Quality Assurance - SATS

Learning Outcomes: What, Why & How

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Workshop Objectives

By the end of this workshop, you should be able to:

- Define goals, objectives and/or learning outcomes

- List main reasons to use/adopt learning outcomes in course syllabus

- Write a list of learning outcomes to courses that you teach

- Map course learning outcomes to program learning outcomes and university objectives or goals.

Bachelor Honours Degree qualification type descriptor

Purpose	The Bachelor Honours Degree qualifies individuals who apply a body of knowledge in a specific context to undertake professional work and as a pathway for research and further learning
Knowledge	Graduates of a Bachelor Honours Degree will have coherent and advanced knowledge of the underlying principles and concepts in one or more disciplines and knowledge of research principles and methods
Skills	Graduates of a Bachelor Honours Degree will have: • cognitive skills to review, analyse, consolidate and synthesise knowledge to identify and provide solutions to complex problems with intellectual independence • cognitive and technical skills to demonstrate a broad understanding of a body of knowledge and theoretical concepts with advanced understanding in some areas • cognitive skills to exercise critical thinking and judgement in developing new understanding • technical skills to design and use research in a project • communication skills to present a clear and coherent exposition of knowledge and ideas to a variety of audiences
Application of knowledge and skills	Graduates of a Bachelor Honours Degree will demonstrate the application of knowledge and skills: • with initiative and judgement in professional practice and/or scholarship • to adapt knowledge and skills in diverse contexts • with responsibility and accountability for own learning and practice and in collaboration with others within broad parameters • to plan and execute project work and/or a piece of research and scholarship with some independence
Volume of learning	The volume of learning of a Bachelor Honours Degree is typically 1 year following a Bachelor Degree. A Bachelor Honours Degree may also be embedded in a Bachelor Degree, typically as an additional year

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Knowledge
"Knowing That"

Skills
"Knowing How to"
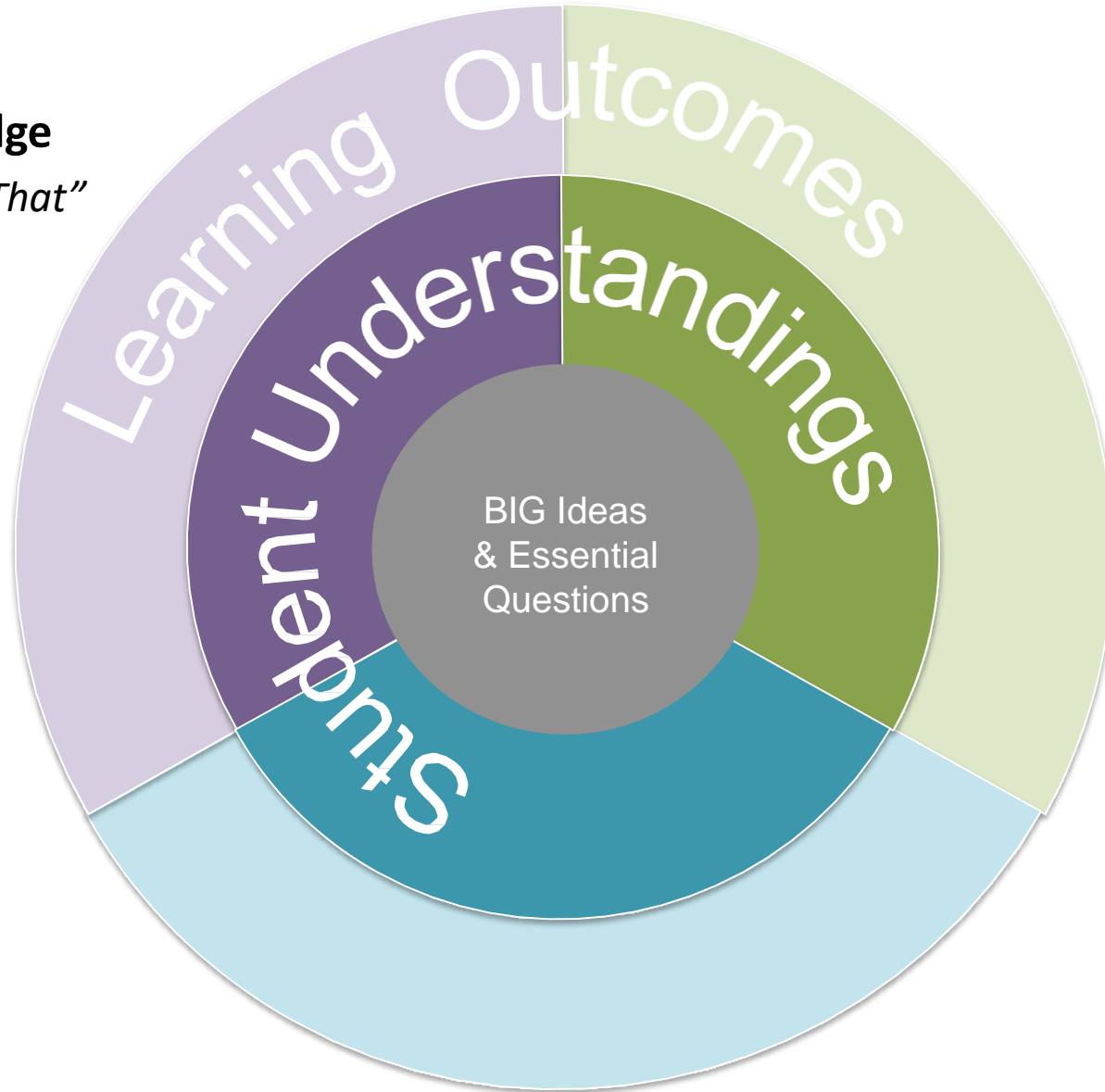
Attitude
"Knowing the Value of"

Learning Outcomes

Student Understandings

BIG Ideas & Essential Questions

Goals

A goal is a broad definition of student competence reflecting general intentions and desired outcomes of an institution, program or course. Aims serve the important function to indicate and promote the main values and general directions that guide the process of teaching and learning.

