

Assessment Feedback Sheet

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| **Overall Assessment Grade Achieved** |  |

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| **Learner Name** | |  | | | |
| **Assessor Name** | |  | | | |
| **Qualification Title** | | BTEC - L3 IT Extended Diploma in Computing | | | |
| **Unit/Module No./Title** | | Unit 14 – Computer Game Design | | | |
| **Assignment No./Title** | | 14.1 – Investigate technologies used in Computer Gaming | | | |
| **Learning Aim(s)** | | A: Investigate technologies used in computer gaming | | | |
| **Issue Date** |  | **Planned Submission Date** |  | **Actual Submission Date** |  |

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| First/Second Submission | | |
| Criteria | Criteria Achieved | Assessor’s Feedback *Your feedback should include:*   * *What the learner has done well. (Knowledge, skills, etc.)* * *What the learner has not achieved and what was missing.* * *Information or guidance available to the learner they could have drawn on (e.g. class notes; handouts; resources in assignment brief etc.)* |
| **P1:**  Explain social and technological trends of computer games. |  |  |
| **P2:**  Explain how current and emerging technologies impact computer games’ design and development. |  |  |
| **M1:**  Discuss how current and emerging technologies impact on how games are designed and developed to meet the requirements of the users and the larger computer games industry. |  |  |
| **D1:**  Evaluate the impact of current and emerging technologies on the design and development of computer games to meet the requirements of the users and the computer games industry. |  |  |
| **BTEC Rules**  All resubmissions must be authorised by the **Lead Internal Verifier**. Only **one** resubmission is possible per assignment, providing:   * The learner has met initial deadlines set in the assignment, or has met an agreed deadline extension. * The tutor considers that the learner will be able to provide improved evidence without further guidance. * Evidence submitted for assessment has been authenticated and accompanied by a signed and dated declaration of authenticity by the learner.   Any resubmission evidence **must** be submitted within 10 working days of receipt of results of assessment (BTEC only) | | |
| **Wider Skills (Linked to Positive Futures)** *Comment on the quality of the learner work, the learner’s process and practice during assessment, research skills, presentation, general behaviour and conduct, meeting deadlines, etc.* | | |
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| Assessor Declaration | *I certify that, to the best of my knowledge, the evidence submitted for this assignment/assessment is the learner’s own. I understand that false declaration is a form of malpractice.* | | |
| Assessor Signature: |  | Date: |  |
| Learner Declaration | *I certify that the evidence submitted for this assignment/assessment is my own. I have clearly referenced any sources used in the work. I understand that false declaration is a form of malpractice.* | | |
| Learner Signature: |  | Date: |  |

**Learner Actions**

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| Learner’s Targets/Actions  *What needs to be developed to improve future work?* | *Actions linked to the following Positive Futures outcomes* |
|  | Confidence  Commitment  Collaboration  Resilience |

**Task 1**

**Explain** social and technological trends, emerging technologies and how they impact game development.

**Explain** how current and emerging technologies impact computer games’ design and development.

Some of the up and coming technologies that will impact game development in the near future are unreal engine 5’s lumen and nanite.

The goal of these is to aid game developers in making their games render better and have better visual quality.

Nanite technology (Nanite virtualized micro-polygon geometry) renders super realistic images that are indistinguishable from reality. Instead of having layered high and low poly-models nanite exclusively uses high poly-models, which means that amazing quality images can be rendered by importing millions of polygons directly into unreal engine from complex software like ZBrush.

Nanite geometry is streamed and scaled in real time without need for it to be pre-rendered, which removes the need for any costs for polygon memory, polygon counts, or draw counts; there is also no loss in quality during rendering or streaming and there is no need to bake details onto maps or manually change the level of detail.

Nanite is a revolutionary technology which will completely transform the gaming industry as we know it with its efficiency and maybe even the entertainment industry for animated movie companies such as Disney and Pixar. Games will soon have much better-quality graphics and will consequently have much higher recommended specs to run it.

Lumen technology is a completely dynamic way on portraying lighting in unreal engine 5, it is similar to ray tracing in that it is a rendering technique that is used to generate an image by tracing light ray’s path and simulating its effect on the immediate environment, unlike raytracing lumen doesn’t have a need to wait for the lightmap bakes or manually author lightmap UV’s the redundancy of this step saves a lot of time.

