PDST
Professional Development Service for Teachers
An tSeirbhís um Fhorbairt Ghairmiúil do Mhúinteoirí

An Roinn Oideachais agus Scileanna
Department of Education and Skills

National Workshop 1

LEAVING CERTIFICATE
COMPUTER SCIENCE

Key Messages

- Computer Science is for all
- There are many ways to use the specification
- All Learning Outcomes are interwoven and can be learned in any order
- Centrality of ALTs / Computational Thinking
- Digital Technologies can enhance collaboration, learning and reflection

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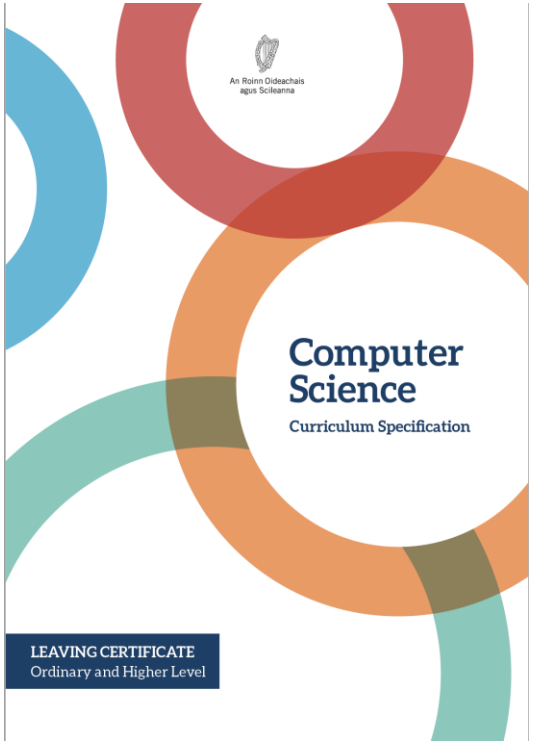
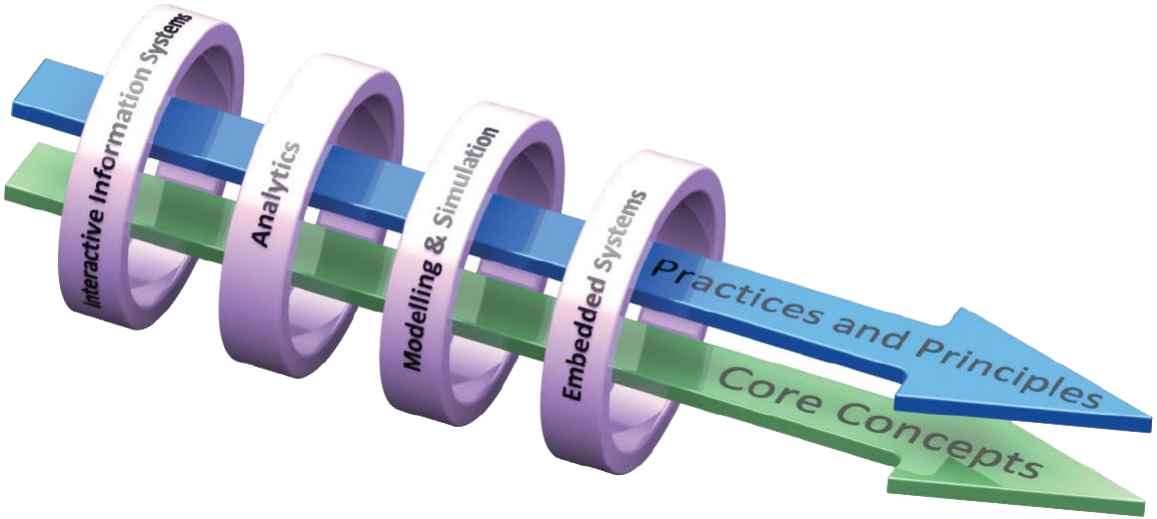
Session 2 – Specification & Learning Outcomes

Leaving Certificate Computer Science Curriculum Specification



LCCS Interwoven



‘Learning outcomes can best be defined as statements of what a learner knows, understands and is able to do after completion of learning.’

CEDEFOP (2009)

