A Proposed Web-based System to Evaluate the Performance of Course Learning Outcomes Based on Educational Process: By Using Ordinal Scale Approach

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***Abstract**:* This study aims to develop a web-based system that evaluates the teaching process based on the course learning outcomes. It includes the active involvement of both the course teacher and the enrolled students on the course. Usually, the teacher delivers the course contents by following the course specification and the course learning outcomes. Here, the teacher is a source of equipping students with all the necessary information about the course and the assessment policies. The students participate in the scheduled assessments, and the teacher evaluates students' performances based on the course learning outcomes. Significantly, the presented study applies the ordinal scale method for evaluating the students' performances in the conducted assessments. The students' performances are measured, and the outcomes help the teacher understand the students' learned skills of the course. Further, the result of the measured outcomes uses for the program performance evaluation at the end of the academic cycle. The presented approach is easy to adapt for any academic course in higher education and enables an effective approach for performance evaluation.

Keywords: web-based system; educational process; course outcomes; bloom taxonomy;

1. Introduction

Education is one of the continuous processes of human life. This process is prepared as per the requirements of the society in a systematic way. The quality of the academic performance is measured based on the activities defined in the course specification. By following the instructions available in the course specification, which help improve learning activities and serve the community in a specific area [1-3].

Generally, any educational program consists of three parts (i) the aim of the program (ii) the teaching process, and (iii) the performance evaluation. For any program, the aim is one of the essential elements and guides for planning and developing of the environment, efficiency, and experiences. It defines the features such as knowledge, skills, and attitudes. Teaching models or the processes help in learning and teaching to gain the predefined objectives. For instance, one of the forefronts of these models is the Mastery learning model, which offers an orderly teaching plan. The other one is the Evaluation model, which follows measurement to check what goals have been achieved through the educational process [4-5].

Similarly, this study develops a web-based application that allows faculty members to create, edit, store, and display course descriptions in their respective courses. The course description orients students to course topics and course learning outcomes by clarifying knowledge and skills to be learned from the course content. It includes the major learning strategies and activities that students will experience during the course delivery. It articulates the specific outcomes that students will achieve in the course. It helps to identify how these outcomes will be measured and assessed. It also includes course information such as textbooks, reference books, teaching, and assessment policies.

The presented study develops an easily accessible online system that is visually attractive and user-friendly. This system caters simultaneously to the different needs of students and academic staff. It provides them with a clear overview of the course description. They need to follow the educational process defined in the course description. The proposed system enhances students' learning by improving awareness of their positions within the curriculum. The system includes a clear step-by-step description of each component of particular skills or knowledge needed for the courses.

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- To contribute to vision 2030 by improving the the educational process outcomes and improvinging students' skills.
- To articulate the specific outcomes that students will achieve in the course.
- To provide students easy access to the course-related information.
- To provide a mechanism that ensures the achievement of desired scientific results.
- To find a mechanism that improves the educational process and the course delivery.

2. Literature Review

Improving curriculum and achieving learning goals are possible by making the academic program content visible and accessible. Mapping learning objectives with the curriculum in higher education is a very important aspect of quality learning and teaching. The adverse effect of mapping is further amplified by the lack of student awareness about the curriculum. Several studies argue the importance of the visibility of learning trajectories across the curriculum and discuss the implementation of a digital curriculum mapping tool. This study introduces and discusses the process and evaluation of the implementation of an interactive digital curriculum mapping tool that has been designed at Utrecht University. The tool was developed to assist academic developers and supervisors in negotiating the problems and facilitating processes of improving curriculum alignment and visibility of learning trajectories for teachers and students [6].

The Evaluation of the Cognitive Learning Process of the Renewed Bloom Taxonomy Using a Web-Based Expert System. This study aims to develop a web-based expert system (WBES) that provides analysis and reports based on the cognitive processes of Renewed Bloom Taxonomy (RBT). It presents the impact of supportive education provided in line with these reports on the academic achievement and mastery learning state of the students. The study was carried out in a quantitative method, and pre-test, post-test matching control group model of semi-experimental designs have been used [7].

Evaluating the satisfaction level of ABET guidelines. The student outcomes compare with Course Learning Outcomes (CLOs) by implementing the proposed model. The study relied on a continuous evaluation to reach a specific level of program satisfaction, mainly through students' evaluation. This will be analyzed through the percentage of students with a specific level of success in direct evaluations. The study also provided a simple way to transfer evaluation data based on learning outcomes. The course performance is measured, and the data analyzed based on student learning outcomes through the CLO-SO mapping [8].

Assessing learning outcomes through students' reflective thinking. In this study, the authors focused on obtaining comments from students about learning outcomes to give feedback about the tasks they accomplished. At the end of the course delivery, a summary report is developed, which includes the feedback analysis result and evidence are being stored as defined in the course specification. The summary reports are very useful information for both teachers and students that can be worked on to improve the course [8].

This study provides an innovative way to evaluate the students' educational performance based on their participation. The proposed model analysis the dataset by following the sample of dynamic modeling framework of Ding and Lehrer. The dataset is used to analyzes the performance and between learning activities, including lectures and educational programs [9].

3. Method

The proposed model relies on several methodologies, such as the analysis and design of the web-based system is the WEBML. The purpose of using this methodology is to analyze, design, and implement a web-based system. It saves the course-related information for future use and by the guidelines of the department quality unit. Further, the methodology uses tracking features and follows the educational process based on the ordinal scale to assess students' understanding and performance in a specific course. The performance is measured based on the students' participation and their responses to the course topics. Finally, the

performance analysis maped to the course learning outcomes [10-16] and stored the result for future use in the department.

