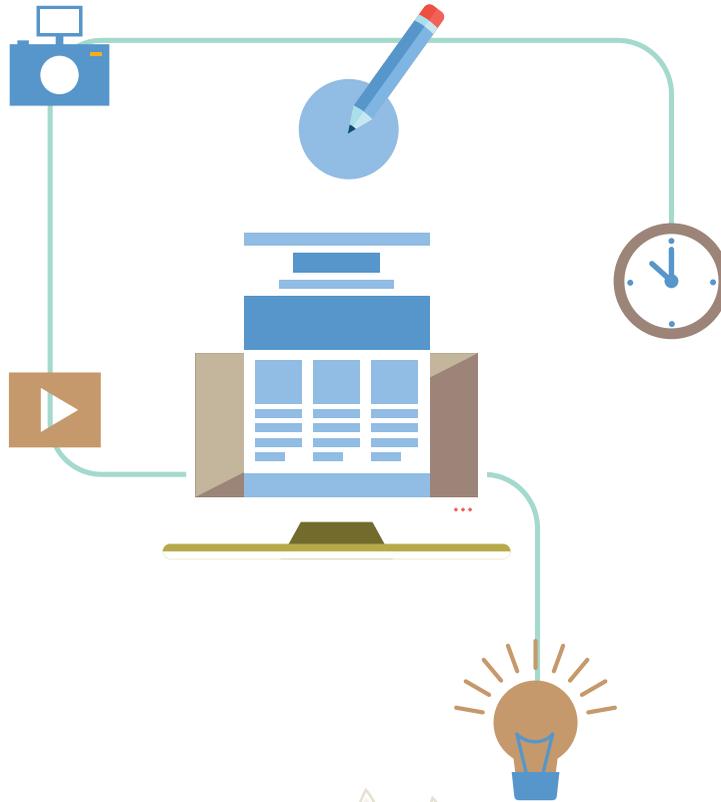


LEARNING OUTCOMES INFORMATION SYSTEMS



بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

مخرجات التعلم

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·⦿· Introduction :

Higher Education in Saudi Arabia has witnessed a rapid development in the recent years, through inaugurating new public and private universities around the country. However, this may have an impact upon the teaching system in general and program outcomes in particular. Therefore, the Ministry of Education has endeavored to improve the quality of program outcomes in all Saudi universities. It then launched the project of learning outcomes (LOs) in Higher Education, in collaboration with the National Center for Assessment in Higher Education. The Bologna process which focuses primarily on LOs has been adopted widely, particularly in most European countries. Thus, this promising project will draw on the Bologna process to come up with LOs for academic programs that are being taught in Saudi universities.

LOs are basically used to ensure the quality of learning and teaching. By using them, it becomes easier to compare two different programs of the same major (i.e. benchmarking). They also help academic departments and teachers to develop course materials and determine course objectives. More importantly, they play a key role in linking teaching and learning with assessment and assisting academic programs to gain accreditation.

Furthermore, LOs have some benefits for students (stakeholders). They will provide them with the necessary information of the program they would like to join. In other words, LOs help stakeholders to know what kind of achievement they will gain by completing a certain program in cognitive (essential knowledge), behavioral (skills and abilities) and affective (attitudes, values or beliefs) domains.

·⦿· Stages of the project :

This project has gone through various stages, as illustrated in Figure 1. It began with forming the main committees that will participate in this project. The National Center for Assessment in Higher Education ran workshops on how to write LOs and exam items based on LOs in which faculty members from various Saudi universities participated. Here are the main stages in more details.



Figure 1. Stages of the LOs project

🕒 **First Phase: Surveying current academic programs**

This phase aims to survey the content of national and international academic programs. The objective is to establish the LOs based on these programs and identify the extent of coverage of these LOs in the academic programs in Saudi universities. The most important steps of this phase include:

1.1 Identifying LOs

A comprehensive survey has been conducted on all programs of Information Systems in Saudi universities, in an attempt to identify the LOs of this major.