- Curriculum and teaching practices aim to link students' learning experiences to the world graduates will confront.
- Students will be competent in critical questioning and analysis.
- Students will have an appreciation of the necessity and difficulty of making ethnical choices.
- Students will know how to make connections among apparently disparate forms of knowledge.

Employability skills

- Employability skills are the transferable skills needed by an individual to make him employable, along with good technical understanding and subject knowledge.
    - Communication and interpersonal skills
    - Team working
    - Problem Solving skills
    - Initiative and enterprise
    - Planning and organizing skills
    - Self Management
    - Learning and adapting
    - Numeracy and Technology.
- University goals should be developed based on the university mission with employability skills of their graduates in mind.

University Learning Goals
example

a) Knowledge of technical fundamentals

b) Problem solving, critical thinking and innovation: Develop innovative technologies and find solutions to engineering problems.

c) Communication and team work: Communicate effectively as members of multidisciplinary teams

d) Social skills and ethical behaviour: Be sensitive to professional and societal contexts and committed to ethical action

e) Leadership: Lead in the conception, design, and implementation of new products, processes, services, and systems

f) Lifelong learning.

Objectives
what you hope your students will learn

A course objective describes what a faculty member will cover in a course. They are generally less broad than goals and more broad than student learning outcomes.

Examples of objectives include:

- Students will gain an understanding of the historical origins of art history.
- Student will read and analyse seminal works in 20th Century American literature.
- Students will study the major U.S. regulatory agencies.
- Students will be taught the conceptual and theoretical tools used in reasoning and problem solving, such as statistics, probability, logic, and decision theory.

Student Learning Outcomes
what your students actually learned

- A learning outcome is a clear and specific statement of what students are expected to learn in a unit and to be able to demonstrate at its completion.
  - ➤ List measurable and essential mastered content-knowledge—reflecting skills, competencies, and knowledge.
  - ➤ Express higher-level thinking skills that integrate course content and activities.
  - ➤ Exactly what assessments are intended to show.
  - ➤ Clear and measurable criteria for guiding the teaching, learning, and assessment process in the course.

BLOOM'S TAXONOMY — COGNITIVE + AFFECTIVE + PSYCHOMOTOR

Program Learning Outcome

Mechanical Engineering Student Learning Outcomes:

a) An ability to apply knowledge of mathematics, science, and engineering

b) An ability to design and conduct experiments, as well as to analyse and interpret data

c) An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

d) An ability to function on multidisciplinary teams

e) An ability to identify, formulate, and solve engineering problems

f) An understanding of professional and ethical responsibility

g) An ability to communicate effectively

h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

i) A recognition of the need for, and an ability to engage in life-long learning

j) A knowledge of contemporary issues

k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Why?

Integrating student learning goals and outcomes at the course and program/department levels serve the following purposes:

1. Increased student awareness of their own learning. clearly communicate your expectations of students. Information promotes equity and reduces unnecessary stress.

2. Frameworks for course design and redesign

3. A method for departmental planning

4. A map for curricular assessment and change. Like it or not, assessment drives learning

5. A method for institutional assessment

6. Improved academic advising

7. Evidence for accreditation

8. provide an opportunity for students to make connections across courses and institutional goals.

How?

Learning outcomes should contain the following three things:

- A verb that describes an observable action

- A description of the conditions under which the action take place: "when given x, you will be able to?"

- The acceptable performance level

Take on the role of your student and ask yourself:

"What do I have to do to convince you that I'm where you want me to be at the end of this lesson, unit or course?"

How?

- Experts often talk about using the acronym S—K—A to frame learning objectives. SKA stands for:

Skills	What students should be able to do by the time the course is completed.
Knowledge	What students should know and understand by the time the course is completed.
Attitudes	What the students' opinions will be about the subject matter of the course by the time it is completed.

Outcomes usually follow the format:

"At the end of the course, students will be able to insert verb here + insert knowledge, skills, or attitudes the student is expected to develop here."

How?

1. Start by thinking about what students will be expected to learn in your unit. Think about the outcomes for the unit in the context of the whole program.
2. Think about how to finish the sentence: 'at the end of this unit of study, students will be able to….'
3. Choose an action verb using Bloom Taxonomy for example.
4. Relate the action verb to the content and skills a student will specifically learn in your unit.
5. Ask: How will I know that students have achieved this in my unit? How will I be able to measure it?

Two things that are not to be confused with learning outcomes:

1. ***Assessment tasks***. 'Write an essay' is not a learning outcome, unless you're teaching a course on essay-writing. The same is true of 'conduct a literature search'.

2. ***Learning and teaching activities***; how you are actually going to go about helping the students to learn something. Activities like workshops or seminars are not learning outcomes.

INTERNAL FLOW

TME222 Fluid Mechanics

Fluid flow is classified as *external* or *internal*, depending on whether the fluid is forced to flow over a surface or in a conduit. Internal and external flows exhibit very different characteristics. In this chapter we consider *internal flow* where the conduit is completely filled with the fluid, and flow is driven primarily by a pressure difference. This should not be confused with *open-channel flow* (Chap. 11) where the conduit is partially filled by the fluid and thus the flow is partially bounded by solid surfaces, as in an irrigation ditch, and flow is driven by gravity alone.

We start this chapter with a general physical description of internal flow through pipes and ducts including the *entrance region* and the *fully developed* region. We continue with a discussion of the dimensionless *Reynolds number* and its physical significance. We then introduce the *pressure drop* correlations associated with pipe flow for both laminar and turbulent flows. Then we discuss minor losses and determine the pressure drop and pumping power requirements for real-world piping systems. Finally, we present a brief overview of flow measurement devices.

OBJECTIVES

When you finish reading this chapter, you should be able to

- Have a deeper understanding of laminar and turbulent flow in pipes and the analysis of fully developed flow

- Calculate the major and minor losses associated with pipe flow in piping networks and determine the pumping power requirements

- Understand various velocity and flow rate measurement techniques and learn their advantages and disadvantages

Chapter 2 Statics of Particles

2.1 INTRODUCTION

In this chapter you will study the effect of forces acting on particles. First you will learn how to replace two or more forces acting on a given particle by a single force having the same effect as the original forces. This single equivalent force is the *resultant* of the original forces acting on the particle. Later the relations which exist among the various forces acting on a particle in a state of *equilibrium* will be derived and used to determine some of the forces acting on the particle.