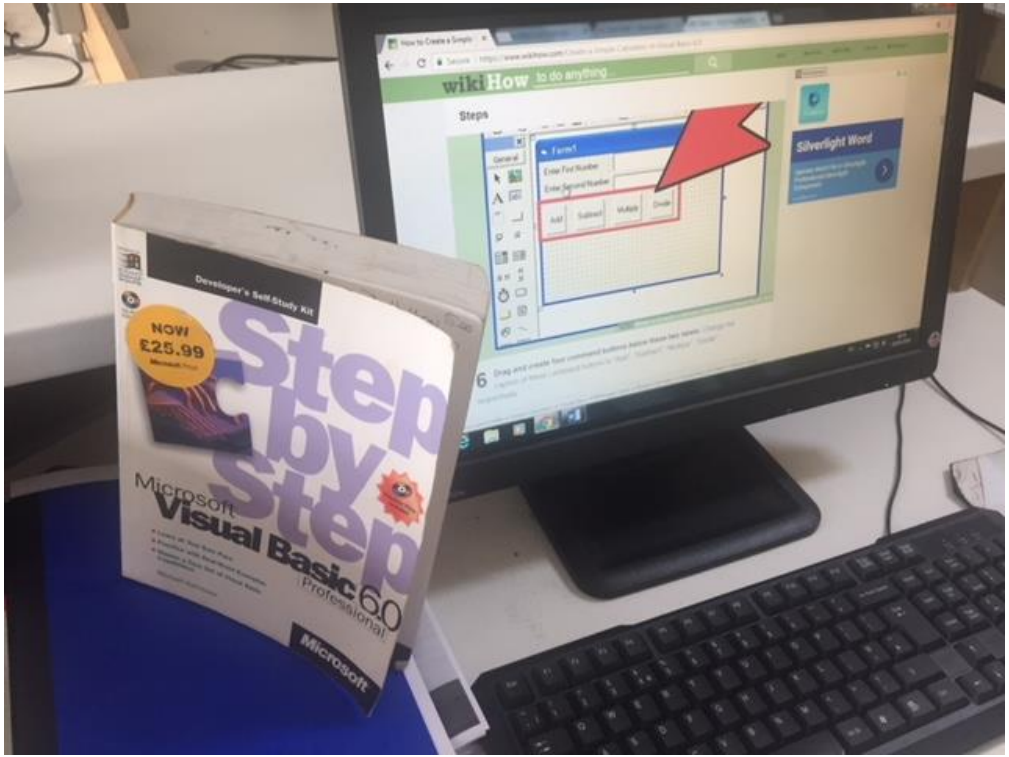
A Perspective

Learning outcomes have become ubiquitous within worldwide curriculum policy in recent years. This move comes with many potential benefits, as it shifts the focus from providers to users of education, and it introduces a common language, addressing issues of progression, transparency and equity (CEDEFOP, 2009).

(Mark Priestly, Univ of Stirling)

