جامعة المستقبل
Mustaqbal University
أول جامعة أهلية بمنطقة القصيم

Program Learning Outcomes Manual

Prepared by

The Quality and Accreditation Department

Under the supervision of

Prof. Mohamed A. Abdel-Halim

Director of Quality and Accreditation Directorate

Chairman of the Quality and Academic Accreditation Standing Committee

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Chapter I

Program and Course Learning Outcomes

The learning process has learning outcomes and objectives, and it is very important for the educational institution to define learning outcomes and learning objectives for its programs and courses, and to propose measurement methods that achieve those outcomes according to a flexible and applicable measurement plan. There are expected gains and problems for learning outcomes.

1.1 Definition of Learning Objectives

The objective of a unit or program is a specific statement of the purpose of education, i.e. it refers to one of the specific areas of learning (knowledge/skill/value) that the teacher intends to introduce the student to.

Examples of goals:

1. Providing students with in-depth knowledge of the performance characteristics of induction motors.

2. Providing students with information about the concept of energy conservation

4. Introducing students to the different styles of pre-Islamic poetry.

1.2 Definition of Learning Outcomes

- Learning outcomes are statements that specify what learners will know or be able to do as a result of a learning activity. Outcomes are usually expressed as knowledge, skills or attitudes. (American Law Libraries Association).
- Learning outcomes are a clear description of what the learner should know, understand and be able to do as a result of learning. (Institute of Learning and Teaching, Sheffield Hallam University)
- Learning outcomes are specific statements of what students should know and be able to do as a result of learning (Morse and Murray, 2005).
- Learning outcomes are statements of what a student is expected to be able to do as a result of a learning activity.... (Jenkins and Unwin).
- Learning outcomes are explicit statements of what we want our students to know, understand, or be able to do as a result of completing courses. (University of New South Wales, Australia).
- Learning outcomes are statements of what the student possesses, acquires and/or is able to demonstrate after completing the course/learning activity
- The learning activity can be, for example, a lecture, a module or an entire program.
- Learning outcomes should not be a “wish or promise” list of what the student can do when the learning activity is completed.
- Learning outcomes must be simple and clear.
- Learning outcomes must be assessable and assessable, meaning they can be measured.

1.3 Important Notes about Learning Objectives and Outcomes

- Learning objectives must be written by the teacher.
- Learning objectives should not be reductionist, but rather expansive and aim to enhance higher-order thinking skills and encourage creativity.
- Learning outcomes must be written from the students' perspective.
- Learning outcomes should not be reductionist, but should be expansive and aim to enhance higher-order thinking skills and encourage creativity.

1.4 Bloom's Hierarchy of Knowledge (Benjamin Bloom (1913 – 1999)

- Bloom viewed learning as a continuous, progressive process of construction – "We build on prior learning to develop ever more complex levels of understanding."
- Bloom conducted his doctoral research in developing a classification of levels of thinking behaviors in the learning process (PhD from the University of Chicago in 1942).
- Bloom worked on drawing the levels of these thinking behaviors, starting from simple recollection of facts at the lowest level to evaluation at the highest level.
- Bloom (1956) proposed that the field of knowledge consists of six successive levels arranged in a hierarchical manner.

1.4.1 Bloom's taxonomy of educational outcomes

- Bloom's taxonomy which was introduced in 1956 is very useful for writing learning outcomes.
- The taxonomy consists of a hierarchy of increasingly complex operations that students must acquire.
- Provides a structure for writing learning outcomes
- Teachers often use Bloom's taxonomy in writing learning outcomes because it provides a ready-made structure and list of verbs.

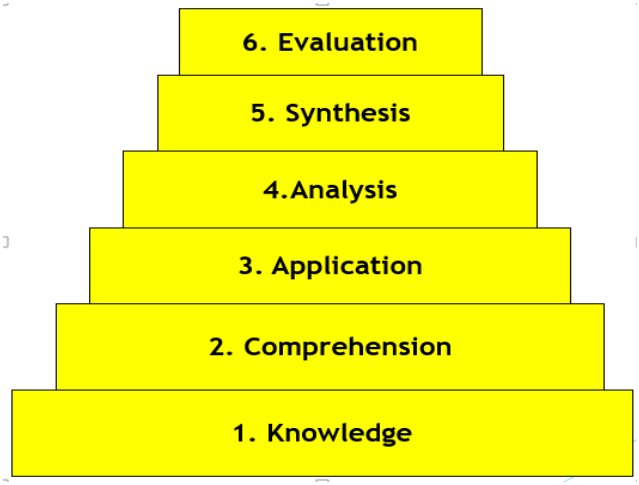

Fig. 1: Bloom's taxonomy

Knowledge area is usually called the cognitive domain ("knowing" or "thinking"), which includes the processes associated with thinking. Bloom proposed some verbs that characterize the ability to demonstrate these processes. These verbs are key to writing learning outcomes, and the list of verbs has expanded since his original publication.

1. Knowledge- the ability to remember or list facts without necessarily understanding them

Appropriate action verbs in this area:

Arrange, collect, identify, describe, repeat, enumerate, examine, find, know, name, list, mention, arrange, outline, present, quote, recall, identify, remember, record, re-sort, connect, pair, reproduce Shows, schedule, and tell.

Examples of knowledge field outcomes:

- Mentions genetics terms: homozygosity, heterozygosity, phenotype, genotype, homologous chromosome pair, etc.
- Identifies and examines the ethical implications of scientific investigations.
- Describes how and why laws change and the consequences of these changes for society.
- Mentions the standards that must be taken into account when caring for a tuberculosis patient.
- Identifies behaviors that constitute unprofessional practice in the attorney-client relationship.
- Gives an outline of the history of the Celtic peoples from the earliest evidence to the island migrations.
- Describes the processes used in engineering when preparing a design brief for a client.
- Mentions the axioms and laws of Boolean algebra.

2. Comprehension- the ability to understand and interpret acquired information

Appropriate action verbs in this area:

Relate, change, clarify, classify, construct, differentiate, transform, decode, defend, describe, differentiate, distinguish, discuss, estimate, explain, express, expand, generalize, identify, clarify, point out, infer, explain, locate, Predicts, recognizes, informs, paraphrases, reviews, selects, solves, translate.

Examples of comprehension field outcomes:

- Distinguishes between civil law and criminal law
- Identify the participants and objectives in the development of e-commerce.
- Critically discusses German literary texts and films in English.
- Predicts the genotype of cells undergoing meiosis and mitosis.
- Translates short passages from contemporary Italian.
- Converts number systems from hexadecimal to binary and vice versa.
- Explains the social, economic, and political effects of World War I on the postwar world.
- Reactions are classified into exothermic and endothermic.
- Identify the forces inhibiting the growth of the educational system in Ireland in the nineteenth century.
- Explains the influence of Greek and Roman culture on Western civilization.
- Recognizes familiar words and basic phrases related to themselves... when people speak slowly and clearly.

