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Coláiste na hOllscoile Corcaigh, Éire
University College Cork, Ireland

ASTI Subject and Programme Representatives Annual Seminar

The Design of Curriculum Specifications within a Learning Outcomes Framework

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21st Sept 2024

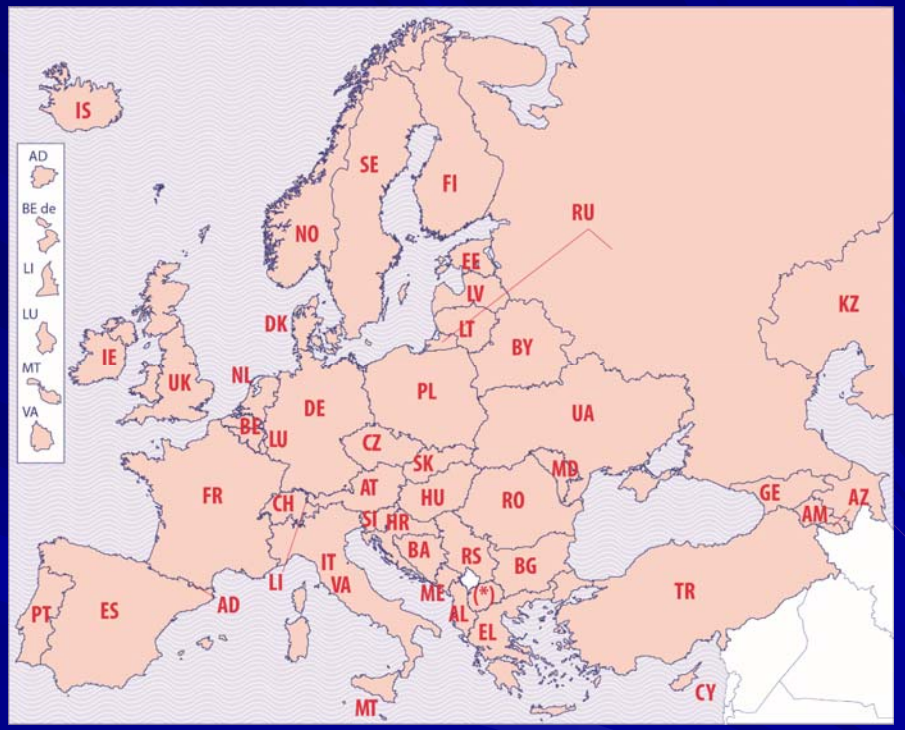
1. Why do we need Learning Outcomes?

The Bologna Process : Clarity in Curriculum Design - Teaching, Learning and Assessment

European Union - all countries
Austria
Belgium
Bulgaria
Cyprus
Croatia
Czech Republic
Denmark
Estonia
Finland
France
Germany
Greece
Hungary
Ireland
Italy
Latvia
Lithuania
Luxembourg
Malta
Netherlands
Poland
Portugal
Romania
Slovakia
Slovenia
Spain
Sweden

Non-European Union
Albania
Andorra
Armenia
Azerbaijan
Belarus
Bosnia Herzegovina
Georgia
Holy See
Iceland
Kazakhstan
Liechtenstein
Montenegro
Moldova
Norway
Macedonia
Russia
Serbia
Switzerland
Turkey
Ukraine
United Kingdom

Total = 48



What are learning outcomes helping us to do?

2. What are Learning Outcomes?

Definition of Learning Outcome

Learning outcomes are statements of what a student should know, understand and be able to demonstrate after completion of a process of learning.

- The learning activity could be, for example, a lesson, a module (short course), workshop or an entire programme.
- Learning outcomes must be simply and clearly described.
- Learning outcomes must not simply be a “wish list” of what a student is capable of doing on completion of the learning activity.
- Learning outcomes must be capable of being validly assessed.

Aims and Objectives

- The Aim of a programme is a broad general statement of teaching intention, i.e. it indicates what the teacher intends to cover in a programme or module or learning activity.
- Example of aim: To give students an introduction to organic chemistry.
- In some countries “Aim” is called a “goal”.
- The objective of a module or lecture is a specific statement of teaching intention, i.e. it indicates one of the specific areas that the teacher intends to cover.
- “My aim is to lose weight. My objective is to lose one kg per week”. My aim is to travel to Australia. My first objective is to get as far as Dubai”.
- Objectives tend to be specific and measurable.

Aims and Objectives

- Examples of objectives:

1. To give students an appreciation of the unique nature of carbon and its ability to bond to other carbon atoms.
2. To give students an understanding of the concept of hybridisation.
3. To ensure that students know some characteristic properties of alkanes and alcohols.
4. To make students familiar with a range of families of organic compounds: alkanes, alcohols, carboxylic acids and esters.

- Aims are general and long term and refer to a series of lessons or unit of work.
- Objectives are more specific and short term.

The language of aims and objectives

- To give students an understanding of …..
- To give students an appreciation of…..
- To make students familiar with……
- To ensure that students know…….
- To enable students to experience …..
- To encourage students to …….
- To provide students with the opportunity to…….

etc.

Examples of Aims

- To give students an introduction to current theories and practice in the area of science education.
- To give students an understanding of what constitutes good science teaching.
- To give students an appreciation of the contribution that science education can make to the ovearall education of young people
- To help students develop the knowledge and professional skills teach science in the secondary school.
- To give students a critical understanding of current debates and issues relating to science education.
- To provide students with the opportunity to develop their critical thinking skills to enable them to engage in highly effective science teaching in schools.
- To assist students to develop as reflective practitioners with an understanding of research methods in education and how these can inform practice in the classroom.

From the definition of Learning Outcome we see:

- Emphasis on the student; the Student-Centred Approach to Teaching and Learning.
- Emphasis on the student's ability to do something.

Teacher-Centred approach to Teaching and Learning

Student -Centred Approach to Teaching and Learning.

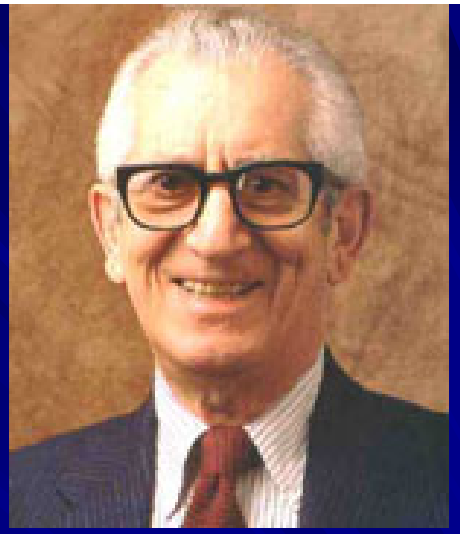
Focus on teaching – aims and objectives and use of terms such as *know, understand, be familiar with.*

Outcomes: Focus on what we want the student to be able to do - use of action verbs such as define, list, name, recall, analyse, calculate, design, etc.

