

Unit 75: Human-computer Interfaces for Computer Games

Unit code:	J/502/5677
QCF Level 3:	BTEC National
Credit value:	10
Guided learning hours:	60

● Aim and purpose

The aim of this unit is to introduce learners to the way humans interact with computer games. Learners will analyse the interface between an interactive game and its users, study control and feedback mechanisms used within games, and design an interface for a game element.

● Unit introduction

People interact with computers and gaming devices using increasingly sophisticated technologies. In addition to the traditional input devices such as the mouse and keyboard, there are touch screens, steering wheels, motion sensors, voice recognition and virtual reality devices. Even the traditional joystick can incorporate force feedback and programmable buttons, with special versions available optimised for particular games (such as flight simulations or combat). Visual feedback can include multiple widescreen displays supplemented by multi-channel surround sound creating an interactive virtual world. Audio feedback provides an edge of realism to help sustain the player's suspension of disbelief.

The study of human-computer interfaces (HCI) is not just about the technology; it also considers how people interact with the application (onscreen objects, menus etc). As HCI provides the main point of contact between a person and the game, it is vital that it is well designed to enable users to focus their attention solely on gameplay.

HCI is an integral part of the game design process typically involving the study, design, construction and implementation of human-centred interactive computer systems. In this unit learners will analyse the interface between an interactive game and its users, develop an understanding of control and feedback mechanisms used within games, and design and evaluate an interface for a game element.

The skills and knowledge developed in this unit are also applicable to many other areas, such as computer interaction for individuals with disabilities, control of medical devices, and military applications and simulations.

● Learning outcomes

On completion of this unit a learner should:

- 1 Understand human-computer interfaces for games
- 2 Understand methods of control and forms of feedback in games
- 3 Be able to prototype an interface for a game using HCI techniques.

Unit content

1 Understand human-computer interfaces for games

Technology: screens; keyboards; joysticks; pads; touch screens; steering wheels; pointing devices; motion detectors; headsets

Interfaces: command line input; speech recognition; menu selection and the methods of selection; sense oriented (graphical, speech, touch); capabilities for intensive data manipulation; intelligent systems; avatars

Human factors: user experience, eg expert, regular, occasional, novice; user requirements, eg vision impaired, physically impaired, learning difficulties; demographics, eg age, gender

User interface design principles: structured (co-location of related elements); simple (user's language, meaningful shortcuts); visible (avoidance of distraction); feedback (clarity, relevance); tolerance (undo, redo, inconsistent input); reusable (uniformity, reduction of user memory process)

2 Understand methods of control and forms of feedback in games

Feedback: visual, eg iconic, colour psychology, inference, player viewpoint, camera techniques (foreshadowing, reveal), lighting effects; physical, eg vibration; audio, eg ambient, dialogue, Foley effects, music, mood, emotion

Information communication: information-rich game world; user needs, eg rapid data analysis for decision making (strategy, tactics); rapid input

User psychology: memory (long term, short term); reasoning; perception; cognition; metaphors

Control method design: mapping system functionality; control methods and user feedback to an interface; prototyping; measuring functionality against user satisfaction; heuristics analysis; context sensitivity; human-computer interface (HCI) diagramming methods

3 Be able to prototype an interface for a game using HCI techniques

Game specification analysis: visual style; audio style; game resources; core game mechanics, game modes, eg game levels, difficulty modes

Interface decisions for each mode: game resources; game mechanics; player actions required; feedback required; input devices, eg mouse, joystick; onscreen input, eg menus, buttons; feedback, eg visual, audio, other

User interface: layout sketches; mode transition (flow chart)

Prototype interface design: eg audio-visual presentation software, interactive media authoring software, commercial or open-source prototyping software

