

Unit 71: Object-Oriented Design for Computer Games

Unit code:	R/600/6656
QCF Level 3:	BTEC National
Credit value:	10
Guided learning hours:	60

● Aim and purpose

The aim of this unit is to enable learners to understand the main concepts and principles of object-oriented design (OOD) and modelling techniques, and to apply those techniques to game design. They will examine object-oriented design structural and operational elements with modelling, and investigate elements of existing games.

● Unit introduction

Game design is a complex process involving many individuals with a wide range of skills. Individual team members will have specialist skills (creative design, programming, management etc) but will still need to communicate effectively to plan and implement game designs. An object-oriented approach to design provides a method of breaking down the complex process of game design into many smaller elements (or objects). Standard modelling techniques such as unified modelling language (UML), which use diagrams and keywords to represent game elements, simplify understanding and make the design process more efficient by allowing game elements to be reused. The modelling techniques provide an interface between creative designers (who can express their requirements without having to know the detail of the code) and programmers (who can use the models to implement the code).

Object-oriented design is one part of the overall design process and should be seen in this context. Normally object-oriented design would start after completion of the creative phase (development of concepts and ideas) and would be used to flesh out ideas. The object approach can then be used to plan the detailed implementation of a project to ensure that milestones and other parameters are met.

In this unit learners will develop their understanding of the main concepts and principles of object-oriented design and how modelling techniques can be adapted for game design. They will develop an understanding of structural and operational elements with modelling, and the approaches involved, by investigating elements of an existing game. Learners will design a complex game element using object-oriented modelling techniques.

● Learning outcomes

On completion of this unit a learner should:

- 1 Understand the purpose of object-oriented design for games
- 2 Understand object-oriented design elements
- 3 Understand object-oriented modelling
- 4 Be able to use object-oriented modelling techniques to design a game element.

Unit content

1 Understand the purpose of object-oriented design for games

Concepts and principles: simplified understanding; reusability; maintenance; efficiency; real-world modelling; collaboration and sharing; communication; quality assurance

Game objects: sprites; characters; weapons; rooms; walls; scenery; instances; rewards, eg bonuses, power-ups

Object properties: colour; size; speed; movement; sounds; health; lives

Actions and events: mouse and keyboard events; create; destroy; collision; timers; scoring

Inheritance: parent; child; inherited behaviours and properties; overriding events

2 Understand object-oriented design elements

Structures: classes; objects; instances; components

Properties: class properties; instance properties; inheritance (class inheritance, instance inheritance)

Methods: method header; method body; encapsulation; attribute visibility

Polymorphism: overloading; overriding

Messaging: communication between objects; message header; message body

3 Understand object-oriented modelling

Unified modelling language concepts: structure (attribute, class); behaviour (activity, event, method); relationship (aggregation, annotation, composition, depends, generalisation/inheritance)

Unified modelling language symbols and notation: classes; relationships; constraints; generalisation

Unified modelling language diagram types: structure (class, object); behaviour (statechart); interaction (collaboration, interaction, timing)

Modelling: object model (class diagrams); dynamic model (sequence diagrams, statecharts)

4 Be able to use object-oriented modelling techniques to design a game element

Game element: object, eg sprite, character, vehicle, weapon, rooms, walls, scenery

Object attributes: properties (colour, visibility, transparency, size, speed, movement); behaviours (mouse events, collision events, keyboard events)

Diagram structural relationships: objects; instances; inheritance; communication; messaging

Diagram event progress: objects; properties; events; behaviours; variables; messages; decisions; loops

Game element specification: documentation, eg unified modelling language (UML), dynamic model, diagrams (structural relationships, event progress)