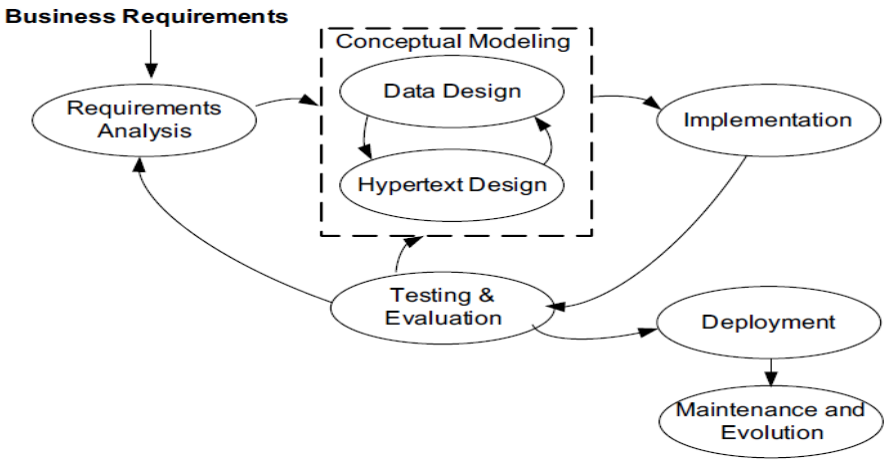

Figure 1. WebML Methodology

Figure 1 describes the relationship between the components of the methodology design. It shows the requirements analysis that links to conceptual design and modeling. The conceptual design explains both data design and hypertext design. Further, the figure also shows the logical relationship between testing and evaluation, implementation, deployment, and maintenance and evaluation.

The ordinal scale has the property of both identity and magnitude; it is a set of ordered values. A scale which "measures" in terms of such values as "more" or "less" "larger" or "smaller". The size of the intervals is not specified; rankings represent ordinal scales. This is qualitative or categorical type, can be used for determining the mode, percentage, chi-square, median, percentile rank, or rank correlation [17-20].

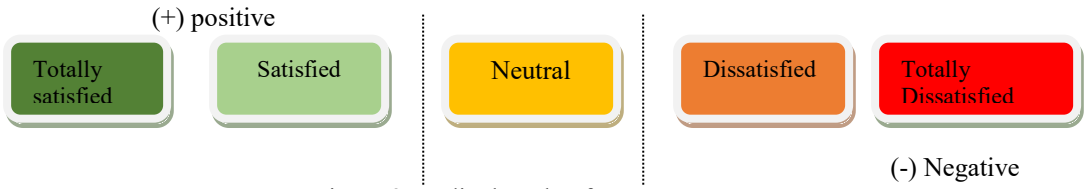

Figure 2. Ordinal Scale of Measurement

Figure 2 shows the scale of measurement. It shows the level of measurement (i) positive scale (satisfied & totally satisfied), (ii) neutral, and (iii) negative scale (dissatisfied and totally dissatisfied).

4. Data Collection

The data was collected at King Khalid University through personal interviews with several faculty members and the other academic staff who are involved in the educational process. **Table 1** shows the participants involved in the interview process. We asked them the following questions:

RQ1: Why do you need to evaluate the educational activities?
RQ2: How do you define the course learning outcomes?
RQ3: Do you follow any taxonomy?
RQ4: Do you feel a specific system is required in the evaluation process?

Table 1. Types and count of members involved in the interview

Type of members	count	Years
Faculty members	25	2019- 2020
Quality Coordinator	3	2019- 2020
Academic audit cell	2	2019- 2020

Apart from the interview, the data is also gathered from the previous course reports on different semesters between the years 2019 to 2020, via quality units in King Khalid University.

5. Analysis Process Diagrams

A. Use Case Diagram

Use case diagrams are generally recognized as behavioral diagrams and use to represent a set of functional activities (use cases). Any use case must supply some observable and valuable outcome to the system's actors or other stakeholders of the system [21].