1.2 Analyzing the content of the national programs

After collecting the content of relevant programs, a thorough analysis was done in order to identify the common components in these programs and the ones that are unique to certain programs. This procedure includes the following:

- Identifying the main components of the major in all Saudi universities.
- Determining the percentages of the main components in these programs.
- Identifying the common sub-components in these programs.
- Determining the percentages of the sub-components in these programs.

1.3 Analyzing the content of some international programs:

The previous procedure was done on the programs of the following universities:

- UNSW Australia Business School.
- University of Montréal.
- California State University.

1.4 Comparing the content of the national and international programs

A comparison was made among the components of the national and international programs in order to identify the common main and sub-components in these programs and the ones that are unique to certain programs.

Second Phase: Proposing the LOs of the program

This phase focuses mainly on identifying the components and their importance in the program. This procedure includes the following:

1. Defining the major accurately and comprehensively in order to determine the features that distinguish it from other similar programs.
2. Proposing the components of the program, based on the survey in the previous phase, and identifying the programs to which they are compared for benchmarking purposes.
3. Determining the importance of each component. To do so, the teaching hours of each component in the program have been calculated.
4. Dividing the main components into sub-components.
5. Identifying the importance of the sub-components, as is illustrated in Table 1.
6. Defining the main components and sub-components of the program on which the LOs will be based.

Table 1. Percentages of main components and sub-components of Information Systems

Main component		Sub-component	%
Business Information Systems	15.38	Innovation and IT Management	9.4
		IT / IS Project Management and strategies	5.6
Information Technology Security	15.38	IT / IS Security	8.8
		IT Infrastructure and Network Management	6.2
System Engineering for IS Applications Development	23.15	IS developing and programming methods	13.4
		IS Project	4.8
		Enterprise Resource Planning	4.8
Database	23.07	Databases & Databases concepts	11.5
		Database Management Systems	7.8
		Algorithms and Data Structures	3.7
System Analyses and Design	15.38	Systems Analysis	10
		Systems Design	5.38
IS Basics	7.69	Operating Systems	5
		Information Systems Fundamentals	2.69
Total			100

••• Third Phase: Writing LOs:

When writing LOs, the following points have been taken into consideration:

1. Drawing on the criteria of writing LOs reported in the literature, e.g. using measurable verbs.
2. Covering Bloom's Taxonomy levels, particularly knowledge, application and analysis.
3. Determining the target content, taking into account the division of the program (i.e. main components, sub-components and LOs) as well as the identification importance of program main and sub-components.

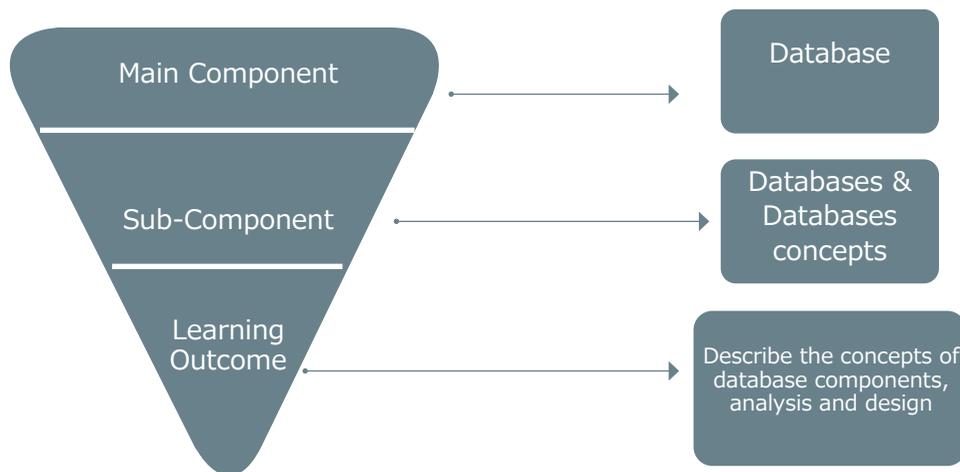


Figure 2. Illustration of the program division into main components, sub-components and LOs

Fourth Phase: Reviewing LOs:

To ensure the quality of the writing process and the use of criteria of writing LOs, the review process went through three stages:

1. Program experts

Three experts of the program were recruited for reviewing the LOs. They were trained on how to assess LOs.