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:	To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:
P1 describe the purpose of object-oriented design for games with some appropriate use of subject terminology [IE]	M1 explain the purpose of object-oriented design for games with reference to detailed illustrative examples and with generally correct use of subject terminology	D1 comprehensively explain the purpose of object-oriented design for games with elucidated examples and consistently using subject terminology correctly
P2 describe object-oriented design elements with some appropriate use of subject terminology	M2 explain object-oriented design elements with reference to detailed illustrative examples and with generally correct use of subject terminology	D2 critically assess object-oriented design elements with supporting arguments and elucidated examples, consistently using subject terminology correctly
P3 review object-oriented modelling with some appropriate use of subject terminology	M3 explain object-oriented modelling with reference to detailed illustrative examples and with generally correct use of subject terminology	D3 critically evaluate object-oriented modelling with supporting arguments and elucidated examples, consistently using subject terminology correctly
P4 apply object-oriented modelling techniques to design a game element with some assistance. [CT; SM]	M4 apply object-oriented modelling techniques to design a game element to a good technical standard with only occasional assistance.	D4 apply object-oriented modelling techniques to design a game element to a technical quality that reflects near-professional standards, working independently to professional expectations.

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

This unit is intended to provide learners with knowledge and understanding of object-oriented modelling techniques and how they can be applied to game design, along with the ability to apply them. The emphasis of the teaching should be on how object-oriented techniques can be used as a communication tool between creative designers and programmers and how this can lead to a more efficient design process.

To help learners understand the concept of objects it would be useful to analyse an existing game, identifying different types of simple objects (for example, characters, weapons and scenery) and listing common properties/behaviours for each (for example, number of limbs, colour, hair, fur, move, etc). To introduce the concept of inheritance, each object could be represented by a simple diagram with a hierarchical structure. It is important to emphasise the use of this simple diagram as a communication tool between the creative designers and the game programmers who will write code to implement each of the objects.

The next stage of teaching could be to use a simple game creation application (for example, Game Maker) to show how game elements are constructed from objects which are reused many times as different instances within a game. Other concepts can also be introduced at this stage, such as methods (through the use of actions and events), messaging (interaction between objects in a game) and inheritance (the same game object being reused with different behaviours). The main concepts and terminology of object-oriented design can be introduced gradually through the use of actual game objects which will help to reinforce understanding. Object-oriented tools such as UML, state transition or event progress diagrams can also be introduced at this stage to model each of the objects, their behaviours and interaction with each other.

Learners will be required to design a complex game element using the object-oriented modelling techniques developed; this could be an element of a game being designed for one of the other units. It should be noted that some of the standard modelling techniques used for programming may need to be modified slightly to model games accurately depending on the application used.

Learners should be encouraged to apply object-oriented design during the development of solutions in other relevant units. At least one programming or scripting language should be used to demonstrate how objects are actually implemented in code. This should be code/script which learners are using or will be expected to use as their knowledge and skills develop.

The unit could be taught through a variety of activities. There will be a need for lectures, discussion and demonstrations as well as practical sessions. Learners will need to experience gameplay and all its ramifications. Research will include the internet as well as taking part in the playing of a variety of games on a range of platforms. Although this game playing is an essential aspect of research in this unit, it must not outweigh the other methods of learning. When playing games the learner must understand the specific reason for such play. In this case they will be looking at games with the intention of 'decomposing' or 'reverse engineering' them into their structural and operational components.

Outside visits and visits from guest speakers could be arranged to support classroom teaching.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way of planning the teaching and assessment of this unit.

Topics and suggested assignments and activities
Introduction to unit and unit assessment.
Introduction to object-oriented design (OOD) and its use for game programming. Learners: <ul style="list-style-type: none">• receive lectures explaining concepts and principles• receive lectures explaining games objects and their OOD attributes• receive lectures explaining the concepts of actions, events and inheritance• conduct private research into OOD used in game programming.
Assignment 1 – Object-Oriented Design: What You Need to Know Learners will write an article on use of object-oriented design in game development for an online gaming ezine. The article must cover: <ul style="list-style-type: none">• concepts and principles• game objects• object properties• actions and events• inheritance.
Introduction to elements of object-oriented design. Learners: <ul style="list-style-type: none">• receive lectures explaining OOD structures, properties and methods using examples drawn from computer game code scripts• receive lectures explaining OOD concepts of polymorphism and messaging, using examples taken from computer game code scripts• conduct private research into game script examples (eg using ActionScript 3) to identify OOD concepts and structures.
Introduction to object-oriented design modelling. Learners: <ul style="list-style-type: none">• receive lectures explaining unified modelling language (UML) concepts, structures, symbols and diagram types• undertake tutor-led workshops to develop OOD modelling skills, constructing class diagrams, sequence diagrams and statecharts• practise construction of OOD modelling diagrams and associated documentation.