With lumen simply moving a light source or creating an object to obstruct the light and form a shadow can completely change the way a scene appears as all the lighting, direct or indirect will change accordingly. The reflections of light can bounce and affect large environments that span multiple kilometres.

This will affect games in the future as with better lighting effects the games will be more immersive and realistic, causing beautiful picturesque landscapes that are impossible to see in the real world to materialise before your very eyes, such as floating islands or upside down volcanoes in fantasy games; large technological empires in sci-fi; ancient undiscovered ruins in historical games.

VR can also be more realistic from this; virtual reality as a whole can grant ‘hyperreal’ experiences that are indistinguishable from reality if it is improved from its current state of only replicating the senses of sight and sound.

In the Science and Medicine fields they are experimenting with potentially using VR as method to re-teach paraplegic people how to walk again with prosthetic limbs, this is just one potential outcome for VR and so far we have barely scratched the surface of its possibilities.

The ‘Oculus Rift’ was one of the first mainstream VR headsets, it shows a video or game and allows you to interact with it by turning your head rather than using a cursor. Over the years VR technology has gotten increasingly more realistic and soon there may be a time where it is nigh indistinguishable from real life, and they may be close to replicating the other senses of touch, taste and smell.

‘Hyperreality’ is where you are in a real life space such as a warehouse or a paintball range and you use VR that correlates to the room so you jumping over a physical blank wall could be seen in your eyes as a large castle so you can manoeuvre around by running, jumping and ducking and maybe even grabbing an object and touching it if that object doubles as a controller like a gun controller for the Nintendo Wii.

This brings me to talk about the concept of full dive VR where your body is put into a temporary state of paralysis whilst your consciousness is inside of the game, but this is only a rough idea with no proof if it will be possible.

Two things that is holding VR back from expanding are the rather expensive costs of VR headsets and the high-end computers needed to run VR games, as well as the large size and hefty weight of them being half a kilogram. Whilst that doesn’t sound like much, having that weight strapped to your head while you are actively moving around and turning can tire you out pretty fast. So, to make VR more widespread producers could aim to reduce the size, weight and cost of VR headsets and the specifications of VR games by optimising them better.

This would push companies that engage in VR headsets to improve their hardware and push the companies that create VR games to improve their software by optimising it and making it have more immersion.

Augmented reality is the so called ‘Younger sibling of VR’. AR isn’t confined to any kind of screen; AR games grant a unique outlook on games such as Pokémon go. You can manoeuvre thorough real-world areas and apply the games objectives to real life. For example, in Pokémon go you could see a Pokémon on your phone screen that was displayed in front of you.

You could play air hockey on any tables you come across at home or on the go, or solve puzzles formed from multiple buildings that have been misplaced. AR technology could even potentially be enhanced with hologram technology, currently hologram technology can only show on surfaces that utilise the correct tech but in the future you may be able to cast a hologram onto any surface you come across via lasers.

As AR currently utilises the rear facing smartphone camera to overlay the game with the real world, if these games gain more traction cameras could potentially be advanced as a much faster pace due to companies competing to see who can come out with the best AR experience.

Improved artificial intelligence technology in games will help to make enemies and NPC’s more realistic and unpredictable, AI has come a long way recently coming from the simple goombas in Super Mario that are only capable of walking in a singular line and doing damage to the player if they are to come into physical contact with him, to enemies in halo 2 that work together to attack the player in battle formations and maybe in the future we will see truly sentient characters in games that can make real time impacts on the world as humans can do in real life.

An example of this would be an intelligent NPC could shirk his duties of helping the player and instead murder any players he sees due to his grudge against a player he met previously; this Rogue AI could go against all pre-programmed paths for it to follow and make its own path.

“You can try and build a really cool, comprehensive AI system which is about letting a character behave in all kinds of ways the designer hasn’t anticipated,” Mitu Khandaker, Ph.D. an assistant arts professor at New York University’s Game Center said. “But if there’s too much of that, there’s no guarantee about which way the story will go and whether it’s going to be any fun.” - https://builtin.com/media-gaming/future-of-gaming

This kind of thinking can potentially create a role-playing game where not only the players but also the sentient races inside the game can have impacts on the game as a whole; a self-learning AI could potentially learn from players that they are not real and begin to question their existence as shown in many sci-fi movies.