The use of the word "particle" does not imply that our study will be limited to that of small corpuscles. What it means is that the size and shape of the bodies under consideration will not significantly affect the solution of the problems treated in this chapter and that all the forces acting on a given body will be assumed to be applied at the same point. Since such an assumption is verified in many practical applications, you will be able to solve a number of engineering problems in this chapter.

The first part of the chapter is devoted to the study of forces contained in a single plane, and the second part to the analysis of forces in three-dimensional space.

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Chapter 4 Pure Bending

4.1 INTRODUCTION

In the preceding chapters you studied how to determine the stresses in prismatic members subjected to axial loads or to twisting couples. In this chapter and in the following two you will analyze the stresses and strains in prismatic members subjected to *bending*. Bending is a major concept used in the design of many machine and structural components, such as beams and girders.

This chapter will be devoted to the analysis of prismatic members subjected to equal and opposite couples **M** and **M′** acting in the same longitudinal plane. Such members are said to be in *pure bending*. In most of the chapter, the members will be assumed to possess a plane of symmetry and the couples **M** and **M′** to be acting in that plane (Fig. 4.1).

M′

Writing Learning Outcomes in the Cognitive Domain

Knowledge

ability to recall or remember facts without necessarily understanding them.

Comprehension

ability to understand and interpret learned information.

Application

ability to use learned material in new situations.

Analysis

ability to break down information into its components.

Synthesis

ability to put parts together.

Evaluation

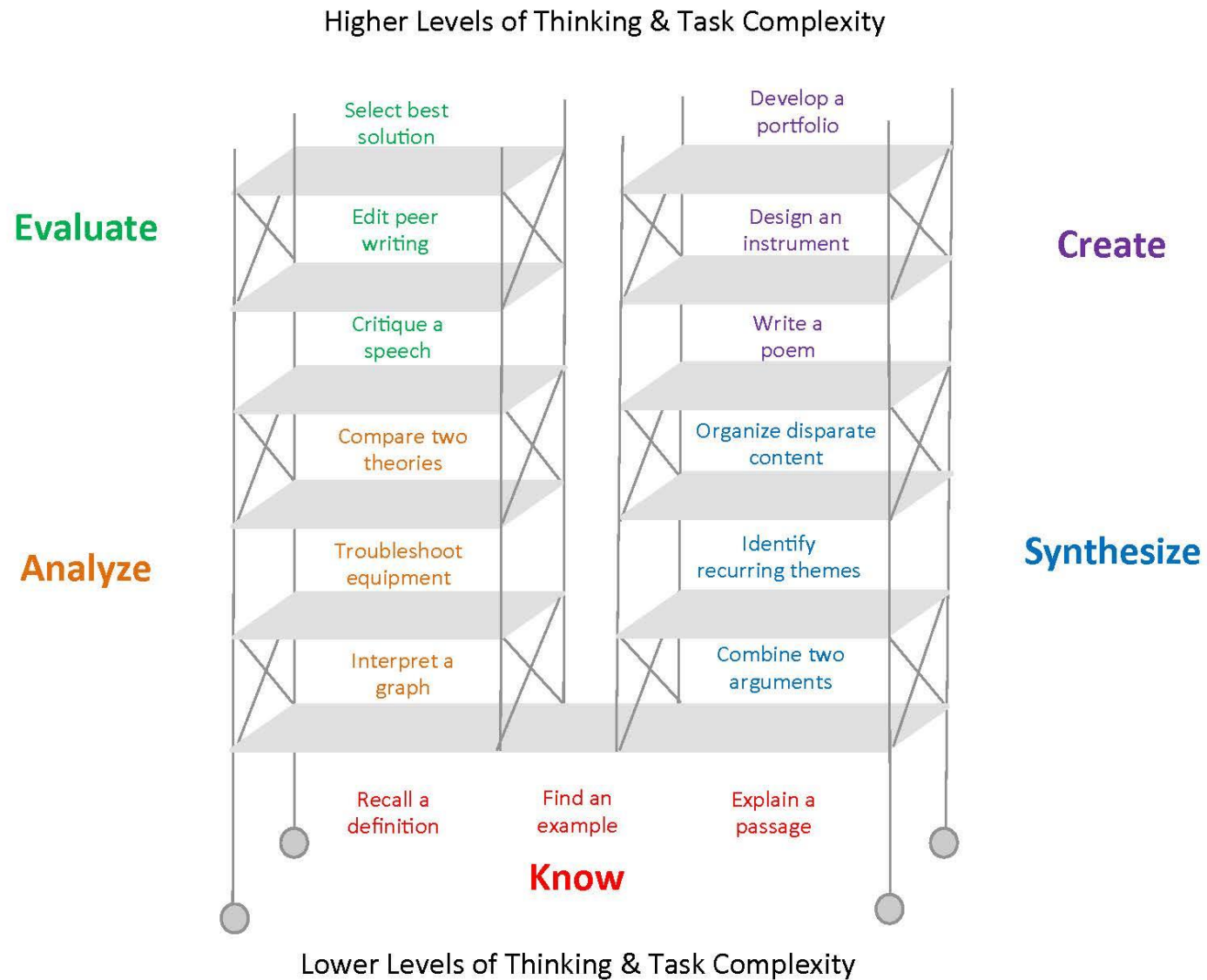ability to judge the value of material for a given purpose.

COGNITIVE

+

AFFECTIVE

+

PSYCHOMOTOR

BLOOM'S TAXONOMY

Figure Title: Scaffold Students for Higher Levels of Learning

Higher Levels of Thinking & Task Complexity

Lower Levels of Thinking & Task Complexity

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Knowledge
Recall /regurgitate facts without understanding. Exhibits previously learned material by recalling facts, terms, basic concepts and answers.

Comprehension
To show understanding finding information from the text. Demonstrating basic understanding of facts and ideas.

Application
To use in a new situation. Solving problems by applying acquired knowledge, facts, techniques and rules in a different way.

Analysis
To examine in detail. Examining and breaking information into parts by identifying motives or causes; making inferences and finding evidence to support generalisations.