Topics and suggested assignments and activities

Assignment 2 – Object-Oriented Design: Elements and Modelling

Learners will write a technical article on object-oriented design elements and modelling for online computer games ezine, discussing in depth OOD elements and UML modelling techniques.

The article must cover:

- structures
- properties
- methods
- polymorphism
- messaging.

Assignment 3 – My Object-Oriented Design Character

As part of the creation of their job-application portfolio of applied object-oriented design skills, learners will design and create an OOD character for a proposed game.

Learners will:

- construct appropriate structural relationship diagrams using UML notation
- construct appropriate event diagrams using UML notation
- author the 'semantic backplane' – documentation such as written use cases that drive the model elements and diagrams
- present their OOD design work as a specification for their character.

Unit learning and assessment review.

Assessment

Evidence for assessment

Evidence for the achievement of learning outcomes 1, 2 and 3 is likely to comprise a combination of observation, presentations, diagrams, charts, ongoing critique, research evidence, logbook or diary evidence and solutions to problems. Presentations must be recorded for the purposes of internal and external verification.

Evidence for the achievement of learning outcome 4 could be a portfolio of evidence containing, for example, structural relationship diagrams using UML notation, event diagrams using UML notation, documentation such as written use cases to support model elements and diagrams, and their OOD design work presented as a specification for the element.

For some elements of this unit, and for some learners, a formal viva voce assessment might be appropriate. When more than one learner in a cohort is assessed in this way, care must be taken to ensure that all learners are asked equivalent questions, and that all are given equal opportunities to expand or clarify their answers. Interviewers must also ensure that questions are not phrased in such a way as to provide or suggest an answer. Formal vivas should be recorded for the purposes of internal and external verification and at least 50 per cent of such assessments must be internally verified.

Application of grading criteria

When applying the grading criteria, tutors should follow the advice given below. Please note that any examples of evidence given here are indicative only. This advice is not inclusive and the examples need not be included in a learner's work in order for that learner to achieve the exemplified grade.

Pass

To achieve a pass grade, learners must achieve all the criteria at pass level. For each of the criteria learners must present evidence that addresses each italicised sub-heading of the content for the learning outcome.

P1: learners will give accurate and substantially complete descriptions of what objects are in general terms (for example, a reusable element of a game such as a car) and how object-oriented design is used to enhance the design process within the games industry. They will discuss only the main concepts and advantages and must use some appropriate technical terms in their explanation (for example, efficiency, ease of maintenance). When explaining the purpose of object-oriented design, a pass grade learner might write, 'The purpose of object-oriented design within games is to allow for efficient and easy extension or upgrades to a game.'

P2: learners will correctly describe the full range of elements as identified in the unit content, giving a substantially complete description of each element. The evidence must describe structures, properties, inheritance, methods, polymorphism and messaging. Some clear understanding of appropriate terminology should be evident but at this grade the learner may not illustrate their response using an appropriate example. When describing 'structures', a pass grade learner might write, 'Object-oriented design uses classes and objects. A class describes something. An object is one actual occurrence of a class. This occurrence is called an "instance" of the class.'

P3: learners will provide a substantially full overview of object-oriented modelling describing structure, symbols and how they are used. A pass grade learner might describe the terminology used within a unified modelling language (UML) environment by the use of diagrams. Explanations should include some use of appropriate terminology.

P1, P2 and P3: evidence will show a basic understanding of technical terminology but learners will generally be unsure about this vocabulary and will make fairly frequent mistakes when they do use it.

P4: through the application of object-oriented modelling techniques learners will produce a simple game element in UML such as a character. For this grade the design will be basic and conventional with limited behaviours but should include examples of object attributes and structural relationships. Evidence might include diagrams, charts, notes and logs. The character should have clearly identifiable attributes and have methods describing how it may interact with other characters. Learners working at this grade will need frequent assistance and support, though they will take note of and make use of this help when it is given. If they are in frequent need of such help but fail to make positive use of it, they should not be considered for a pass grade for this unit.