3. Application- the ability to use learned material in new situations, e.g. Using ideas and concepts to solve problems

Appropriate action verbs in this area:

apply, evaluate, calculate, change, select, complete, represent, create, demonstrate, develop, discover, dramatize, employ, examine, experiment, find, clarify, explain, process, modify, operate, organize, practice, anticipate, prepare , produce, connect, schedule, define, display, draw, solve, transmit, use.

Examples of application area outcomes:

- Creates a timeline of important events in nineteenth-century Australian history.
- Applies knowledge of infection control in the maintenance of patient care facilities.
- Selects and uses advanced techniques to analyze energy efficiency in complex industrial processes.

• Demonstrates proficiency in using vocabulary and grammar as well as the sounds of the language in different ways…..

• Relates energy changes to bond breaking and formation.

• Modifies guidelines in a case study of a small manufacturing company to enable more stringent production quality control.

• Shows how changes in criminal law affected levels of imprisonment in Scotland in the nineteenth century.

• Applies principles of evidence-based medicine to determine clinical diagnosis.

4. Analysis- The ability to divide information into its components

Appropriate action verbs in this area:

Analyze, evaluate, arrange, divide, calculate, classify, identify, compare, relate, show, criticize, discuss, conclude, differentiate, distinguish, divide, examine, experiment, clarify, decide, examine, investigate, arrange, outline, Points, asks, connects, separates, subdivides, tests.

Examples of analysis field outcomes:

• Analyze why society criminalizes certain behaviors.

• Compares different e-business models.

• Identify categories of different areas of specialized interest in dentistry.

• Discusses the economic and environmental impacts of energy conversion processes.

• Identify and measure sources of errors in measurements.

• Calculates gradient of maps in m, km, % and ratio.

• Critically analyzes a wide range of texts from different genres and from different time periods.

• Compares the classroom practice of a newly qualified teacher with that of a teacher with 20 years of teaching experience.

• Computes logic functions for programmers, decoders and multiplexers

• Looks for mutual relationships and ideas (understanding organizational structure)

5. Synthesis- the ability to put parts together

Appropriate action verbs in this area:

Discuss, arrange, collect, classify, compose, compose, create, design, develop, innovate, establish, explain, formulate, generalize, generate, integrate, invent, manufacture, manage, amend, organize, create, plan, prepare, suggest, repeat Arrange, reconstruct, connect, reorganize, revise, rewrite, prepare, summarize.

Examples of synthesis domain outcomes:

• Identify and formulate problems that can be solved in energy management.

• Proposes solutions to complex energy management problems orally and in writing.

• Compiles sequences of high-level assessments into a program format.

• Integrates concepts of genetic processes in plants and animals.

• Summarizes the causes and effects of the Russian revolutions of 1917.

• Relates the sign of enthalpy changes to exothermic and endothermic reactions.

• Organizes an educational program for the patient.

6. Evaluation- The ability to judge the value of a material for a particular purpose

Appropriate action verbs in this area:

Evaluate, confirm, argue, attach, choose, compare, conclude, contradict, persuade, criticize, decide, defend, distinguish, explain, evaluate, interpret, judge, justify, measure, predict, classify, recommend, relate, solve, review, Record, summarize, support, validate, and perform.

Examples of evaluation outcomes:

• Acknowledges the importance of key participants in bringing about change in Irish history

• Develops marketing strategies for different e-business models.

• The role of sports and physical education in promoting health among young people.

• The effect of the change in temperature on the equilibrium position is expected...

• Summarizes Michael Faraday's major contributions to the field of electromagnetic induction.

1.5 Revised Bloom's Taxonomy: Anderson and Krathwohl (2001)

It uses verbs instead of infinitives, as shown in the table below:

Table 1: Bloom and Anderson hierarchy symmetry

Bloom (1956)	Anderson and Krathwohl (2001)
Knowledge	To remember
Comprehension	To understand
Application	To apply
Analysis	To analyse
Synthesis	To create
Evaluation	To evaluate

Analysis, synthesis, and evaluation are considered higher order thinking skills in Bloom and Anderson's taxonomy.

1.6 The Emotional (Feeling) and Psychomotor (Action) Domains of the Outcomes

There are two other areas of learning outcomes as follows:

1.6.1 The emotional domain (feeling) - concerned with issues of values and attitudes

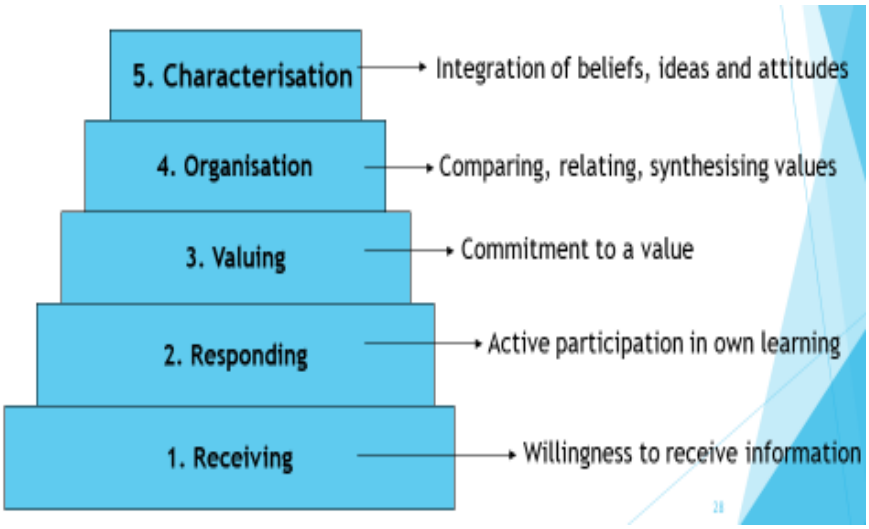

Figure 2: Emotional (feeling) field sequence

Action verbs appropriate to the emotional domain

appreciates, accepts, helps, tries, challenges, collects, completes, defends, proves (believes in), discusses, argues, embraces, follows, clings to, integrates, orders, organizes, joins, shares, judges, praises, asks, links, Participates, supports, develops, evaluates.

Examples of learning outcomes in the area of emotion (feeling)

- Recognizes the need for professional ethical standards.
- Appreciates the need for confidentiality in the professional relationship with the client.
- Demonstrates a desire to communicate well with patients.
- Deals with participants in an ethical and humane manner.
- Resolves conflicting issues between personal beliefs and ethical considerations.
- Takes responsibility for the welfare of children in care.
- Participates in class discussions with colleagues and teachers.

1.6.2 Psychomotor (doing) field

This area was not addressed by Bloom. It involves coordinating brain activity with muscle movement.

Action verbs appropriate to this field

Bend, grasp, handle, work, lead, reach, relax, shorten, extend, part (by touch), lead (subtly).