Synthesis
To change or create into something new. Compiling information together in a different way by combining elements in a new pattern or proposing alternative solutions.

Evaluation
To justify. Presenting and defending opinions by making judgements about information, validity of ideas or quality of work based on a set of criteria.

Key words:

Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation
Choose, Observe, Show, Copy, Omit, Spell, Define, Quote, State, Duplicate, Read, Tell, Find, Recall, Trace, How, Recite, What, Identify, Recognise, When, Label, Record, Where, List, Relate, Which, Listen, Remember, Who, Locate, Repeat, Why, Match, Reproduce, Write, Memorise, Retell, Name, Select	Ask, Extend, Outline, Cite, Generalise, Predict, Classify, Give examples, Purpose, Compare, Illustrate, Relate, Contrast, illustrate, Rephrase, Demonstrate, Indicate, Report, Discuss, Infer, Restate, Estimate, Interpret, Review, Explain, Match, Show, Express, Observe, Summarise, Translate	Act, Employ, Practice, Administer, Experiment with, Relate, Apply, Group, Represent, Associate, Identify, Select, Build, Illustrate, Show, Calculate, Interpret, Simulate, Categorise, Interview, Solve, Choose, Link, Summarise, Classify, Make use of, Teach, Connect, Manipulate, Transfer, Construct, Model, Translate, Correlation, Organise, Use, Demonstrate, Perform, Develop, Plan, Dramatise	Analyse, Examine, Prioritize, Appraise, Find, Question, Arrange, Focus, Rank, Assumption, Function, Reason, Breakdown, Group, Relationships, Categorise, Highlight, Cause and effect, In-depth discussion, Reorganise, Choose, Inference, Research, Classify, Inspect, See, Differences, Investigate, Select, Discover, Isolate, Separate, Discriminate, List, Similar to, Dissect, Motive, Simplify, Distinction, Omit, Survey, Distinguish, Order, Take part in, Divide, Organise, Test for, Establish, Point out, Theme, Comparing	Adapt, Estimate, Plan, Add to, Experiment, Predict, Build, Extend, Produce, Change, Formulate, Propose, Choose, Happen, Reframe, Combine, Hypothesise, Revise, Compile, Imagine, Rewrite, Compose, Improve, Simplify, Construct, Innovate, Solve, Convert, Integrate, Speculate, Create, Invent, Substitute, Delete, Make up, Suppose, Design, Maximise, Tabulate, Develop, Minimise, Test, Devise, Model, Theorise, Discover, Modify, Think, Discuss, Original, Transform, Elaborate, Originate, Visualise	Agree, Disprove, Measure, Appraise, Dispute, Opinion, Argue, Effective, Perceive, Assess, Estimate, Persuade, Award, Evaluate, Prioritise, Bad, Explain, Prove, Choose, Give reasons, Rate, Compare, Good, Recommend, Conclude, Grade, Rule on, Consider, How do we, Select, Convince, know?, Support, Criteria, Importance, Test, Criticise, Infer, Useful, Debate, Influence, Validate, Decide, Interpret, Value, Deduct, Judge, Why, Defend, Justify, Determine, Mark

Actions / Outcomes:

	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation
Actions:	Describing, Finding, Identifying, Listing, Locating, Naming, Recognising, Retrieving	Classifying, Comparing, Exemplifying, Explaining, Inferring, Interpreting, Paraphrasing, Summarising	Carrying out, Executing, Implementing, Using	Attributing, Deconstructing, Integrating, Organising, Outlining, Structuring	Constructing, Designing, Devising, Inventing, Making, Planning, Producing	Attributing, Checking, Deconstructing, Integrating, Organising, Outlining, Structuring
Outcomes:	Definition, Fact, Label, List, Quiz, Reproduction, Test, Workbook, Worksheet	Collection, Examples, Explanation, Label, List, Outline, Quiz, Show and tell, Summary	Demonstration, Diary, Illustrations, Interview, Journal, Performance, Presentation, Sculpture, Simulation	Abstract, Chart, Checklist, Database, Graph, Mobile, Report, Spread sheet, Survey	Advertisement, Film, Media product, New game, Painting, Plan, Project, Song, Story	Abstract, Chart, Checklist, Database, Graph, Mobile, Report, Spread sheet, Survey

Questions:

Knowledge:
- Can you list three ...?
- Can you recall ...?
- Can you select ...?
- How did _____ happen?
- How is ...?
- How would you describe ...?
- How would you explain ...?
- How would you show ...?
- What is ...?
- When did ...?
- When did _____ happen?
- Where is . . . ?
- Which one ...?
- Who was ...?
- Who were the main . . . ?
- Why did ...?

Comprehension:
- Can you explain what is happening . . . what is meant . . .?
- How would you classify the type of ...?
- How would you compare ...?contrast ...?
- How would you rephrase the meaning ...?
- How would you summarise ...?
- What can you say about ...?
- What facts or ideas show ...?
- What is the main idea of ...?
- Which is the best answer ...?
- Which statements support ...?
- Will you state or interpret in your own words ...?

Application:
- How would you use...?
- What examples can you find to ...?
- How would you solve _____ using what you have learned ...?
- How would you organise _____ to show ...?
- How would you show your understanding of ...?
- What approach would you use to...?
- How would you apply what you learned to develop ...?
- What other way would you plan to ...?
- What would result if ...?
- Can you make use of the facts to ...?
- What elements would you choose to change ...?
- What facts would you select to show ...?
- What questions would you ask in an interview with ...?

Analysis:
- What are the parts or features of ...?
- How is _____ related to ...?
- Why do you think ...?
- What is the theme ...?
- What motive is there ...?
- Can you list the parts ...?
- What inference can you make ...?
- What conclusions can you draw ...?
- How would you classify ...?
- How would you categorise ...?
- Can you identify the difference parts ...?
- What evidence can you find ...?
- What is the relationship between ...?
- Can you make a distinction between ...?
- What is the function of ...?
- What ideas justify ...?