2. National universities

A draft of the LOs was sent to all Saudi universities, in an attempt to get feedback from the faculty members of Information Systems Department in these universities. This was a very crucial step as it showed us to what extent the LOs covered the major and whether the importance of main components and sub-components was determined properly.

3. Electronic review

The draft of the LOs was also posted on the website of the National Center for Assessment in Higher Education, in an attempt to get feedback from experts of Information Systems everywhere. Then, it was advertised that the LOs for Information Systems were available online for review.

••• **Fifth Phase: Revising LOs :**

The comments and feedback received from the review process were approved by the reviewing committee and then sent to the committee of writing LOs to revise them accordingly. After revising the LOs, the reviewing committee approved the changes that were made.

••• **Sixth Phase: Final draft of LOs**

After the revision process, the final draft of the LOs for Information Systems was written for official use in the future, as is shown in Table 2.

1-Main Component: Business Information Systems

Description: Graduates are expected to operate knowledge and practices related to business and management sciences that provide strong foundation about cross-functional business processes; or any other process that are based on the integration between IS/IT and business.

Sub-Components	Learning Outcomes
<p>1.1 Innovation and IT/IS Management: To understand what information systems are, and how they are being used to facilitate organizational processes and societal and economical change</p>	1) Recognize the process and structure of business organizations and their management techniques.
	2) Analyze business processes for developing purposes.
	3) Discuss the ability of identifying the best available ways to measure and improve business quality using scientifically based methods.
	4) Apply the main marketing trends that have an influence on different markets.
	5) Classify various means of business information system communications and the ways of utilizing them within organizations.
	6) Define the basic concepts of the decision-making process within information system scope.
	7) Develop technical and administrative plans to convert from traditional business methods to electronic ones.

Sub-Components	Learning Outcomes
<p>1.2 IT Project Management and strategies: To develop, execute, and supervise plans, policies, programs, and practices that control, protect, deliver, and enhance the value of data and information assets.</p>	1) Develop the necessary plans to make use of IT project management to serve the goals of the organization.
	2) Define the concepts of information economics at the enterprise level.
	3) Justify how Information System forms a key source of competitive benefit for businesses.
	4) Structure IS-related activities to maximize the business value of IS within and outside the company.
	5) Apply existing and emerging information technologies, the functions of IS and its impact on the organizational operations.
	6) Evaluate the issues and challenges associated with successfully and unsuccessfully incorporating IS into a firm.
	7) Explain how strategic decisions are made concerning acquiring IS resources and capabilities.
	8) Apply information system development strategies to industries' needs.
	9) Define the role of IT control and service management frameworks from the information systems perspective.

2.Main Component: Information Technology Security

Description: Graduates are expected to employ knowledge and practices related to the protection of information systems or information against the unauthorized access or modification by users, during storage, processing, and transit of data.

Sub-Components	Learning Outcomes
<p>2.1 IT/IS Security: To demonstrate how an information security management system should be planned, documented, implemented and improved, according to the international standard of information security management.</p>	1) Recognize the challenges of current and up-to-date information security.
	2) Explain how important cryptographic algorithms are used in information security in the context of IT business.
	3) Identify and clarify public-key based asymmetric algorithms for encryption-based security of information.
	4) Describe the access control mechanism utilized for user authentication and authorization.
	5) Describe Secure Sockets Layer (SSL) as a common solution enabling security of many applications, including Internet-based commerce.
	6) Describe how to secure Internet Protocol (IP) communications by using Internet Protocol Security (IPSec).
	7) Justify the importance of physical security and discuss ways to improve physical security of an enterprise.
	8) Use security tools and applications as firewalls and intrusion prevention systems.
	9) Explain malicious software issues such as those introduced by software-based viruses and worms.
	10) Analyze common software security issues such as buffer overflow.
	11) Describe the basic process of risk assessment in the context of IT security management.