Caveat: Use / History / Skills

Teaching and Learning in Computing

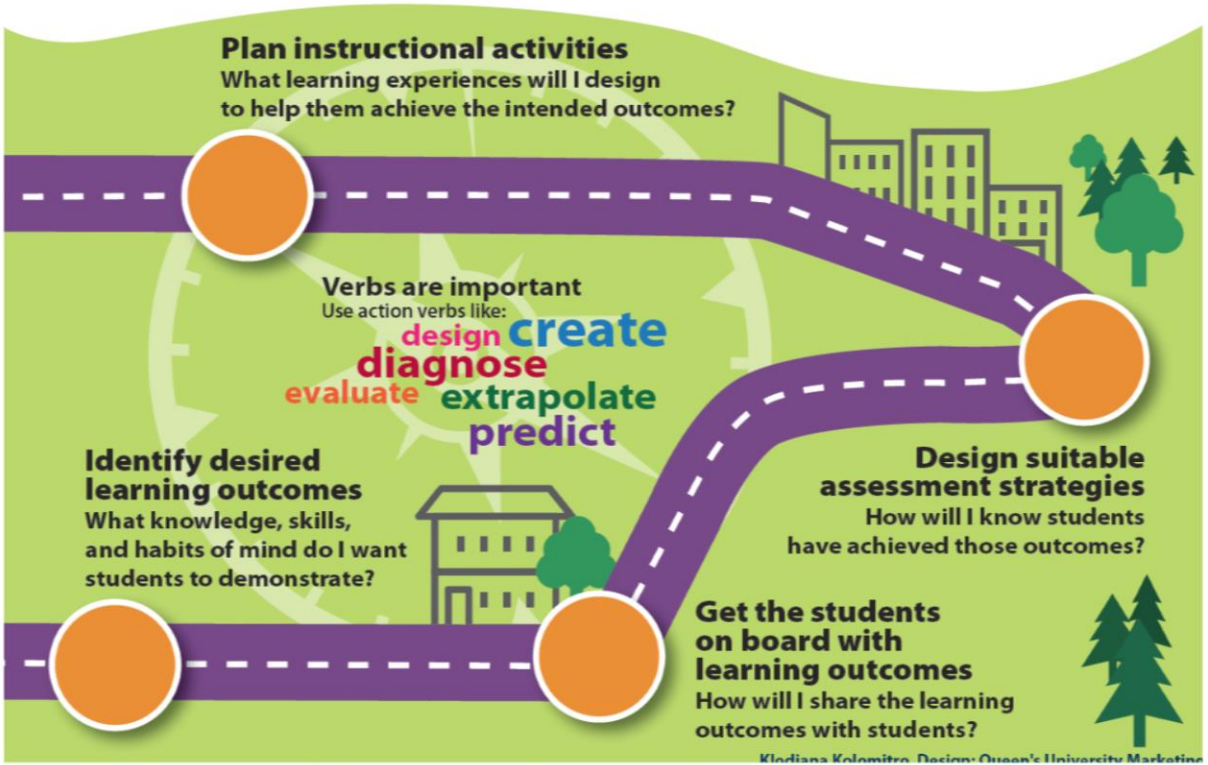


Teaching and Learning in Computing - 2

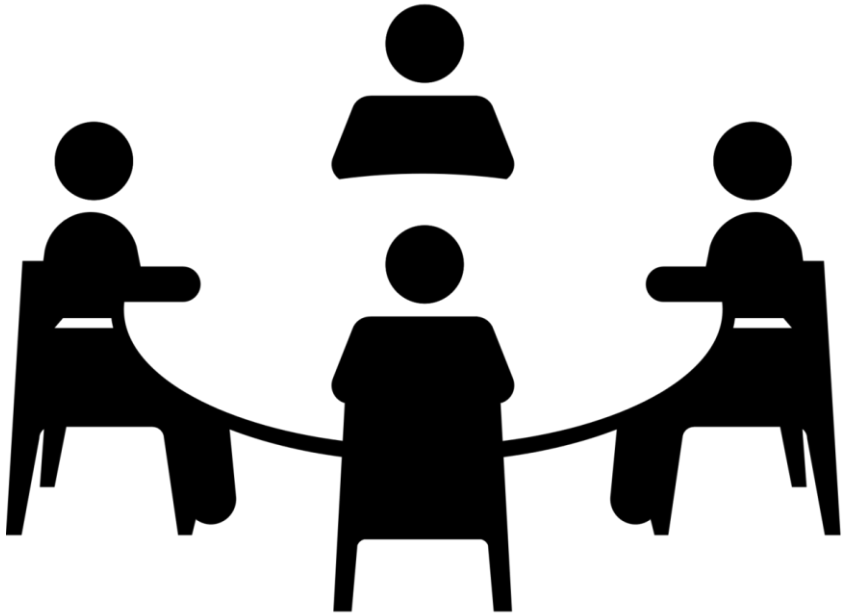
- New Specification
- Learning Outcomes
- Think / Pair / Share
- Differentiation
- Group work
- Independent / student-centered

Learning Outcomes

Learning outcomes are direct statements that describe the knowledge, skills, and habits of mind that students are expected to reliably demonstrate after a learning experience.



Group Activity



Group Warmup Activity - Instructions

Log onto the shared document and examine the learning outcomes and how they are grouped by strands of the course and by lower and higher order thinking.

https://tinyurl.com/ybx9cjgw

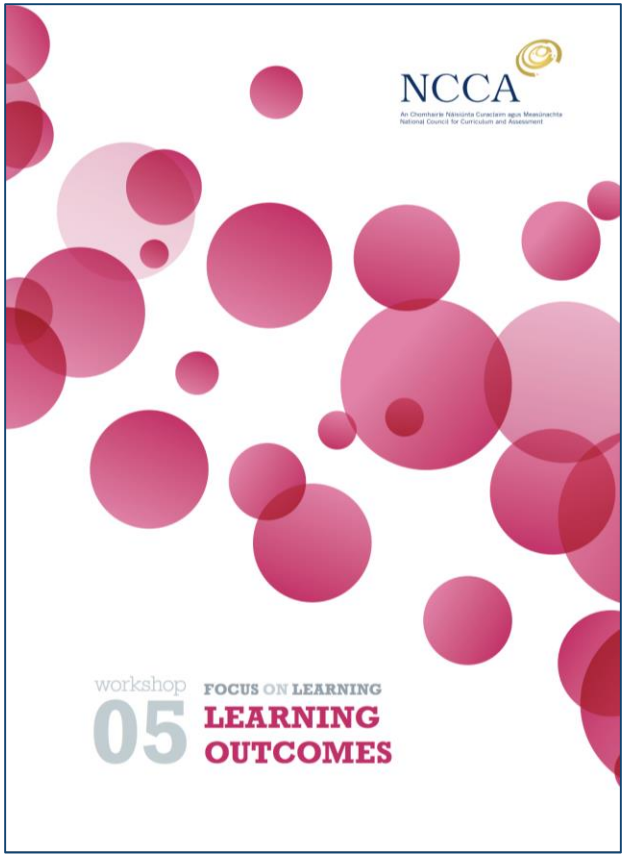
Comptational Thinking	Computers and Society	Designining and Development	Evaluation and Testing
Abstraction	Algorithms	Computer Systems	Data
Interactive Information Systems	Analytics	Modelling & Simulation	Embedded Systems
Lower Order Thinking			Higher Order Thinking
Remember - recall facts and basic concepts Understand - explain ideas or concepts	Apply - use information in new situations	Analyse - draw connections among ideas Evaulate - justify a stand or decision	Create - produce new or original work
1.1. describe a systematic process for solving problems and making decisions	1.3. solve problems by deconstructing them into smaller units using a systematic approach in an iterative fashion	1.5. evaluate alternative solutions to computational problems	1.7. develop algorithms to implement chosen solutions
1.2. explain how the power of computing enables different solutions to difficult problems	1.4. solve problems using skills of logic	1.8. evaluate the costs and benefits of the use of computing technology in automating processes	2.6. construct algorithms using appropriate sequences, selections/conditionals, loops and operators to solve a range of problems, to fulfil a specific requirement
1.6. explain the operation of a variety of algorithms	1.9. use modelling and simulation in relevant situations	1.12. compare the positive and negative impacts of computing on culture and society	2.9. Assemble existing algorithms or create new ones that use functions (**including recursive**), procedures, and module
1.10. discuss when heuristics should and could be used and explain the limitations of using heuristics	2.5. use pseudo code to outline the functionality of an algorithm	**1.16. Compare two different user interfaces and identify different design decisions that shape the user experience**	1.22. read, write, test, and modify computer programs
1.11. discuss the complex relationship between computing technologies and society including issues of ethics	2.7. implement algorithms using a programming language to solve a range of problems	1.23. reflect and communicate on the design and development process	**3.2. create a basic relational database to store and retrieve a variety of forms of data types**
1.13. identify important computing developments that have taken place in the last 100 years and consider emerging trends that could shape future computing technologies	2.8. apply basic search and sorting algorithms and describe the limitations and advantages of each algorithm	2.19. test solutions and decisions to determine their short-term and long-term outcomes	**3.4. develop algorithms that can find the frequency, mean, median and mode of a data set**
1.14. explain when and what machine learning and AI algorithms might be used in certain contexts	2.16. use data types that are common to procedural high-level languages.	**3.5. structure and transform**	**3.8. develop a model that will allow different scenarios to be tested**
1.15. consider the quality of the user experience when interacting with computers and list principles of universal design, including the role of a user interface and the factors that contribute to its usability	2.17. use ASCII and Unicode character sets to encode/decode a message and consider the importance of having such standards	**3.6. represent data to effectively communicate in a graphical form**	3.13. develop a program that utilises digital and analogue inputs
1.17. describe the role that adaptive technology can play in the lives of people with special needs	2.18. collect, store and sort both continuous and discrete data	**3.9. analyse and interpret the outcome of simulations both before and after modifications have been made.**	3.14. design automated applications using embedded systems
1.18. recognise the diverse roles and careers that use computing technologies	1.20. collaborate and assign roles and responsibilities within a team to tackle a computing task		
2.1. use abstraction to describe systems and to explain the relationship between wholes and parts	1.22. read, write, test, and modify computer programs		
2.2. use a range of methods for identifying patterns and abstract common features	**3.3. use appropriate programming languages to develop an interactive website that can display information from a database that meets a set of users' needs**		
2.3. implement modular design to develop hardware or software modules that perform a	**3.7. use algorithms to analyse and interpret data in a way that informs decision-making**		