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 human-computer interfaces for games with some appropriate use of subject terminology	M1 explain human-computer interfaces for games with reference to detailed illustrative examples and with generally correct use of subject terminology	D1 critically evaluate human-computer interfaces for games with supporting arguments and elucidated examples, and consistently using subject terminology correctly
P2 summarise accurately methods of control and forms of feedback in games with some appropriate use of subject terminology	M2 explain methods of control and forms of feedback in games with reference to detailed illustrative examples and with generally correct use of subject terminology	D2 critically evaluate methods of control and forms of feedback in games with supporting arguments and elucidated examples, and consistently using subject terminology correctly
P3 prototype an interface for a game using human-computer interface techniques working within appropriate conventions and with some assistance. [CT; RL]	M3 prototype an interface for a game using human-computer interface techniques to a good technical standard showing some imagination and with only occasional assistance.	D3 prototype an interface for a game using human-computer interface techniques to a technical quality that reflects near-professional standards, showing creativity and flair and 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 designed to provide learners with knowledge of the different approaches to human-computer interface design. Learners should develop an understanding of the benefits of a well-designed interface and learn how to assess the satisfaction of the user. Using this knowledge and understanding, learners will create and evaluate an interface for a game element.

The unit could be covered through a variety of activities within the teaching sessions. There will be a need for lectures, discussion and demonstrations as well as practical sessions. Learners will also need to experience gameplay. Research will include using the internet as well as taking part in the playing of a variety of games on a range of platforms. Although game playing is an essential aspect of research in this unit, it must not outweigh the other methods of learning. When playing games learners must understand the specific reason for this play.

Learners could be encouraged to carry out a series of investigations into existing products and interfaces. One approach would be to provide a guided investigation requiring learners to explore a recommended range of games, experiencing differing interfaces each using a range of input devices. Comparisons could be made between using different input devices (mouse, joystick, gamepad etc) with the same interface. Learners could then present their findings highlighting the pros and cons of different devices with differing interfaces. They might consider, for example, whether one particular device is more suitable for a particular interface than another.

Learners will be required to design their own interface to match a game specification. Tutors can provide a specification for the whole group; alternatively learners might develop the HCI for a game specified in an assignment done for another unit. However it is provided, learners should be working to a properly defined game specification which should allow them to cover all of the requirements of the unit content.

All projects in this unit should be supported by ongoing technical exploration of the games media. Outside visits and visitors should be included where appropriate.

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 typical interfaces.

Learners:

- receive lectures explaining interfaces typical of common games
- receive lectures explaining user demographics and requirements
- play range of computer games identifying and noting the interface used and its impact within the game, commenting on suitability for user categories.

Topics and suggested assignments and activities

Assignment 1 – Human-computer Interfaces: What You Need to Know

Learners will write an article for an online games ezine on the principles of HCI applied to games, identifying typical interfaces used with a range of technologies and matching user needs to typical interfaces.

Article will cover:

- technologies
- interfaces
- human factors
- user interface design principles.

Introduction to forms of feedback typical in games.

Learners will:

- receive lectures explaining feedback typical of common games
- receive lectures explaining more formal design methods and heuristics
- play range of computer games to research, identify and note the feedback used and its impact within the game, commenting on suitability.

Assignment 2 – Feedback and Control in Games: What You Need to Know

Learners will write an article for an online games ezine on feedback and control methods used in games.

Article will cover:

- forms of feedback
- information communication
- user psychology
- control method design.

Assignment 3 – My Interface Design

Working as creatives within the industry, learners have been tasked with designing a user interface to match a game specification. Learners will design and create an HCI for the proposed game.

Learners will:

- analyse control needs and identify control methods to be implemented via the interface
- analyse information needs and identify those to be addressed in the interface
- identify feedback most appropriate for the interface
- document the proposed interface
- produce a simulation of the designed interface using audio-visual presentation software.

Unit learning and assessment review.

Assessment

Evidence for assessment

Evidence for assessment is likely to comprise a combination of presentations, written reports and diaries or logs of work.

Evidence for achievement of learning outcomes 1 and 2 could be in the form of a presentation or written report (or a combination of both) on the learner's research into existing games and associated input/output devices. Evidence of the achievement of learning outcome 2 could also include a critical analysis of an interface used in a commercially available game.