Sub-Components	Learning Outcomes
<p>2.2 IT Infrastructure and Network Management: To operate and employ both computer and systems architecture, and communication networks, with an overall focus on the services and capabilities that IT infrastructure solutions enable in an organizational context.</p>	1) Discuss the infrastructures for global e-business and strategic framework for managing a global SME business.
	2) Define the principles underlying layered systems architectures and their application.
	3) Decide and justify the salutations and needs of organization infrastructure such as clients, servers, network devices, wired and wireless network.
	4) Justify how IT infrastructure components are organized into infrastructure solutions in different organizations.
	5) Describe through practical examples how protocols are used to enable communication between computes
	6) Configure an IT infrastructure solution for a small business, including a network based on standard technology.
	7) Distinguish the structure of large-scale organization from the perspective of IT infrastructure solution.
	8) Determine the components of a large-scale organization based on IT infrastructure solutions.
	9) Assess different design and implementation components of IT Infrastructure to provide business solutions.
	10) Configure simple infrastructure security solutions.

3.Main Component: System Engineering for IS Applications Development

Description: Graduates are expected to apply the engineering techniques to ensure that end users' requirements are achieved throughout the system life cycle, and explain how to manage, design, implement and evaluate each process of the system life cycle.

Sub-Components	Learning Outcomes
<p>3.1 IS developing and Programming methods: To use a different family of programming languages, including Imperative, Object-Oriented, Functional, Scripting, and, Logical. To identify the common concepts used to create programming languages. To compare and contrast factors and commands that affect the programming state.</p>	1) Solve complex business issues using problem solving techniques through an appropriate programming language.
	2) Use appropriate types of selection constructs in a programming language.
	3) Construct programs that use methods and single dimensional arrays.
	4) Describe how to represents data and construct programs using two or multi-dimensional arrays.
	5) Illustrate how a program can be designed as a collection of communicating objects.
	6) Define principles of modularity, encapsulation, information hiding and abstraction.
	7) Construct the UML diagrams that depict the program structure.
	8) Apply the factors that contribute to a good object oriented programming to a real-world solution.
	9) Apply inheritance and interfaces to extend and override the functionality of classes.
	10) Develop simple GUI interfaces for a computer program to interact with users.
	11) Solve complex business issues using problem solving techniques through an appropriate programming language.

Sub-Components	Learning Outcomes
<p>3.2 IS Project: To apply the management of Information Technology (IT) project techniques and use computer software in the management of these and other projects to increase the performance of their functions in an organization.</p>	1) Describe the traditional method and the agile method which are used to develop IS.
	2) Explain the elements of project team management and the responsibilities of a project manager.
	3) Justify a project initiation and the activities in the project planning phase of the SDLC.
	4) Illustrate how the real-world scope of a new system is determined.
	5) Develop a project schedule using different tools.
	6) Manage large scale information systems projects.
	7) Evaluate the quality of Information Systems.
	8) Assess quality standards with regard to Information Systems projects.
	9) Plan project phases over time frame using projects planning tools.
	10) Give professional oral presentations.