- Aims: Give broad purpose or general intention of the programme.
- Objectives: Information about what the teaching of the module hopes to achieve.
- Learning outcomes are not designed to replace the traditional way of describing teaching and learning but to supplement it.

3. How do I write Learning Outcomes?

Benjamin Bloom (1913 – 1999)

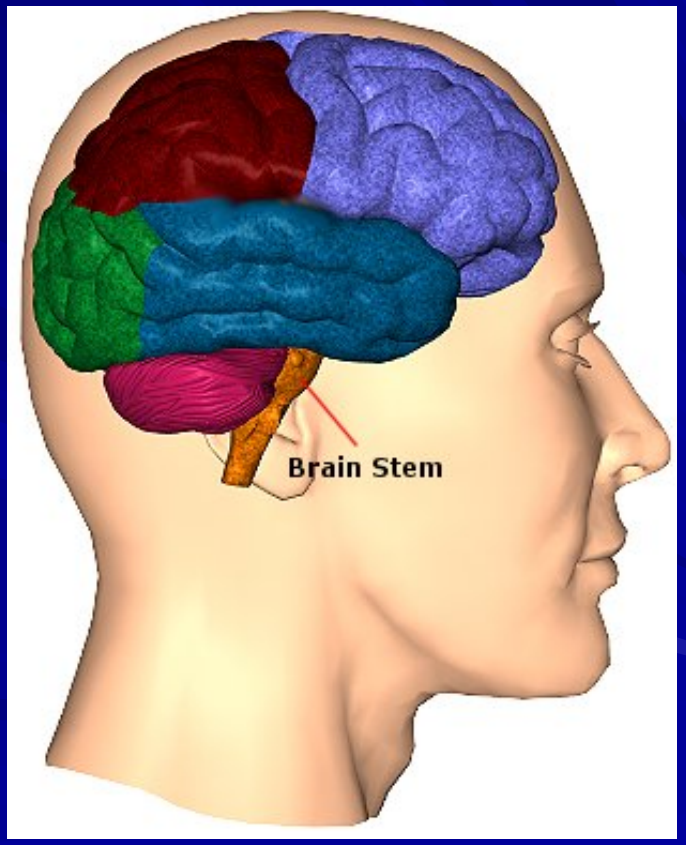


- He looked on learning as a process – we build upon our former learning to develop more complex levels of understanding
- Carried out research in the development of classification of levels of thinking behaviours in the process of learning. PhD University of Chicago in 1942.
- Worked on drawing up levels of these thinking behaviours from the simple recall of facts at the lowest level up to evaluation at the highest level.

Bloom's Taxonomy of Educational Objectives

- Bloom's taxonomy (1956) is a very useful aid to writing learning outcomes.
- The taxonomy consists of a hierarchy of increasingly complex processes which we want our students to acquire.
- Provides the structure for writing learning outcomes
- Bloom's Taxonomy is frequently used by teachers in writing learning outcomes as it provides a ready made structure and list of verbs.

Bloom (1956) proposed that learning is a process that consists of six successive levels arranged in a hierarchy.



- This area is commonly called the **cognitive ("knowing" or "thinking") domain** (involving thought processes).
- Bloom suggested certain verbs that characterise the ability to demonstrate these processes.
- These verbs are the key to writing learning outcomes.
- The list of verbs has been extended since his original publication.
- The "toolkit" for writing learning outcomes!

Action Verbs

- Learning outcomes are statements of what a student should know, understand and be able to demonstrate or DO after completion of a process of learning .
- Since they are statements describing observable behaviour, we must use action verbs when writing learning outcomes.

What is an action verb?

- An action verb describes the activity that the subject of a sentence is doing,

e.g. John paints the garage. *Paints* is the action verb.

Mary describes the scenery. *Describes* is the action verb.

Sean solves the problem. *Solves* is the action verb.

Stative verbs

The opposite type of verb to action verbs are stative verbs. Stative verbs describe a state. Some examples of stative verbs are:

- Know
- Understand
- Appreciate
- Believe

Whilst action verbs are always used in writing learning outcomes and examination questions, stative verbs must never be used in writing learning outcomes or examination questions.

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Writing and using learning outcomes: a practical guide

VIEWS
36,170
DOWNLOADS
87,620
Files

Abstract

The overall aim of the Bologna Agreement (1999) is to improve the efficiency and effectiveness of higher education in Europe. One of the main features of this process is the need to improve the traditional ways of describing qualifications and qualification structures. As a step towards achieving greater clarity in the description of qualifications, by 2010 all modules and programmes in third level institutions throughout the European Union will be written in terms of learning outcomes. International trends in education show a shift from the traditional teacher-centred approach to a student-centred approach, i.e. the focus is not only on teaching but also on what the students are expected to be able to do at the end of the module or programme. Statements called learning outcomes are used to express what the students are expected to achieve and how they are expected to demonstrate that achievement.
Learning outcomes are defined as statements of what a learner is expected to know, understand and/or be able to demonstrate after completion of a process of learning (ECTS, 2005). When writing learning outcomes it is helpful to make use of Bloom's Taxonomy of Educational Objectives. This classification or categorisation of levels of thinking behaviour

Available for free download:

https://cora.ucc.ie/items/e866d6e9-4fcb-4c00-a80c-478cdf55e7ef


Ag Scriobh agus ag Úsáid Torthaí Foghlama
Treoir Phraiticiúil
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Writing and Using Learning Outcomes
A Practical Guide
Dr Declan Kennedy
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Ben-Gurion University of the Negev
BTC BGU
Konrad Adenauer Stiftung
תהליך בולוניה ותפוקות הלמידה
המדריך המעשי
ד"ר דקלן קנדי
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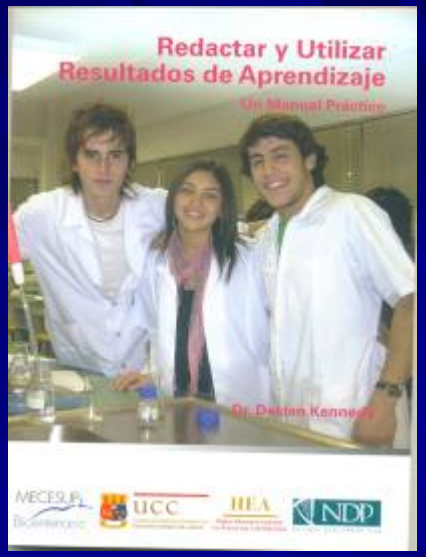
Redactar y Utilizar Resultados de Aprendizaje
Un Manual Práctico
Dr. Declan Kennedy
MECESUP
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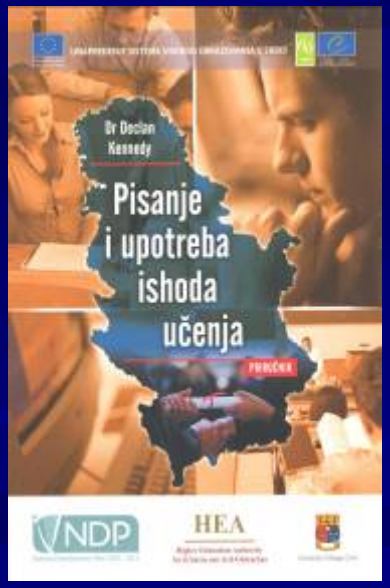
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Pisanje i upotreba ishoda učenja
PRIRUČNIK
NDP
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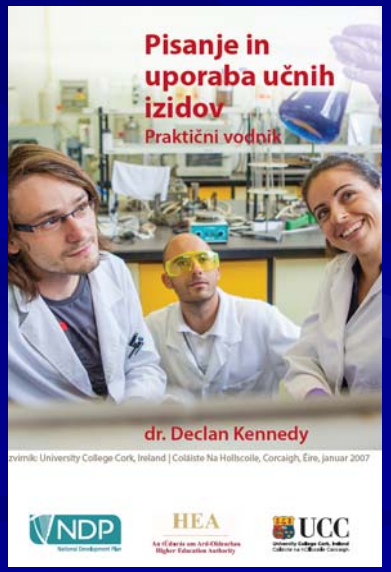
صياغة مخرجات التعلم واستخدامها
(دليل إجرائي)
تأليف
الدكتور ديكلان كينيدي
جامعة كلية كورك ايرلندا
ترجمة
أ.د. سعيد بن محمد الزهراني و أ.د. عبد الحميد اجبار
جامعة الملك سعود - الرياض
HEA
NAIRTL