Examples of psychomotor domain

Laboratory skills

• Operates the specified set of equipment on the unit safely and efficiently in the chemistry laboratory.

• Calibration is performed accurately and safely in the laboratory.

• Constructs simple scientific drawings of geological features in the field.

Clinical skills

• Conducts physical examination of patients in outpatient clinics and general medical wards, except critical care settings.

• Performs venipuncture and basic CPR.

Presentation skills

• Provides an effective presentation.

• Demonstrates a range of graphic and CAD communication techniques.

• Performs basic vocal and motor tasks (theatrical studies).

The learning domains can be summarized according to Bloom's Taxonomy and the revised as shown in Fig. 3, as developed by the learning Center of Vanderbilt University.

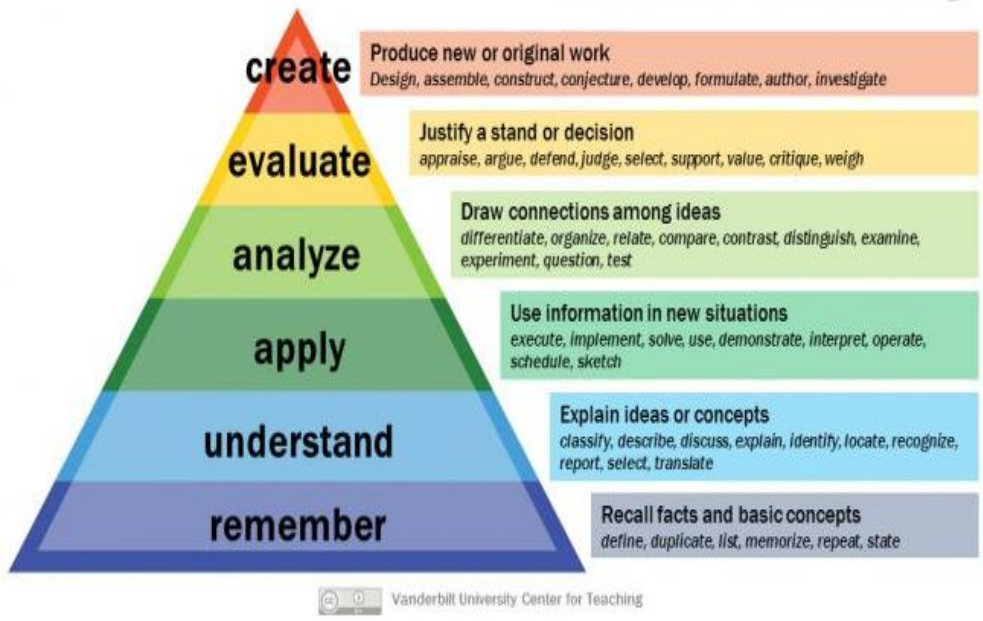

Fig. 3: Developed Bloom's Taxonomy of knowledge

1.7 Benefits and Problems of Assigning Learning Outcomes

1.7.1 Benefits of setting learning outcomes

- Helps explain to students more clearly what is expected of them and thus help guide them in their studies – motivation and sense of purpose
- It helps teachers focus more clearly on exactly what they want students to achieve in terms of knowledge and skills.
- It helps teachers clarify their thinking about what they want to achieve and a shared language of learning outcomes helps facilitate discussion with colleagues.
- Contribute to determining evaluation criteria more effectively.
- Provide guidance to employers on the knowledge and understanding possessed by program graduates, i.e. demonstrating the value of the program in terms of program learning outcomes and unit learning outcomes.
- Forms the basis for initiating a discussion about teaching and learning in university level institutions.

1.7.2 Problems caused by inaccurate learning outcomes

- It can limit learning if learning outcomes are written within too narrow a framework as a result of a lack of intellectual challenge for learners.
- Harmful to the assessment-based curriculum if learning outcomes are too limited.

• It can lead to confusion among students and teachers if guidelines are not adhered to when formulating learning outcomes etc.

1.8 National Qualifications Framework- Kingdom of Saudi Arabia

The National Qualifications Framework; NQF, represents a comprehensive and unified system for building qualifications, organizing them, and placing them in levels, based on learning outcomes. This model aims to link qualifications issued by recognized national or international awarding bodies. (Educational and training), with the associated levels of the National Qualifications Framework in the Kingdom of Saudi Arabia. The National Qualifications Framework in the Kingdom of Saudi Arabia (NQF) constitutes a comprehensive and unified structure for building, organizing and classifying qualifications into levels based on learning outcomes. Equally important, the framework also provides a common language and a sound reference for comparison purposes. Moreover, it is a functional tool to facilitate better transfer of knowledge, skills and values across different business environments at both national and international levels.

NQF definition of outcomes is Statements of what a learner is expected to know, understand and/ or be able to demonstrate at the end of a period of learning, which are defined in terms of knowledge, skills, values, and attitudes. Learning outcomes can be measured using evaluation tools consistent with the associated level

1.8.1 Proposed output areas of the National Qualifications Framework (NQF)

• Knowledge and Understanding

• Skills

The skills are divided into:

- Cognitive skills
- Practical and physical skills
- Communication and information technology skills

• Values, independence and responsibility

Bloom's taxonomy and the other two domains can be linked to the learning outcomes domains of the National Qualifications Framework, as the levels of knowledge are related to knowledge, cognitive skills, communication skills, and information technology, while the domains of values and responsibility are related to the domain of emotion (feeling), and the psychomotor domain outcomes are related to practical and physical skills.

1.8.2 Learning levels according to the National Qualifications Framework

The Saudi National Qualifications Framework has identified 8 levels of learning. Figure 4 shows these eight levels of learning