Group Activity A - Instructions

Each group should pick 2 different learning outcomes (one from strand 3 and one from strand 1 or 2).

Discuss and write down:

- *What would you teach to your class for this LO?*
- *What teaching & learning strategies could you use?*
- *How would you know this learning outcome has been achieved?*
- *Can it be linked to other parts of the course?*



https://ncca.ie/media/4107/learning-outcomes-booklet_en.pdf

Benefits of Learning Outcomes for Teachers

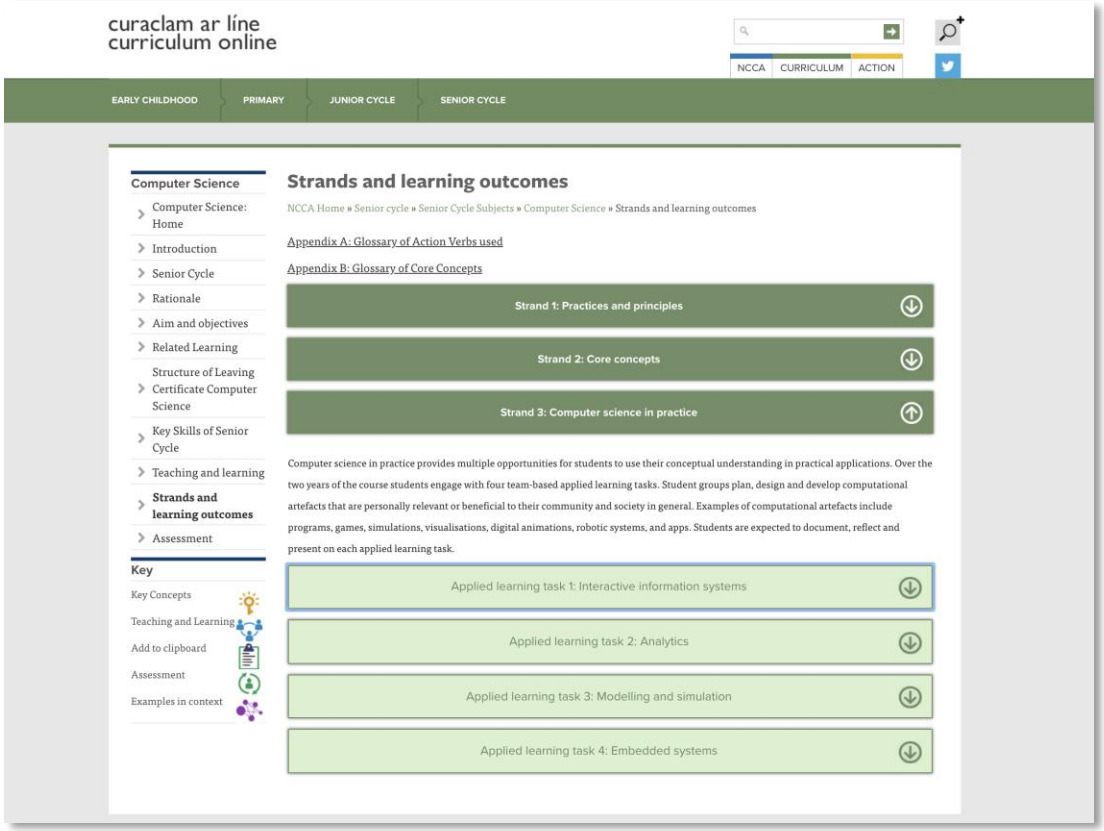
Effective course design	• By keeping learning outcomes front and center, teachers can develop courses in which all aspects of the course, including learning activities and assessments, support what they want students to learn *(a)*.
Effective assessment of learning	• Clear expectations make it easier to evaluate students' progress and ensure that assessments are targeting the appropriate level of knowledge or skill *(a, b)*.
Better time management	• Well-defined learning outcomes simplify difficult decisions about what content to include and what to omit when preparing lessons and assessments *(b, c)*.
Improved communication	• Teachers can use learning outcomes to have explicit and constructive dialogues with students about the course and their learning, and with colleagues about the expectations of courses *(b)*.
Improved teaching experience	• Teachers who use learning objectives report less anxiety, more confidence interacting with students, and use more diverse teaching and assessment approaches *(b, c)*.