Pisanje in uporaba učnih izidov
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Pisanje i korišćenje ishoda učenja
Praktični Vodič
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1. Knowledge - ability to recall or remember facts without necessarily understanding them

- Use action verbs such as:

  Arrange, collect, define, describe, duplicate, enumerate, examine, find, identify, label, list, locate, memorise, name, order, outline, present, quote, recall, recognise, recollect, record, recount, relate, repeat, reproduce, show, state, tabulate, tell.

Examples: Knowledge

- *Recall* genetics terminology: homozygous, heterozygous, phenotype, genotype, homologous chromosome pair, etc.
- *Identify* and consider ethical implications of scientific investigations.
- *Describe* how and why laws change and the consequences of such changes on society.
- *List* the criteria to be taken into account when caring for a patient with tuberculosis.
- *Define* what behaviours constitute unprofessional practice in the solicitor – client relationship.
- Outline the history of the Celtic peoples from the earliest evidence to the insular migrations.
- *Describe* the processes used in engineering when preparing a design brief for a client.
- Recall the axioms and laws of Boolean algebra.

2. Comprehension - ability to understand and interpret learned information

- Use action verbs such as:

Associate, change, clarify, classify, construct, contrast, convert, decode, defend, describe, differentiate, discriminate, discuss, distinguish, estimate, explain, express, extend, generalise, identify, illustrate, indicate, infer, interpret, locate, predict, recognise, report, restate, review, select, solve, translate.

Examples: Comprehension

- ***Differentiate*** between civil and criminal law
- ***Identify*** participants and goals in the development of electronic commerce.
- ***Discuss*** critically German literary texts and films in English.
- ***Predict*** the genotype of cells that undergo meiosis and mitosis.
- ***Translate*** short passages of contemporary Italian.
- Convert number systems from hexadecimal to binary and vice versa.
- ***Explain*** the social, economic and political effects of World War I on the post-war world.
- ***Classify*** reactions as exothermic and endothermic.
- ***Recognise*** the forces discouraging the growth of the educational system in Ireland in the 19th century.
- ***Explain*** the impact of Greek and Roman culture on Western civilisation.
- ***Recognise*** familiar words and basic phrases concerning themselves….when people speak slowly and clearly.

3. Application: ability to use learned material in new situations, e.g. put ideas and concepts to work in solving problems

- Use action verbs such as:

Apply, assess, calculate, change, choose, complete, compute, construct, demonstrate, develop, design, discover, dramatise, employ, examine, experiment, find, illustrate, interpret, manipulate, modify, operate, organise, practice, predict, prepare, produce, relate, schedule, select, show, sketch, solve, transfer, use.

Examples application

- *Construct* a timeline of significant events in the history of Australia in the 19th century.
- *Apply* knowledge of infection control in the maintenance of patient care facilities.
- *Select* and employ sophisticated techniques for analysing the efficiencies of energy usage in complex industrial processes.
- *Show* proficiency in the use of vocabulary and grammar, as well as the sounds of the language in different styles…..
- *Relate* energy changes to bond breaking and formation.
- *Modify* guidelines in a case study of a small manufacturing firm to enable tighter quality control of production.
- *Show* how changes in the criminal law affected levels of incarceration in Scotland in the 19th century.
- *Apply* principles of evidence-based medicine to determine clinical diagnoses.

4. Analysis: ability to break down information into its components, e.g. look for inter-relationships and ideas (understanding of organisational structure)

- Use action verbs such as:

Analyse, appraise, arrange, break down, calculate, categorise, classify, compare, connect, contrast, criticise, debate, deduce, determine, differentiate, discriminate, distinguish, divide, examine, experiment, identify, illustrate, infer, inspect, investigate, order, outline, point out, question, recognise, relate, separate, solve, sub-divide, test.

Examples: Analysis

- *Analyse* why society criminalises certain behaviours.
- *Compare* and contrast the different electronic business models.
- *Categorise* the different areas of specialised interest within dentistry.
- *Debate* the economic and environmental effects of energy conversion processes.
- *Identify* and *quantify* sources of errors in measurements.
- *Calculate* gradient from maps in m, km, % and ratio.
- Critically *analyse* a broad range of texts of different genres and from different time periods.
- *Compare* the classroom practice of a newly qualified teacher with that of a teacher of 20 years teaching experience.
- Calculate logical functions for coders, decoders and multiplexers.
- Recognise trends in atomic radii in the Periodic Table of the Elements.

5. Synthesis - ability to put parts together and create new ideas from old concepts

- Use action verbs such as:

Argue, arrange, assemble, categorise, collect, combine, compile, compose, construct, create, develop, design, devise, establish, explain, formulate, generate, generalise, infer, integrate, invent, make, manage, modify, organise, originate, plan, prepare, propose, rearrange, reconstruct, relate, reorganise, revise, rewrite, set up, summarise.

Examples: Synthesis

- *Recognise* and formulate problems that are amenable to energy management solutions.
- *Propose* solutions to complex energy management problems both verbally and in writing.
- Assemble sequences of high-level evaluations in the form of a program.
- Integrate concepts of genetic processes in plants and animals.
- *Summarise* the causes and effects of the 1917 Russian revolutions.
- *Relate* the sign of enthalpy changes to exothermic and endothermic reactions.
- *Organise* a patient education programme.

6. Evaluation: Ability to make a judgement of the value of material for a given purpose (Summative and Judgemental)

- Use action verbs such as:

  Appraise, argue, ascertain, assess, attach, choose, compare, conclude, contrast, convince, criticise, decide, defend, discriminate, explain, evaluate, interpret, judge, justify, measure, predict, rate, recommend, relate, resolve, revise, score, summarise, support, validate, value.