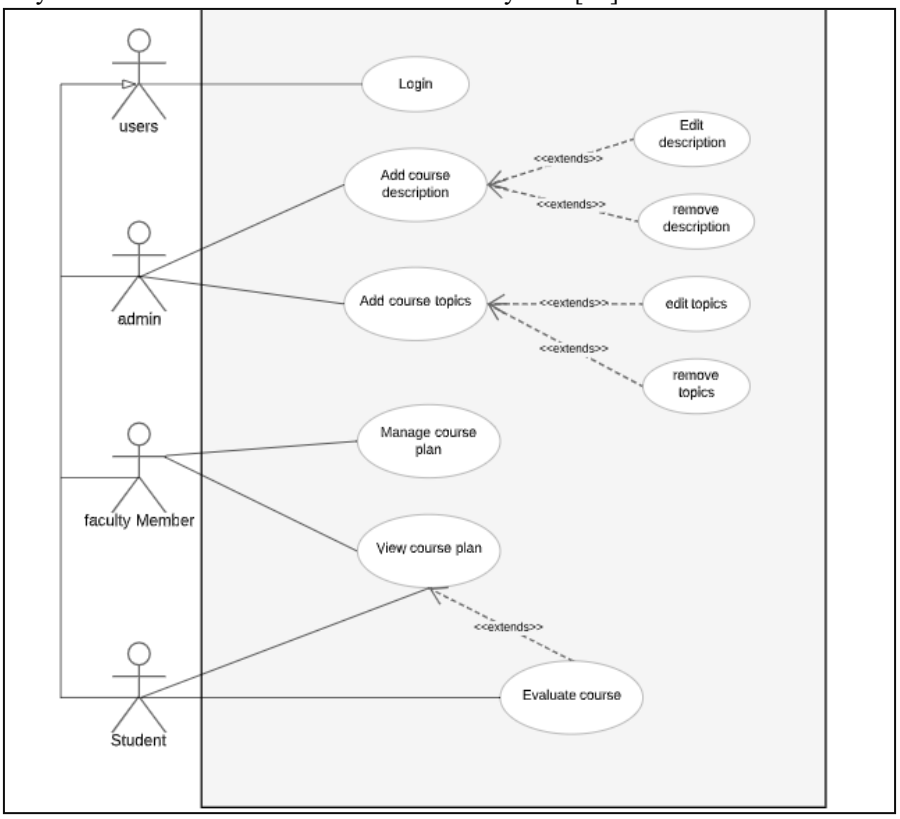

Figure 3. Use Case Diagram

Figure 3 describes a use case diagram that shows the actions of actors (users, admin, faculty, and students). The actors perform the actions in the related scenarios and hierarchies.

B. Entity Relationship diagram

An entity-relationship diagram represents the relation between the system's entities in a particular field of knowledge. A basic ER-model is collected of entities and their types. This also identifis the potential relationships between entities from the entire system (instances of those entity types) [22]. This relation discusses between the courses entities [23-24]

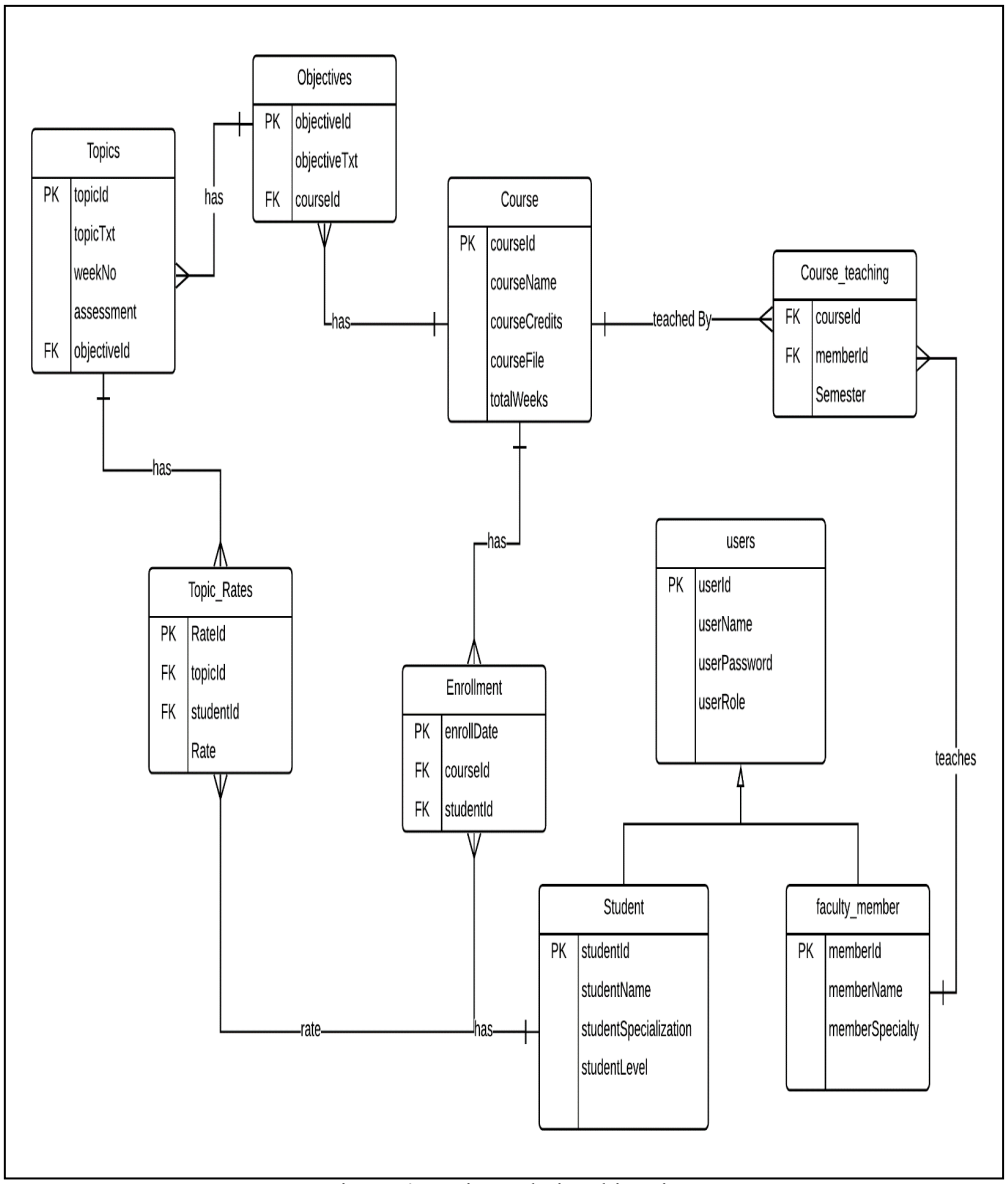

Figure 4. Entity Relationship Diagram

Figure 4 describes the relationships between the entities. It shows 9 entities, i.e., topic, student, and the possible mapping between the entities. In the figure, the topic is an entity, that maps with entities topic-roles and objectives; between these entities the possible relation is shown with the relation,..