(a) Wang, X., Su, Y., Cheung, S., Wong, E., & Kwong, T. (2013). An exploration of Biggs' constructive alignment in course design and its impact on students' learning approaches. *Assessment and Evaluation in Higher Education, 38*, 477-491.

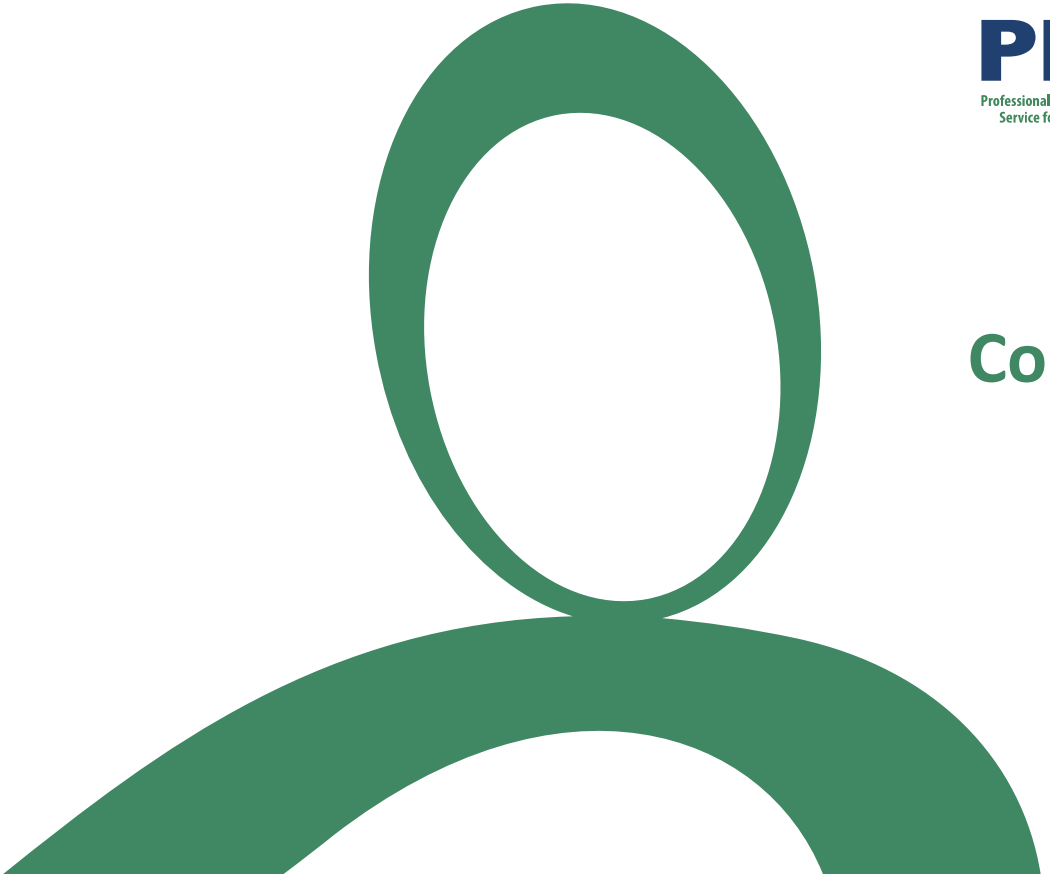
(b) Simon, B., & Taylor, J. (2009). What is the value of course-specific learning goals? *Journal of College Science Teaching, 39*, 52-57.

(c) Reynolds, H. L., & Kearns, K. D. (2017). A planning tool for incorporating backward design, active learning, and authentic assessment in the college classroom. *College Teaching, 65*, 17-27.