Examples: Evaluation

- Assess the importance of key participants in bringing about change in Irish history
- Evaluate marketing strategies for different electronic business models.
- Appraise the role of sport and physical education in health promotion for young people.
- Predict the effect of change in temperature on the position of equilibrium in the given reaction.
- Summarise the main contributions of Michael Faraday to the field of electromagnetic induction.
- Assess the Arrhenius acid-base theory in the light of the Bronsted-Lowry theory of acids and bases.

SUMMARY GUIDELINES FOR WRITING LEARNING OUTCOMES

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As part of the Bologna Process reforms, all modules and programmes throughout the European Higher Education Area are described in terms of Learning Outcomes. Learning outcomes are statements of what a student should know, understand and be able to demonstrate after completion of a process of learning.

Learning Outcomes are described in relation to three domains of learning, i.e. cognitive (knowledge-based), affective (attitudes and values) and psychomotor (practical skills). Most learning outcomes are written in the cognitive domain but, depending on the subject area being studied, learning outcomes may also be written in the affective and psychomotor domains.

Writing Learning Outcomes

Bloom's taxonomy (Fig. 1) is helpful when writing Learning Outcomes in the cognitive domain. Ranging from the lower to the higher order thinking skills, Fig. 2 provides some suggested action verbs.

When writing Learning Outcomes:

1. Always use action verbs. Think about completing the sentence *At the end of this module students should be able to:*
2. Keep the sentence short. More than one action verb can be used in the same sentence.
3. Try to ensure that module Learning Outcomes range across all levels of Bloom's Taxonomy in each year of the programme.
4. Programme Learning Outcomes should map on to the appropriate level of the National Qualifications Framework.

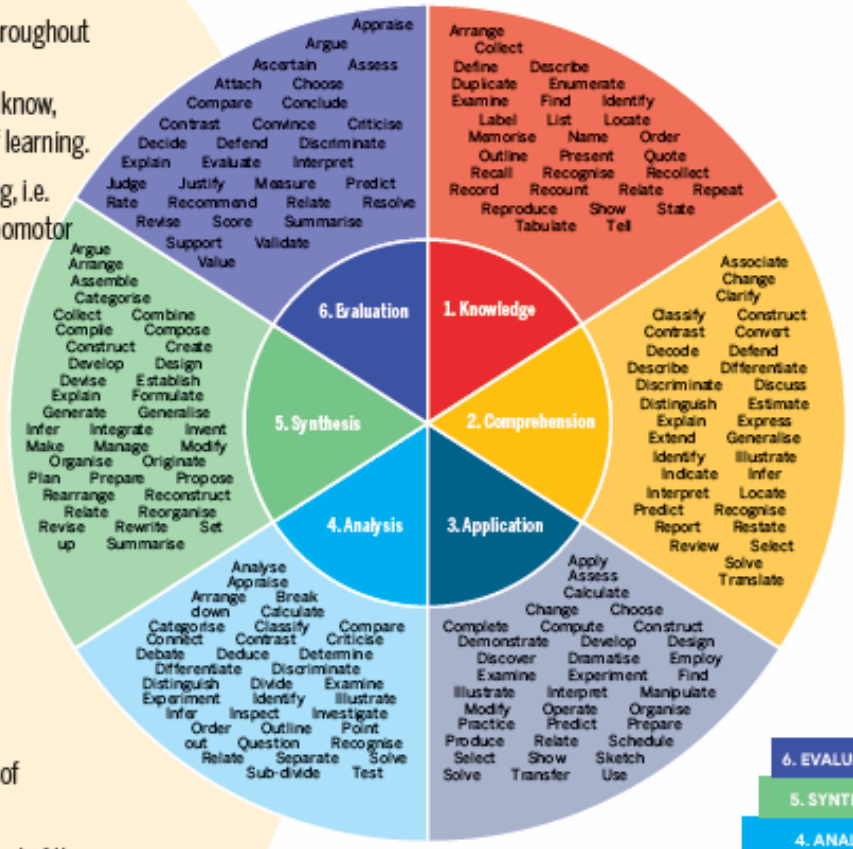


Fig. 2 Action verbs in the cognitive domain

Fig. 1 Learning Outcomes in the Cognitive Domain (knowing, thinking)

Anderson and Krathwohl's Taxonomy (2001)

Bloom (1956)

- Knowledge
- Comprehension
- Application
- Analysis
- Synthesis
- Evaluation

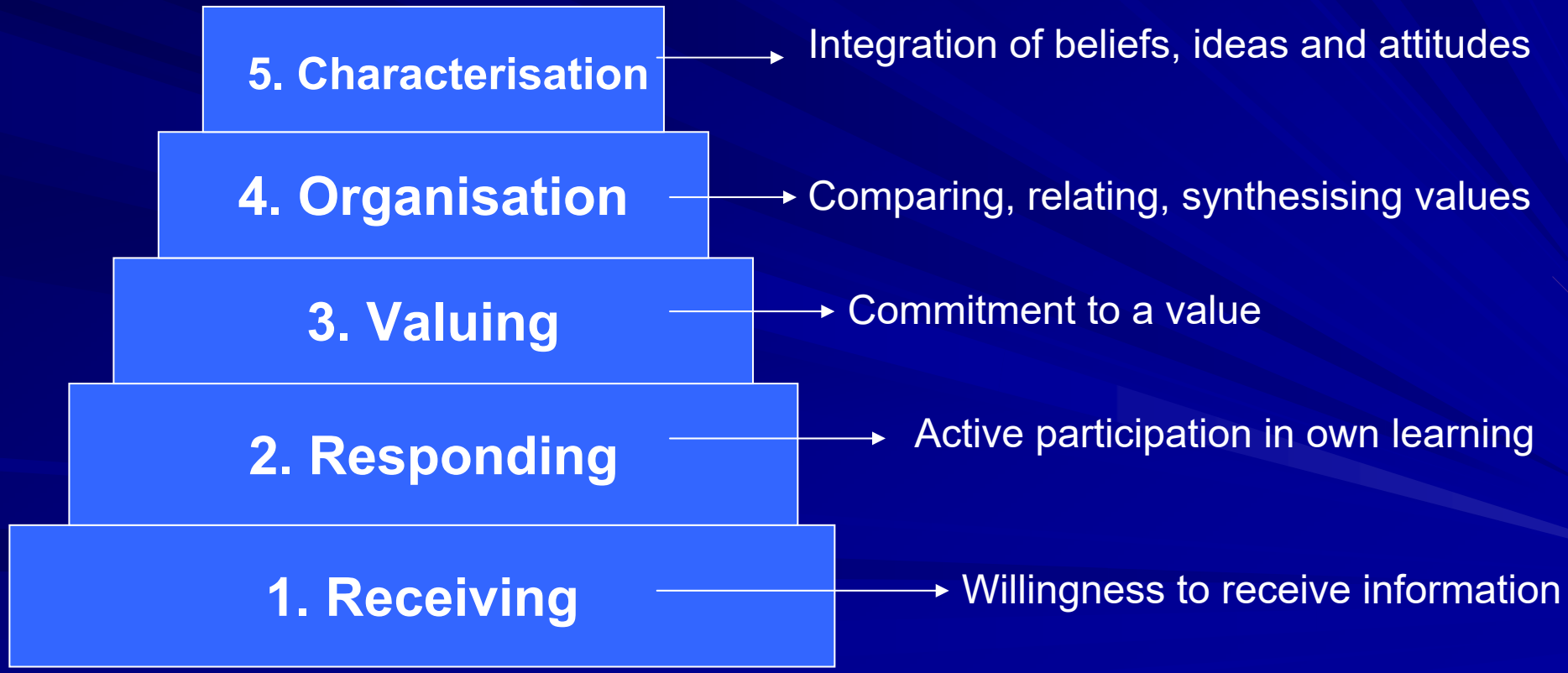
Anderson and Krathwohl (2001)