Merit

To achieve a merit grade, learners must achieve all the pass and all the merit grade criteria. For each of the criteria learners must present evidence that addresses each italicised sub-heading of the content for the learning outcome.

M1: when explaining the purpose of object-oriented design, learners will select specific appropriate examples to demonstrate how objects can be reused within a game (for example, specific characters and their attributes and behaviours). The explanation will be comprehensive and use appropriate terminology to describe the advantages of using an object-oriented approach to design. A merit grade learner might write, 'Object-oriented design is used within a board game where by modifying the playing pieces used, the game function can be easily changed. For example, by replacing draughts pieces with chess pieces the game can change from chess to draughts.'

M2: evidence will cover structures, properties, inheritance, methods, polymorphism and messaging. Learners will explain object-oriented design elements by referring to specific examples using appropriate terminology. A merit grade learner, when explaining inheritance, might write, 'The introductory level of *Game X* has a scene where the player may choose to pass through one of many doors. These doors are game elements which, although essentially the same, may have different features and behaviours (for example, different properties,

methods, one has glass panels, one has wood panels). Each door is an object which is a member of a class called “door”. Each door element has been defined in code as a special version of the general door.’

M3: learners will provide an overview of object-oriented modelling describing UML concepts, UML symbols and how they are used, and demonstrate the ability to construct a model using a recognised UML diagram type. For this grade, modelling must be accurate; each object model must include appropriate structure, behaviours and relationships, and be described using a correct diagram; there must be evidence of use of appropriate terminology. To explain their understanding of object-oriented modelling a merit grade learner might select and model specific objects of a game. By modelling a suitable example such as a racing car object, the learner could demonstrate their understanding of how it might be described in a UML environment including attributes such as colour, shape, engine size, top speed and methods such as accelerate, brake, steer left, steer right.

M1, M2 and M3: learners will use technical vocabulary for the most part correctly, but may make mistakes or be unsure about usage at times.

M4: learners will produce an involved design for an element of a game through the application of object-oriented modelling techniques. In addition to including examples of object attributes and structural relationships, learners will also evolve diagrams or charts to show interaction and state changes over time. Evidence might include diagrams, charts, notes and logs. The element should have clearly identifiable attributes and have methods describing how it may interact with other elements. The application of the modelling techniques will have been correct and learners may have required some support when dealing with more complex technology or trying to apply more sophisticated techniques. As with the pass grade learner, they will benefit from any help given.

Distinction

To achieve a distinction grade, learners must achieve all the pass, all the merit and all the distinction grade criteria. For each of the criteria learners must present evidence that addresses each italicised sub-heading of the content for the learning outcome.

D1: learners will explain with supporting arguments why object-oriented design is the best approach to game design, citing specific examples of how time and cost can be saved through the efficient reuse of code. The arguments made by the learner will be clear and expressed using fluent technical language. It will be evident that the examples and explanation express the learner’s personal understanding. When explaining the purpose of object-oriented design, a distinction grade learner might write, ‘Object-oriented design promotes greater flexibility in game programming, by permitting well designed classes to be instantiated as objects which interact during the moment of gameplay. The reuse of the classes gives economies in development time during the development of a single game, and the code itself can be reused in subsequent game development whether for a sequel or not. The classes can be used as base implementations in any game that requires them, though a minimum of additional programming may be needed to optimise them to the new game. The reuse of classes gives logical and visual placeholders which speed up game development.’

D2: evidence will cover structures, properties, inheritance, methods, polymorphism and messaging. Learners will critically assess the benefits of object-oriented design elements by comparing specific examples using appropriate terminology. A distinction grade learner, when explaining inheritance, might write, ‘In object-oriented design, inheritance is a way to form new classes by using classes that have already been defined. This is intended to help reuse existing code with little or no modification. In Game Y a number of identical balls are used. However, some balls differ slightly – but only when they bounce. The game programmer reused code by first defining a ball class and defining all balls as belonging to this class. The special balls override the normal bounce behaviour of the class with their own special version.’

D3: learners will provide a comprehensive critical assessment of object-oriented modelling. They will describe in depth UML concepts and symbols and how they are used, and justify why they have selected to model specific objects in a game. They will demonstrate a wide-ranging knowledge of how object-oriented modelling is applied by implementing most features of a UML modelling tool appropriately and independently.

