ENGINEERING LEARNING OUTCOMES AND GRADUATE ATTRIBUTES

A WORKSHOP
ORGANISED BY
COUNCIL FOR THE REGULATION OF ENGINEERING IN NIGERIA (COREN)

on 08th MARCH, 2021

Outcomes of the Workshop

At the end of this workshop, participants are expected to:

1. know what exactly are outcomes.
2. discuss different domains of learning outcomes.
3. explain different engineering graduate attributes and their importance
4. comprehend the engineering

   knowledge attribute profile

   complex problem solving profile

   complex activities profile

Outline of the Workshop

1. What exactly are outcomes?
2. Different domain of learning outcomes
3. Engineering graduate attributes
4. Q & A

What exactly are outcomes?

- Outcomes are ***clear learning results that we want students to demonstrate at the end of significant learning experiences.***
- They ***are what learners can actually do with what they know and have learned.*** (Tangible application of what has been learned).
- Outcomes are ***actions and performances*** that embody and reflect learner competence in ***<u>using content, information, ideas, and tools successfully.</u>***
- They represent the ultimate result that is sought from the learning *(*Spady, 1994).

ENGINEERING LEARNING OUTCOMES

Domains of Engineering Learning Outcomes

Domains associated with engineering learning outcomes are:

1. Knowledge

It is about:

a) Concepts and principles of scientific foundation

b) Application of knowledge to solve related problems

c) Seeking and using new knowledge to adapt to change

Domains of Engineering Learning Outcomes…

2. Skill Psychomotor\ Practical\ Technical

It is about:

a) Use of systematic approach

b) Knowledge and application of practice

c) Proficiency in intervention activities and use of resources

d) Use of evidence – based approaches

e) Practice, Practice and Practice

Domains of Engineering Learning Outcomes…

3. Social Responsiveness & Responsibility

It is about:

a) Capacity building for sustainable livelihood.

b) Respecting cultural differences and finding opportunities in building skills.

c) Managing work processes to produce an overall positive impact on society.

Domains of Engineering Learning Outcomes…

4. Professionalism, Values, Attitudes, Ethics

It is about:

a) Commitment to set of shared values, excellence, altruism, responsibility, compassion, accountability, honesty and integrity, respect, cultural diversity and beliefs.

b) Commitment to scientific methods.

c) Autonomy in setting and enforcing these values.

d) Responsibilities to self- regulate and uphold values for clients, profession & society.

Domains of Engineering Learning Outcomes…

5. Critical Thinking & Scientific Approach

It is about:

a) Ability to use scientific methods, solve problems and evaluate outcomes for clients.

b) Seeking and using of appropriate information to solve problems.

c) Ability to undertake self- assessment and be self-directed.

d) Ability to use evidence.

Domains of Engineering Learning Outcomes…

6. Communications & Team Skills

It is about:

a) Ability to communicate information verbally and in writing

b) Effective presentation skills

c) Being an effective member and leader of a team

d) Effective interpersonal relationship

Domains of Engineering Learning Outcomes…

7. Management & Entrepreneurial Skills

It is about:

a) Building faith and commitment (Creating a vision).

b) Creating a NICHE (making own **Brand** and being own **CEO**).

c) Planning and following through (**Goals & Outcomes).**

d) Utilizing their strengths and what they do best.

Domains of Engineering Learning Outcomes…

7. Management & Entrepreneurial Skills…

It is about:

e) Partnering and building relationships and being resource to others.

f) Understanding their value propositions (Negotiations Skills).

g) Engaging risks and reality simultaneously.

h) Being proficient in English.

