Virtual Laboratory Experiment Design Guidelines (VLEDG)
Set I - Selection of broad goal of the experiment

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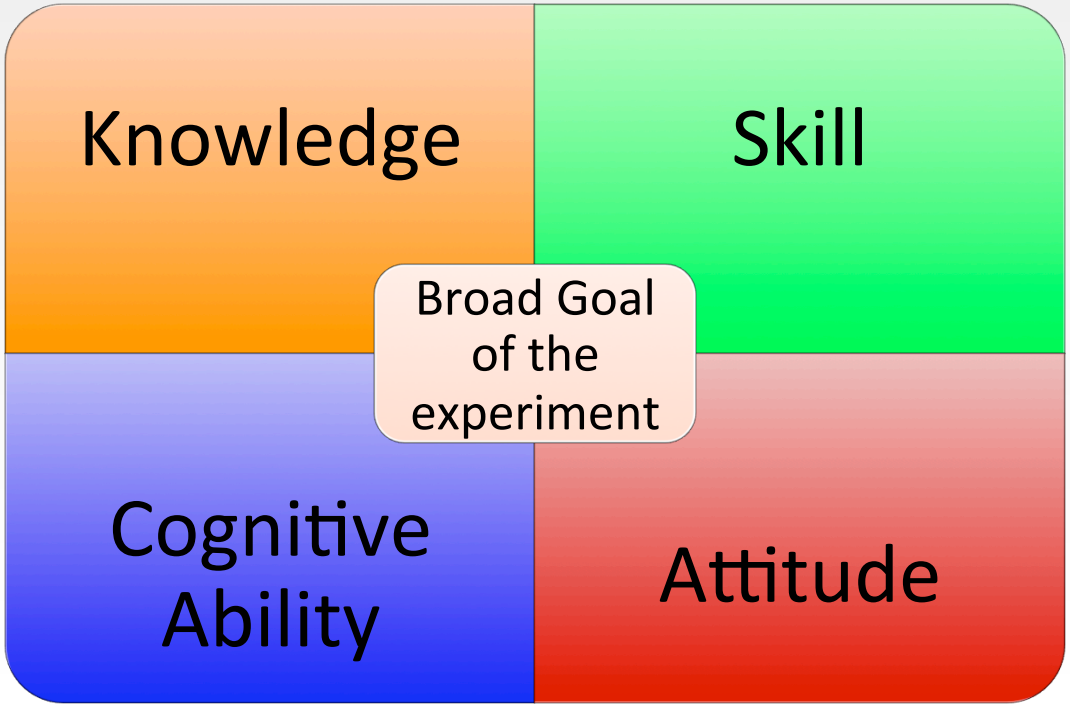
Broad Goal of laboratory experiment

Can be any one of the following four dimensions



Broad Goal - Knowledge

There are three main domains of learning and all teachers should know about them and use them to design their lessons (A. Hofstein and V.Lunetta, 2016). These three domains are

- Cognitive (knowledge based)
- Affective (emotive based)
- Psychomotor (action based)

Cognitive OR Knowledge Dimension

Has four components

- Facts,
- Concepts,
- Procedures
- Principles

What is a fact?

It is logically associated pieces of information. Some examples are names, dates, and events. For the Basic and Advanced Electronics laboratory environment the examples of facts are components, equipment etc.

Knowledge Dimension - What is a concept?

The classical theory of concepts says that concepts have a definitional structure.

Adequate definitions of the kind required by this theory usually take the form of a list of features.

These features must have two important qualities to provide a comprehensive definition. Features entailed by the definition of a concept must be both necessary and sufficient for membership in the class of things covered by a particular concept.

A feature is considered necessary if every member of the denoted class has that feature. A feature is considered sufficient if something has all the parts required by the definition.

For the Basic and Advanced Electronics laboratory environment the examples of concepts are PN Junction diode, Transistor etc.

Knowledge Dimension - What is a procedure?

It is a set of ordered steps, sequenced to solve a problem or accomplish a goal.

For the Basic and Advanced Electronics laboratory environment the examples of procedures are:

A sequence of steps carried out to perform an experiment.

A sequence of steps carried out to analyse a circuit etc.

Knowledge Dimension - What is a principle?

A principle is basically either cause-and-effect or relationships. It explains or predicts why something happens in a particular way.

For the Basic and Advanced Electronics laboratory environment the examples of principles are:

- Ohms law
- Barkhausen criterion for oscillation etc.

Example for classification of knowledge.

Facts	Concepts	Procedures	Principles
Definition, Symbols	Construction and internal Working, Piecewise linear model, Space charge capacitance C_T of diode, Breakdown mechanism	Diode under no bias, forward bias and reverse bias	V-I Characteristics, Diode operating point, Diode current equation, Relationship between Diode Current and Diode Voltage, Effect of temperature on diode characteristics

Revised Blooms' Taxonomy for Knowledge Dimension

Taxonomy (general) is the practice and science of classification of things or concepts, including the principles that underlie such classification.

Revised Blooms' taxonomy is the Classification of Knowledge to be at six levels. These are:

1. Recall
2. Understand
3. Apply
4. Analyse
5. Evaluate
6. Create

Knowledge dimension and Blooms' taxonomy

Knowledge Components: Facts, Concepts, Procedures and Principles

Knowledge Levels: Recall , Understand, Apply , Analyse , Evaluate, Create

These components can be achieved at the six levels

For example:

- Understand a particular concept
- Apply a particular procedure
- Evaluate the various principles
- Create a method

Broad Goal – Develop Skill

This is the ability to do something well and also termed as expertise.

The various skills that can be developed in the laboratory environment are practical skills, manipulative skills, investigative, inquiry process skills etc.

The design of the experiment will depend on the type of skill you wish to achieve.

Broad Goal – Develop Cognitive Ability

This is the ability of an individual to perform the various mental activities most closely associated with learning and problem solving.

Various cognitive abilities are: logical reasoning, computational thinking, pattern recognition, etc.

Broad Goal – Develop Attitude

This is predisposition or a tendency to respond positively or negatively towards a certain idea, object, person, or situation.

Attitude influences an individual's choice of action, and responses to challenges, incentives, and rewards.

This is related to the affective domain. Examples are: Team work, Confidence, Persisitence, Following ethical practices, etc.

Select you Broad Goal

- Select the topic from your course for which you wish to design virtual laboratory experiment
- Identify the knowledge components such as concepts, principles, and procedures of the topic.
- Make a decision regarding which of the concepts, principles and procedures you wish to convert to a virtual laboratory experiment.
- Identify the skills you wish to develop.
- Identify the cognitive ability you wish to develop.
- Select the ones you wish to target through the experiment.

Guidelines are provided for the following Broad Goals

Broad goal					
Knowledge	Concept	Procedures	Principles		
	Understand	Understand	Understand		
	Apply	Apply	Apply		
	Analyze	Analyze	Analyze		
	Evaluate	Evaluate	Evaluate		
		Create			
Skill	Practical	Manipulative	Investigative	Inquiry process	Communicating results
Cognitive Ability	Problem Solving				
Attitude	Team Work				

What next?

In the next video we will cover the details of how you can formulate the Learning Objectives of your virtual laboratory experiment.