- To remember
- To understand
- To apply
- To analyse
- To evaluate
- To create

Not a great attempt to modify Bloom's Taxonomy.

Two other domains in Bloom's Taxonomy

AFFECTIVE DOMAIN ("Feeling") concerned with value issues : involves attitudes.



Action verbs for affective domain

Appreciate, accept, assist, attempt, challenge, combine, complete, defend, demonstrate (a belief in), discuss, dispute, embrace, follow, hold, integrate, order, organise, join, share, judge, praise, question, relate, share, support, synthesise, value.

Examples of Learning Outcomes in Affective Domain

- Accept the need for professional ethical standards.
- Appreciate the need for confidentiality in the professional client relationship.
- Display a willingness to communicate well with patients.
- Relate to participants in an ethical and humane manner.
- Resolve conflicting issues between personal beliefs and ethical considerations.
- Embrace a responsibility for the welfare of children taken into care.
- Participate in class discussions with colleagues and with teachers.

PSYCHOMOTOR (“Doing”) DOMAIN

Work never completed by Bloom. Involves co-ordination of brain and muscular activity Psychomotor skills involve manual dexterity and only apply in some programmes. They are important in some fields of study, e.g. high levels of psychomotor skills are required for a surgeon, an artist, or a musician.”

- action verbs for this domain: bend, grasp, handle, operate, manipulate, perform, reach, relax, shorten, stretch, differentiate (by touch), perform (skilfully), etc.

Laboratory skills

- *Operate the range of instrumentation specified in the module safely and efficiently in the chemistry laboratory.*
- *Perform titrations accurately and safely in the laboratory.*
- *Construct simple scientific sketches of geological features in the field.*

Clinical Skills

- Perform a comprehensive history and physical examination of patients in the outpatient setting and the general medical wards, excluding critical care settings.
- Perform venipuncture and basic CPR.

Presentation skills

- Deliver an effective presentation.
- Demonstrate a range of graphic and CAD communication techniques.
- Perform basic voice and movement tasks (theatre studies).
- Design a well-illustrated poster presentation to summarise the research project.

Learning Outcomes in the Affective Domain

Bloom also proposed a taxonomy for writing Learning Outcomes in the affective domain. Verbs include: Appreciate, accept, assist, attempt, challenge, combine, complete, defend, demonstrate (a belief in), discuss, dispute, embrace, follow, hold, integrate, order, organise, join, share, judge, praise, question, relate, share, support, synthesise, value.

Learning Outcomes in the Psychomotor Domain

The psychomotor domain refers to practical skills. High levels of psychomotor skills are required by professionals such as surgeons, artists, musicians and laboratory scientists.

If the psychomotor domain is relevant to your subject discipline, the following list of verbs may be helpful: bend, grasp, handle, operate, manipulate, perform, reach, relax, shorten, stretch, differentiate (by touch), perform (skilfully).

Aims and Objectives

The curriculum can be described in terms of aims and objectives, which is a more teacher-centred approach. Aims are long term and general, and relate to programmes. Objectives are short term, specific and relate to modules.

Aims and objectives are written using phrases such as:

- To give students an understanding of...
- To make students familiar with...
- To ensure that students know...
- To enable students to experience...

What number of Learning Outcomes?

- 5 to 8 Learning Outcomes per module
- 5 to 10 Programme Learning Outcomes

Aligning Learning Outcomes to Teaching and Learning activities and to Assessment

Having written the Learning Outcomes for your students, always ask yourself how each Learning Outcome will be assessed. The Learning Outcomes we write should always be linked to teaching and learning activities and to assessment so that these various elements are aligned. This is known as constructive alignment and ensures thoughtful design of the curriculum (Fig. 3).

The key question is **What must the students be able to DO in order to show that they have achieved the Learning Outcome?** Details of how to check for constructive alignment using a simple three-column table are given in the online resources specified below.

Learning Outcomes are the common language in Education. ECTS credits are the common "currency" or reward that students receive for achieving the Learning Outcomes.

Fig. 3 Constructive alignment.

For more details and support visit
www.ucc.ie/en/cirtl/resources/learningoutcomes/
Writing and Using Learning Outcomes – A Practical Guide Available from cora.ucc.ie/handle/10468/1613

To further enhance your practice, join CIRTL's level 9 programmes on Teaching and Learning in Higher Education
www.ucc.ie/en/cirtl/professional-development/

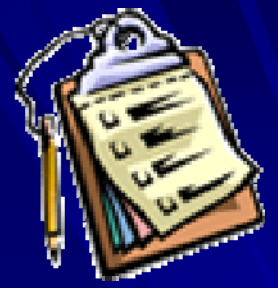
The challenge of beginning the task of writing Learning Outcomes

- It is vital that learning outcomes are clearly written so that they are understood by students, teachers and all educational stakeholders.
- When writing learning outcomes it may be helpful to you if you focus on what you expect students to be able to demonstrate upon completion of the learning outcome.
- Avoid complicated sentences. If necessary use one than one sentence to ensure clarity..
- Avoid certain words such as know, understand and be familiar with as these are not active verbs,

Common errors in writing learning outcomes

- Using the term “understand”. Instead of this term, ask the students to show their understanding by using a learning outcome containing action verbs such as explain, discuss, illustrate, solve, etc.
- Using the term “appreciate” in the cognitive domain. Instead of this term, ask the students to show their appreciation of a specific concept by asking them to evaluate, discuss, outline or summarise.

Checklist for writing learning outcomes for modules



- ❑ Have I begun each outcome with an action verb?
- ❑ Have I avoided terms like *know*, *understand*, *learn*, *be familiar with*, *be exposed to*, *be acquainted with*, *be aware of* and *appreciate*?
- ❑ Have I included learning outcomes across the range of levels of Bloom's Taxonomy?
- ❑ How will I assess the Learning Outcome?

4. What is international best practice in curriculum design?

SCIENCE - February 2023

Developing a New Template for Designing Syllabi for Irish Secondary School Subjects.