Evidence for achievement of learning outcome 3 should be a prototype HCI design generated to satisfy a given game specification and using, for example, audio-visual presentation software, employing one slide per game mode (level) and with functioning interactive links. Tutors can either produce a standard game specification for all learners or agree individual game specifications created by learners in work done for other units. The game specification used should provide sufficient scope to cover all elements of HCI design. It need not be complex; the description should include details about the challenges in the game, the actions available to the player, the core mechanics, and some different gameplay modes (game levels) to be supported. The prototype does not require specialist software: it is sufficient to prototype the HCI design using presentation software or interactive media authoring software. The prototype should be supported by an extended dossier including the learner's comprehensive notes analysing the HCI needs of the game. Learners should also include documentation recording their decisions and sketches of their design. They should comment on how their design meets the HCI needs. Learners should reflect upon their work through self-evaluation and by obtaining feedback from their tutor and peers. The reflection should compare their finished design against their original target, and must examine the usability of their design, making comments on its effectiveness.

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 pass criteria. 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 HCI covering the main concepts and using some appropriate technical terms. When describing HCI, a pass grade learner might note, 'A human-computer interface is the method of interacting with a game. The user could interact by using a joystick or mouse to control a character. Different levels of difficulty may be used to determine how much control a user has.'

P2: learners will summarise methods of control and forms of feedback in games giving accurate and substantially complete descriptions. For example, a learner might note, 'When a user plays a game they have certain expectations. For example, users normally expect that when you hold the fire button down this will cause continuous firing of a weapon; if this does not happen then users can become confused or dissatisfied.'

P1 and P2: 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.

P3: learners will design an interface employing techniques of HCI. The design will be basic and conventional but should still function correctly and demonstrate some consideration of user interface design principles. Documentation should evidence some initial analysis of the game specification, indicating what HCI needs have been observed, but the analysis will be superficial. There will be some record of design decisions including input devices planned for use in the game and how the user obtains feedback. These should be supported by layout sketches which have been annotated to explain their contents. Design decisions will be conventional and lacking explanation with only cursory annotation to sketches. Learners will provide a flow chart showing how a player might navigate between levels, but this is likely to lack detail and have limited usefulness. The planned interface should be prototyped using, for example, audio-visual presentation software employing one slide per game mode and with functioning interactive links. To achieve a pass grade some functionality and some usability must be evident. In presenting the prototype, it must be clear that the design would function, though to a limited extent. Learners may require 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 how the HCI is applied to the user interfaces of computer games, learners will select specific appropriate examples. The explanation will be comprehensive and use appropriate terminology in descriptions and explanations. A merit grade learner might note, 'HCI is about developing an engaging, intuitive interface. For example, in Game X users have the choice of selecting from a range of supported input devices. To get up to speed they can start the game in training mode before switching to a level of their choice (beginner, advanced, expert).'

M2: learners will explain methods of control and forms of feedback in games with reference to detailed illustrative examples, expressing ideas with clarity and with generally appropriate use of subject terminology. A merit grade learner might note, 'When playing Game X the user can tell that the car is starting to lose traction because the tyres begin to screech (audio feedback) and smoke appears from the tyres (visual feedback). The force feedback steering wheel also judders. The combination of effects makes the game very realistic.'

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

M3: learners will design a functional game interface using human-computer interface techniques to a good technical standard. The final design will apply the concepts and principles of HCI competently, demonstrating best practice in recognising the needs of the player. Documentation will evidence good analysis of the game specification and there will be a comprehensive record of interface design decisions with some comments justifying the choice. Each game mode will be examined and differences in user interface needs will be explained. Clear layout sketches and navigation charts will be prepared with helpful annotation. Work will be approached methodically and with adequate preparation. Learners will reveal some imagination in their interface design. Most elements of the planned interface will be fully operational and prototyped using, for example, audio-visual presentation software, employing one slide per game mode and with functioning interactive links. There may be some technical shortcomings in the operation of the prototype but such flaws will not be serious or so frequent as to render the design unsuccessful. In presenting the prototype, it must be clear that the design would function efficiently. The user interface will have been tested with records made of any user problems. Learners may need occasional support, particularly when dealing with more complex technology or trying to apply more sophisticated techniques. As with the pass grade learner, they will benefit from such support.