Sub-Components	Learning Outcomes
<p>3.3 Enterprise Resource Planning (ERP):</p> <p>To ensure that technical and socio-technical aspects of the systems have been developed in the appropriate ways, and to ensure that the integration between information systems and the organizational resources have been well studied and identified.</p>	1) List the basic concepts of ERP systems for manufacturing or service companies, and the differences among MRP, MRP II, and ERP systems.
	2) Define the typical ERP systems, and the advantages and disadvantages of implementing such systems.
	3) Use material requirements for planning, master production scheduling, and planning the capacity requirements.
	4) Examine systematically the planning mechanisms in an enterprise, and identify all components in an ERP system and the relationships among them.
	5) Describe production planning in an ERP system, and systematically develop plans for an enterprise.
	6) Use business techniques and methods to determine the correct details of purchasing transactions and the right time to buy an item, and use these methods in material management.
	7) Recognize the difficulties of a manufacturing execution system
	8) Select an appropriate performance measure for different objectives, and apply priority instructions to shop floor control.
	9) Operate analytical techniques used in mining and extracting data in order to make strategic decisions.

4.Main Component: Database:

Description: Graduates are expected to use knowledge and practices related to the data structure, storage, management, and process. The knowledge includes the key techniques in modern database and data structure theories and practices.

Sub-Components	Learning Outcomes
<p>4.1 Databases & Databases concepts: To value database history, modern database systems, the different models used to design a database, and Structured Query Language (SQL), which is the standard language used to access and manipulate databases.</p>	1) Describe the concepts of database components, analysis and design.
	2) Link and modify database tables using Relational models.
	3) Use the Structured Query Language (SQL) to create and handle database systems.
	4) Use different Database Management systems such as Oracle and SQL Server.
	5) Analyze a statement of data requirements to identify and express the different constituents of the conceptual data model.
	6) Develop data warehouses and Databases.
	7) Create full business solutions using advanced database models and techniques.
	8) Apply normalization techniques to logical database designs up to the third normal form.

Sub-Components	Learning Outcomes
<p>4.2 Database Management Systems: To explain the various types of locking mechanisms utilized within database management systems, and the different types of database failures as well as the methods used to recover from these failures.</p>	1) Analyze a set of data forms to identify and express the different constituents of the conceptual data model
	2) Examine a relational database schema to identify its different constituents, such as primary keys, foreign keys, and integrity constraints
	3) Describe a relational database schema using both formal specification and diagrammatical forms and draw the conceptual data model using ERD.
	4) Transform a conceptual data model into a relational database model.
	5) Reverse engineering of a relational data model into its corresponding conceptual data model
	6) Identify relational database designs and update anomalies
	7) Apply normalization techniques to logical database designs up to the third normal form.
	8) Build a relational database schema using the standard SQL's DDL and DML.
	9) Construct SQL queries to respond to a specific information request using data aggregation, calculations, views, sub-queries, embedded queries, manipulation, and report generation.

Sub-Components	Learning Outcomes
<p>4.3 Algorithms and Data Structures: To design and implement elementary Data Structures such as arrays, trees, Stacks, Queues, and Hash Tables.</p>	1) Differentiate between static and dynamic data structures.
	2) Determine the tradeoffs between different data structures.
	3) Design and analyze more efficient algorithms for solving basic problems.
	4) Demonstrate linear and binary search techniques in problem solving.
	5) Represent and implement linked data structures.
	6) Apply different operations, including search, insertion, and deletion, to linked lists.
	7) Describe and represent different tree terminologies.
	8) Develop different operations, including search, insertion, and deletion, on trees and binary search trees.
	9) Comprehend, compare, and apply recursive sorting algorithms in problem solving.

5. Main Component: System Analyses and Design

Description: Graduates are expected to design and develop the correct definition of business problems and user requirement in a systematical and documented way

Sub-Components	Learning Outcomes
<p>5.1 Systems Analysis: To use different methods to understand the organizations and users' needs for possible business automation.</p>	1) Identify the difference between functional and nonfunctional system requirements.
	2) Analyze data entities and domain classes needed in an information system.
	3) Describe different methods (Traditional, Contemporary and Radical methods) for requirements determination.
	4) Applying requirements determination methods in developing information systems of real world applications.
	5) Using data flow diagrams (DFDs) to build the logical modeling of processes in order to analyze the system process requirements.
	6) Decompose data flow diagrams into lower-level diagrams and balance higher-level and lower-level data flow diagrams.
	7) Apply data flow diagrams to discuss process modeling for information systems real-world applications.
	8) Comprehend the concepts of unified modeling language (UML), the standard approach to modeling a system in the object-oriented world.
	9) Apply the steps used in UML to break down the system into a use cases, activity diagrams and sequence diagram models.