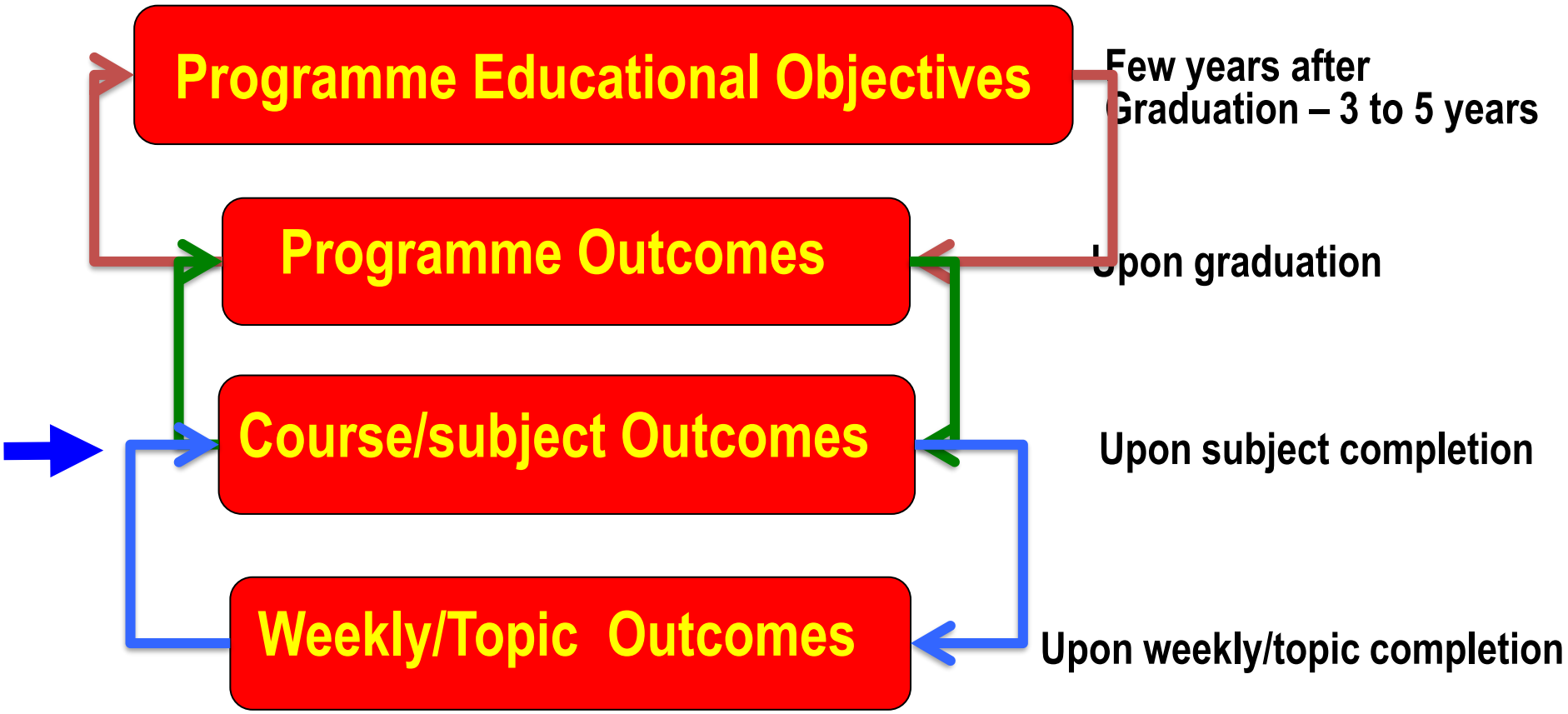
Domains of Engineering Learning Outcomes…

8. Lifelong Learning & Information Management

It is about:

a) Creating “educational interest”
b) Creating learning opportunities
c) Effective self-directed learning (SDL) activities
d) Use of IT
e) Retrieving relevant information and using it to benefit client/service

Different Levels of Learning Outcomes



Engineering Graduate Attributes

Graduate Attributes

Statements that describe what students are expected to know and be able to do by the time of graduation.

A set of individually assessable outcomes indicative of the graduate's potential competency.