This development in AI technology can usher in a new age of robotics where they can take over most human roles and in the gaming industry, they can create hyperreal experiences.

Cloud gaming may be the future of most games, requiring a good internet connection may be a prerequisite to enjoy this type of gaming. Rather than games development companies creating games that require more expensive equipment, some developers are attempting to help out consumers by using the cloud to broadcast games. With this, there will be no issues about storage space as games will not be stored locally, similar to web browser games. Utilizing the cloud for gaming grants the opportunity to have even larger server sizes that can hold massive amounts of players.

The game will be run on a different system and will be broadcasted to your screen so your computers specifications will not matter as there will not be any so called ‘lowest specifications to run the game’. As there is no bottom line for this, games could even be run on Chromebooks or age-old devices that have been outdated for a long time.

An example of this is Google’s Stadia, they say ‘Play instantly with one click You choose the screens where your games live. Play on [compatible](https://support.google.com/stadia/answer/9578631) laptops, desktops, phones, and tablets. It’s up to you. And to play on TVs’ this is a cloud gaming platform that spans multiple devices and can be accessed nearly anywhere at any time, opening up a whole new world in terms of portability and consumer satisfaction. - google stadia website

It is said to be capable of streaming games to your devices at and below a resolution of 4K and a frame rate of 60 frames per second which can make your gaming experience more than satisfactory and will not hinder you at all.

As I stated earlier however having a good connection to the cloud may be a prerequisite and lack of this could stop you from playing games in the case of your Wi-Fi going down.

This can change gaming by making specifications irrelevant to run games and as such less people will bother paying for expensive high-end pc’s.

**Task 2**

**Discuss** and **Evaluate** the impact of current and emerging technologies on the design and development of computer games to meet user and industry requirements.

Ray tracing > ambient occlusion – Ambient occlusion is a shading and rendering technique used to give all materials properties (whether they absorb or reflect light) and uses algorithms to calculate how different areas in a scene reacts to the ambient lighting in the surroundings to create the perfect lighting for your virtual environment, raytracing does this automatically and as such it saves you time and effort, boosting your efficiency in doing your work. Ambient occlusion can also soften the overall lighting in your scene if it's too bright.

It has 4 types, Regular AO, HBAO (Horizon Based Ambient Occlusion) which is also called HDAO depending on whether you use AMD or Nvidia, SSAO (Screen Space Ambient Occlusion) and VXAO (Voxel Accelerated Ambient Occlusion).

AO uses shapes to determine the space in between different lightings and uses shading to make the whole scene look better by using some shadows and the glint of the sun off of reflective surfaces to add a touch of realism to an otherwise flat, lifeless scene.

SSAO is a good alternative to regular ambient occlusion for older PC’s with low CPU power as instead of using shapes to determine the space in between different lightings it makes use of sleight of hand with pixel depth to give off the appearance of lighting changes.

It does not make use of the CPU so there will be less lag compared to regular ambient occlusion. It also looks better compared to it. Game developers may enjoy the fact that SSAO does not have any load times which results in smoother gameplay, for simple games this is a, good viable counterpart to regular AO.  
  
HBAO and its AMD counterpart HDAO are the same thing, it is basically an all-around upgrade from SSAO and is better in all aspects. It renders the different samples of darkened areas in full resolutions, giving multiple shades to shadows and making them look more realistic. Shadows even appear in places that they do not in SSAO such as corners and plants, giving the game a touch more realism.

This is harder to run than SSAO and requires a decent computer to use without low frame rates.

VXAO is the best in quality out of the different types of ambient occlusion, as such it is the hardest to run. Unlike the previously explained versions of ambient occlusion it renders in objects that are in the background and not even in the scene that you are currently viewing. This makes the environment look realistic.

It does not have the standard issues that most ambient occlusion types have such as unstable results around the borders of the screen, blurriness, locality, lack of occlusion around the objects in the foreground and dark halos due to that.

This is because it does not rely on screen space data and instead on a voxel representation of the surrounding environment, which is why it doesn’t matter where objects are in relation to the camera.

