











#### Schedule



Session 1	Exploring Modelling and Simulation
11.00 - 11.30	Tea/Coffee
Session 2	From Learning Outcomes to Learning Experiences
13.00 - 14.00	Lunch
Session 3	Curriculum Planning

### **Key Messages**



LCCS can be mediated through a constructivist pedagogical orientation.



The ALTs provide opportunities for students to develop their theoretical and procedural understanding of the course.



The coursework assessment offers students an opportunity to combine (and build on) the skills and knowledge they have accumulated through engaging with the ALTs and demonstrate their own individual creativity



All learning outcomes (LOs) are interwoven and should be studied concurrently at different stages of the course and should not be studied in a linear order



Purposeful reflection on one's accumulated experience leads to greater learning than the accumulation of additional experiences.



Digital technologies can be used to enhance collaboration, learning and reflection.





Phase 1 teachers have done a great job in introducing LCCS.

Ongoing support is needed to ensure that the subject can flourish.







## Session 1

## **Exploring Modelling and Simulation**

## By the end of this session participants will have:



relflected on and shared their experiences to date in relation to the teaching and learning of LCCS and in particular to ALT3 Modelling and Simulation

engaged in an activity to develop a simple model of fish populations

had an opportunity to refresh their skills in Python and JavaScript and see programming as a process

developed a deeper understanding of terminology in relation to modelling and simulation

reflected on ideas to facilitate the effective learning of modelling and simulation in their own classrooms

## Section I Introduction

#### **Leaving Certificate Computer Science**



The tasks provide **opportunities for students to develop their theoretical and procedural understanding** as they grapple with computer science practices, principles and core concepts in increasingly sophisticated applications. (Pg. 10)

These **artefacts should relate to the students' lives and interests**. Where possible, the artefacts should be beneficial to the community and society in general (Pg. 10)

Through engaging in self-directed learning and reflection, students will plan, monitor, and evaluate their own learning and **develop a positive sense of their own capacity to learn** (Pg. 15)

"The core concepts are developed theoretically and applied practically. In this way, conceptual classroom-based learning is intertwined with experimental computer lab-based learning throughout the two years of the course." (Pg. 20)



## **Breakout Activity 1 (reflect and discuss)**

Discuss the following prompt questions in your breakout rooms ...

- 1. What types of artefacts did your students produce for ALT3?
- 2. In what ways were the artefacts relevant to students' lives and interests?
- 3. In what way(s) did the tasks provide opportunities for students to develop their theoretical and procedural understanding of computer science practices, principles and core concepts?
- 4. In what ways were students supported to develop a positive sense of their own capacity to learn?
- 5. What was your approach to the ALTs?



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#### **Post Breakout Points**







# **Mentimeter**

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What would you like to learn today and how do you want to share it?











## **Section II**

## Developing a Population Model





Models are representations of the world around us ...



## **Modelling and Simulation**



Modelling, programming, and coding require careful analysis of patterns and relationships to solve problems. In this applied learning task, **students will engage with a problem that is difficult to solve analytically, but that is amenable to a solution using simulation or modelling**. Students will develop a computer system that simulates or models the problem. Engaging with a problem in this way will heighten students' awareness and understanding of how algorithms can be used across a wide range of disciplines and subjects. (Pg. 23)

3.8. develop a model that will allow different scenarios to be tested

3.9. analyse and interpret the outcome of simulations **both before and after modifications have been made.** 

3.10. explain the benefits of using agent-based modelling and how it can be used to demonstrate emergent behaviours

## **A Sustainable Fish Population Model**



Variables: initial fish population, growth rate, allowable harvest number of years

Problem statement: Is the fish population sustainable?









## **A Sustainable Fish Population Model**



A JavaScript coding activity ...



https://glitch.com/edit/#!/alt3-population?path=index.html%3A1%3A0







## **Section III**

## Modelling and Simulation Terminology

Modelling and Simulation – Keywords to Know

Models Simulation Agent-based-models (ABM) Emergent Behaviour

## Mentimeter

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I don't know the word at all
Seen/heard but don't know the meaning
I think I know the meaning
I know a meaning





#### Example



https://www.washingtonpost.com/graphics/2020/world/corona-simulator/



#### Discussion





If modeling a contagion with one person sick, doing a random walk amongst the population, then the model can demonstrate how that contagion spreads to the entire population.

*If, instead of a random walk, the people behaved differently- congregated at the local supermarket for example and exercised social distancing otherwise - then the contagion's behaviour will differ too, spread slower hopefully.* 

If small fish for instance swam around randomly until they cam close to another small fish. There after the two fish stayed together, collecting other small fish. What would emerge is a school of little fish, swimming around together, pretending to be one great big fish

If a population had to compete for a scarce food supply, then those who are faster/stronger might get that food for themselves, the weaker would starve and die off, and the food supply might become sufficient for the reduced population.



## Modelling



The process by which phenomena or objects can be represented (a good example of abstraction)

A theoretical framework from which past performances can be used to make predictions about the future

Can be physical or abstract (mathematical or computational)

Rule based models



#### **Simulations**

Shows what happens when a model is run

A third pillar of science (in addition to theory and experimentation)

## **Agent Based Modelling**



A kind of modelling used to explore the behaviour of large scale complex systems which are made up of autonomous individuals called agents

Each agent has a set of properties which change/can be modified

Because the agents are autonomous the values of the properties for each individual agent can differ

The behaviour of the overall system is determined by the collective (as opposed to the individual) behaviour.

## Agent Based Modelling Systems (ABMS)

Systems in which agents are modelled and behave individually (as opposed to collectively)

#### **Emergent Behaviours**

A characteristic of a system that results from the interaction of its components Defining characteristic may be unpredictability

## Models to explore post-workshop (next slide)

Some questions to consider when looking at these models are:

- 1.Is this an agent based model?
- 2.What is being modelled?
- 3.What are the agents?
- 4.Is there any emergent behaviour?

5. In what ways are models like this different to the fish population model?





#### **Examples of Agent Based Models**









Netlogo











Angry Birds

**Boids** 

Home Heating

## Conclusions

- 1. LCCS is difficult (for students to learn and teachers to teach)
- 2. Pedagogies are proven to work
- 3. Planning learning around ALTs is key
- 4. Constructivist approach is important



- 5. Growth mindset is at least as important as natural ability
- 6. Student-centric approach (teachers adopt a guide-on-the-side rather than a sage-on-the-stage approach)

"The teacher should help, but not too much and not too little, so that the student shall have a reasonable share of the work" and, "If the student is not able to do much, the teacher should leave him at least with some illusion of independent work."

George Polya, How To Solve It





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