Unit **2**: **3D Modelling**

Level: 3

Unit type: Optional

Guided learning hours: 60

Unit in brief

Learners will examine the practical application and geometric theory of 3D modelling, and how it supports the design and development of 3D models used in different industries.

Unit introduction

3D modelling is the art of creating characters and objects for 3D models, including life forms, scenery, vegetation, furniture, and vehicles. - s

As a 3D modelling artist you will need to understand and acquire practical skills in using technologies that will enable you to design and develop realistic 3D models. This unit will prepare you with the knowledge, confidence and skills needed to become a creative computing professional either directly through employment or an apprenticeship scheme or to support continuing studies within further and higher education. This unit would complement many of the other creative computing and software development units available in this qualification.

In this unit you will investigate the application of 3D modelling in a range of industries and determine how the technology is currently being used. You will undertake research into geometric theory, and you will apply practical skills in designing and developing your own 3D models. You will use specialist software and hardware technologies to portray the 3D models as realistically as possible in an efficient and effective way. An insight will be gained into how rendered 3D models are displayed on a computer screen. Finally, you will plan and monitor your own skills, knowledge and behaviours against the development of 3D models and demonstrate how this will inform future personal and professional development.

Learning aims

The aims of this unit are to:

AExamine the application of 3D modelling used in industries

BDesign 3D models to meet client requirements

CDevelop 3D models to meet client requirements

DReview the development of 3D models.

Unit Summary

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| Learning Aim | Key teaching areas | Suggested summary of assessment evidence |
| AExamine the application of 3D modelling used in industries. | A1 Applications of 3D modelling in industries  A2 Geometric theory  A3 3D modelling development technologies. | A mini website providing information focussing on the application of 3D modelling used in industries along with geometric theory and 3D modelling development technologies. |
| BDesign 3D models to meet client requirements. | B1 Computational thinking skills  B2 Principles of mathematics  B3 Schematic design documentation | A practical activity involving designing, preparing schematics and creating 3D models following schematics. |
| CDevelop 3D models to meet client requirements. | C1 Principles of 3D modelling  C2 Developing 3D models  C3 Testing 3D models  C4 Reviewing 3D models  C5 Quality characteristics |
| DReview the development of 3D models. | D1 Review the development processes and outcomes  D2 Presentation skills  D3 Reviewing own skills, knowledge and behaviours development | A report focussing on what went well and what did not go so well when developing 3D models following schematics.  The report should show a good understanding of the fundamental development processes of 3D modelling including potential improvement in design. |

Learning aims and unit content

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| Learning aim A: Examine the application of 3D modelling used in industries |
| **A1 Applications of 3D modelling in industries**  Applications of 3D modelling, including:   * media, aerospace, automotive architecture and construction, urban design and landscape, pharmaceutical * disaster management, environmental impact modelling, 3D cadastre, demographics, models, product design, animations, TV, film, games, education * displaying 3D polygon animations * application programming interface to include Direct 3D and openGL * graphics pipeline including modelling, lighting, viewing, projection, clipping, scan conversion, texturing and shading, display * rendering techniques to include radiosity and ray tracing * rendering engines including distributed rendering techniques, lighting, textures, fogging, shadowing, vertex, pixel shaders and level of detail.   **A2 Geometric theory**  Geometric theory to design 3D models including vertices, lines, curves, edge, polygons, element, face and primitives   * Meshes, e.g. wireframe, coordinate geometry * Two-dimensional and three-dimensional, surfaces, polygon-count, naming conventions, topology * Mesh construction including box modelling, extrusion modelling * Common primitives, e.g. cubes, pyramids, cylinders, spheres.   **A3 3D modelling development technologies**  Hardware, including:   * Computer systems with enhanced performance capabilities, e.g. processor, memory, storage, video cards * Monitors, scanners, digitisers, plotters, 3D printers   Software, including:   * 3D modelling software, e.g. 3D Studio Max, Lightwave 3D, Maya, Modo, Silo, ZBrush, AutoCAD, Cinema 4D, Softimage, XSI, Paint Shop Pro, GIMP, Paint.net * File formats, e.g. 3ds, .mb, .lwo, .C4d, .dxf, .obj, .blend, .u3d, .mesh, .XML * Plugins. |