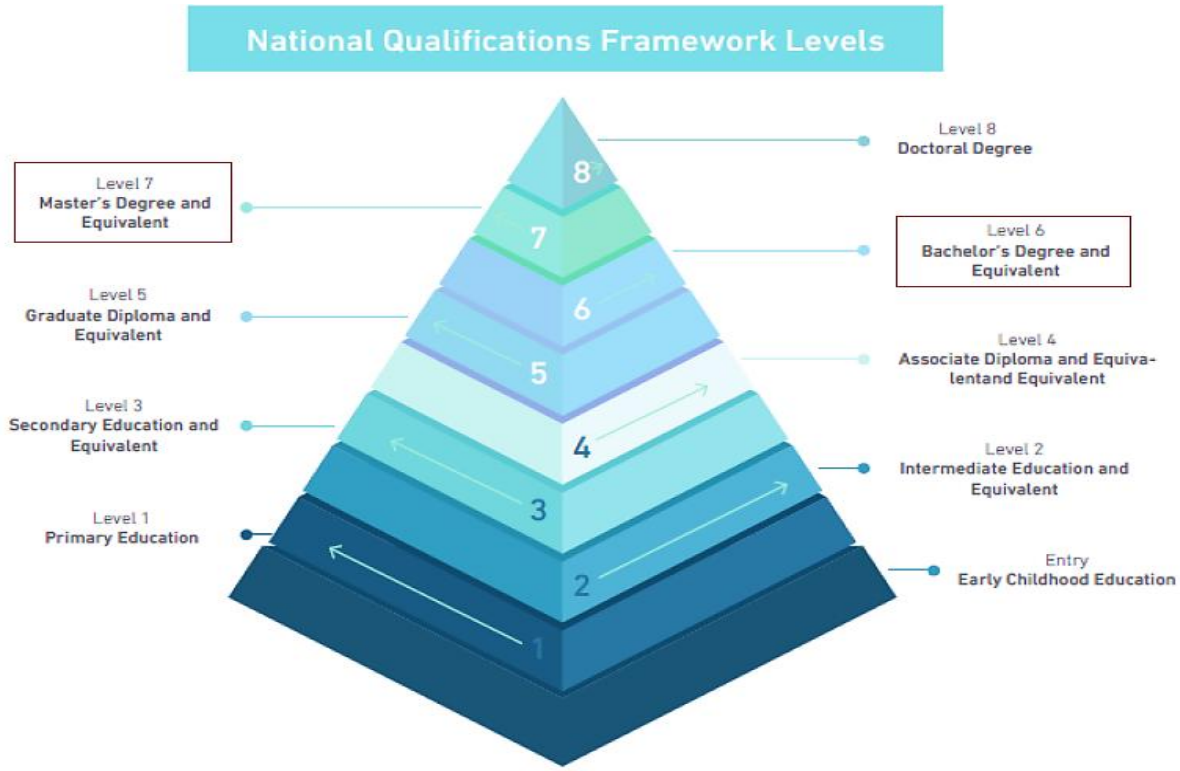

Fig. 4: NQF levels of learning

The Sixth Level of NQF PLOs

The PLOs for the BSc degree or the equivalent degrees (sixth level) are as given in the following table:

NQF Sixth Level of PLOs
Knowledge and Understanding • Broad in-depth integrated body of knowledge and comprehension of the underlying theories, principles, and concepts in one or more disciplines or field of work, • In-depth knowledge and comprehension of processes, materials, techniques, practices, conventions, and/or terminology, • A broad range of specialized knowledge and understanding informed by current developments of a discipline, profession, or field of work, • Knowledge and comprehension of research and inquiry methodologies
Cognitive Skills • Apply integrated theories, principles, and concepts in various contexts, related to a

discipline, profession, or field of work.
- Solve problems in various complex contexts in one or more disciplines or fields of work.
- Use critical thinking and develop creative solutions to current issues and problems, in various complex contexts, in a discipline, profession or field of work.
- Conduct inquiries, investigations, and research for complex issues and problems.

Practical and Physical Skills

- Use and adapt advanced processes, techniques, tools, instruments, and/or materials in dealing with various complex practical activities.
- Carry out various complex practical tasks and procedures related to a discipline, professional practice, or field of work.

Communication and ICT Skills

- Communicate effectively to demonstrate theoretical knowledge comprehension and specialized transfer of knowledge, skills, and complex ideas to a variety of audiences.
- Use mathematical operations and quantitative methods to process data and information in various complex contexts, related to a discipline or field of work.
- Select, use, and adapt various standard and specialized digital technological and ICT tools and applications to process and analyze data and information to support and enhance research and/or projects.

Values and Ethics

- Demonstrate commitment to professional and academic values, standards, and ethical codes of conduct, and represent responsible citizenship and coexistence with others

Autonomy and Responsibility

- Effectively plan for and achieve academic and/or profession-al self-development, assess own learning and performance, and autonomously make decisions regarding self-development and/or tasks based on convincing evidences.
- Autonomously and professionally manage tasks and activities related to the discipline and/or work,
- Collaborate responsibly and constructively on leading diverse teams to perform a wide range of tasks while playing a major role in planning and evaluating joint work,
- Actively participate in advancing the discipline and society.

1.9 Specialized Academic Criteria

- Based on the keenness of the Education and Training Evaluation Commission to build and develop high-quality national academic programs, the Commission has worked on preparing specialized academic standards.

- Main learning outcomes have been identified for each specialization.
- The main objective of this is to set specialized learning outcomes that should be achieved - at least - by students of the specialization (field) immediately before graduation.

1.10 How to Prepare the Program Learning Outcomes

1.10.1 Guiding rules

- The largest role is played by the "Program Quality Committee" under the supervision of the Development and Quality Unit and in cooperation with the old professors in the program to assign and prepare the program's outputs.
- The outcomes are written taking into account the following points:

  - PLOs are written from the student's perspective using measurable or observable verbs.

  - Describes the measurable data (knowledge, understanding, skills, and values) that students demonstrate by the time of graduation.

  - The program learning outcomes should be consistent with the Saudi National Qualifications Framework (NQF).

  - The program learning outcomes should be consistent with the specialized academic criteria set by NCAAA for the different specializations.

  - The program learning outcomes should be consistent with labor market requirements, and the program learning outcomes should work and help meet the characteristics of the program graduates.

  - Learning outcomes should be consistent with the program's mission and the characteristics of university graduates.

- The program learning outcomes must be linked to a course or group of courses, and the study plan must not contain a course that is not linked to any program outcome.

1.10.2 Characteristics of measurable program learning outcomes

To ensure that the learning outcomes of the program are measurable, it is useful to:

- Use active verbs and avoid using phrases such as "understands" and "knows" without specifying how students can demonstrate their understanding or knowledge.
- Use simple language and avoid overly detailed statements.
- be specific. For example, "Students will be able to use the major concepts, language, and theories of the discipline to explain psychological phenomena" is specific compared to the

vaguer statement, “Students will know the major concepts, language, and theories of science.”

- Distinguish between learning processes and learning outcomes, for example, “Graduates will complete a thesis” is not a learning outcome. Some results also speak to the overall quality of the undergraduate program, for example, “Students will apply and be accepted for graduate study.” However, outcomes such as these are not specific “learning outcomes” in terms of knowledge, skills and values, and should not be included within program learning outcome statements.
- Consider using “or” to formulate a learning outcome for programs with elective tracks, for example, “Students will be able to analyze works of art or They will be able to create works of art.”
- Avoid complex deliverables that require different statements of evidence. The statement “Students will be able to write and speak effectively” has two consequences. Sometimes multiple verbs in a score can be omitted if they are redundant or less important.
- Consider the type of projects/tasks students will undertake in which they will be required to demonstrate their ability to think/act like a physicist, linguist or musician, consistent with the training provided in their discipline, and as specified in the program learning outcome.
- Assignments in advanced courses can be used/reviewed to evaluate program learning outcomes. In undergraduate programs, final year projects (research papers, research reports and artistic works) allow students to demonstrate the most advanced level of their skills and knowledge. In graduate programs, the qualifying examination, defense of the thesis proposal, and dissertation provide such opportunities for faculty to measure program learning outcomes.

