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First Year

Concept: **Relationships and Variables I**

Exploring patterns and relationships through Number; including additive and multiplicative relationships and the properties of Number

Student Context: First Year Students

Learning Outcomes: N2(c), N4, AF1 (a), (b), (c), AF4 (a), AF7

Learning outcomes from the Unifying strand are decided by the class teacher

Key Learning:

- Students should understand and be able to distinguish between additive, multiplicative and proportional relationships (including rational numbers)

- Students should be able to distinguish between relative and absolute comparisons

- Students analyse and interpret problems involving patterns, including being able to:
  o extend and manipulate a pattern to expose and identify its key features

- Students use tables, graphs and words as mathematical tools to represent a pattern, problem or relationship in different ways and understand that:
  o each representation may expose features of a problem, pattern or relationship that the others do not
  o different representations may be used in conjunction with each other

- Students should learn about inverse operations, and commutative, distributive and associative properties in Number

- Students develop their understanding of a variable by using letters as unknowns in a variety of problem contexts including some real-world contexts

Ongoing Assessment
- Can students solve problems using appropriate/multiple representations where required?
- Can students use the properties of Number to manipulate and solve number problems?
- Can students distinguish between relative and absolute comparisons?
- Can students identify patterns in the context of a problem (including real-life) and identify what is fixed and what is varying?

Learning Experiences
- Unifix Cubes
- Sunflower Problem (www.projectmaths.ie – Teacher Resource Booklet Workshop 4)

Notes/Reflection

Units are in development and are subject to change based on ongoing departmental consultation, collaboration and feedback.

Concept: **Relationships and Variables II**

Develop the concept of a function using geometric relationships (area, surface area & volume)

Student Context: First Year Students with some prior knowledge of patterns

Learning Outcomes: GT1, GT2, N3 (b), N4, AF1 (a), (b), (c), AF2 (a), (b), (c), AF3 (a) (i)&(ii) (b) (i), AF4 (a), (b), AF7

Learning outcomes from the Unifying strand are decided by the class teacher

Key Learning:

- Students use mathematical tools (tables, graphs etc.) to further develop their understanding of letters as variables in the context of geometry

- Students develop their understanding of relationships as functions, including:
  - Understanding that the dependent variable is governed by the independent variable(s)

- Students use formulae to calculate quantities and should understand that the inputs and outputs are instances of the relationship

Ongoing Assessment

- Can students recognise dependent and independent variables in a formula and explain their understanding of the interaction between them?
- Can students use specified geometric formulae accurately?
- Can students select, justify and apply suitable strategies to solve problems in shape and space?

Learning Experiences

Notes/Reflection

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Concept: **Relationships and Variables III**
Development of understanding of the links between representations of patterns and generalised algebraic form (linear and quadratic) and consolidation of procedural fluency related to formulae including geometric formulae

Student Context: First Year students with some prior knowledge of patterns, relationships and variables

Learning Outcomes: AF1 (a), (b), (c), AF2 (a), (b), (c), AF3 a(i)&(ii), AF4 (a), AF7, N1 (a)

Key Learning: Learning outcomes from the Unifying strand are decided by the class teacher

- Students develop their understanding of situations where letters stand for quantities, including:

  o Additive and multiplicative models
  o Expressions of equality
  o Linear and non-linear relationships
  o Representations of relationships using words, tables and graphs

- Students analyse patterns (manipulatives, list, table, graphical, worded etc.)

  o In the case of linear and quadratic relationships be able to:
    ▪ Identify the pattern type with justification
  o In the case of linear relationships
    ▪ Develop the general term
    ▪ Begin to examine relationships between the constants and variables
    ▪ Model situations and solve problems in context

- Students represent linear equations graphically and solve them algebraically and graphically

Ongoing Assessment
- Can students identify various types of mathematical relationships (additive, multiplicative, linear, non-linear, proportional, non-proportional, inverse, quadratic) with justification?
- Can students develop the general term for linear relationships?
- Can students convert between mathematical representations and determine the improvements or limitations of various representations?
- Do students understand the concept of equality?
- Can students represent and solve linear equations graphically and algebraically?