6. Design

A. Design Process Diagram:

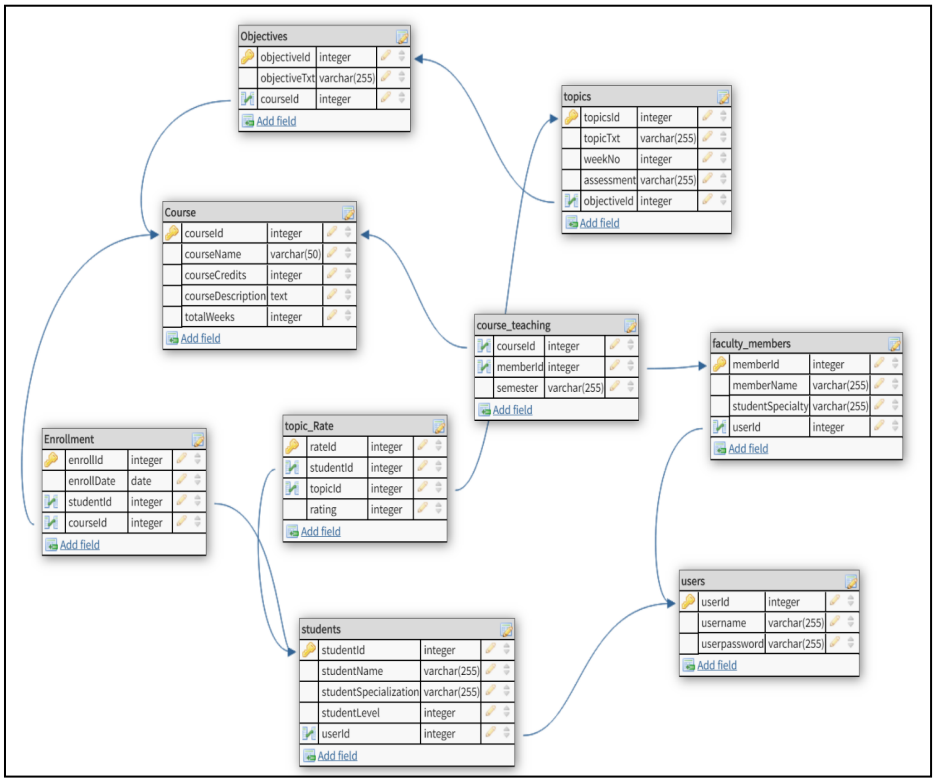

Figure 5. Database Relational Model

Figures 5 describes the relational model of the design strategy. It shows 9 entities with their attributes and potential relations among them.

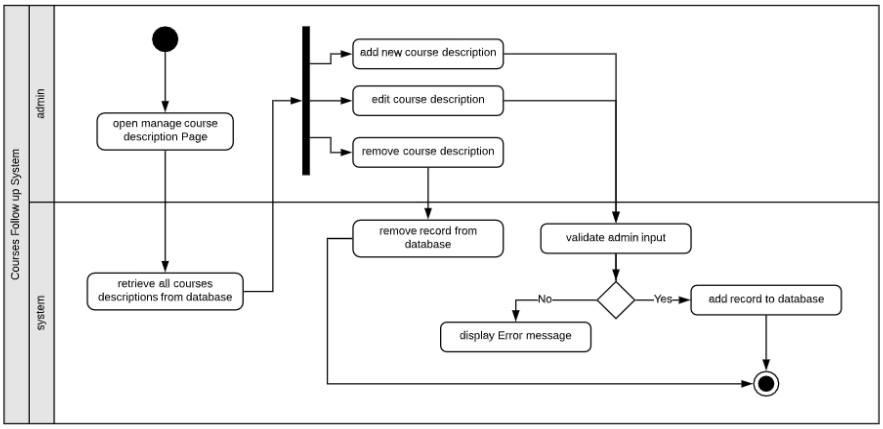

Figure 6. Manage Course Description

Figure 6 shows the process of managing the courses using activity diagram. It shows in 2 levels, one the activities perform at the system level and the second at the administration level.

As shown in Figure 6, the system admin will login in the system and manage the course description feature to insert, update or remove the activities and the description of specific the course. The system will validate admin input before action taken against the system database.

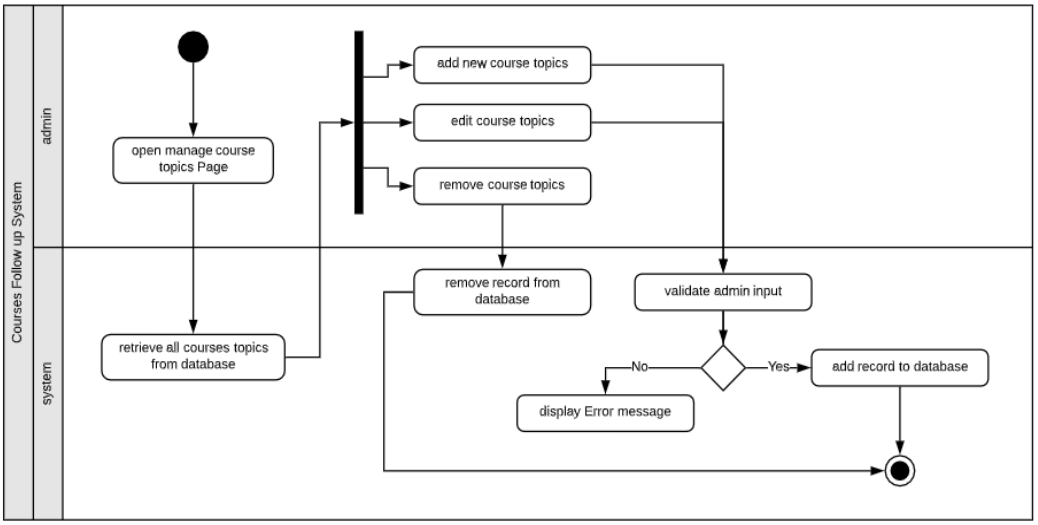

Figure 7. Manage Course Topics

As shown in Figure 7 system admin will login to the system and use manage course topics feature to insert, update or remove topics of a specific course. The system will validate admin input before action taken against system database.