Sub-Components	Learning Outcomes
<p>5.2 Systems Design: To apply the principles of how to design and implement an Information system, and demonstrate the knowledge and skills required to conduct the main tasks typically required in these phases. It also includes experience selecting and using the most suitable design and implementation techniques to develop a system from a requirements specification.</p>	1) Describe the major components, levels of design and design phase activities.
	2) Demonstrate the steps involved in the traditional approach to designing the application architecture.
	3) Build and review the iterative process of object oriented design (design steps).
	4) Discuss the importance of the principles of user-centered design and explain how to write user-computer interaction scenarios as dialogs .
	5) Define system inputs and outputs.
	6) Describe the difference between windows forms and browser forms, and the key principles used in web design.
	7) Develop Event, Use cases, and Event Table.
	8) Differentiate between the traditional approach and the object-oriented approach when modeling the details of a use case.
	9) Write brief, intermediate, and complete developed use case descriptions.

6. Main Component: IS Basics

Description: Graduates are expected to understand the fundamentals of computer literature and Information systems including data concepts and information processing

Sub-Components	Learning Outcomes
<p>6.1 Operating Systems: To understand the major components of an operating system (from processes to threads), and explore more advanced topics in the field, including memory management and file input/output.</p>	1) Illustrate the objectives and functions of a modern operating system.
	2) Differentiate between operating system types such as multiprogramming, timesharing and real time systems.
	3) Describe the hardware features that support the interaction and control of the operating system of the computer hardware and software such as interrupts, timer and dual mode.
	4) Justify the need of the various types of operating system services and how they are used by application software through system calls and APIs.
	5) Compare and contrast the various ways of structuring an operating system such as object-oriented, modular, micro-kernel, layered and virtual systems.
	6) Recognize the data structures and operations (such as context switching and dispatching) needed to support the management of many tasks (including recognition of different states of a tasks).
	7) Discuss the types of processor scheduling such as short-term, medium-term, and long-term.
	8) Compare between the different inter process communication models in terms of speed, convenience and implementation.
	9) Compare and contrast the common algorithms used for both preemptive and non-preemptive scheduling of tasks in operating systems, such as FCFS, SJF, priority, Round Robin, Multilevel queue and multilevel feedback queue.
	10) Differentiate between the various approaches to solving the problem of mutual exclusion and to supporting synchronization in an operating system.

Sub-Components	Learning Outcomes
<p>6.2 Fundamentals of Information Systems: To use basic computer applications and state how various types of information systems provide the information needed to gain business intelligence, in an attempt to support the decision making for the different levels and functions of the organization.</p>	1) Use basic office applications (such as Microsoft Office Pack) to provide basic business solutions.
	2) Recognize how and why information systems are used to support business solutions of organizations.
	3) Demonstrate how businesses are using information systems to create competitive advantage.
	4) Recognize the value of information systems and how it can be used for investments.
	5) Formulate a business case for a new information system, including estimation of both costs and benefits.
	6) Describe how information systems enable new forms of commerce between individuals, organizations, and governments.
	7) Define emerging technologies that enable new forms of communication, collaboration, and partnering.
	8) Demonstrate how enterprise systems help organizations to establish stronger relationships with their clients and suppliers.
	9) Recognize how enterprise systems are widely used to reinforce organizational structures and processes.
	10) Describe why and how organizations choose to develop and/or acquire information systems and technologies to support their business operations.
	11) Recognize the ethical concerns that information systems emphasize in society and the impact of information systems on crime.