1.10.3 How to use program learning objectives to write program learning outcomes

The program has a mission statement and written goals and learning objectives, so these can be used as a basis for writing the program's learning outcomes. Learning objectives may be more general than the set of programs learning outcomes, may be written from the perspective of what the program intends to do or impart rather than what students intend to learn, and may or may not be measurable. However, learning objectives may be revised to clarify the expected outcomes of teaching.

1.11 Preparing Course Learning Outcomes (CLOs)

The main role in writing these outcomes is for faculty members and relevant committees such as course committees. The course learning outcomes are written taking into account the following points:

- CLOs are written from the student's perspective using measurable or observable verbs.

- The learning outcomes of a course or educational unit describe measurable data (knowledge, understanding, skills, values, and responsibility) in detail, linked to the contents and activities of the course, which students demonstrate at the end of the course or educational unit.

Course learning outcomes (CLOs) are specified in the course specifications, and courses are linked to program learning outcomes (PLOs) at specific levels (unrelated, introductory, practiced or mastered).

Chapter II

Evaluating the Achievement of the Course Learning Outcomes

2.1 Introduction

To effectively assess whether your students are meeting the course learning outcomes, you need to choose an appropriate assessment method. Different assessment methods allow you to assess different learning outcomes in the knowledge, skills and values. For example, while one method may ask students to demonstrate analytical skills, another may focus on collaboration. The assessment method chosen will determine the selection of the appropriate task.

To choose the appropriate evaluation method, the lecturer must be aware of the following:

• Course learning outcomes

• The program learning outcomes served by those learning outcomes

• Assessment methods that will allow your students to demonstrate skills and knowledge.

Taking these three aspects into consideration places the student and their learning at the center of learning design.

2.2 Test purposes

• Tests of learning

• Tests for learning

• Tests as learning

2.2.1 Tests of Learning

The instructor can use tests to help determine whether students are meeting grade level standards. Learning assessments are usually grade-based and can include the following:

Exams

Folders

Final projects

Standardized tests

They often have a definite grade associated with them that communicates student accomplishments to teachers, parents, students, institute-level administrators, and district leaders.

Common types of learning assessment include:

Summative tests

Norm-referenced Tests

Benchmarked tests

2.2.2 Tests for learning

Learning assessments provide the lecturer with a clear snapshot of student learning and understanding as the lecturer teaches – allowing them to adjust everything from classroom management strategies to the lecturer's lesson plans as they go along.

Learning assessments should always be ongoing and actionable, and when a teacher creates tests, keep these key questions in mind:

-What do students still need to know?

- What did the students benefit from the lesson?

- Did the students find this lesson very easy? Very Difficult?

- Did my teaching strategies reach students effectively?

- What are the most misunderstood things among students?

- What did you want the students to learn most from this lesson? Did you succeed?

There are many ways the instructor can conduct assessments for learning, even in crowded classrooms. It should be remembered that these tests aren't just for students, they're to provide the instructor with actionable feedback to improve his learning.

Common types of learning assessment include formative tests and diagnostic tests.

2.2.3 Tests as learning

Assessment as learning actively engages students in the learning process. It teaches critical thinking and problem-solving skills and encourages students to set achievable goals for themselves and measure their progress objectively.

Lecturers can help engage students in the learning process as well, and one study showed that "students in most cases cited the target knowledge as the reason the task was made interesting and engaging, followed by the way the content was approached in the classroom."

2.3 Types of Questions and Tests

2.3.1 Different types of questions

Test questions can be categorized into seven types of test questions, along with tips for using each: 1) Multiple Choice, 2) True/False, 3) Matching, 4) Short Answer, 5) Essay, 6) Oral, and 7) arithmetic.

2.3.2 Different types of tests

There are different types of tests in education, from subjective, objective, summative, and formative to diagnostic tests for health education. These tests help measure students'

knowledge and levels of understanding of academic subjects. Tests also provide a basis used for rewards and recognition.

2.3.3 Most common types of tests

There are three common types of tests: written tests, oral tests, and physical skills tests.

2.3.4 Purpose of different types of tests

Distance or hybrid learning environments have presented some challenges for lecturers, and some students have lost part of their academic progress for this reason, but motivating students to learn and grow remains a consistent goal. Assessing students in meaningful ways can help motivate them and enable them to progress as they become responsible for their learning.

But testing can contribute to anxiety for many students, assessments can be difficult to properly organize, and can be time-consuming to grade. As an attendee, it is important to know that a student's progress is not just a number on a report card. There is much more to assessments than just giving an end-of-unit test or preparing for a final exam, as assessments help shape the learning process in all subjects, and give you insights into how well students are learning.

The main purpose of testing in educational institutes should be to provide interpretive information to lecturers and institute leaders about their impact on students, so that these lecturers get the best possible information about what steps need to be taken with their teaching and how they need to change and adapt. We often use hiding in scientific institutes to inform students of their progress and achievement, and this is of course important, but what is more important is to use this information to inform lecturers of its impact on students. Using assessments as feedback for lecturers is useful and important, and this benefit is maximized when tests are timely, informative and linked to what lecturers are actually teaching.

The types of tests can be classified into six types:

- Diagnostic tests
- Formative tests
- Summative tests
- Negative tests (involuntary choice)
- Tests with reference principles
- Benchmarked tests

Different types of tests can help the instructor understand students' progress in different ways. This understanding can inform the teaching strategies you use, and may lead to important modifications.

2.4 Measuring the Learning Outcomes of Courses and Educational Units

To measure the learning outcomes of the course or educational unit, one of the following methods can be followed:

i. Using all the activities and tasks used during the teaching period of the course/educational unit, such as quarterly examinations, short tests, reports, and interactive groups, in addition to, of course, the final exam to measure the extent to which the expected outcomes of the course/educational unit have been achieved. In this regard, each activity has an appropriate weight that is consistent with the activity and its comprehensiveness and depth.

ii. Using all activities and tasks used during teaching the course/unit, such as semester exams, short tests, reports, and interactive groups, for formative measurement of the learning outcome, while the final test, regardless of its type, is used for summative measurement. This method has a disadvantage of not using some type of students works such as homeworks and assignments which are very helpful in measuring some learning outcomes.

2.5 Testing Design for Measuring Learning Outcomes

The following must be taken into account:

- Setting test questions so that each question or a specific part of it is limited to measuring a specific outcome.
- Developing student discussion questions during presentations (graduation project/master's thesis) so that they aim to measure a specific outcome.
- Design assignments to measure specific, non-overlapping outcomes.