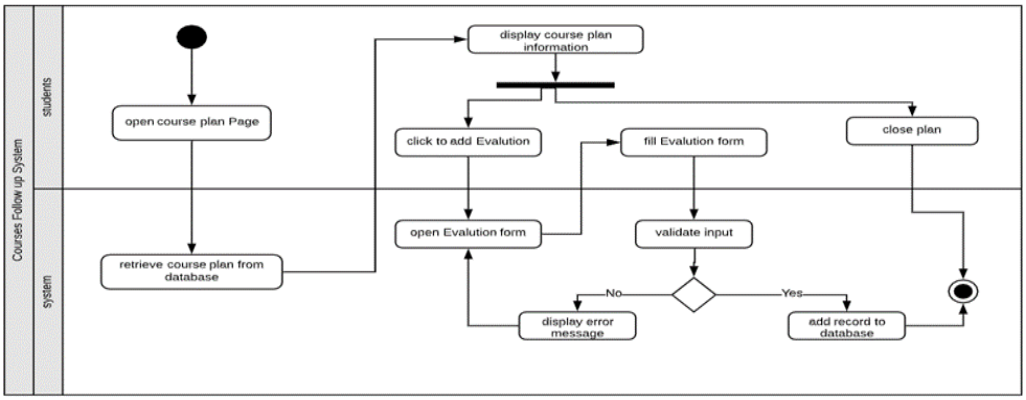

Figure 8. Display Course Plan and Evaluate Course

Figure 8 shows the process of managing the courses using an activity diagram. It shows in 2 levels, one of the activities perform at the system level and the second at the administration level.