- https://www.gamedesigning.org/learn/ambient-occlusion/

Ray tracing is a rendering technique that generates images via tracing the path of any light sources and simulating their effects on the surrounding areas and objects. Unlike ambient occlusion ray tracing has actual moving shadows depending on the light source and not just darkened corners and grooves that appear to have shadows.

Ray tracing uses virtual light sources and simulates the path that the rays of light will take as well as calculating how each object will reflect, refract or absorb light rays. This shows a much more lifelike scene of how light interacts in real life environments. It attempts to perfectly recreate lighting and make it behave as it does in real life by using calculations and algorithms to ‘trace the path that a beam of light would take in the physical world’, by doing this it results in an environment almost indistinguishable from reality.

Ray tracing, if done in real time is very taxing on your hardware, specifically your GPU. Nvidia says ‘Ray tracing is essentially following the light beams ‘from your eye to the objects that light interacts with’. It isn't just a slight tweak to graphics which results in a small change in the surrounding shadows, it actually changes the entire environment and can fundamentally change how you interact and play with the virtual world. - https://www.tomsguide.com/us/what-is-ray-tracing,news-27880.html?cv=1

One of the downsides of ray tracing is the large cost of hardware that is required to run it as it is very CPU and GPU intensive, the RTX 20 series is recommended as a minimum to game with Realtime ray tracing, these cards cost a lot for example the RTX 2080 costs £700 as of 23/09/2020. - Nvidia website

It also forms reflections in real time, if you looked into a mirror in a game without ray tracing the game would pre-render it or use tricks such as rendering a completely identical room on the other side of it to create an optical illusion that looks like a reflection, but with real time ray tracing this is not needed.

Shadows formed by moving light sources such as the sun at different times of the day or a flickering candlelight, as of now the games will look much better for the developers and the few consumers that have good enough hardware to render it. But soon enough when there is broader hardware support for ray tracing more people will be able to enjoy it.

Unreal engine’s Lumen technology is a form of ray tracing that reflects lighting off of different materials depending on how reflective they are, and some areas will be darker as they naturally should be.

Ray Tracing is superior for higher-end equipment and will significantly affect Games development and animation in the long run by permitting games developers, graphics designers, animators and editors to create more realistic light reflections, shadows, lights and less visible blocky tessellation.

Ray tracing is utilized when creating images and videos that are animated or CGI, but that is only a feasible option because studios can utilise the processing power an entire server farm for their rendering needs or they could use cloud computing servers to render the graphics. But doing this is no small feat and would be incredibly taxing on the hardware. Because of this doing it in real time with games is not feasible for existing hardware.

Games traditionally used something like ambient occlusion or an alternative where they use rasterization instead. These methods ‘convert the 3D graphics into 2D pixels to display on your screen’, however rasterization also requires heavy use of shaders to properly portray scenes with realistic lighting.

Currently only the newest GPU’s can do real-time ray tracing in games, but in the future, this won't be an issue as more powerful cards become commonplace and raytraced games become the norm. However, until then games will have to use ambient occlusion and rasterization.

- https://www.telcotalk.sg/gadget-news/what-is-ray-tracing-the-games-the-graphics-cards-and-everything-else-you-need-to-know?cv=1

-https://developer.nvidia.com/rtx/raytracing

The industry requirements for lighting technologies and shading / rendering techniques are the required hardware for users to use the techniques in their games, and the desires of the game developers and what they want to use the tech for.

For ray tracing you need a very good graphics card such as an RTX 20 series as it is a very new technology and is very GPU intensive. Whilst Ambient occlusion is not as new and does not have as high requirements for specs, some AO types can run off of only a CPU and others need a low-end GPU to run like VXAO.

The desires of the developers using these technologies is to grant the best possible experience to the player or viewer with their shading to make the most visually appealing scenes and environments. The developers must also think about the possibility that users would not have a good enough pc to play at high settings so there should be an option to use lower settings to still have a decent gaming experience, because no matter how good your game looks if there is lots of frame drops and lag it will not be an enjoyable experience.