Chapter III

Plans for Measuring Program Learning Outcomes

3.1 Tools for measuring learning outcomes

Measuring tools are classified into direct and indirect tools. Direct tools are opinion-free tools and rely on documented student work, while indirect tools are opinion-based tools, whether the opinion of students, professors, or other relevant parties.

3.1.1 Direct Tools

Include:

- Student work: course tests, tests, course assignments
- Senior Design Project report and student presentations.
– Field training
- Senior Exit Exam to measure the learning outcomes

3.1.2 Indirect tools

Include:

– Course surveys
- Alumni opinion polls
– Employer opinion polls
- Questionnaires for training site supervisors
– Reports of professional advisory committees
- Reports of student advisory committees
– Independent opinion reports, etc

3.2 Assessment and Evaluation of the PLOs Achievement

3.2.1 Steps to conduct the evaluation

Systematic assessment of student learning involves a series of discrete steps. This section provides an overview of each step. The systematic approach to evaluation consists of the following six steps:

1. Formulate a comprehensive, meaningful, and measurable set of program learning outcomes (program learning outcomes).

2. Explain how the curriculum supports the program learning outcomes.

3. Develop a plan to systematically collect evidence of student achievement of the program learning outcomes.

4. Collect, analyze and interpret evidence.

5. Use the resulting information to develop recommendations for improving student learning (including revising curriculum, teaching methods, and advising) and/or reviewing and improving program learning outcomes and assessment methods.

6. Implementation of recommendations.

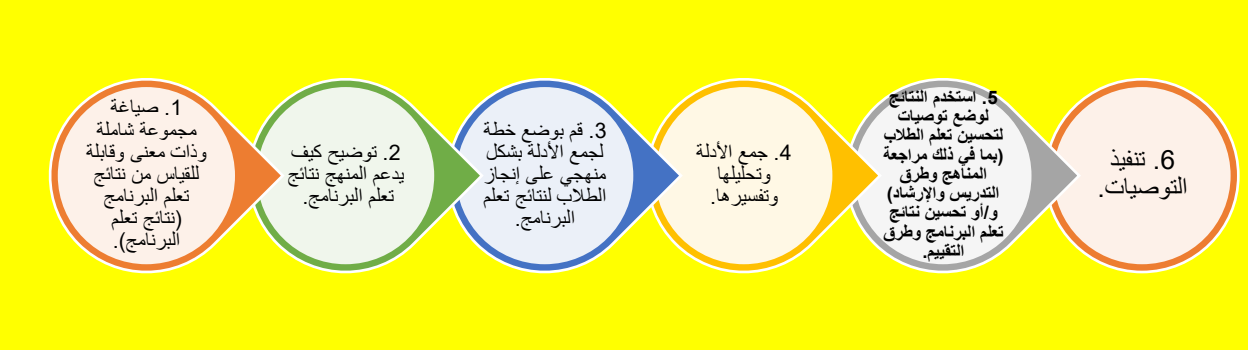

Figure 2.1: Steps for evaluating learning outcomes

3.3 Plans for Measuring and Evaluating Program Outcomes

The success of any academic program in achieving its educational outcomes, as well as the process of continuous improvement of the program, depends on measuring and evaluating the level of its students' acquisition of its educational outcomes. This requires developing a measurement plan for those outputs. When developing a measurement plan, the following rules must be taken into account:

- The plan achieves measurement of all program learning outcomes in a time period that is compatible with the program's time period (every two years, for example).
- The plan ensures that all program learning outcomes are measured once at least every two years (according to the requirement of NCAAA).
- The plan should lead to accurate results while not exhausting faculty members during implementation.
- The plan achieves a correct and strong link between the program's courses and the program's learning outcomes.
- The plan should take into account use of direct and indirect tools in measurement, and include how to link them.
- The plan should set clear thresholds for evaluating results.
- The plan should explain how to document the results.

3.3.1 Proposed Plans for Bachelor's Degree Programs

Several proposals exist in this regard, and the appropriate plan is selected based on the academic level, the nature and specialization of the program, and the number of students enrolled.

A) The First Plan

Main Outline of the Plan

• The level of course alignment with program learning outcomes is determined as either Introductory (I), Practical (P), Mastery (M), or Unrelated, depending on the course's relevance to the level at which it is offered. The following criteria can then be used by program committees to select courses for assessing outcomes:

• Since outcomes reflect what students can demonstrate, understand, and perform, selected courses should have a high relevance (M) or (P).

• Selecting courses that cover multiple outcomes will make the workload for program faculty manageable.

• Courses offered to students at higher levels and capstone courses, such as the graduation project and field training (if applicable), are suitable for assessing program learning outcomes.

• The program's learning outcomes are divided over a four-year period, with the outcomes of each year being measured so that all outcomes are assessed over the four years for a given cohort.

• A senior exit exam is administered at the end of the assessment cycle and is used with a specific weight alongside other tools to measure learning outcomes.

• The cycle is repeated every two years for subsequent cohorts of students.

• Direct assessment is accompanied by indirect assessment.

B) The Second Plan

Main Outline of the Plan

• The level of course alignment with program learning outcomes is determined as either introductory (I), practice (P), mastery (M), or unrelated, depending on the course's relevance to the level at which it is offered. The following criteria can then be used by program committees to select courses for outcome assessment:

• Courses at the introductory and intermediate levels are selected for formative assessment of program learning outcomes. This allows program committees to address any shortcomings that may arise in these outcomes.

• Since learning outcomes reflect what students can demonstrate, understand, and perform by graduation, assessment should be summative. This means selecting courses from the upper levels of the program and ensuring a P or M correlation between the selected courses and the PLOs.

• Courses offered to students at the upper levels, along with capstone courses such as the graduation project and field training (if applicable), are more suitable for summative assessment of program learning outcomes, alongside graduation courses in the final semesters.

• Assessment is conducted for a specific cohort.

• A Senior Exit Exam is administered at the end of the assessment cycle and is used with a specific weight alongside other tools to measure outcomes.

• Assessment is repeated for successive cycles every two years for other cohorts of students.

• Direct assessment is accompanied by indirect assessment.

C) The Third Plan

This plan is suitable for programs that present educational material in the form of integrated and customized learning units, such as medical programs and some health science programs. Main Outlines of the Plan

• The learning outcomes of each learning unit are defined and then linked to the program's learning outcomes as either Introductory (I), Practice (P), Mastery (M), or Unrelated.

• Formative assessment of learning outcomes is conducted during and throughout the duration of the learning unit, and formative assessment is used for improvement.

• Summative assessment of learning outcomes is conducted using the final exam. Upon graduation, the program's summative learning outcomes are assessed by linking them to the learning outcomes of the group of learning units.

• Direct assessment is accompanied by indirect assessment.

3.3.2 Temporary Plan for Evaluating Program Learning Outcomes

Time may not permit long-term measurement, and a Self-Study Report (SSR) for the program may be urgently required. This report must include an evaluation of the program's learning outcomes assessment results. In this case, a temporary plan may be implemented.