Professor Áine Hyland & Dr Declan Kennedy

Abstract

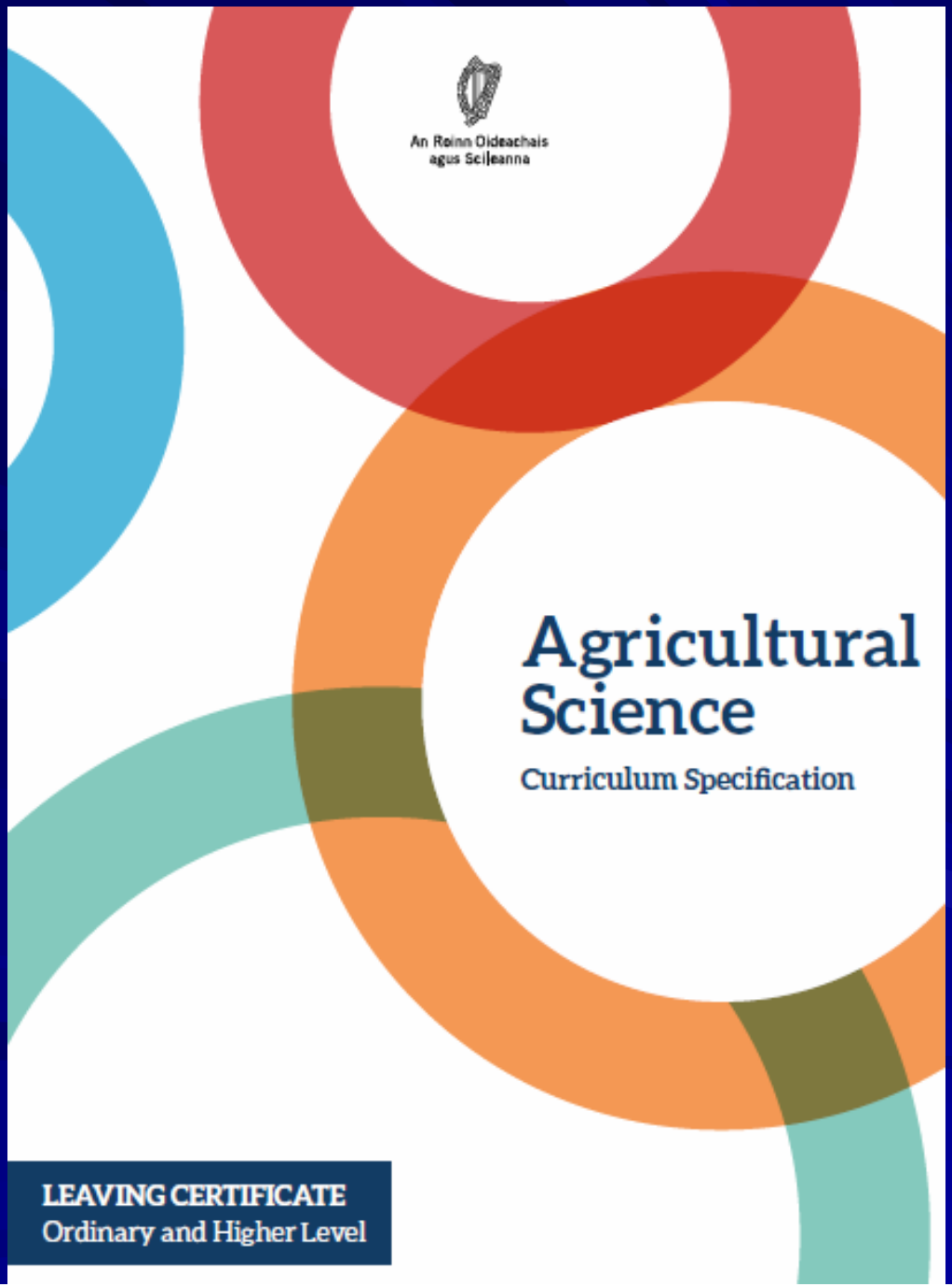
This paper "Developing a new template for designing syllabi ("curriculum specifications") for secondary school subjects in Ireland" addresses curriculum and syllabus design in Ireland in the past decade. The issue has been a contentious one in recent years since a new approach for designing curriculum was introduced by the National Council for Curriculum and Assessment (NCCA) at the beginning of the millenium. Taking account of concerns expressed by teachers and academics about the current design template being used by the NCCA, this paper proposes a new template for the design of Leaving Certificate syllabi, based on examples of good practice internationally.

- **The Irish Science Teachers' Association (2019).** In 2019 the ISTA published a report *Listening to the Voice of Science Teachers*. This report summarised the findings of a survey completed by its members (ISTA 2019). A total of 762 science teachers completed the survey. Among its findings were the following:
  - Lack of depth of treatment in the Junior Cycle science syllabus was a major problem for teachers in identifying what topics they should be teaching in the classroom.
  - 85% of teachers believed that the template of syllabus design used at Junior Cycle was unsuitable for use at Senior Cycle level.
  - There was concern for student and teacher well-being due to the stress caused by trying to suc-

Topic content			Opportunities to cover:		Practical suggestions
Learning outcomes		To include	Maths	Working scientifically	
C2.1a	explain what is meant by the purity of a substance, distinguishing between the scientific and everyday use of the term 'pure'			WS1.4a	Purification of compounds. (PAG C4, PAG C7)
C2.1b	use melting point data to distinguish pure from impure substances		M1a, M1c, M1d, M2a		Measurement of melting point.
C2.1c	calculate relative formula masses of species separately and in a balanced chemical equation	the definition of relative atomic mass, relative molecular mass and relative formula mass	M3b, M3c	WS1.3c, WS1.4c	
C2.1d	deduce the empirical formula of a compound from the relative numbers of atoms present or from a model or diagram and vice versa		M3b, M3c	WS1.1b, WS1.4a	
C2.1e	explain that many useful materials are formulations of mixtures	alloys			
C2.1f	describe, explain and exemplify the processes of filtration, crystallisation, simple distillation, and fractional distillation	knowledge of the techniques of filtration, crystallisation, simple distillation and fractional distillation		WS1.2b, WS1.2c, WS2a, WS2b	Separation of mixtures and purification of compounds. (PAG C4, PAG C7) Distillation of mixtures (PAG C4)
C2.1g	describe the techniques of paper and thin layer chromatography	using aqueous and non-aqueous solvents and locating agents		WS1.2b, WS1.2c, WS1.4a, WS2a, WS2b	Paper or thin layer chromatography. (PAG C3)
C2.1h	recall that chromatography involves a stationary and a mobile phase and that separation depends on the distribution between the phases	identification of the mobile and stationary phases		WS1.4a	

Oxford, Cambridge and RSA Examination Board (Awarding Body) GCSE Chemistry Curriculum Specification.