Created by Sara M. Fulmer



https://www.curriculumonline.ie



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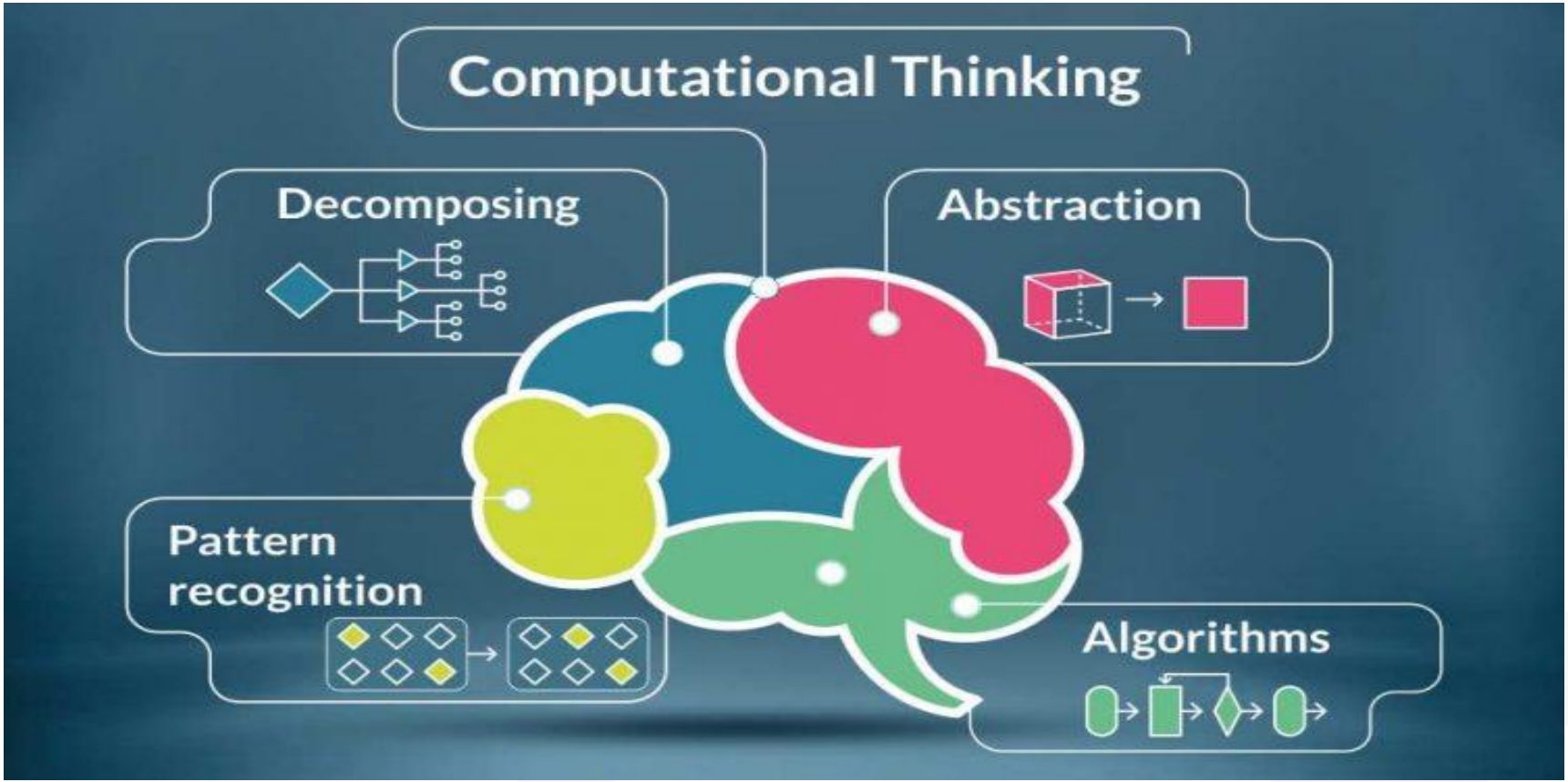
Computational Thinking

What is Computational Thinking?

- Problem Solving Methods: for a ‘Computer’
- Help

- Several Models: eg 4 Concepts / Pillars:
- *Decomposition*
- *Pattern Recognition*
- *Abstraction*
- *Algorithm Formation*


Computational Thinking
Decomposing
Abstraction
Pattern recognition
Algorithms

Computational Thinking

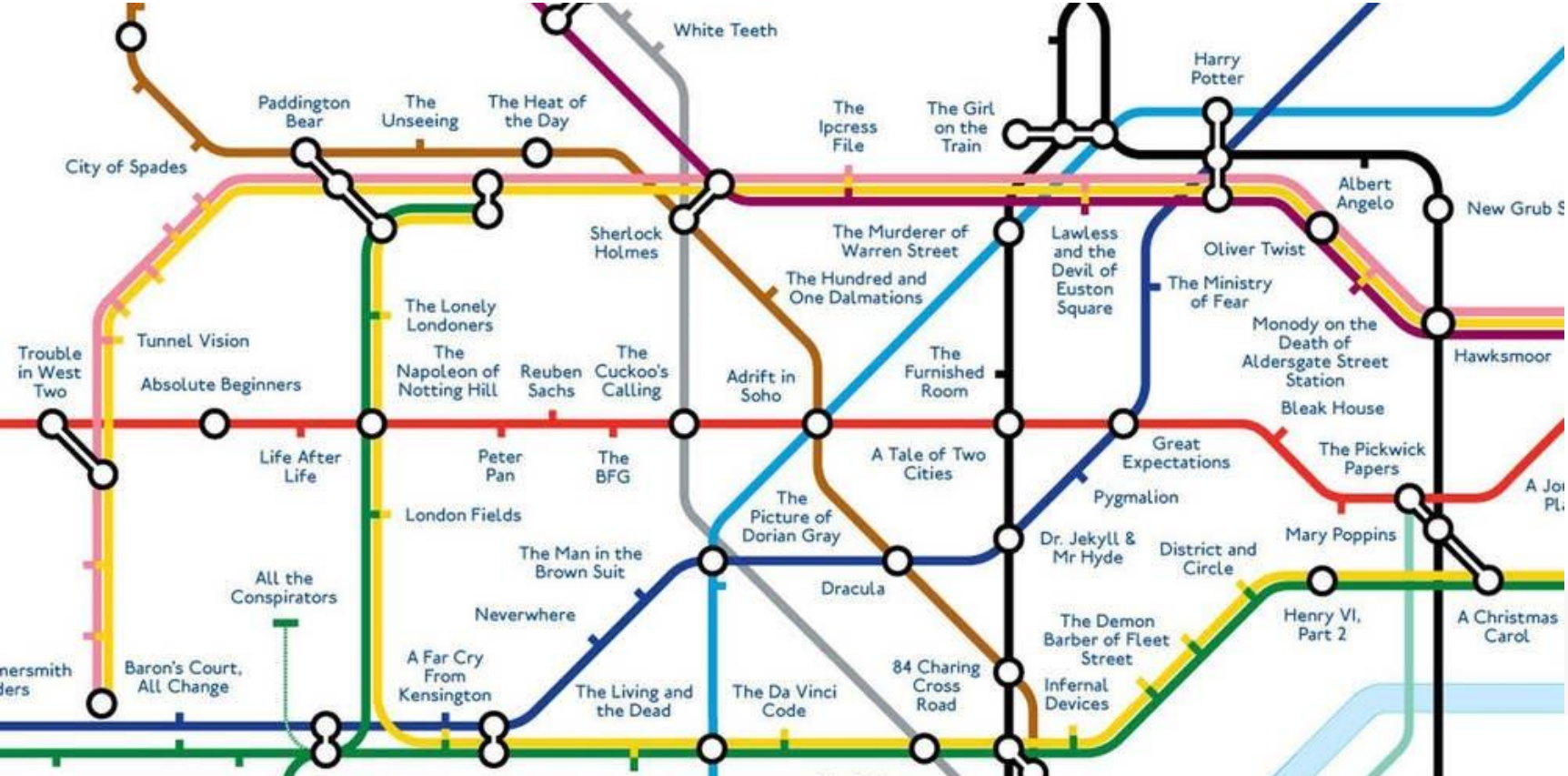
- Monty Hall Problem
- How to Subtract
- London Underground
- Money – Change (Activity): White board
- Sisters