Main Outlines of the Plan

• If results for courses delivered in previous years are unavailable, all learning outcomes (direct and indirect) will be assessed and documented using available courses and surveys, particularly those conducted in the final academic year, with a Senior Exit Exam administered to graduating students.

• The outcomes will be evaluated, and conclusions drawn.

• Based on this evaluation, improvement procedures and/or plans will be developed.

3.4 Evaluation of Program Learning Outcomes

Direct and indirect measurement of output verification is followed by analyzing the results, assessing the level of verification, and then taking the necessary actions and improvement processes.

3.4.1 Direct assessment of program learning outcomes

• Direct assessment of program learning outcomes is conducted through student work during courses using various assessment tools as listed in the course specifications; like:

- Student assignments and reports
- Short tests for students
- Student discussions in the classroom
- Presentations in the classroom
- The Capstone Senior Design Project report and the student presentation

• Tools included in course specifications must be carefully designed in order to be successful in assessing the learning outcomes to which the courses contribute.

• A threshold is set by the program committee for the level of achievement to assume the program learning outcomes have been met.

• The level of achievement for each output is determined using two measures:

- Average AM scores as a percentage not less than the threshold value, which is a vertical scale representing the depth of verification.
- The percentage of students who achieved the threshold, which is a horizontal measure. In order to say that the specified program learning outcomes have been achieved horizontally, at least an acceptable and satisfactory percentage of the students who attended the final exam must obtain a percentage not less than the specified threshold.

3.4.2 Indirect assessment of program learning outcomes

• Indirect formative assessment of the program learning outcomes is conducted through the results of student surveys for courses associated with each of the identified program learning outcomes.

• At the end of each semester, students are measured through a questionnaire to express their opinion on the extent to which the course-related outcomes have been achieved and the good planning and management of the course.

• The program committee should set a threshold for the level of achievement of the program learning outcomes, so that a decision on the achievement of the learning outcomes can be made by calculating the arithmetic mean/median of the students' rating.

- Undergraduate programs determine the formative level of PLOs based on the survey results of the group of program courses linked to the exit in each semester.
- Undergraduate programs measure and evaluate the aggregate level of PLOs at graduation based on the results of the surveys of the program's final year group of courses with the peak courses associated with the exit.
- The questionnaire for students expected to graduate is considered an effective tool to measure and evaluate the cumulative level of PLOs upon graduation
- Stakeholder questionnaires are used to measure and evaluate the program outcomes.

3.5 Recommendations and Improvement Actions

The next stage of the process of analyzing and evaluating learning outcomes results is to use the results to develop recommendations to improve student learning (including reviewing curricula, teaching methods, and advising) and/or improving program learning outcomes and assessment methods. These improvements are proposed by the Program Quality Committee and included in the program's annual operational plan and advancement. To the department council to approve it, and then complete the procedures according to the college and university regulations.

3.6 Method of Calculating the achievement level of the PLOs Through the Direct Measures

As several courses are used to measure the achievement of a learning outcome (PLO1) - and each course has its own credits and maximum grade, this should be taken into consideration as follows:

Assume that the credit hours for the courses are: C1, C2, C3…

The grades assigned to the Output (PLO1) as a percentage of the total course grades are: M1, M2, M3...

The percentages of achievement of this outcome in the three courses are: A1, A2, A3…

The percentage of achieving this outcome (PLO1) is calculated by the following equation:

$A_R = (A1xC1xM1+ A2xC2xM2+ A3\times C3xM3 + \ldots)/ (C1\times M1+ C2xM2+ C3xM3 + \ldots)$

3.7 Practical Application of the Direct Measurement of an PLO

3.7.1 Example from an Electrical Engineering Program

Course EE 330 has been linked to the PLOs as shown in the following table:

	CLOs	Aligned-PLOs
1.0	**Knowledge and Understanding:**	

CLOs		Aligned-PLOs
1.1	Recognize construction, connections, principle of operation and modelling of single-phase transformers, three-phase transformers and autotransformers.	K.2
1.2	Recognize and illustrate fundamentals of the ac machines such as the concept of the rotating flux, the induced voltage and torque.	K.2
1.3	Recall construction, principle of operation, modeling of the synchronous generator.	K.2
1.4	Determine the synchronization process of the alternators.	K.2
1.5	Recall construction, principle of operation and modeling of synchronous motor.	K.2
1.6	State the starting methods of synchronous motors.	K.2
2.0	**Skills:**	
2.1	Able to determine and analyze the transformers, synchronous generator and synchronous motor performance characteristics.	S.2
2.2	Able to choose the suitable control method of the synchronous machines.	S.2
2.3	Understand and able to troubleshoot the technical problems associated with electrical machines in electrical power systems.	S.2
3.0	**Values:**	
--	-----	---

According to the course specification, the CLOs of the course will be measured as follows:

Code	Course Learning Outcomes	Assessment Methods
1.0		
1.1	Recognize construction, connections, principle of operation and modelling of single-phase transformers, three-phase transformers and autotransformers.	• Assessments of reports, homework and assignments • Five planed quizzes • Two midterms exams • Final exam
1.2	Recognize and illustrate fundamentals of the ac machines such as the concept of the rotating flux, the induced voltage and torque.	
1.3	Recall construction, principle of operation, modeling of the synchronous generator.	
1.4	Illustrate the synchronization process of the alternators.	
1.5	Recall construction, principle of operation and modeling of synchronous motor.	
1.6	State the starting methods of synchronous motors.	
2.0		
2.1	Able to determine and analyze the transformers, synchronous generator and synchronous motor performance characteristics.	• Assessments of reports, homework and assignments • Five planed quizzes • Two midterms exams • Final exam
2.2	Able to choose the suitable control method of the synchronous machines.	
2.3	Understand and able to troubleshoot the technical problems associated with electrical machines in electrical power systems.	
3.0		
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Course information and tests are as follows:

- The number of credit hours for EE 330 (C1) is 3 hours
- A short exam (quiz) was designed to measure the course learning outcomes (1.1 & 1.2), and the average score of students was 8.7 out of 10, noting that the weight of the quiz is two marks.
- In the second semester exam, parts of questions related to the course learning outcomes (1.3& 1.4) were set, and their total maximum score was 4 marks, and the average score for students' answers was 3.81.
- In the final test, parts of questions were set about the course learning outcomes (1.3-1.6), and their total maximum score was 6 marks, and the average score for students' answers was 5.32 out of 6 marks.

Accordingly, the measurement of achieving the K.2 (A1) output is as follows:

A1 = (8.7/10x100x0.02 + 3.81/4x100x0.16+ 5.52/6x100x0.60)/(0.02+0.16+0.60) = 89.9

- The grades assigned to Director K.2 are (2 + 4 + 6), i.e. 12 grades, and therefore the ratio of the exit grade to the total grade (M1) is 100/12, i.e. 0.12.