A graduate of an engineering programme to be accredited by COREN is expected to have ability of:

1. **Knowledge of Engineering Sciences (**Breadth, depth and types of education)**:**

   Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of developmental and complex engineering problems (*conceptualization of engineering models*);

2. Problem Analysis (Complexity of Analysis)**:**

Identify, formulate, research literature and analyze developmental and complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences;

3. Design/Development of Solutions
(Breadth and uniqueness of engineering problems) **:**

Proffer solutions for developmental or complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations;

4. Investigation (Breadth and depth of investigation and experimentation)**:**

Conduct investigation into developmental or complex problems using research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions;

5. Modern Tool Usage:

Create, select and apply appropriate techniques, resources and modern engineering and ICT tools, including prediction, modelling and optimization to developmental and complex engineering activities, with an understanding of the limitations;

6. The Engineer and Society (Level of knowledge and responsibility)**:**

Apply reasoning informed by contextual knowledge including Humanities and Social Sciences to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice;

7. Environment and Sustainability:

Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development;

8. Ethics (Differentiating Characteristic) :

Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice, including adherence to the COREN Engineers' Codes of Conduct;

9. Communication

(Level of communication according to type of activities performed)**:**

Communicate effectively on developmental or complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions;

10. Individual and Team Work (Role in and diversity of team**):**

Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings;

11. Lifelong Learning :

Recognize the need for, and have the preparations and ability to engage in independent and lifelong learning in the broadest context of technological and social changes.

12. Project Management (Level of management required for differing types of activity)**:**

Demonstrate knowledge and understanding of engineering, management and financial principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments;

An Engineering programme which targets to develop these attributes in its graduates must ensure that its curriculum encompasses all the desired elements of ***Knowledge Profile, Complex Problem Solving*** and ***Complex Engineering Activities***

Knowledge Attribute Profile

S/No.	Attribute
K1	A systematic, theory-based understanding of the **natural sciences** applicable to the discipline.
K2	Conceptually-based **mathematics**, numerical analysis, statistics and formal aspects of computer and information science to support analysis and modelling applicable to the discipline.
K3	A systematic, theory-based formulation of **engineering fundamentals** required in the engineering discipline.
K4	Engineering **specialist knowledge** that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

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Knowledge Attribute Profile ….

S/No.	Attribute
K5	Knowledge that supports **engineering design** in a practice area.
K6	Knowledge of **engineering practice** (technology) in the practice areas in the engineering discipline.
K7	**Comprehension** of the role of engineering in society and identified issues in engineering practice in the discipline: ethics and the professional responsibility of an engineer to public safety; the impacts of engineering activity: economic, social, cultural, environmental and sustainability.
K8	Engagement with selected knowledge in the **research literature** of the discipline.

Range of Complex Problem Solving

	Attribute	Complex Problems
1	Preamble	Engineering problems which cannot be resolved without in-depth engineering knowledge, and have some or all of the characteristics listed below:
2	Range of conflicting requirements	Involve wide-ranging or conflicting technical, engineering and other issues.
3	Depth of analysis required	Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models.
4	Depth of knowledge required	Requires research-based knowledge much of which is at, or informed by, the forefront of the professional discipline and which allows a fundamentals-based, first principles analytical approach.

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Range of Complex Problem Solving ….

	Attribute	Complex Problems
5	Familiarity of issues	Involve infrequently encountered issues
6	Extent of applicable codes	Are outside problems encompassed by standards and codes of practice for professional engineering.
7	Extent of stakeholder involvement and level of conflicting requirements	Involve diverse groups of stakeholders with widely varying needs.
8	Consequences	Have significant consequences in a range of contexts.
9	Interdependence	Are high level problems including many component parts or sub-problems.

Range of Complex Engineering Activities

	Attribute	Complex Activities
1	Preamble	Complex activities means (engineering) activities or projects that have some or all of the following characteristics listed below:
2	Range of resources	Involve the use of diverse resources (and for this purpose, resources include people, money, equipment, materials, information and technologies).
3	Level of interaction	Require resolution of significant problems arising from interactions between wide-ranging or conflicting technical, engineering or other issues.

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Range of Complex Engineering Activities….

	Attribute	Complex Activities
4	Innovation	Involve creative use of engineering principles and research-based knowledge in novel ways.
5	Consequences to society and the environment	Have significant consequences in a range of contexts, characterized by difficulty of prediction and mitigation.
6	Familiarity	Can extend beyond previous experiences by applying principles-based approaches.

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Thank you

The End

Q & A