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| Learning aim B: Design 3D models to meet client requirements |
| **B1 Computational thinking skills**  Application of computational thinking skills and following predefined processes to design and develop 3D models, including:   * Logical thinking * Algorithmic thinking * Optimal thinking.   **B2 Principles of mathematics**  Application of mathematical principles and processes to design and develop 3D models, e.g.:   * Algorithms (procedural modelling) * Boolean algebra * Coordinate geometry * Solids (3D shapes) * Topology.   **B3 Schematic design documentation**  Schematic documentation to include:   * requirements of the brief (audience, purpose and clients requirements) * research including:   + market research   + process planning * legal and ethical considerations, e.g. copyright, patents, registered designs, trademarks, British standards, European conformity, confidentiality, decorum, representation (race, gender, sexuality, religion) * ideas/prototypes including:   + brainstorming, sketches, scene setup, schematics   + pre-visualisation, e.g. concept drawings, storyboards, manufacturing plan, level diagrams, 2D and 3D architectural drawings   + key visual themes/aesthetics   + ergonomics   + anthropometrics   + virtual/physical   + error proofing * hardware, software and other resources required * test plans to test correctness, content and presentation * constraints, e.g. polygon count, image resolution, output size, file type, file size, rendering time. |

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| Learning aim C: Develop 3D models to meet client requirements |
| **C1 Principles of 3D modelling**  Application of 3D modelling principles and processes to develop 3D models including:   * 3D modelling design schematics * computational thinking skills and processes applied to 3D modelling * principles of mathematics applied to 3D modelling * prototyping and 3D model selection * 3D modelling tools and techniques to develop 3D models * Quality characteristics used to test and assess suitability of 3D models.   **C2 Developing 3D models**  Use 3D modelling tools and techniques to develop 3D models, e.g.:   * file management, e.g. loading, properties, merging, replacing, importing, saving, naming conventions and directory structure * viewpoint and controls, e.g. configuration, command panels * keyboard shortcuts * floating palettes, toolbars * interface customisation * drawing aids and units, e.g. layers, grids, snap * measurement units, e.g. mil, thou, mm, centimetre, inches * object naming conventions * geometric models and text, e.g. box, tube, plane, sphere, disc, cone, cylinder, pyramid, 3D text, topology * mesh building and editing, e.g. vertices (adding, editing, deleting), polygons (planar, non-planar), polygon count * modelling, e.g. layers, modification (move, rotate, sketch, deform) * organic modelling, e.g. sub-division surfaces, weight maps, level of detail * extensions, e.g. bevel, extrude, lathe, combine (Boolean, patch) * duplication, e.g. mirrors, array, clone * nurbs, e.g. relational modelling, curves, control vertices, UV coordinates, surfaces, extrudes, sweeps, skinning, trims, fillets, surface approximation * virtual camera concepts, e.g. lens length, field of vision (FOV) * focus and aperture, depth of field * cameras, e.g. creating a camera and/or camera view and their properties * conversion from real-world equivalents especially in light of digital photography and use of small sensors * lighting, e.g. ambient, distant, area, spot, point, linear, photometric, raytraced * volumetric, e.g. fog, mist * texturing, e.g. creating textures, loading, applying textures to objects, material editor, material modifiers, material types (bitmap, procedural, rigging) * rendering, e.g. scene (rendering controls, rendering options, output size and aspect ratio, safe frame, file type, file size, image resolution (adapted for TV, film, web, desktop, image formats, compression).   **C3 Testing 3D models**   * Test 3D models * Obtain feedback from others, e.g. effectiveness, presentation, performance and purpose * Make improvements and/or refinements to 3D models in response to testing and feedback from others.   **C4 Reviewing 3D models**  Reviewing the 3D models against:   * Quality of the 3D models * Fitness for audience and purpose * Suitability against the original requirements * Legal and ethical constraints * Technology constraints * Strengths and improvements.   **C5 Quality characteristics**  Sources of quality characteristics which can be measured suitably against 3D models. Examples include:   * Correctness * Content * Presentation. |