Synthesis:
- What changes would you make to solve...?
- How would you improve ...?
- What would happen if...?
- Can you elaborate on the reason...?
- Can you propose an alternative...?
- Can you invent...?
- How would you adapt _____ to create a different...?
- How could you change (modify) the plot (plan)...?
- What could be done to minimise (maximise)...?
- What way would you design...?
- Suppose you could _____ what would you do...?
- How would you test...?
- Can you formulate a theory for...?
- Can you predict the outcome if...?
- How would you estimate the results for...?
- What facts can you compile...?
- Can you construct a model that would change...?
- Can you think of an original way for the ...?

Evaluation:
- Do you agree with the actions/outcomes...?
- What is your opinion of...?
- How would you prove/disprove...?
- Can you assess the value/importance of...?
- Would it be better if...?
- Why did they (the character) choose...?
- What would you recommend...?
- How would you rate the...?
- What would you cite to defend the actions...?
- How would you evaluate ...?
- How could you determine...?
- What choice would you have made...?
- What would you select...?
- How would you prioritise...?
- What judgement would you make about...?
- Based on what you know, how would you explain...?
- What information would you use to support the view...?
- How would you justify...?
- What data was used to make the conclusion...?
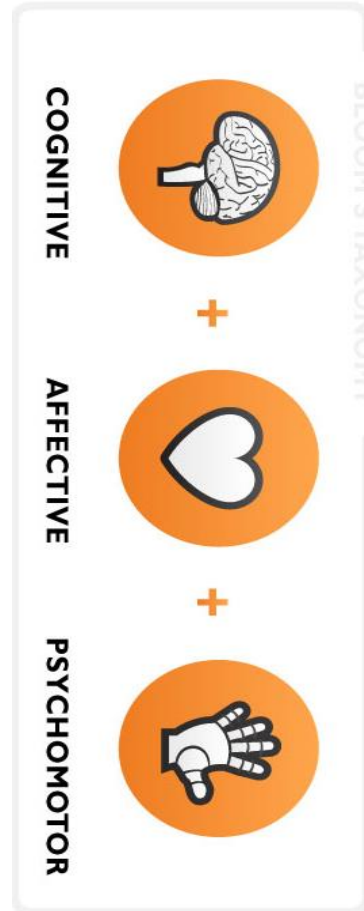
Bloom's Taxonomy: Teacher Planning Kit

Writing learning outcomes in the affective domain

✓ This domain is concerned with issues relating to the emotional component of learning and ranges from basic willingness to receive information to the integration of beliefs, ideas and attitudes.

✓ In order to describe the way in which we deal with things emotionally, Bloom and his colleagues developed five major categories:

Affective Domain
Feeling and Attitude

Characterization
Organization
Valuing
Responding
Receiving

COGNITIVE + AFFECTIVE + PSYCHOMOTOR

Receiving: This refers to a willingness to receive information,

Responding: This refers to the individual actively participating in his or her own learning,

Valuing: This ranges from simple acceptance of a value to one of commitment,

Organisation: This refers to the process that individuals go through as they bring together different values, resolve conflicts among them and start to internalise the values,

Characterisation: At this level the individual has a value system in terms of their beliefs, ideas and attitudes that control their behaviour in a consistent and predictable manner

Receiving	Responding	Valuing	Organization	Characterization
Openness to new information or experiences	Active participation in, interaction with, or response to new information or experiences	Attaching value or worth to new information or experiences	Incorporating new information or experiences into existing value system	Full integration/ internalization resulting in new and consistent attitudes, beliefs, and/or behaviors
Ask Choose Describe Follow Give Hold Identify Locate Name Select Reply Use	Answer Assist Aid Compile Conform Discuss Greet Help Label Perform Practice Present Read Recite Report Select Tell Write	Complete Demonstrate Differentiate Explain Follow Form Initiate Join Justify Propose Read Share Study Work	Adhere Alter Arrange Combine Compare Complete Defend Formulate Generalize Identify Integrate Modify Order Organize Prepare Relate Synthesize	Act Discriminate Display Influence Listen Modify Perform Practice Propose Qualify Question Revise Serve Solve Verify Use

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Examples of Learning Outcomes Relevant to the Affective Domain

- Accept the need for professional ethical standards.
- Appreciate the need for confidentiality in the professional relationships.
- Display a willingness to communicate well with all stakeholders.
- Value a willingness to work independently.
- Participate in class discussions with colleagues and with teachers.
- Display a professional commitment to ethical practice.

Writing learning outcomes in the psychomotor domain

Imitation: Observing the behaviour of another person and copying this behaviour.

Manipulation perform certain actions by following instructions and practicing skills.

Precision: Carry out a task with few errors and become more precise without the presence of the original source.

Articulation Co-ordinate a series of actions combining two or more skills. Patterns can be modified to fit special requirements or solve a problem.

Naturalisation : Displays a high level of performance naturally ("without thinking"). Skills are combined, sequenced and performed consistently with ease.
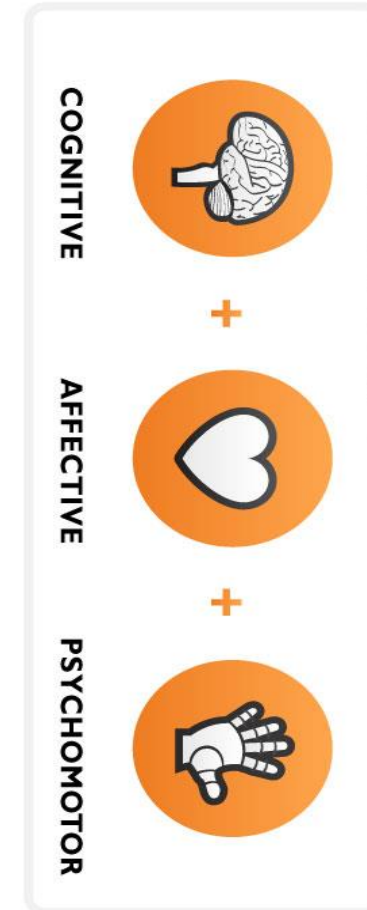
Writing learning outcomes in the psychomotor domain
Doing Skills

- The psychomotor domain deals with manual or physical skills.

- It is the "doing" domain.