Learning Experiences

Notes/Reflection

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Second Year

Concept: **Relationships and Variables IV**
Consolidation of understanding of the links between representations of patterns and generalised algebraic form (linear and quadratic) and investigation of exponential relationships

Student Context: Second Year Students with prior knowledge of patterns, variables and representation

Learning Outcomes: AF1 (a), (b), (c), AF2 (a), (b), (c), AF3 (a) (i), (ii), (iii), (b), (i), (ii), (d) (i), (ii), (iii), (iv), (v), AF4 (a), (b), (d), AF5, AF6, AF7 (a), (b), N1 (c)

Learning outcomes from the Unifying strand are decided by the class teacher

Key Learning:
- Students analyse patterns (manipulatives, list, table, graphical, worded etc.)
  - In the case of linear and quadratic relationships
    - Develop the general term
    - Begin to examine relationships between the constants and variables
    - Model situations and solve problems in context
  - In the case of exponential relationships be able to:
    - Identify the pattern type with justification

- Students represent and solve linear and quadratic equations both graphically and algebraically, and recognise situations where one mathematical strategy or procedure is more appropriate than another

- Students develop their understanding of variables in the context of linear, quadratic, exponential and real-life patterns and relationships, including:
  - using variables to represent an unknown quantity
  - using variables to mathematise a problem

- Students should develop their understanding of relationships as functions, including:
  - using graphical representations to mathematise a problem
  - being able to interpret representations
  - making connections between graphical representations and real-life phenomenon

Ongoing Assessment
- Can students develop the general term for linear and quadratic relationships?
- Can students convert between mathematical representations and determine the improvements or limitations of various representations?
- Can students represent and solve linear and quadratic equations graphically and algebraically?
- Can students identify exponential relationships using their defining characteristics?
- Can students identify the dependant and independent variable in a pattern of real-life situation and attempt to generalise observed pattern(s)?

Learning Experiences//Notes/Reflection

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Concept: **Relationships and Variables V**
Understanding of relationships and how variables are related and represented
In different situations including in the context of geometric relationships

Student Context: Second year students

Learning Outcomes: AF1 (a) (b) (c), AF4 (a) (b), AF6, AF7 (c) (d), GT1, GT2 (a) (c) (e), N3 (b)

Learning outcomes from the Unifying strand are decided by the class teacher

Key Learning:
- Students should understand that there are a variety of mathematical representations that can be useful when solving problems, including:
    - understanding that different representations preserve meaning
    - understanding that different representations may expose features of a problem that others do not
    - understanding that different representations may be used in conjunction with each other

- Students should further develop their understanding of a variable, including:
    - understanding that a variable is a quantity that can vary in the context of a mathematical problem

- Students should further develop their understanding of relationships as functions, including:
    - understanding that the dependent variable is governed by the independent variable(s)
    - understanding that ordered pairs may be instances of a function
    - quantifying the change between variables
    - identification and classification of the type of change between variables

Ongoing Assessment

- Can the student use the most appropriate representation(s) of a problem to analyse, interpret and present their solution(s)?
- Can students transition between a variable and a fixed unknown in context?

Learning Experiences
- Fencing an Enclosure task (JCT Mathematics CPD 2019 -2020)
- 'Match the Stories' (www.projectmaths.ie – Modular Course 3 (Algebra & Number, Module 1)
- Describing relationships (Task adapted from www.openupresources.org)

Notes/Reflections

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Third Year

Concept: **Relationships and Variables VI**
Development of understanding in relation to patterns, relationships and the meaning of a mathematical function

Student Context: Third Year Students with prior knowledge of patterns, relationships, dependant and independent variables, multiple representations, frequent engagement with problem posing and problem solving and the use of algebraic generalisation to model curricular and real-life motivated situations

Learning Outcomes: AF7 (c), (d), AF4 (a), (b), (d), AF6, GT1, GT2 (a), (b), (c), (d), (e), N3 (b), GT4, GT 5 (b), (c)
Learning outcomes from the Unifying strand are decided by the class teacher

Key Learning:
- Students understand that a function is a relation in which the value of a variable is dependent on one or more other variables and that particular values for the independent variable generate one and only one outcome for the dependant variable (Watson *et al* 2013)
  See also page 41 of current LC Syllabus: '[Students] were formally introduced to the concept of a function as that which involves a set of inputs, a set of possible outputs and a rule that assigns one output to each input.'

- Students understand that quantitative relationships can be represented as functions for the purpose of:
  o Formulating and mathematising problems
  o Communicating effectively and precisely, including justifying reasoning, interpreting results and explain conclusions
  o Solving mathematical problems in familiar and unfamiliar contexts

- Students should further develop their use of a variety of representations that are useful for solving problems, including:
  o Understanding that different representations have strengths and limitations, including:
    ▪ Graphs may require estimation but easily let us identify important features such as highest point or steepest section
    ▪ Tables immediately let us find output values but only for limited input values
    ▪ Equations let us precisely compute outputs for all inputs, but only one at a time
  o Understanding that the strengths and limitations of different representations can help choose and justify appropriate strategies for problem solving

Ongoing Assessment Can students flexibly translate between mathematical representations?
Can students differentiate between the use of specified formulae as a calculation tool and specified formulae as functions?
Can students transition between a variable and a fixed unknown in context?

Learning Experiences
Notes/Reflection

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