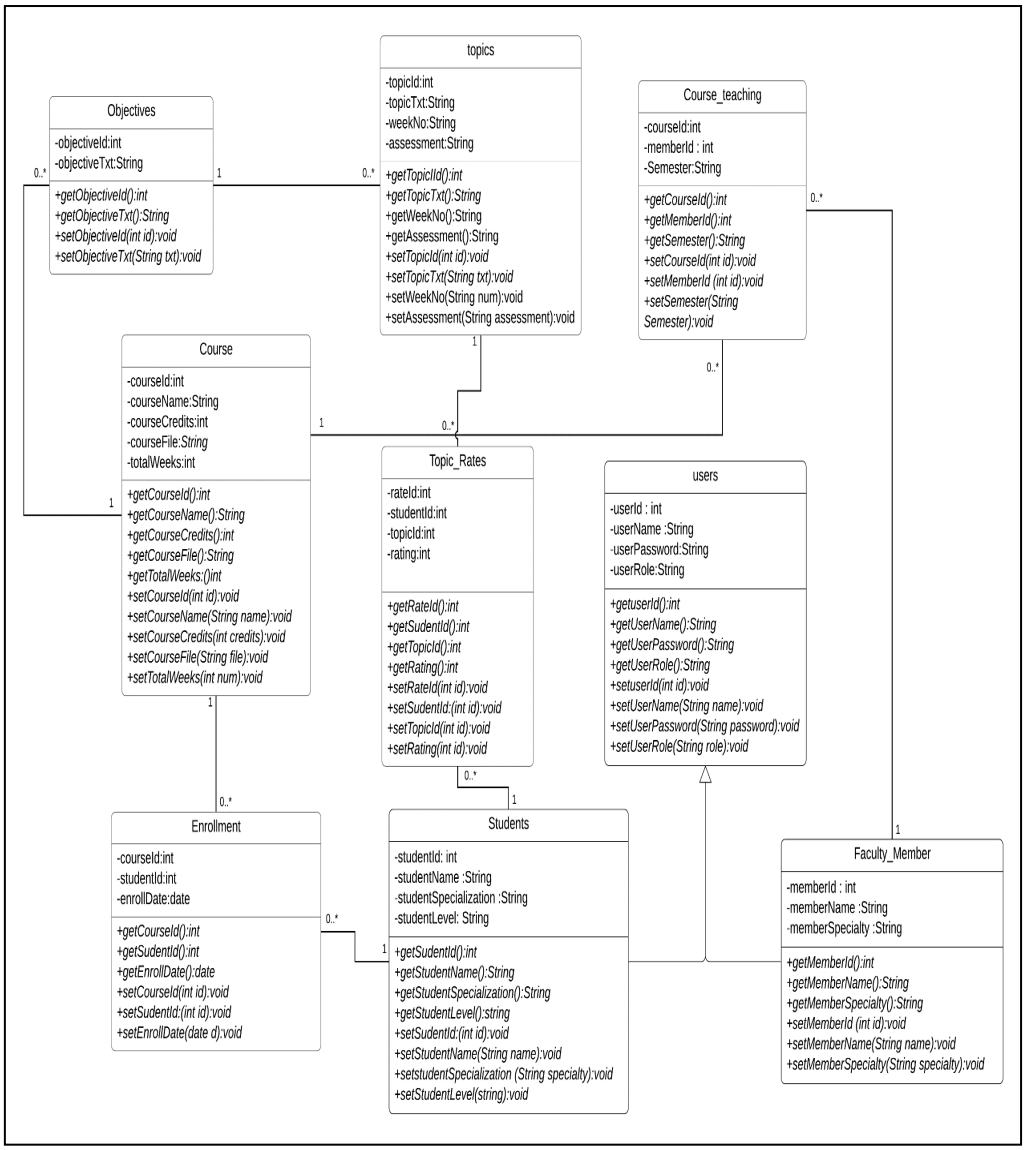

Figure 9. Class Diagram

Figure 9 shows the class diagram of the proposed system. It consists of 9 classes, which in turn splits into three segments, (i) class name, (ii) Attributes and their types, and (iii) the functions associated with these entities.

B. Equation Design to calculate course evaluation via CLO

1. Define courses $C_t = \{C_1, C_2, C_3, \dots, C_n\}$
2. Define the course learning outcomes $C_{lo} = \{lo_1. lo_2. lo_3 \dots . lo_n\}$.
3. Define the students $C_{std} = \{std_1. std_2. std_3 \dots . std_n\}$.
4. Make evaluation to students learning outcome set

$$STD_{set} = \{STDlo_{1\ of\ 5}, STDlo_{2\ of\ 5}, STDlo_{3\ of\ 5}, STDlo_{4\ of\ 5}, STDlo_{5\ of\ 5}\}$$

5. Define total number of students evaluate

$$TNSTD = NSTDlo_{1\ of\ 5} + NSTDlo_{2\ of\ 5} + NSTDlo_{3\ of\ 5} + NSTDlo_{4\ of\ 5} + NSTDlo_{5\ of\ 5}$$

6. Calculate the average of students evaluate to the course depend on all student learning outcomes

$$AVSTD_{set} = \frac{(NSTDlo_{1\ of\ 5} + NSTDlo_{2\ of\ 5} + NSTDlo_{3\ of\ 5} + NSTDlo_{4\ of\ 5} + NSTDlo_{5\ of\ 5})}{STD_{set}}$$

- $if\ AVSTD_{set} = STDlo_{1\ of\ 5}\ then\ the\ student\ satisfaction\ is\ Totally\ Dissatisfied$
- $if\ AVSTD_{set} = STDlo_{2\ of\ 5}\ then\ the\ student\ satisfaction\ is\ Dissatisfied$
- $if\ AVSTD_{set} = STDlo_{3\ of\ 5}\ then\ the\ student\ satisfaction\ is\ Neutral$
- $if\ AVSTD_{set} = STDlo_{4\ of\ 5}\ then\ the\ student\ satisfaction\ is\ Satisfied$
- $if\ AVSTD_{set} = STDlo_{5\ of\ 5}\ then\ the\ student\ satisfaction\ is\ Totally\ Satisfied$

Table 2. Symbol Description

Symbol	Description
C_t	Total number of courses
C_{lo}	Course learning outcomes
C_{std}	Students
STD_{set}	Set of student evaluation course learning outcomes
$TNSTD$	total number of students evaluate
$AVSTD_{set}$	Average of students evaluate course learning outcomes
$STDlo_{1\ of\ 5}$	Students Totally Dissatisfied
$STDlo_{2\ of\ 5}$	Students Dissatisfied
$STDlo_{3\ of\ 5}$	Students Neutral
$STDlo_{4\ of\ 5}$	Students Satisfied
$STDlo_{5\ of\ 5}$	Students Totally Satisfied