- The diagram outlines the five levels in this domain

Doing Skills
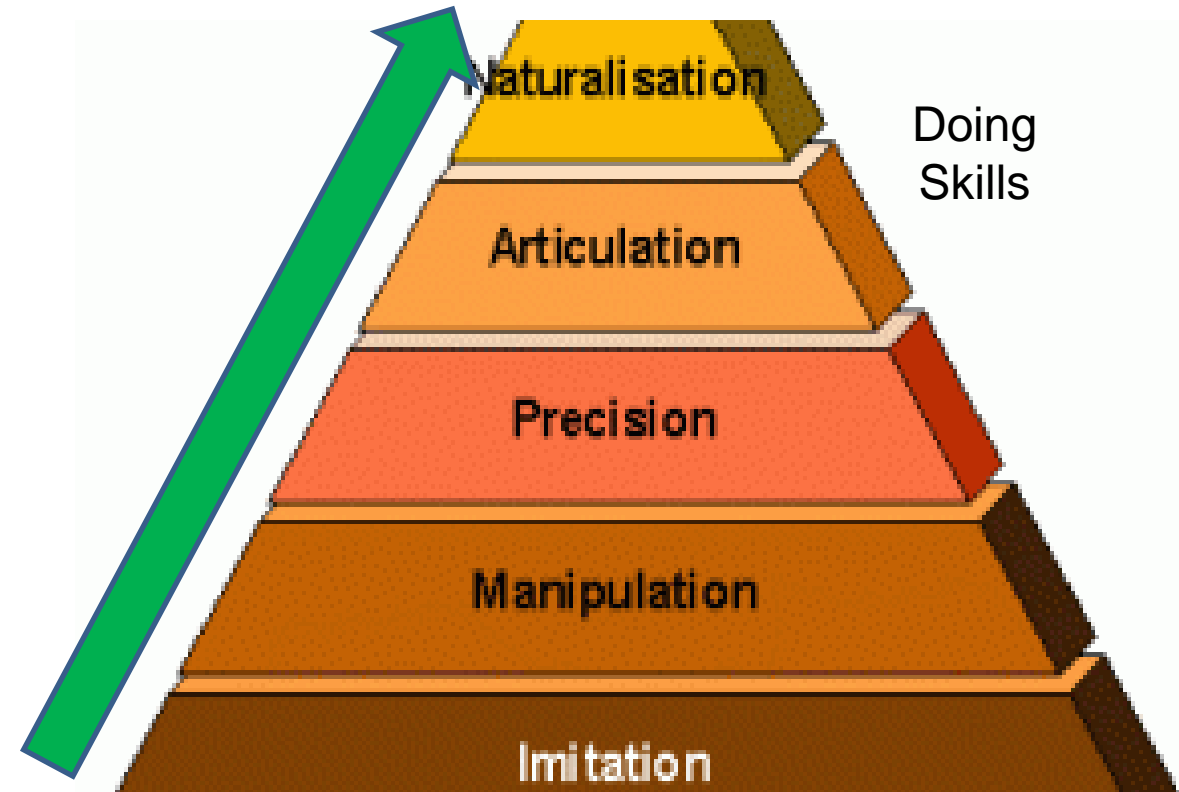
Psychomotor Domain Levels				
------------------Increasing Complexity------------------>				
Imitation	**Manipulation**	**Precision**	**Articulation**	**Naturalization**
Observing and copying another's action/skill	Reproducing action/skill through instruction	Accurately executing action/skill on own	Integrating multiple actions/skills and performing consistently	Naturally and automatically performing actions/skills at high level
Adhere Copy Follow Repeat Replicate	Build Execute Implement Perform Recreate	Calibrate Complete Control Demonstrate Perfect Show	Adapt Combine Construct Coordinate Develop Formulate Integrate Master Modify	Design Invent Manage Project Specify

- The Interpersonal domain focuses on people interacting with others.

- It takes on greater importance than perhaps in the past.

- The levels in this domain should not be considered hierarchical, but more as a list of skills
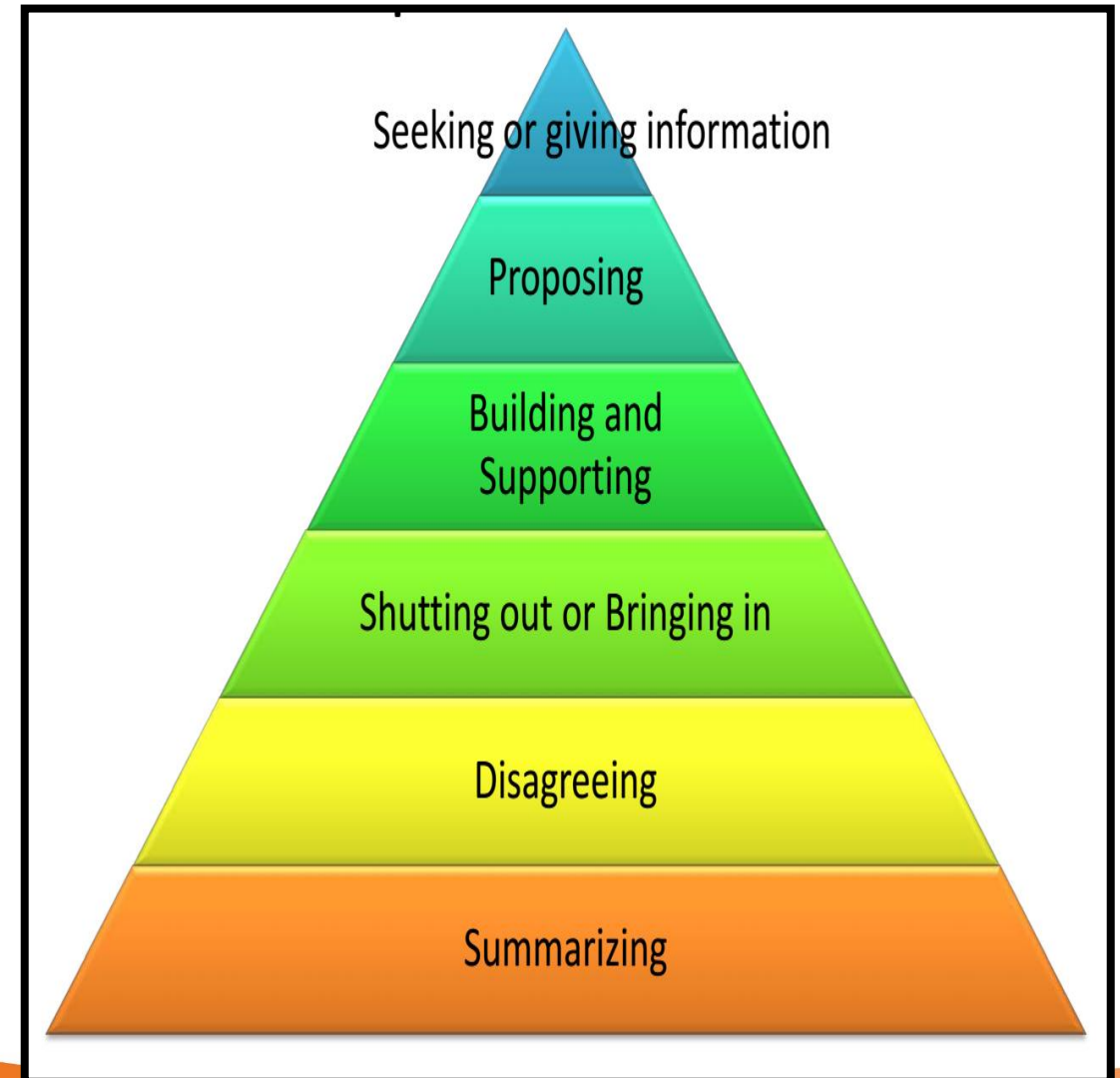
Summarizing
- To provide an abbreviated version of the original content
- Taking an active listening position - restate