Modelling will be to a near-professional standard with each object exhibiting appropriate structure, behaviours and relationships. At this grade a learner might write comments to justify object-oriented modelling as a tool in game design in preference to a procedural modelling method such as algorithmic design.

D1, D2 and D3: technical vocabulary will be secure and used correctly and confidently at all times.

D4: learners will produce a design for a complex game element, evidencing use of UML and dynamic models. They should be able to justify why they have used each diagram and the structure within it. The structure and layout of the diagrams should be presented to a near-professional standard and implemented to industry standards. A distinction grade learner might produce a well-formed character object with evidence of design in depth complete with associated documentation in UML format. The documentation will be complete. In all practical activity distinction grade learners will be capable of working autonomously and effectively. The term 'working independently' means that they are able to work on their own initiative and do not need constant support or supervision, give the work their full commitment, work positively and cooperatively with others, and meet deadlines. In other words, they have the kind of self-management skills that would be expected of them in a professional context. Note also that this criterion should not be taken to mean that learners do not seek advice or that they work without discussing things with their tutor, but rather that they are not dependent upon the support of others and that if they take advice they weigh it carefully for themselves.

Programme of suggested assignments

The table below shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the assessment and grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, M1, D1	Assignment 1 – Object-Oriented Design: What You Need to Know	Article on use of object-oriented design in game development for online gaming ezine.	<ul style="list-style-type: none"> All preparatory notes. Ezine article.
P2, M2, D2 P3, M3, D3	Assignment 2 – Object-Oriented Design: Elements and Modelling	Technical article on object-oriented design elements and modelling for online computer games ezine.	<ul style="list-style-type: none"> All preparatory notes. Ezine article.
P4, M4, D4	Assignment 3 – My Object-Oriented Design Character	Creation of job-application portfolio of applied object-oriented design skills.	Portfolio containing: <ul style="list-style-type: none"> structural relationship diagrams using UML notation event diagrams using UML notation documentation such as written use cases to support model elements and diagrams their OOD design work presented as a specification for their character.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC Creative Media Production suite. This unit has particular links with the following units in the BTEC Creative Media Production suite:

Level 2	Level 3
3D Computer Game Engines	Computer Game Design
Creative Media Production Project	Computer Game Engines
	Creative Media Production Management Project

There are opportunities to relate the work done for this unit to Skillset National Occupational Standards in Interactive Media and Computer Games as follows:

- IM1 Work effectively in interactive media
- IM7 Code scripts to provide functionality for interactive media products
- IM8 Determine the implementation of designs for interactive media products
- IM9 Provide creative and strategic direction for interactive media projects
- IM16 Plan content for web and multimedia products
- IM17 Architect interactive media products
- IM20 Design electronic games
- IM21 Program electronic games to develop functionality.

Essential resources

Learners will need access to current research on object-oriented modelling with particular reference to games. Learners should have access to a variety of media forms, with viewing, listening and reading facilities as appropriate.

Employer engagement and vocational contexts

Centres should develop links with local interactive media production studios which could be approached to provide visiting speakers, study visits or samples of typical products.

Skillset, the Sector Skills Council for the creative media sector, has a substantial section of its website dedicated to careers, including job descriptions – www.skillset.org/careers/.

Further general information on work-related learning can be found at the following websites:

- www.aimhighersw.ac.uk/wbl.htm – work-based learning guidance
- www.businesslink.gov.uk – local, regional business links
- www.nebpn.org – National Education and Business Partnership Network
- www.vocationallearning.org.uk – Learning and Skills Network
- www.warwick.ac.uk/wie/cei/ – Centre for Education and Industry, University of Warwick – work experience and workplace learning frameworks.