The industry standard at the moment is ambient occlusion as of right now as it is a more feasible option for most computers and it is currently able to run on most computers. In the future as hardware improves the standard will shift over to raytracing, currently however this is not feasible aas the required tech is new and expensive.

Cloud computing > desktop computing - In cloud computing your data is stored on a remote server (the cloud), whereas in desktop computing your data is saved on a local storage drive inside of your computer.

Desktop computing is the normal thing that everyone uses on their devices unless they have a Chromebook. It consists of storing data on an USB, HDD or an SSD. A stock computer comes with the operating system stored on the local storage drive which is hardware.

Storing data on a local drive has both pros and cons compared to storing it on the cloud, one of these benefits is that you can access it much faster than the cloud and there is no chance of your data being stolen, lost or destroyed if the servers are hacked or they go down for maintenance.

You also have complete control over how your data is stored on your device, you can choose who has the specific permissions to access specific data and you can also use whatever security protocols you want to. Some people may feel more comfortable with this as you are not entrusting your data in the hands of an unknown person, and while there is the chance of your computer being hacked and data being stolen, the chance of a hacker targeting you specifically is much lower than the chance of hacker attempting to hack a large cloud hosting company like Microsoft for reasons such as publicity and infamy by publicly publishing people's private data and passwords.

One downside to storing data locally is that your data is not as accessible as cloud stored data as it is restricted to a single device and in the case that you lose that device, it is stolen or broken you will not be able to access your data. This also affects collaboration and usability for group works that have multiple people working on a single document as it is much easier if done on cloud.

Another downside of this is that you will have to pay a rather substantial sum of money to upgrade your storage as you need to buy a new piece of hardware and fit it into your device, some devices such as smartphones cannot be expanded or have a limit in the size of their micro SD card of 64GB of external storage only.

“Storing data locally on your hardware also exposes your data to physical threats. A physical threat is theft or damage of equipment, damage by accidents such as floods, fires or any other disasters including terrorist actions. This usually targets servers or backups and can be prevented or at least safe guarded against by keeping them secluded in a secure area with locked doors and pass codes guarded by trusted employees. Physical threats to computer systems are also sometimes caused by losing your secure credentials. This is not a physical threat in the sense of damaging your equipment, but it is the loss of a password and the related disclosure of sensitive data that puts your computer out of action. You can easily and safely reset a compromised password or even get a new one, but it's essential to keep a copy of the most recent password on hand to avoid a potential security breach in the future.” - my unit 7 work

Local backups of your data can be destroyed by disasters or accidents which is why large companies usually have an offsite server warehouse for storing the backups of their data, this is a fundamental element of a good disaster recovery plan.

Storing data on the cloud is storing it on a remote database, away from your physical computer, that you can access through the internet or an application such as OneDrive. It can span multiple servers or locations, and most of the times maintenance on it is done by the company that is hosting the server, for example Google for Google Drive and Microsoft for OneDrive.

Cloud computing gives a remote server that is off-site and is the answer for storage on all platforms.

The benefits of this are ease of access and data retrieval as you can access your data from virtually any modern device that has internet or mobile data connection, this allows for people to work at home and easily do group work or projects with teams more efficiently.

It also started the BYOD initiative; this is where you bring your own device to work or education to do your work and or research. It is the trend of employees using their own devices to connect to their organisations networks and systems to access work-related systems, and possibly delicate or secret data that the company may want to keep private. This raises the risk of data breaches and can have the risk of virus, spyware and ransomware from the employees' devices infiltrating work networks and potentially stealing data.

Some cloud storage apps are free such as OneDrive and Google Drive but other you are required to pay for if you want to access them and may have extra installments for giving you a higher amount of storage space the more money you pay. Some services may follow a pay as you go monthly plan and others may have a onetime large payment to permanently own a storage drive and a small payment for maintenance and security monthly.

Fun fact: 'businesses that switch to cloud computing can cut their energy consumption by up to 70%'.