Disagreeing
- Having a contradictory opinion
- Discreetly and with consideration, voice a difference of opinion or variation of an idea being discussed by a group or team

Shutting out or Bringing in
- Excluding or involving members of a group or team in the exchange of ideas both verbal and written
- Asking the members of a project to share their opinions

Building and Supporting

To further a project as a member of a team; to provide positive feedback; to assist another person toward accomplishing a collective goal

Active listening during project meetings then help provide solutions to problems; providing constructive feedback

Proposing

To formally put forward an idea

Suggesting or recommending a change to a project or offering a new project for consideration

Seeking or giving information

Asking for or giving explanations, facts, or other supplemental information from or to other individuals

Asking a teacher or work supervisor for clarification on a project

Checklist for writing learning outcomes

When writing learning outcomes, I need to:
- ✓ Focus on outcomes, not processes
- ✓ Start each outcome with an action verb
- ✓ Use only one action verb per learning outcome
- ✓ Avoid vague verbs such as know and understand
- ✓ Check that the verbs used reflect the level of learning required
- ✓ Ensure that outcomes are observable and measurable
- ✓ Write the outcomes in terms of what the learner does, not what the instructor does
- ✓ Check that the outcomes reflect knowledge, skills, or attitudes required in the workplace
- ✓ Include outcomes that are woven into the entire course (such as work effectively in teams)
- ✓ Check that there are the appropriate number of outcomes (no more than three per major topic)
- ✓ Check that the outcomes fit within program and course goals.

Mapping

- After a department has created or confirmed the learning outcomes that are appropriate for its program, the next step is to map the outcomes onto the curriculum.

- Mapping (also called "charting") outcomes allows the department to identify which courses address each of the learning outcomes.

- This activity is useful for communicating where within the curriculum learning outcomes are introduced, practiced, and mastered.

- Learning outcomes are introduced in lower level courses and then further developed in courses that occur later in students' careers.

- This process allows departments to ensure that the entire curriculum offers students sufficient opportunity to develop the knowledge and skills associated with each of its outcomes.

A curriculum map consists of a table with two axes; one axis lists program outcomes, and the other lists courses in the major.

Program Student Learning Outcomes	ULG (A)	ULG (B)	ULG (C)	ULG (D)	ULG (E)	ULG (F)
a) An ability to apply knowledge of mathematics, science, and engineering						
b) An ability to design and conduct experiments, as well as to analyse and interpret data						
c) An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability						
d) An ability to function on multidisciplinary teams						
e) An ability to identify, formulate, and solve engineering problems						
f) An understanding of professional and ethical responsibility						
g) An ability to communicate effectively						
h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context						
i) A recognition of the need for, and an ability to engage in life-long learning						
j) A knowledge of contemporary issues						
k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.						

University Learning Goals/Objectives	Course xxx
a) Knowledge of technical fundamentals	
b) Problem solving, critical thinking and innovation	
c) Communication and team work	
d) Social skills and ethical behaviour	
e) Leadership	
f) Lifelong learning	

Program Student Learning Outcomes	Course xxx
a) An ability to apply knowledge of mathematics, science, and engineering	
b) An ability to design and conduct experiments, as well as to analyse and interpret data	
c) An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	
d) An ability to function on multidisciplinary teams	
e) An ability to identify, formulate, and solve engineering problems	
f) An understanding of professional and ethical responsibility	
g) An ability to communicate effectively	
h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	
i) A recognition of the need for, and an ability to engage in life-long learning	
j) A knowledge of contemporary issues	
k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	