C. *Interface Design*

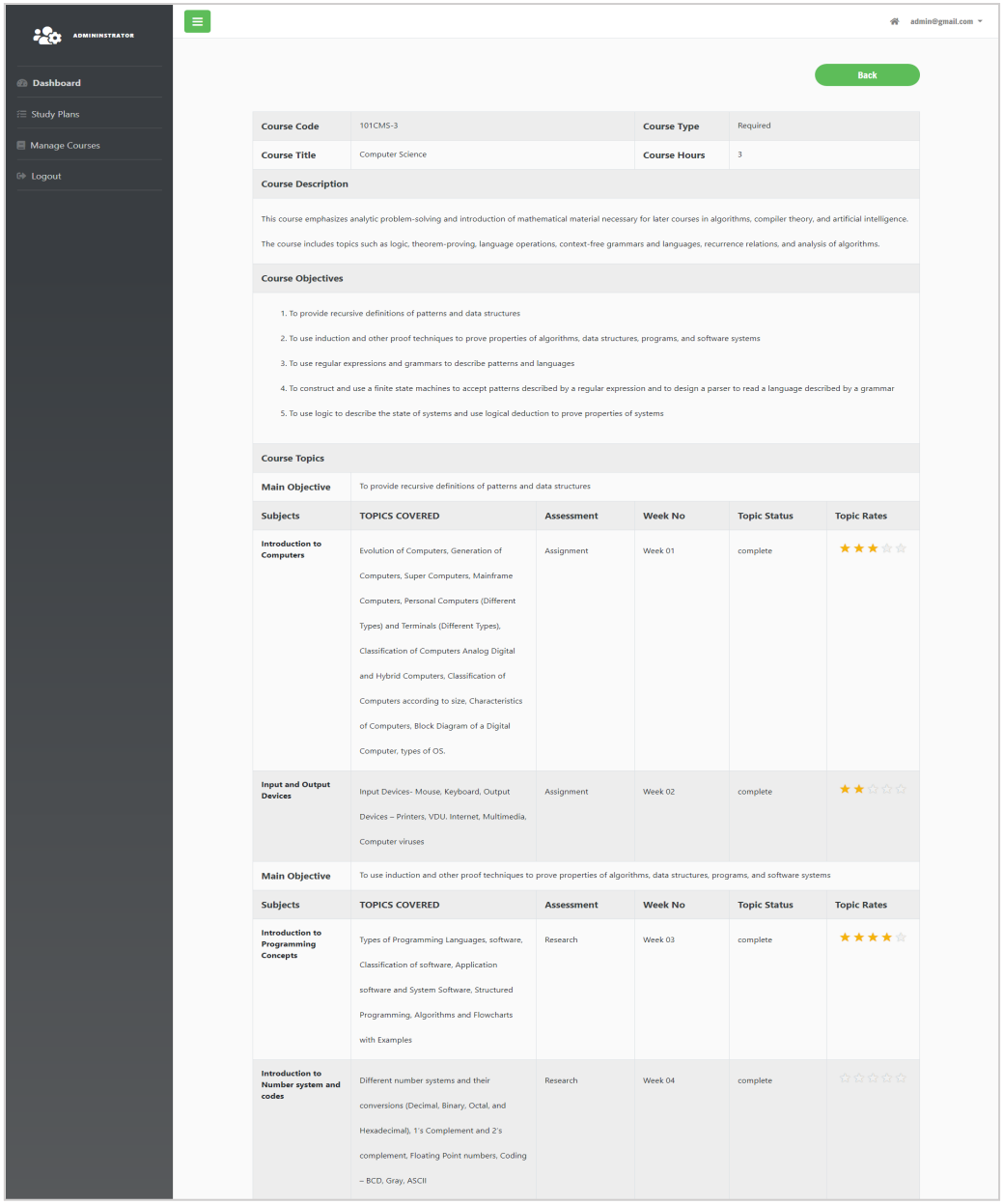

Figure 10. View Course Study Plan and Topics evaluating

Figure 10 shows the detailed report that includes course topics, assessment plan, and assessment evaluation result. It also shows the tracking of course coverage, such as the topics covered.

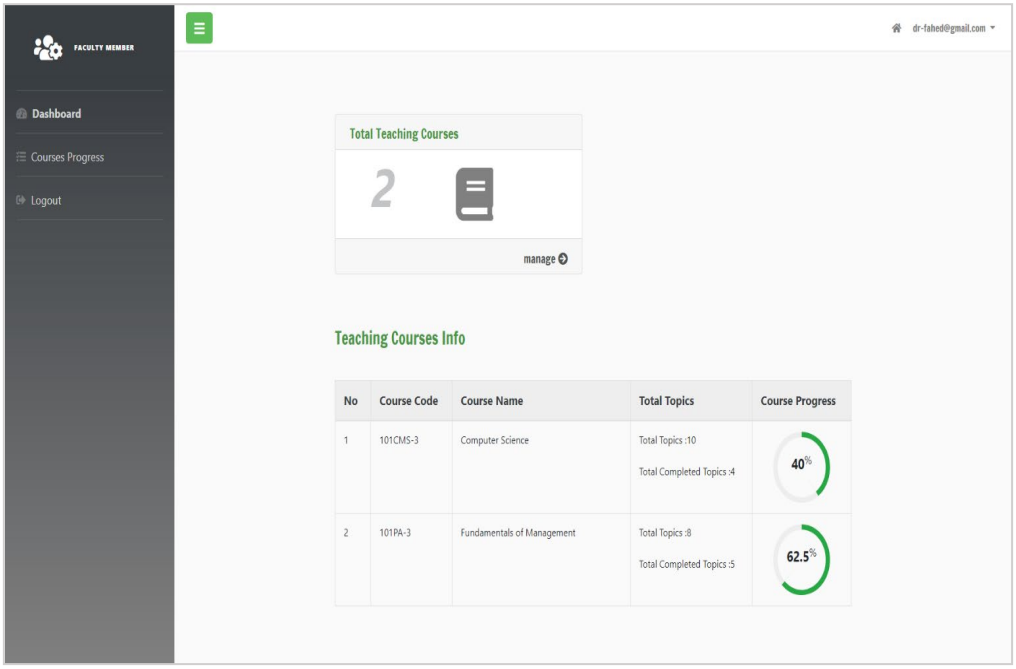

Figure 11. Faculty Member dashboard interface

Figure 11 shows the performance activities of faculty members. It shows information about teaching courses, topics tracking, and course progress.