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| Learning aim D: Review the 3D modelling development processes. |
| **D1 Reviewing the development process and outcomes**  Sources of information, including prototype and finished 3D models, design schematics, client requirements, feedback from others  Review and evaluation of:   * Testing and measurement activities undertaken * Record keeping for 3D models in relation to design, development, testing and modifications * Client requirements and the extent to which these have been met * Feedback from (others/client) and outcomes of action taken * Use of context (e.g. locale, immersive) * Constraints e.g. time, copyright, device capabilities, technology constraints * Strengths and weaknesses of 3D models * Development omissions * Priority setting * Own time management and progress * Production skills, e.g. ideas generation, design schematics, modelling specification * Modelling and prototype processes * Alternative manufacturing techniques * Potential design and development improvements   **D2 Presentation skills**  Communication requirements:   * Media conventions and requirements to convey intended meaning, e.g. written (email, design documentation, recording documentation, reports, visual aids for presentation use, etc.); verbal communication requirements (one to one and group informal and formal situations) * Use of tone and language for verbal and written communications to convey intended meaning and make a positive and constructive impact on audience, e.g. positive and engaging tone, technical/ vocational language suitable for intended audience, avoidance of jargon etc. * Responding constructively to the contributions of others, e.g. supportive, managing contributions so all have the opportunity to contribute, responding to objections, managing expectation, resolving conflict, etc.   **D3 Reviewing own skills, knowledge and behaviours development**   * Planning, and recording opportunities for skills, knowledge and behaviours development including the setting of relevant targets with timescales, how and when feedback from others will be gathered. * Reviewing and responding to the outcomes of own skills, knowledge and behaviours development including the use of feedback from others. * Own behaviours and their impact on outcomes to include professionalism, etiquette, supportive of others, timely and appropriate leadership, accountability. * Evaluating targets set for skills, knowledge and behaviour development to obtain insights into own performance. |

Outline Programme of Suggested Assignments

These outlines are suitable for developing full assignments. Centres should refer to authorised assignment briefs when developing their own assignments.

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| Assignment 1: How 3D modelling is used  Learning Aim A: Examine the application of 3D modelling used in industries |
| **Description and Tasks**  Demonstrate an understanding of how 3D modelling is applied in industries and present findings as a mini website which will include a slideshow and report. Tasks are to:   * Carry out research into how 3D modelling is applied in industries and present findings in the mini website * Produce a report to explain how geometric theory can be applied to 3D modelling supported by examples * Carry out research into 3D modelling development technology and present findings in a slideshow supported with screenshots |
| **Retake opportunity**  Similar tasks possible covering elements not included from the content |

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| Assignment 2: Developing 3D models  Learning Aim B,C,D: Design, Develop 3D models to meet client requirements and review the development of 3D models |
| **Description and Tasks**  Demonstrate practical skills when designing and developing 3D models to meet client requirements. Review and reflect on the practical activity. Prepare a report to explain what went well and what did not go so well when developing the 3D models including feedback consideration and improvements. Tasks are to:   * Produce planning and monitoring documentation for the 3D models that reflects computational thinking along with the principles of mathematics * Produce schematic design documentation for the 3D models to meet client requirements * Develop 3D models to meet client requirements matching designs * Review and reflect on the development process of 3D models considering sources of information along with constraints findings to be presented in a report * Review and reflect on the strengths and weaknesses of the 3D models including feedback and outcome of action taken to improve the 3D models findings presented in a report * Review and reflect on the knowledge and skills developed, including time management along with approach throughout the development of 3D models * Produce a professional report that explains the development process of the 3D models including planning and presentation skills |
| **Retake opportunity**  Similar tasks possible covering elements not included from the content |

Assessment criteria

To pass this unit, learners need to demonstrate that they can meet all the learning aims for the unit. The assessment criteria determine the standard required to achieve the unit.

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| Pass | Merit | Distinction |
| Learning aim A: Examine the application of 3D modelling used in industries | |  |
| **AP1** Explain how 3D modelling is used across different industries. | **AM1** Discuss how geometric theory is applied to 3D modelling and their limitations when used across different industries. | **AD1** Evaluate how geometric theory is applied to contrasting 3D modelling and their limitations when used across different industries. |
| **AP2** Explain how geometric theory is applied to 3D modelling. |
| Learning aim B: Design 3D models to meet client requirements | |  |
| **BP3** Produce designs for 3D models showing how computational thinking skills and the principles of mathematics have been applied. | **BM2** Justify design decisions explaining how the final 3D models design will fulfil its purpose and requirements, the principles of 3D modelling and any technical and design constraints. | **SD2** Evaluate the final 3D models including refinements made as a result of 3D modelling optimisation, geometric theory, feedback from others, principles of 3D modelling and any technical and design constraints. |
| **BP4** Review the 3D models designs with the client and intended audience to inform final decisions and any refinements required. |
| Learning aim C: Develop 3D models to meet client requirements | |
| **CP5** Produce 3D models to meet the design, ensuring that the product is fully tested. | **CM3** Optimise the 3D models considering enhanced features, quality characteristics, geometric theory, testing and feedback from others. |
| **CP6** Review the 3D models with the client and intended audience to inform improvements. |
| Learning aim D: Review the development of 3D models | |  |
| **DP7** Describe the development process and outcomes to identify where improvement in own behaviours and computing skills is required | **DM4** Discuss the development process and outcomes demonstrating the contribution of own behaviours and computing skills to identify personal development requirements | **UD3** Evaluate the development process and outcomes, reflecting on the contribution of own behaviours and computing skills to plan and prioritise personal performance development requirements |