Qualitative Quality Function Deployment (QFD) Matrix – Table 1 of 4

H = High
M = Medium
L = Low

Desired Student Outcome	Basic Math and Sciences	General Education Requirements	English Composition	ENGR 102 Introduction to Engineering	Engineering Science Electives	CE 204 – Numerical Methods & Programs	CE 210 - Engineering Graphics	CE 214 - Statics	CE 215 - Mechanics of Solids	CE 218 - Mechanics of Fluids	CE 251 - Surveying	CE 301 - Engineering Communications	CE 310 - Probability and Statistics in CE	CE 323 - Hydraulic Engineering	CE 329 - Fluid Mechanics Lab.	CE 333 - Elem. Struct. Analysis	CE 334 - Structural Design in Steel (CETE)	CE 335 - Struct. Des. In Concrete (CETE)
(a) Apply knowledge of math, science, and engineering	H			M	H	H	L	H	H	H	H	L	H	M			H	L	L
(b) Design/conduct experiments, and analyze/interpret data	H			M							H		H		H				
(c) Design a system, component, or process to meet a need	L			H			L						L	H			L	H	H
(d) Function on multidisciplinary teams	M			H										L	M				
(e) Identify, formulate, and solve problems				H	M	M	M	M	H	M	M			M	M		M	H	M
(f) Understand professional and ethical responsibilities		L	L	M			L					L							
(g) Communicate effectively	M	H	H	M		M	M	L	L		M	H			M	M	L		L
(h) Be broadly educated to help understand impact of solutions		H	L									L	L			L			
(i) Recognize need for engaging in life-long learning				M	M														
(j) Demonstrate awareness of contemporary societal issues		H	M	M									M			L			
(k) Use techniques, skills, and tools of modern engineering practice					M	M					M		L	M	L	L	L		L
(l) Pass the FE exam as the first step towards PE registration					M	H	H	H			L			L	M		H	H	H
(m) Be proficient in the major areas of civil engineering					M	M								L	H		H	H	H

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الجامعة الألمانية الأردنية
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Course Outline

TME212 Statics:

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Skill Development

Intellectual skills: critical, analytical, synthesising and problem-solving skills

- Lectures, seminars, discussion groups, practicals, research projects and fieldwork encourage the:
  - assimilation of new knowledge;
  - development of a critical analysis of the field of study;
  - application of basic principles in a wider context.
- Supervisions provide opportunities for:
  - close and regular contact with academic staff;
  - development of structured arguments;
  - discussion with peers and supervisors.
- Examinations, essays and set problems assess skills of:
- comprehension;

- argument and analysis;
- planning and information-gathering;
- report writing;
- time management and working under pressure.

- *Extra-curricular development opportunities: These include participating in:*
  - *College and University academic societies;*
  - *internal and external conferences;*
  - *competitions*

Skill Development
Communication skills: written, oral, non-verbal, formal or informal and active listening

- Written communication skills are developed through the appraisal of a *Student* written work. Instructors should be able to aid a *Student* in improving his:
  - clarity of writing;
  - layout and presentation;
  - referencing and use of appendices, bibliographies and diagrams;
  - more specialist techniques such as translations and technical drawing or writing.
- Oral communication skills can be developed through:
  - presentation of work and ideas in supervisions and seminars;
  - discussion and debate between peers and supervisors;
- presentation of research work at informal or formal symposia or conferences.

- *Extra-curricular development opportunities: These include participating in:*
  - *internal and external conferences;*
  - *drama societies;*
  - *University radio;*
  - *student newspapers.*

Skill Development

Interpersonal skills: working with or motivating others, flexibility and adaptability

- Even if a course does not include teamwork, *Student* will still be able to practice interpersonal skills through interaction with peers and instructors in a supervision group. Group work helps to develop interpersonal skills such as:
    - negotiation skills and diplomacy;
    - flexibility and adaptability;
    - teamwork;
    - delegation skills.

- *Extra-curricular development opportunities: College membership and participating in sport, theatre and music helps to develop:*
    - *an ability to interact with a wide range of people;*
    - *community spirit and ability to work together;*
    - *a sense of consideration and support for others.*

Skill Development

Organisational skills: working independently, taking initiative, managing your finances and time, balancing academic

- *Student* will need to be organized to:
  - prepare for exams;
  - complete dissertations and extended essays (you will need to demonstrate your ability to organize substantial quantities of research data, structure a lengthy argument and manage your time);
  - arrange work experience or time spent abroad as part of your course.

- *Extra-curricular development opportunities: Including helping to run and promote:*
  - *sports teams;*
  - *societies;*
  - *committees.*
  - *Also managing:*
  - *family commitments/childcare;*
  - *budgets/finances.*

Skill Development
Computer literacy

- *Student* computer skills should be used often during the course of his studies, including:
  - word-processing - build up your typing speed and accuracy and learn to use text formatting features;
  - data analysis - develop your knowledge of spreadsheet and data packages such as Excel;
  - presentation software - formal presentations may be part of your coursework and may involve using software such as PowerPoint;
  - the Internet - web-based research is now an essential skill in almost every field and most departments post supplementary teaching material online;

  - email - there are conventions that you should be aware of for using email for academic or professional purposes.

- *Extra-curricular development opportunities: These include participating in:*
  - *committees or societies (particularly as webmaster or treasurer);*
  - *student newspapers.*

Skill Development
Research skills

- *Student* be encouraged to develop proficiency in a range of strategies, techniques and tools.

- Projects and dissertations develop skills in a range of research techniques:
  - use of primary sources (especially for literature or history projects);
  - data management and analysis;
  - critical analysis and thesis construction.

- Some subjects provide comprehensive training in specialist research methods, for example:
  - data acquisition techniques;
  - fieldwork;
  - practicals and experiments;
  - statistical methods.

- *Extra-curricular development opportunities. These include participating in:*
  - *student newspapers;*
  - *student politics.*

Skill Development
Numeracy

- Development opportunities within the SATS system:
  - Mathematical ability is inherent in some disciplines, and it is important that all students maintain at least a rudimentary comprehension of numeracy.
  - Activities which demonstrate numeracy could include analyzing data using statistical methods.

- *Extra-curricular development opportunities. These include:*
  - *managing personal finances;*
  - *fundraising;*
  - *acting as treasurer for a committee or society (this offers an opportunity to become familiar with financial accounts, spreadsheets and databases);*
  - *undertaking numeracy tests which are offered by the Careers Service.*

Skill Development
Foreign language skills

- Development opportunities within the SATS system:
  - The acquisition and use of a second language is inherent in some courses, either as an integral part of the course or as an option.
  - If a course includes a year abroad think ahead to what a *Student* can learn during that time in addition to language skills. When the *Student* graduate, will he be able to prove that he can operate confidently in a foreign country?

- *Extra-curricular development opportunities. Language skills are a strength to any graduate, whether in further research, employment, leisure or travel. Opportunities to develop your skills include:*
  - *using the Language Centre's services and resources;*
  - *joining foreign language societies or cultural societies;*
  - *watching foreign films in their original languages.*