Assuming that the program linked 3 other courses to measure the learning outcome K.2 - according to the matrix linking the courses to the program learning outcomes - the information related to those courses could be summarized as shown in the following table:

Course	C1	Full Mark	Assigned Marks	M	A	Notes
EE 201 Electrical Circuits	3	100	14	0.14	88.00%	--
EE 330	3	100	12	0.12	89.97%	--
EE 432	3	100	10	0.10	87.91%	--
Senior Design Project	5	200	14	0.07	91.22%	EE 491 and EE 492

Based on this information, the percentage of achievement of learning outcome K.2 based on the courses can be calculated as follows:

A_{CR} = (88.00x3x0.14 + 89.97x3x0.12 + 87.91x3x0.10 + 91.22x5x0.07)/(3x0.14 + 3x0.12 + 3x0.10 + 5x0.07)

= 89.26

From the results of the "Senior Exit Exam" test for graduate students, the average student results for the questions related to Exit K.2 was 80.1%. Taking into account that the weight of this test is 0.3 and the weight of the courses is 0.70, the final result for achieving Exit K.2 is calculated as follows:

A_R = (89.26x0.7 + 80.10x0.3)/(0.7 + 0.3) = 86.51

For further clarification, Appendix A shows the parts of the questions related to the course learning outcomes and related to the program learning outcome K.2.

3.8 Practical Application for Indirect Measure of an PLO

Indirect measurement gives the opportunity to seek the opinion of stakeholders in determining the program's performance, including measuring the program's learning outcomes.

This evaluation is based mainly on questionnaires to survey stakeholders such as students, graduates, and employers.

It is necessary to analyze and evaluate the results of the questionnaires in the same way as the evaluation method using direct methods, so that each method can support the other.

3.8.1 Example from an Engineering Program

The results of the surveys for items related to learning outcomes K.2, S.4 and V.2 can be summarized in the following table:

Outcome	Item(s) result*				Assessment of the level outcome achievement
	Students Survey (program Quality) PO_SU_0	Field training Supervisors Survey PO_FTR_SUP	Alumni survey PO_GRAD	Employers survey PO_EMPO	
K.2	4.2 out of 5.0	4.3 out of 5.0	----	4.2 out of 5.0	4.23 out of 5.0
S.4	4.3 out of 5.0	---	---	4.1 out of 5.0	4.2 out of 5.0
V.2	3.9 من 5.0	4.0 out of 5.0	---	4.1 out of 5.0	4.0 out of 5.0

* Respondents' average rating of the item(s) associated with the outcome

Appendix B shows the items associated with Outputs k.2, S.4 and V.2 in the questionnaires used.

3.9 Evaluating the Direct and Indirect Measures of the Outcomes

The results are evaluated in light of the specified thresholds and assessment trends over the past years and comparing the boys' section to the girls' section, if applicable.

Regarding direct measurement, the previous Engineering program has set 70% as the threshold for achieving the learning outcomes, and since the percentage of achieving the K.2 output calculated in 3.7.1 is 86.51%, this indicates that the outcome has been achieved through direct measurement, and by referring to the questionnaires of the relevant parties, we find that the outcome has been achieved. With a rate of 4.23 according to the table given in 3.8.1, and since the threshold specified in this regard by the Bachelor of Electrical Engineering program is 3.75, the result of the indirect measurement supported the result of the direct measurement.

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Appendix A: Question Parts Related to K.2

The parts highlighted in yellow are these related to program learning outcome K.2

[redacted] **EE 330**

College of Engineering **2nd Quiz**

EE Department [redacted]

NAME: **ID NO.:**

Answer the following questions **Time allowed: 15 mins**

a) State the conditions of electromechanical energy conversion for electrical machines.

b) False or True:

i- A machine having a rotor of 4 poles and a stator of 6 poles produces a uniform torque ( )

ii- A machine having a rotor of 4 poles and a stator of 6 poles produces a pulsating torque only ( )

iii- Two rotating flux waves produces an instantaneous torque only if they have the same speed ( )

[redacted] **EE 330**

College of Engineering **First Mid-Term Exam**

EE Department [redacted]

NAME: **ID NO.:**

Answer all questions **Time allowed: 75 mins**

Q.1 –a) State 4 types of the transformers as regarding the transformer function.

–b) state the assumptions for the transformer to be considered as an ideal one.

–c) A single-phase power system consists of a 220 V, 60 Hz generator supplying a load of impedance $2.9\angle 30^{o}$ ohm through a transmission line of impedance 0.08 + j 0.11 ohm.

i. Calculate the load voltage, supply current and power-factor, and the line power losses.
ii. Suppose a step up transformer of turns ratio 1:30 is placed at the generator end and a 30:1 step down transformer is placed at the load end, calculate the load voltage, generator current and power-factor, and the line power losses in this case.

Q.2- a) Prove, using voltage phasor diagram, that the transformer has a positive voltage regulation when it delivers a lagging power factor current.

- b) A 10-kVA, 8000/230-V distribution transformer has a series impedance referred to the primary side of 80 + j 350 ohm. The components of the excitation branch are R_C = 550 k- ohm and X_M = 60 k-ohm.

i. Using the accurate calculations, calculate the voltage regulation of the transformer at full-load 0.85 leading power factor.
ii. Calculate the transformer efficiency at the condition of (i).
iii. What is the transformer power factor at which the transformer voltage regulation has a zero value?
iv. What is the transformer P.F at which the full-load voltage regulation has a minimum value?

Appendix B: Surveys' Items Related to the Concerned Learning Outcomes

Outcome K.2

Survey	Item(s)	Notes
Students Survey (program Quality)	لقد طورت المعارف والمهارات اللازمة لمهنتي التي اخترتها.	
Field Training Supervisors Survey	• Possess adequate scientific background	
Alumni survey	-----	
Employers survey	• يمتلك الخريج مهارات الفهم والاستيعاب	

Outcome S.4

Survey	Item(s)	Notes
Students Survey (program Quality)	• لقد حسن البرنامج مهاراتي في الاتصال.	
Field Training Supervisors Survey	----	
Alumni survey	-----	
Employers survey	• خريج لديه مهارات لغة إنجليزية جيدة (في حال طلبها في العمل • يمتلك الخريج مهارات المحادثة والتواصل الشفهي في العمل	

Outcome V.2

Survey	Item(s)	Notes
Students Survey (program Quality)	• لقد ساعدني البرنامج في تطوير الاهتمام الكافي لدي للسعي في الاستمرار في تحديث معلوماتي حسبما يستجد في مجال دراستي.	
Field Training Supervisors Survey	• Has the ability for learning and searching	
Alumni survey	-----	
Employers survey	• يمتلك الخريج القدرة على التكيف مع التكنولوجيا الحديثة	