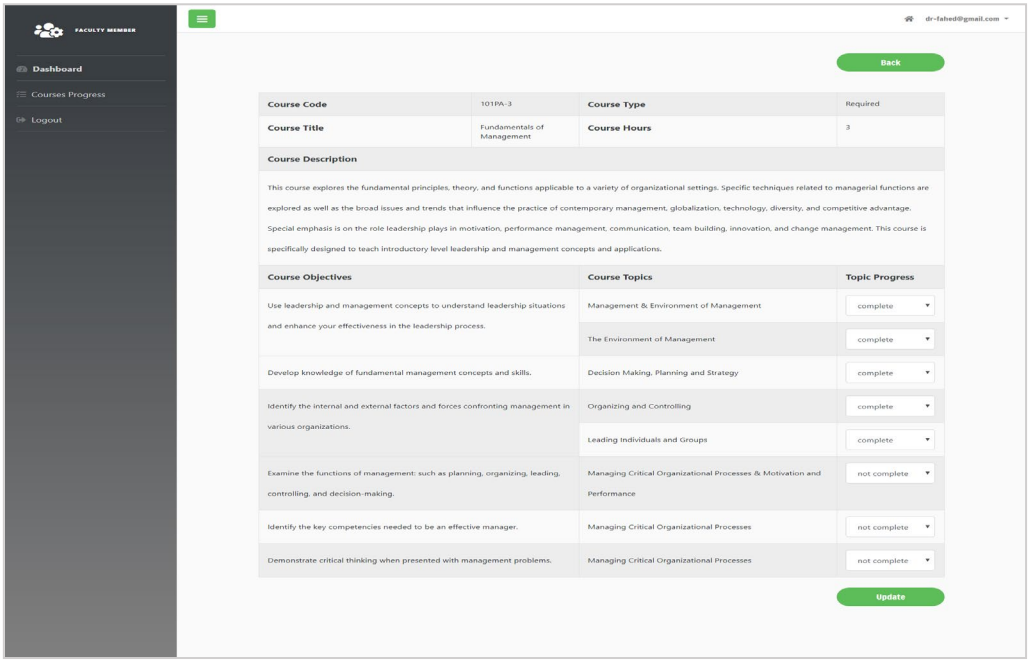

Figure 12. Manage Course Progress interface

Figure 12 describes the course details. It shows the course contents, such as course name, course code, course description, learning outcomes, objectives, and other course-related information.

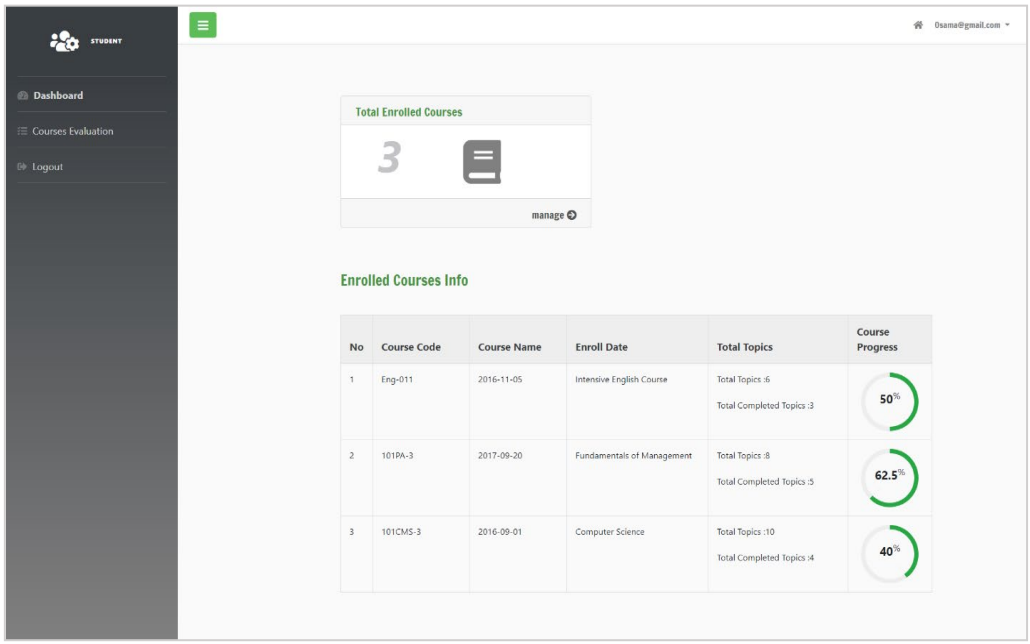

Figure 13. Student dashboard interface

Figure 13 describes the student's dashboard. It includes several components, such as course information, enrollment date, topics in the course, and finally, the students' performance in the enrolled courses.

7. Implementation and result analysis

The proposed system has gone the practical implantation by all the stakeholders. They used the system for activities such as course delivery, performance evaluation, course assessments, and evaluation. The system was used for the first semester of the academic year 2019-2020. All most all the teachers have used the system and influenced by the systems' contribution to minimize their efforts on the academic activities that they performed. Table 3 describes the responses of the stakeholders about their experiences during the implementation of the system. The stakeholders' feedback is encouraging, and they are recommending other teachers who have not been used.

Table 3. Implementation results of the proposed system

Type of users	Faculty members		Quality Coordinator		Academic audit cell		Academic audit cell	
	Total 30		Total 7		Total 3		Total 150	
	Satisfied	Not satisfied	Satisfied	Not satisfied	Satisfied	Not satisfied	Satisfied	Not satisfied
	25	5	6	1	3	0	120	30

8. Conclusion

The proposed model is unique in its features and provides the ability to manage all the activities needed to deliver an academic course in higher education. The faculty members handling their courses have full freedom to access and update materials and perform the required activities about their courses. Students also equally benefited from these activities by their teachers. The system also provides the ability to measure the course learning outcomes

using students 'evaluation practices of the course contents. The measured outcomes give a detailed report of students learning with respect to their performance levels.

Importantly, the proposed system's additional features includes managing course-related documents (e.g., course specification, course reports, etc.) and controlling these documents. It provides user-friendly environment for both faculty members and students. The faculty members have full access to their course activities, whereas the students have restricted access. The proposed system is designed considering all types of courses of an academic program. Educators should consider such a system for academic and research purposes.

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