5. What are the consequences of poor quality of curriculum design?



Introduced in September 2019

STUDENTS LEARN ABOUT:	STUDENTS SHOULD BE ABLE TO:
3.1 Plant physiology	▸ relate the main structures of the plant to its fundamental processes: photosynthesis, respiration, transpiration and nutrient absorption ▸ describe the principles of genetic improvement and selection: • performance testing • physical traits • progeny testing • genotyping and genomic selection • natural selection ▸ understand the principles of genetic engineering, identifying genes in characterised crop genomes and understanding how they produce proteins to tackle specific crop diseases
3.2 Classification/ identification	▸ apply their knowledge of structure and function to identify a variety of grasses, cultivated crops and weeds ▸ distinguish between annual, biennial and perennial lifecycles ▸ explain the importance of plant breeding and seed variety
3.3 Production	▸ describe the growth cycle of grass and of another food crop (forage or for human consumption) **and of an energy or catch crop** ▸ discuss strategies for crop protection against diseases (fungal, bacterial or viral)
3.3.1 Establishment	▸ discuss the effect of soil quality, seedbed preparation, seed selection and sowing on the productivity of a crop ▸ understand how a variety of soil factors influence productivity ▸ investigate the effect of weather and soil conditions on the percentage germination of an agricultural seed * ▸ **compare plant uniformity from certified and uncertified seed*** ▸ **compare establishment for grass with that of one other crop ***

SCIENCE - May/November 2023

Leaving Certificate Agricultural Science – implications for the new Leaving Certificate Biology, Physics and Chemistry syllabi

Dr Ryan Gallagher, Colm Cronin & John O' Brien

The current Leaving Certificate biology, chemistry and physics syllabi all require updating but their 'tried and tested' syllabi structure was well liked by teachers. Each of the subjects was divided into four components: Content, Depth of Treatment, Activities and Social & Applied Aspects. In addition, each of the syllabi was accompanied with a Guidelines for Teachers document to further clarify the syllabi. Following an initial consultation on a Background Paper in Nov-Dec 2014 and a Consultation Report in March 2015, a draft specification for Leaving Certificate Agricultural Science was developed for consultation and published in 2016. Significantly the draft specification had moved away from the current Leaving Certificate science specification was examined for the first time in 2021. Since the introduction of the new specification there has been a sharp decline in number taking the subject (Table 1)

Table 1. Number of students taking Leaving Certificate Agricultural Science.

Year	Number
2020	8500
2021	8468
2022	7413
2023	7460

Conclusions

It is of serious concern that there is a lack of constructive alignment in the Leaving Certificate Agricultural Science syllabus (specification), i.e. there is a lack of alignment between the learning outcomes, the teaching and learning activities and also the assessment. This lack of alignment is caused by the lack of depth of treatment in the syllabus. Teachers do not know how to interpret many of the learning outcomes and it is left to the teacher to try to "unpack" or interpret what these learning outcomes mean. It is not the role of the teacher to decide on the meaning of the learning outcomes. This is the role of the NCCA subject development group that has responsibility for designing the syllabus. Without depth of treatment, many learning outcomes are meaningless and impossible to interpret.

As a result of the poor quality syllabus, it is clear from an analysis of the 2021 Leaving Certificate Higher Level Agricultural Science examination paper that major problems are arising in the examination questions:

- Students are being asked questions on topics that are not mentioned in any of the learning outcomes.
- Questions are appearing on the exam paper on details that teachers never realised were on the syllabus.
- In some cases it is impossible to relate questions on the exam paper to any learning outcomes.

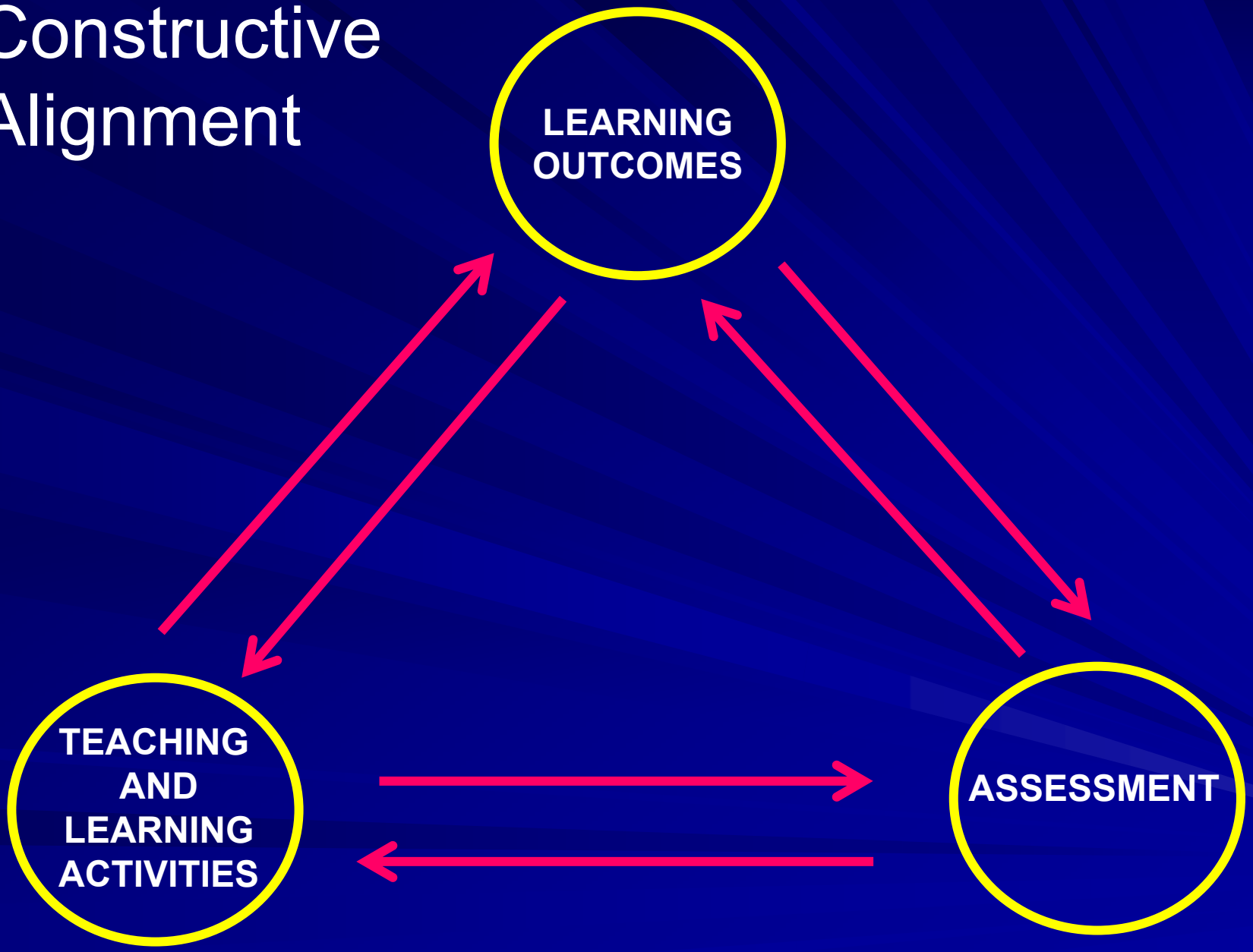
	Number of students studying Agricultural Science at Leaving Certificate			
LC EXAM	HIGHER LEVEL	ORDINARY LEVEL	TOTAL	
2020	7371	1130	8501	
2021	7553	915	8468	
2022	6218	1195	7413	
2023	6132	1328	7460	
2024	5501	917	6418	Decline 8501 - 6418 = 2083. Percentage decline 2083/8051 = 24.5%
	Decline = 24.5%			
Note the decline in number of students taking Ag Science from 8051 to 6418				
This drop in numbers of 2083 students represents a fall of 24.5% since 2020				