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 critically analyse human-computer interfaces with supporting arguments, using elucidated examples, expressing ideas fluently and using subject terminology correctly. A distinction grade learner might note, 'Game Y has a very sophisticated interface. Users can use a joystick, steering wheel or mouse for direct control of the car. Additional control (such as gear change, throttle, view etc) can be controlled by keyboard input or alternatively additional controls and buttons can be used on the joystick. The default control options can be altered in the game setup menu to provide a totally customised interface which best suits the user. The custom functions make the user feel more in control of the gameplay and as a result they are more likely to keep playing.'

D2: learners will critically analyse methods of control and forms of feedback in games with supporting arguments and elucidated examples, expressing ideas fluently and using subject terminology correctly. A distinction grade learner may note, 'I played Game Y using both a mouse and a force feedback joystick. While it is possible to play the game with the mouse there is no doubt that the game designers expect users to own a joystick. Playing the game with the mouse is quite awkward and not very natural. The force feedback joystick on the other hand is both addictive and realistic. The aircraft responds to joystick movements exactly as you would expect. As you land the aircraft on the runway and feel the judder of the joystick when the wheels touch down, you really do feel as though you have landed a real plane. This proves the importance of recommending a particular input device to get maximum enjoyment from the game.'

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

D3: learners will design a game interface of a technical quality that reflects near-professional standards. The product will implement the concepts, principles and standards of HCI with creative flair. A full range of HCI concepts and principles will be shown in the design and final prototype. The interface design will comply with all current requirements for the purpose specified. Full evidence of thorough preparation will be present including the creative design process of analysis and decision making together with clear evidence of consideration of good practice and current requirements. Imaginative and thoroughly well-annotated layout sketches and flow charts will be provided. There will be evidence that these documents have been used in the preparation of an effective prototype. In presenting the prototype, it must be clear that the design would function efficiently and fully satisfy HCI best practice. Work will be completed on time and be fully tested, including prototyping and user trials. 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, 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 – Human-computer Interfaces: What You Need to Know	Article for online games ezine on principles of HCI applied to games.	<ul style="list-style-type: none"> All preparatory notes. Article as word processed or electronic document.
P2, M2, D2	Assignment 2 – Feedback and Control in Games: What You Need to Know	Article for online games ezine on game feedback and control.	<ul style="list-style-type: none"> All preparatory notes. Article as word processed or electronic document.
P3, M3, D3	Assignment 3 – My Interface Design	Working as a creative within the industry, learner is tasked with design of a user interface to match a game specification.	Interface design portfolio containing: <ul style="list-style-type: none"> analytical notes on game specification documented decisions on interface design screen layout sketches flow chart audio-visual presentation prototyping the interface in operation (one slide per game mode, with interactive links).

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
	Computer Game Design
	Sound for Computer Games
	Computer Game Story Development

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
- IM5 Design user interfaces for interactive media products
- IM6 Use authoring tools to create interactive media products
- IM7 Code scripts to provide functionality for interactive media products
- IM8 Determine the implementation of designs for interactive media products
- IM10 Initiate interactive media projects
- IM12 Devise and evaluate user testing of interactive media products
- IM13 Conduct user testing of interactive media products
- IM17 Architect interactive media products
- IM20 Design electronic games
- IM21 Program electronic games to develop functionality
- IM22 Test electronic games.

Essential resources

Learners will need access to current research on human-computer interface developments with particular reference to games. Access to a range of computer games and a wide range of associated input devices is essential. Learners must have access to software that will enable prototyping of their interface design.

Employer engagement and vocational contexts

Centres should develop links with local game development studios which could be approached to provide visiting speakers, study visits or samples of typical interface layouts and documentation.