Computational Thinking

234-159

1.Modern Primary School way.
2.Old Primary school way.
3.Shop Assistant.
4.Dart player.

The Tube


White Teeth
Harry Potter
Paddington Bear
The Unseeing
The Heat of the Day
The Ipcress File
The Girl on the Train
City of Spades
Albert Angelo
New Grub S
Sherlock Holmes
The Murderer of Warren Street
Lawless and the Devil of Euston Square
Oliver Twist
The Hundred and One Dalmations
The Ministry of Fear
The Lonely Londoners
Monody on the Death of Aldersgate Street Station
Hawksmoor
Tunnel Vision
Trouble in West Two
Absolute Beginners
The Napoleon of Notting Hill
Reuben Sachs
The Cuckoo's Calling
Adrift in Soho
The Furnished Room
Bleak House
Life After Life
Peter Pan
The BFG
A Tale of Two Cities
Great Expectations
The Pickwick Papers
Pygmalion
The Picture of Dorian Gray
London Fields
Mary Poppins
Dr. Jekyll & Mr Hyde
District and Circle
The Man in the Brown Suit
All the Conspirators
Dracula
Neverwhere
The Demon Barber of Fleet Street
Henry VI, Part 2
A Christmas Carol
Baron's Court, All Change
A Far Cry From Kensington
The Living and the Dead
The Da Vinci Code
84 Charing Cross Road
Infernal Devices

CT Activity 1

Euro coins are issued in the denominations shown

€1 = 100c

What is the minimum number of coins required to make up €27.93 cents?

CT – Activity 2

Who has more sisters, boys or girls?

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Applied Learning Tasks

Students work in teams to carry out four applied learning tasks over the duration of the course.

Each of which results in the creation of a real or virtual computational artefact.

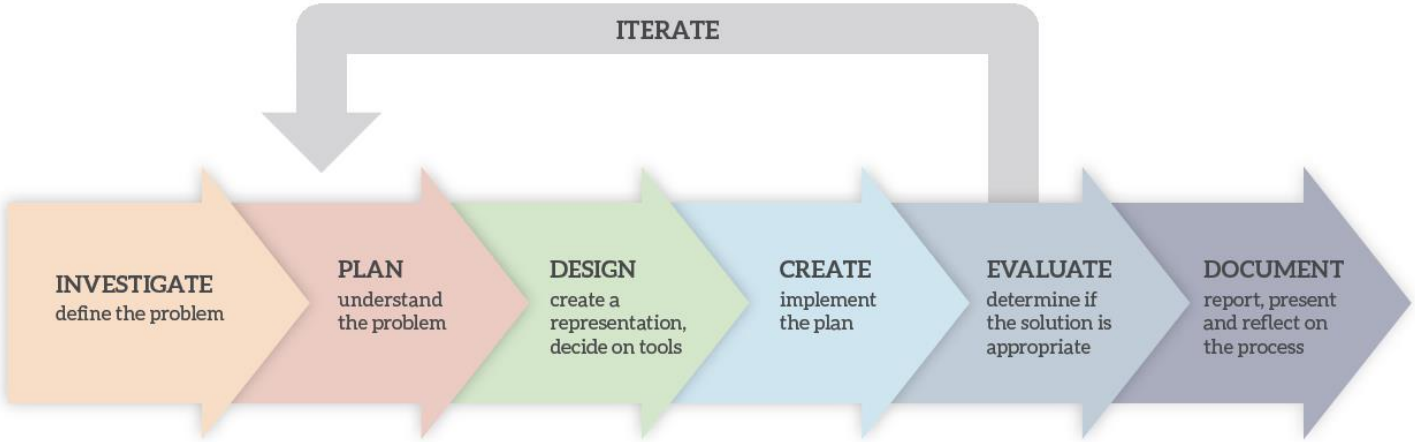
These artefacts should relate to the students' lives and interests.