“However regardless of which storage method you choose there is always the risk of external threats. An example of external threat is data theft (it is also possible for theft to be an inside job) and withholding of digital information for either political purposes, such as defamation or exposing someone’s crimes, or financial gains (to gain money through blackmail or stealing it). The data that is obtained by the attacker maybe sold to a third party or they may encrypt the data and sell the decryption key to the organisation it was taken from using ransomware ( the purpose of this is to lock them out of their data and force them to pay to open it), this can be protected against by locking it in a secure area to protect it from people who have malicious intent towards the company such as rivals or thieves. This is usually classed as cybercrime and is when someone on the inside tries to get into the system and use it as ransom or to obtain data. These can be protected against by having a firewall / antivirus software.” - my unit 7 work

Edge networks are used to stream all forms of media and TV. It can be used by having multiple servers in different locations so that customers can get the best connection based on their location, for example a gamer in the UK would use an EU server instead of an NA one. This gives the best possible user experience.

Both cloud and desktop storage have their pros and cons as I have explained, quite a lot of businesses nowadays choose to use cloud storage as it is easy to maintain and share files between different employees.

Some businesses even use a hybrid storage that uses both on-site local storage and off-site cloud storage, this is done by doing work on local storage then backing it up to the cloud for extra security. This gives you the benefits of both, fast speed and control over your data that local storage gives you as well as the increased accessibility for collaboration and sharing files.

In conclusion, storing data on the cloud is better if your data is not private and needs to be shared with others to be edited or read.

Cloud gaming requires a good internet connection as it is needed to view the ‘streamed’ game from your device. As games are stored and played from the cloud there is no need for storage space in your local drives or any need for expensive hardware. Utilizing the cloud for gaming grants the opportunity to have even larger server sizes that can hold massive amounts of players.

The game will be run on a different system and will be broadcasted to your screen so your computers specifications will not matter as there will not be any so called ‘lowest specifications to run the game’. As there is no bottom line for this, games could even be run on Chromebooks or age-old devices that have been outdated for a long time.

This can change gaming by removing the need for powerful pc’s as not all consumers have the required funds to buy these. If cloud gaming gets better and more mainstream developers may make games specifically for it that have larger servers and higher specs as they know that it won't restrict the gamers computer, this may also cause people to buy better internet connections to play games better.

Local gaming requires a good computer for high end games and a decent internet connection too if you want to play online with others.

Gaming from your computer instead of over a cloud server will have significantly less input lag / latency so this will be the definite choice for competitive gaming and tournaments. The reason for this delay is that the input from your mouse and keyboard is sent from your computer over the cloud network to the pc that the game is being played on and streamed from, to the game servers, then the video is sent back to you over the cloud in real time. Local gaming is definitely better if you have bad internet connection or it goes down a lot as then you will be able to play some offline games to pass the time.

Google stadia uses a DNS server to circumvent this problem and skips these steps, providing a fast connection to your games and fast response virtually the same as local gaming with little to no latency.

However, you will have to perform maintenance on your computer if something goes wrong with your hardware, there is also the need to upgrade your computer when a new game with higher specs comes out, this is not a problem with cloud gaming as there is a lower chance of the computers running into problems and if, by chance, they do run into problems you can stream from another cloud computer while the broken one is being fixed by the hosting company.

You can also stream from your pc to a different device like your smartphone, similar to how cloud gaming works except there is no cloud network and your pc is doing all the hard work.

The industry requirements for cloud computing and desktop computing is the required hardware for users to run apps and games on their desktop pc’s, and the desires of the app developers and what they want to use the tech for.

For cloud computing you need a very good internet connection as it is all online and if you lose your connection you will not be able to access any apps. Whilst desktop computing is not as new and does not have such a requirement, as it is more local and can even be used offline.

The desires of the developers using these technologies is to grant the best possible experience to the use when they do any work or watch videos or play games for entertainment. The developers know that what the users want the most is an enjoyable gaming experience; this can be done easily on both cloud and desktop computing but on desktop computing you are limited by your hardware and most people do not have a very good computer that can run the best games at max settings, but for cloud computing you don’t need that and you can play any games at maximum settings from any device regardless of its hardware as long as you have an internet connection.

The industry standard at the moment is desktop computing as of right now as it is a more feasible option for most computers and has been for a long time as cloud computing is still fairly new. In the future as the standards of internet connections improves the standard may shift over to cloud computing, but it also may stay the same as there are security issues with cloud computing and it is not as reliable as localised computing; using cloud computing is easier and more accessible but it trades security for that feature.