The new Agricultural Science syllabus (specification) was introduced in September 2019 and examined for the first time in 2021

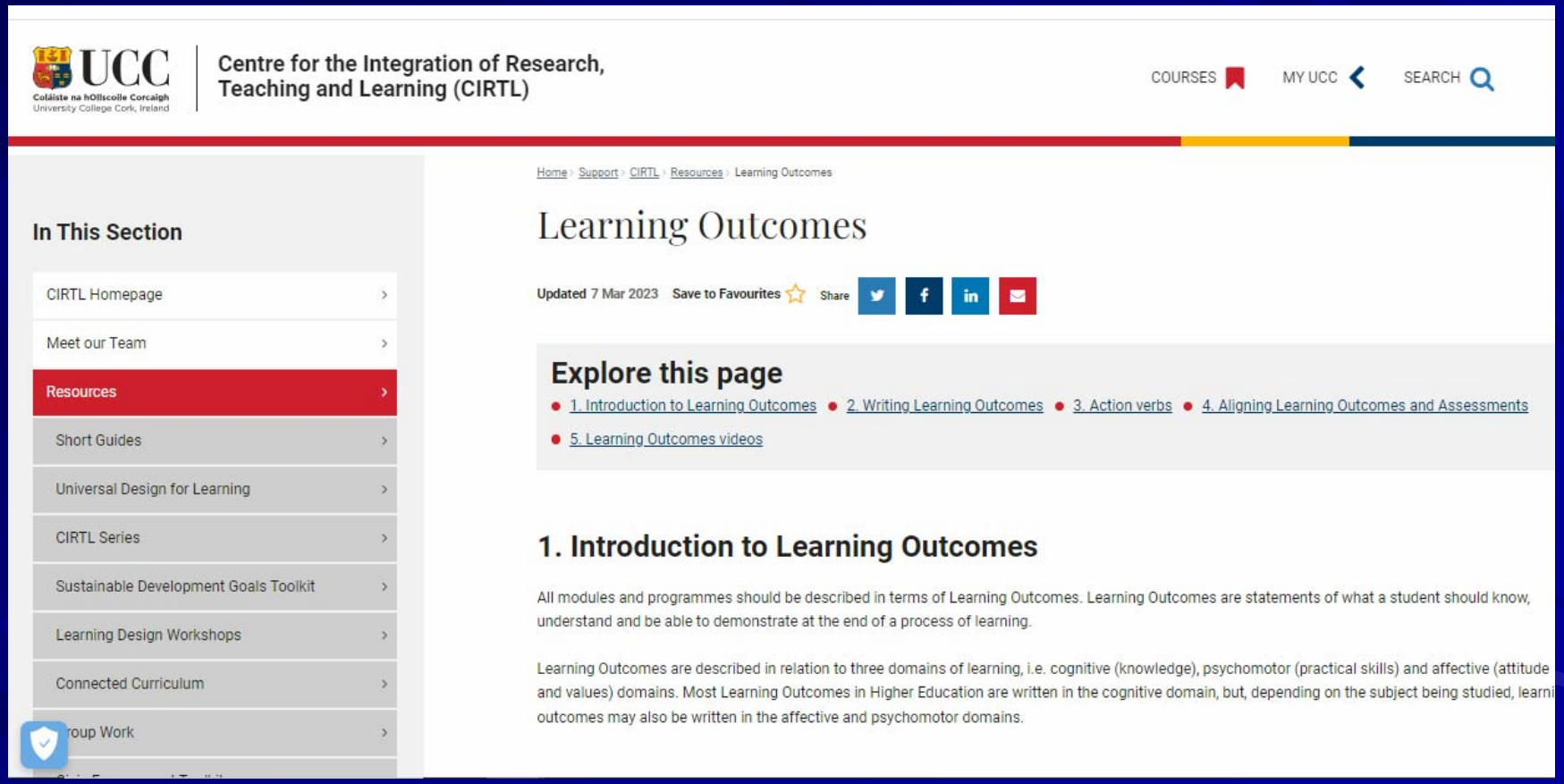
Students learn about	Students should be able to
2.3. Behaviour of gases	
Gases • relationships between pressure, volume, temperature of gases	1. explain what is meant by the ideal gas, **accounting for deviations of real gases from ideal gas behaviour**
The ideal gas • the model of an ideal gas which was developed to enable analysis and predictions of how gases behave • the ideal gas equation $PV = nRT$ (van der Waal's equation is not required)	2. solve and interpret quantitative problems using the ideal gas equation
Modelling • how to verify and use the ideal gas equation	
2.4. Hydrocarbons	
Sources and impact • how organic compounds are divided into many groups, with hydrocarbons being the simplest organic compounds, in terms of composition, consisting of C and H only	1. outline the main sources of hydrocarbons and their uses in industry and society
• the continued, extensive use of hydrocarbons, the main sources being fossil fuels, living matter and synthesis	2. identify and research one major impact on society of the extensive use of hydrocarbons[RI]
Properties and structure • how to prepare ethene, using ethanol; investigation includes combustion and tests for unsaturation, using bromine water and acidified potassium manganate(VII)	3. conduct an experiment to prepare ethene, observe its physical properties, and investigate some of its chemical properties
• how based on the type of carbon-carbon bonds present, hydrocarbons can be sub-divided into aliphatic (alkanes, alkenes, alkynes) and aromatic hydrocarbons (exemplified by benzene)	4. describe and compare different groups of hydrocarbons, including composition, bonding and structure, and relate these to their characteristic properties
• the naming of hydrocarbon compounds follows systematic IUPAC rules (up to C6 only to be considered)	
• the nature of the carbon-carbon bonds, the intermolecular forces and relative molecular mass that can also help to explain the properties of hydrocarbons	5. explain and predict differences, if any, in properties within each of the following: • straight chain alkanes of different carbon number • alkanes of the same carbon number • monounsaturated straight chain alkenes
• the characteristic properties that include state of matter, boiling point, combustion, solubility in water and non-polar solvents, and reactivity (aliphatics only)	
• prediction of the behaviour for alkanes and alkenes up to C6	

Leaving Certificate Chemistry Curriculum Specification p. 22 (Sept 2024)

Constructive Alignment



Everything you need to know about Learning Outcomes is available online at https://www.ucc.ie/en/cirtl/resources/learningoutcomes/



The End