Where possible, the artefacts should be beneficial to the community and society in general.

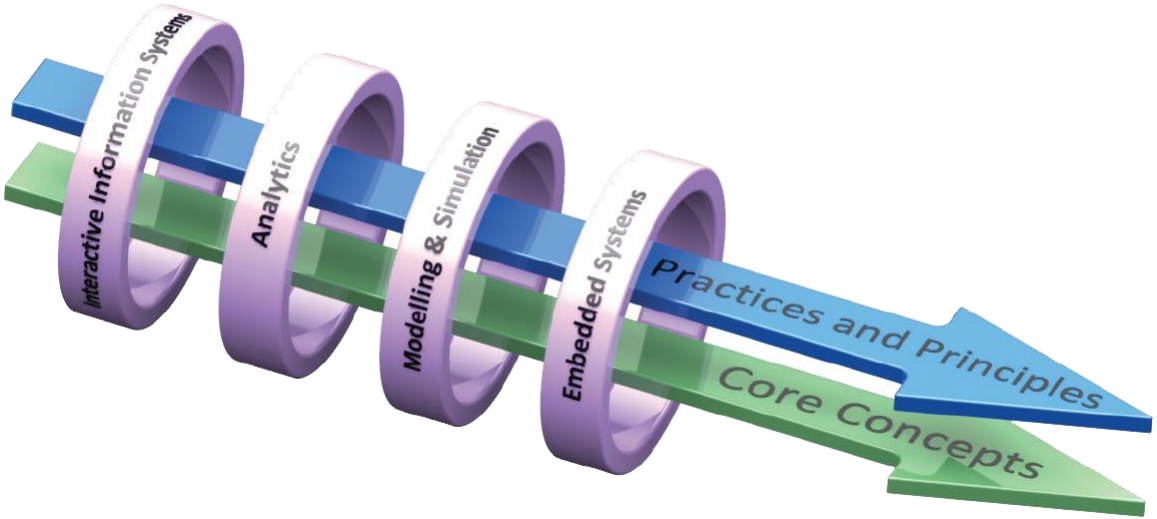
Examples of computational artefacts include programs, games, web pages, simulations, visualisations, digital animations, robotic systems, and apps.

The four applied learning tasks explore the four following contexts:

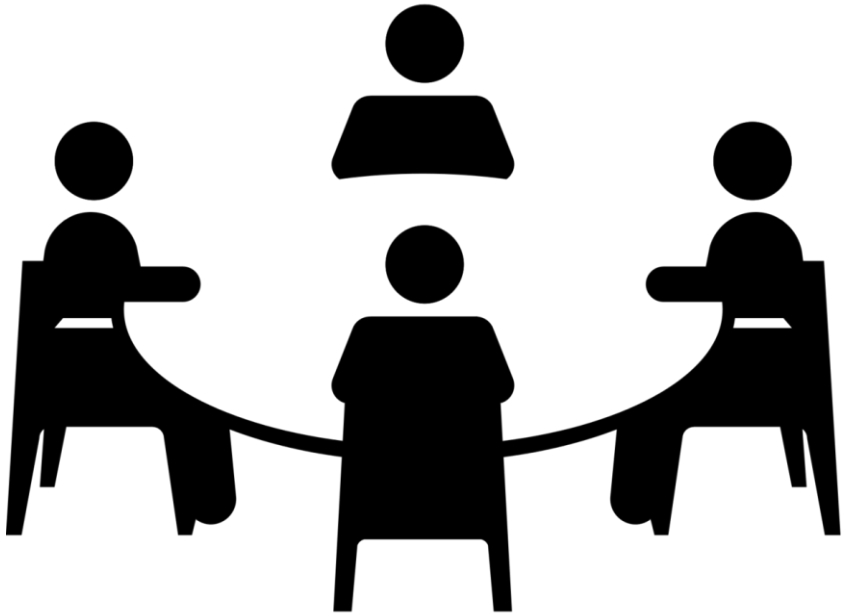
- Interactive information systems
- Analytics
- Modelling and simulation
- Embedded systems.


ITERATE
INVESTIGATE
define the problem
PLAN
understand the problem
DESIGN
create a representation, decide on tools
CREATE
implement the plan
EVALUATE
determine if the solution is appropriate
DOCUMENT
report, present and reflect on the process

LCCS Interwoven



Group Activity



Activity: ALT

1. Each group will use the shared document choose a particular ALT –
   (ALT 1: Web design ALT 2: Analytics ALT3: Modelling, Simulation
   ALT4: Embedded Systems)
2. In groups start brainstorming as to possible project ideas for students. Aim for as many ideas as you can.
3. Write your ideas in the doc – can be text / images etc.
4. Present ideas to the wider group.

ALT Activity: Pick one Activity from Brainstorming and Expand

In groups teachers expand on one of their ideas from earlier.

- *What teaching & learning strategies could you use?*
- *How would you assess?*
- *Can it be linked to other parts of the course?*
- *What theory could be taught at the same time?*
- *In terms of planning where in the course do you see this ALT fitting in?*

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