:

2 Courses Skills Improve

Skill Name	No.Of Questions	First Time Exam		Last Time Exam	
		Correct Answers	correct answer per skill Ratio	Correct Answers	correct answer per skill Ratio
remembering	500	370	74	410	82
Comprehension	100	64	64	72	72
Application	500	316	63.2	375	75
Analysis	200	94	47	134	67
Evaluation	100	19	19	49	49
Receiving	200	176	88	180	90
Valuating	100	52	52	64	64
Organization	300	205	68.33333333	219	73
Totals	2000	1296	64.8	1503	75.15

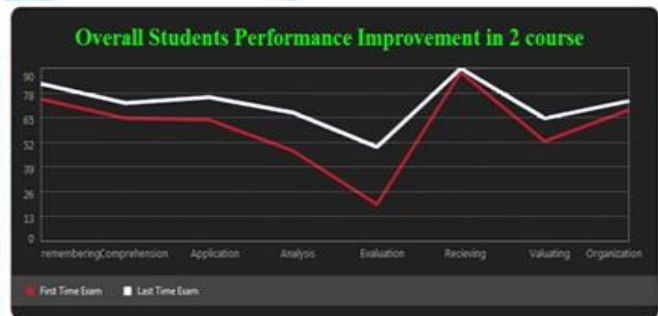


Fig 18: Overall Students Performance improvement in 2 Courses

- For Individual Student

1. One Student of 1st year of EED:

Fundamental of Programming

Skill Name	No.Of Questions	First Time Exam		Last Time Exam	
		Correct Answers	correct answer per skill Ratio	Correct Answers	correct answer per skill Ratio
remembering	3	2	66.666666 %	2	66.666666 %
Analysis	1	1	100 %	1	100 %
Evaluation	1	0	0 %	1	100 %
Receiving	2	1	50 %	1	50 %
Valuating	1	0	0 %	1	100 %
Organization	2	1	50 %	2	100 %
Totals	10	5	50 %	8	80 %

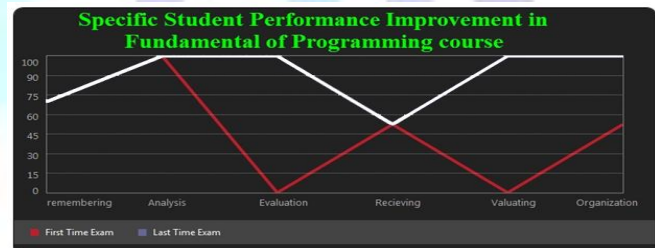


Fig 19: Individual Student Performance improvement in Fundamental of Programming Course

One Student of 1st year of EED:

Matlab Course

Skill Name	No.Of Questions	First Time Exam		Last Time Exam	
		Correct Answers	correct answer per skill Ratio	Correct Answers	correct answer per skill Ratio
remembering	2	1	50 %	1	50 %
Comprehension	1	0	0 %	0	0 %
Application	5	3	60 %	4	80 %
Analysis	1	0	0 %	1	100 %
Organization	1	1	100 %	1	100 %
Totals	10	5	62.1 %	7	70 %

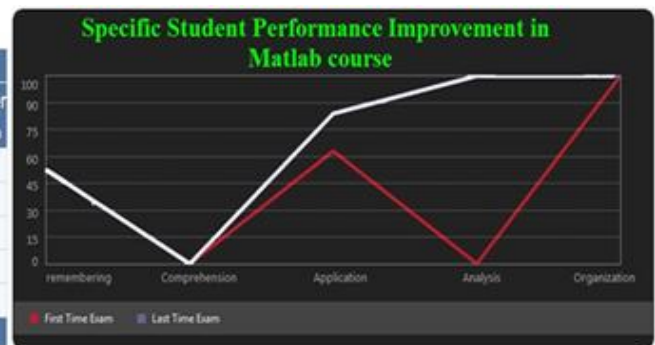


Fig 20: Individual Student Performance improvement in Matlab Course



Based on those results, a validation study is presented to measure the effect of using SAPMS in detecting Students' and instructors' performance strength and weakness points and curves which show the student and instructor performance impacts are displayed.

Conclusions

We provide new student assessment system based on quality perspectives which aides all stockholders in educational environment in improving their performance to reach better results. Our system is called SAPMS. The analysis and design of the proposed system were presented briefly. After that we showed set of screen shots of that represent the developed system. Finally, we illustrated the validation process which performed on students of two classes in two subjects for each class. This validation showed the student strength and weakness points in their skills and for each topic which help both students and teachers of them from improving the student's skills.

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