Indicative reading for learners

Textbooks

Baylis P, Freedman A, Procter N et al – *BTEC Level 3 National Creative Media Production, Student Book* (Pearson, 2010) ISBN 978-1846906725

Baylis P, Freedman A, Procter N et al – *BTEC Level 3 National Creative Media Production, Teaching Resource Pack* (Pearson, 2010) ISBN 978-1846907371

Gold J— *Object-Oriented Game Development* (Addison-Wesley, 2004) ISBN 978-0321176608

Makar J – *Macromedia Flash MX Game Design Demystified* (Macromedia, 2002) ISBN 978-0735713987

Miles R and Hamilton K – *Learning UML 2.0* (O'Reilly Media Inc, 2006) ISBN 978-0596009823

Overmars M – 'Learning Object-Oriented Design by Creating Games' in *Potentials* (the journal of the Institute of Electrical and Electronic Engineers), December 2004-January 2005, Volume 23, Issue 5, pages 11-13 (available from www.cs.uu.nl/research/techreps/repo/CS-2004/2004-057.pdf)

Rollings A and Morris D – *Game Architecture and Design: NRG Programming* (New Riders, 2003) ISBN 978-0735713634

Swamy N and Swamy N – *Basic Game Design and Creation for Fun and Learning* (Charles River Media, 2006) ISBN 978-1584504467

Websites

www.cs.uu.nl/research/techreps/repo/CS-2004/2004-057.pdf – article on learning object-oriented design by creating games, by M Overmars, author of Game Maker software (available from www.yoyogames.com/make)

www.developer.com/design/ – software development resources and articles

www.devmaster.net/articles/oo-game-design/ – game development encyclopaedia

www.gamasutra.com – respected website for all things game development, sister publication to the respected print magazine *Game Developer*; excellent game developer resources

www.macromedia.com/devnet/mx/director/articles/oop_dir_flash.html – article on designing and implementing objects

www.tdan.com/special003.htm – special feature on event progress diagrams

Delivery of personal, learning and thinking skills

The table below identifies the opportunities for personal, learning and thinking skills (PLTS) that have been included within the pass assessment criteria of this unit.

Skill	When learners are ...
Independent enquirers	<p>researching concepts and principles of object-oriented design that make it suitable for use in constructing computer games, judging the value of the information found and using it to support their arguments</p> <p>carrying out research to develop ideas for their own character specification using OOD techniques</p>
Creative thinkers	<p>generating ideas for specifying a character using OOD techniques and authoring specification documentation to provide a semantic backplane of written use cases to support their model diagrams</p> <p>trying out different ways of creating their UML diagrams, following ideas through to complete a meaningful design</p> <p>adapting their ideas as circumstances change</p>
Self-managers	<p>organising their time and resources and prioritising their actions whilst generating ideas, and when designing and specifying their character</p> <p>seeking out challenges or new responsibilities and showing flexibility when circumstances change</p> <p>dealing with competing pressures, including personal and work-related demands</p> <p>responding positively to change, seeking advice and support when needed.</p>

Although PLTS are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are ...
Reflective learners	<p>setting goals with success criteria for their UML and OOD work</p> <p>inviting feedback on their own work and dealing positively with praise, setbacks and criticism</p> <p>evaluating their learning and experience to inform future progress</p>
Team workers	<p>if working in a group to produce and share learning about UML and OOD, taking responsibility for their own role</p> <p>managing their personal contribution to and assimilating information from others in discussions about OOD modelling techniques to reach agreements and achieve results.</p>

● Functional Skills – Level 2

Skill	When learners are ...
ICT – Use ICT systems	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	using UML drawing systems to generate OOD diagrams
Manage information storage to enable efficient retrieval	managing digital files prepared and stored for their OOD design
Follow and understand the need for safety and security practices	using UML drawing systems to generate OOD diagrams
Troubleshoot	
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	creating and finding object-oriented modelling and design evidence for a portfolio
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	conducting web-based research on the use of object-oriented design methods in game development
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: <ul style="list-style-type: none"> • text and tables • images • numbers • records 	building and presenting their portfolio of object-oriented modelling and design evidence preparing report documents on the use of object-oriented design methods in game development
Bring together information to suit content and purpose	
Present information in ways that are fit for purpose and audience	
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	taking part in brainstorming sessions to generate ideas as a response to an assignment brief
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	studying books, journals, papers to research object-oriented design and unified modelling language concepts and methods
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	creating their personal portfolio incorporating ideas, notes, diagrams and documentation presented as an OOD specification for their character.