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

Adams E – *Fundamentals of Game Design* (Prentice Hall, 2006) ISBN 978-0131687479

Carroll J – *Foundations of Design in HCI: A Special Issue of 'Human-computer Interaction'* (Lawrence Erlbaum Associates Inc, 2006) ISBN 978-0805893823

Carroll J – *HCI Model Theories and Frameworks* (Morgan Kaufmann, 2003) ISBN 978-1558608085

Choquet D – *1000 Game Heroes* (Taschen, 2002) ISBN 978-3822816332

Crawford C – *Chris Crawford on Game Design* (F T Prentice Hall, 2003) ISBN 978-0131460997

Dix A – *Human-Computer Interaction* (Prentice Hall, 2003) ISBN 978-0130461094

Koster R – *Theory of Fun for Game Design* (Paraglyph Press, 2004) ISBN 978-1932111972

Preece J, Rodgers Y and Sharp H – *Interaction Design: Beyond Human-Computer Interaction* (John Wiley & Sons Ltd, 2007) ISBN 978-0470018668

Premier Press Development – *Game Interface Design* (Premier Press, 2004) ISBN 978-1592005932

Rouse R – *Game Design, Theory and Practice* (Wordware Game Developer's Library, Wordware Publishing Inc, 2006) ISBN 978-1556229121

Websites

hci-journal.com – *Human-Computer Interaction*, a journal of theoretical, empirical, and methodological issues related to user science and system design

www.bcs-hci.org.uk – the website of the British Human-Computer Interaction Group

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

www.gamedev.net – a forum, with good articles on all things game development and excellent game developer resources

www.igda.org – non-profit-making industry body, useful for research and learning support

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 ...
Creative thinkers	generating ideas for their game interface trying out different ways of creating their interface, following ideas through to complete a functioning prototype adapting their ideas as circumstances change
Reflective learners	reviewing and reflecting on their proposed game interface setting goals with success criteria for their interface production work inviting feedback on their own work and dealing positively with praise, setbacks and criticism evaluating their learning and experience to inform future progress.

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 ...
Independent enquirers	carrying out research into principles of interface design and its application to computer games carrying out analysis and research to develop ideas for their own interface design for a game
Team workers	if working in a group to produce an interface design, taking responsibility for their own role managing their personal contribution to discussions to reach agreements and achieve results
Self-managers	organising time and resources and prioritising actions whilst analysing control and information needs and when creating their simulated interface.

● 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	handling graphic design and audio-visual presentation systems to prototype their interface
Use ICT to effectively plan work and evaluate the effectiveness of the ICT system they have used	planning for the prototyping of a game interface
Manage information storage to enable efficient retrieval	managing files sourced and created for their prototype game interface
Follow and understand the need for safety and security practices	handling graphic design and audio-visual presentation systems to prototype their interface
Troubleshoot	handling graphic design and audio-visual presentation systems to prototype their interface
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	sourcing reference material for their interface design
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	
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 prototype interface showing their analysis of their game specification, documenting the interface decisions made and their generation of ideas, flow charting mode transitions and reviewing their work
Bring together information to suit content and purpose	developing an audio-visual presentation of their interface design prototype
Present information in ways that are fit for purpose and audience	presenting their prototype game interface design
Evaluate the selection and use of ICT tools and facilities used to present information	preparing a reflective commentary on their performance
Select and use ICT to communicate and exchange information safely, responsibly and effectively including storage of messages and contact lists	gathering feedback on their interface design work as part of their self-reflective practice

Skill	When learners are ...
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	using estimation and calculation to plan screen layouts using estimation and calculation to work out timings for editing of feedback by sound or video clips for integration into their product
Identify the situation or problem and the mathematical methods needed to tackle it	
Select and apply a range of skills to find solutions	
Use appropriate checking procedures and evaluate their effectiveness at each stage	
Interpret and communicate solutions to practical problems in familiar and unfamiliar routine contexts and situations	
Draw conclusions and provide mathematical justifications	
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 a game specification
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	studying game manuals to research interface design for games
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	producing their report documents, ideas, notes, production documentation, test reports, and reflective commentary.