Teacher guidance

Resources

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Assessment Guidance

**This unit is assessed internally by the centre and externally verified by Pearson.**

**Please read this guidance in conjunction with Section [TBC] Internal assessment. Some items not to forget from the original assessment criteria include:**

Learning aim A: Examine the application of 3D modelling used in industries

For AD1: learners must produce a report that evaluates how geometric theory is applied to contrasting 3D models and the limitation when used across different industries with particular focus on box modelling, polygon-count, coordinate geometry including solids (3D shapes), Boolean algebra, algorithms (procedural modelling)

For AM1: learners will have produced a report that discusses how geometric theory is applied to contrasting 3D models and the limitation when used across different industries with particular focus on box modelling, polygon-count, coordinate geometry. Learners will also produce a slideshow to explain 3D development technology looking at the hardware and software used to develop complex 3D models

For AP2: learners will produce a report that explains how geometric theory is applied to 3D models with focus on at least 1 aspect of mesh construction and coordinate geometry

For AP1: learners will produce a mini website that provides information on the application of 3D modelling used in at least 3 industries such as automotive, pharmaceutical, media including screenshots

Learning aim B: Design 3D models to meet client requirements

For SD2: learners will produce a report that evaluates the final 3D models showing annotated screenshot examples of refinements made as a result of 3D modelling optimisation, geometric theory, principles of 3D modelling. The report will also evaluate feedback from others including any technical and design constraints.

For BM2: learners will produce a report that justifies the design decisions explaining how the final 3D models design will fulfil its purpose and requirements, the principles of 3D modelling and any technical design constraints. The report will draw reference to how the client requirement was met, record keeping for the 3D models in particular designs development, testing and modification. Feedback, constraints, time management, potential improvements along with strengths and weakness of the 3D models designs

For BP4: learners will produce a report that reviews the 3D models designs with the client and intended audience to inform final decisions and any refinements required. The report will consider as a minimum the fitness for audience and purpose, legal and ethical issues, strengths and weaknesses including improvements, suitability against original requirements.

For BP3: learners must produce schematics of the 3D models to include annotated drawings to reflect computational and optimal thinking skills in particular sources of inspiration and creativity, storyboards, scene setup, concept drawing, key visual theme. At least 2 principles of mathematics such as coordinate geometry, solids (3D shapes)

Learning aim C: Develop 3D models to meet client requirements

For CM3: learners must provide evidence to support improving the 3D models to include geometric models and text, mesh building, conversion from real-world equivalents, rendering, texturing

For CP6: learners will produce evidence of reviewing 3D models with client and intended audience to inform improvement including feedback on effectiveness, presentation, performance and purpose

For CP5: learners will use appropriate hardware and software to develop the 3D models to meet client requirements and design. The evidence produced will include schematics, screen prints to demonstrate use of the tools along with the application of the principles of mathematics, a detailed test plan, evidence to support monitoring of progress throughout the development of the 3D models.

Learning aim D: Review the development of 3D models

For UD3: learners will produce a report which evaluates the 3D models developed looking at improvements stemming from the feedback received. The report will determine the strengths and weaknesses of the 3D models and the development process undertaken throughout including their own behaviour. Planning and recording will be addressed in the report along with constraints

For DM4: the report will provide evidence of reflecting on the feedback received and how the client requirements has been met along with constraints, strengths and weaknesses of the 3D models including the approach taken, computing skills and knowledge developed.

For DP7: the learner will produce evidence that shows some reflection on meeting the client requirements along with consideration of the feedback received, evidence of the test results will be addressed along with outcomes. Learners will also identify where computing skills require further development including own behaviour

Links to other units

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