Bachelor's thesis

Information technology

NTIETS12P

2017

Miika Perkola

BEST PRACTICES OF LEVEL DESIGN

TURKU AMK
TURKU UNIVERSITY OF APPLIED SCIENCES

BACHELOR'S THESIS | ABSTRACT

TURKU UNIVERSITY OF APPLIED SCIENCES

Information Technology | Game Technology

2017 | 32

senior teacher & professor Mika Luimula

Miika Perkola

BEST PRACTICES OF LEVEL DESIGN

The thesis was commissioned by Rockodile Games that is a Finnish game development company. The purpose of this thesis was to research what level design is and what the best practices are that the commissioning company could use in their future projects. The gathered knowledge is then applied into analyzing the commissioning company's existing product in order to achieve a complete picture on what level design is. The thesis introduces basic level design including the design process and level production.

The thesis examines level design and level designers in general and establishes some of the tools level designers have at their disposal. It also covers the topic of design process and presents all the steps needed to shape an idea into a solid plan that can be executed later. Later the thesis covers the topic of level production with a focus on different level editors. The concluding section examines all the topics that were researched in the thesis using an existing product.

KEYWORDS:

level design, level editor, designer, player guiding

OPINNÄYTETYÖ (AMK) | TIIVISTELMÄ

TURUN AMMATTIKORKEAKOULU

Tietotekniikka | Peliteknologia

2017 | 32

yliopettaja & dosentti Mika Luimula

Miika Perkola

KENTTÄSUUNNITTELUN HYVÄKSI TODETUT TOIMINTATAVAT

Kenttäsuunnittelu on prosessi, jolla valmistetaan kenttiä, tasoja ja peliympäristöjä peleihin. Tämän opinnäytetyön tarkoitus oli tutkia, mitä kenttäsuunnittelu on ja mitkä ovat kenttäsuunnittelun hyväksi todettuja toimintatapoja, joita yritys pystyisi hyödyntämään tulevissa projekteissaan.

Työssä kerättiin tietoa kenttäsuunnittelusta ja analysoitiin jo olemassa olevaa tuotetta kerättyjä tietoja käyttäen. Näin saatiin kattava kuva siitä, mitä kenttäsuunnittelu on. Opinnäytetyössä tutkittiin kenttäsuunnitteluun liittyviä perusasioita sekä suunnitteluprosessia ja kenttien tuotantoa. Suunnitteluprosessissa pitää huomioida erityisesti oman kehitystiimin vahvuudet ja työskentelytavat. Aineistona käytettiin kenttäsuunnittelu-alan ammattilaisten kirjoituksia ja tutkimuksia.

Opinnäytetyössä käsiteltiin kenttäsuunnittelua ja kenttäsuunnittelijoita yleisesti, sekä selvitettiin, mitä työkaluja kenttäsuunnittelijoilla on käytössään. Työssä tutkittiin myös suunnitteluprosessi ja siinä kaikki tarvittavat vaiheet, jotta ideoista voidaan muodostaa vahva suunnitelma. Tavoitteena oli saada aikaan suunnitelurunko, jota voidaan hyödyntää myöhemmin. Työssä käsiteltiin myös kenttätuotantoa keskittyen eri kentänmuokkaustyökaluihin sekä käytiin läpi kaikkia edellä käsiteltyjä tietoja hyväksikäyttäen jo olemassa olevan tuotteen kenttäsuunnittelua ja kenttien tuotantoa.

Opinnäytetyö antaa kattavan kuvan kenttäsuunnittelusta ja listaa hyväksi todettuja toimintatapoja myöhempää käyttöä varten. Työn tuloksena saatiin kattava suunnitteluprosessi ja listaus hyväksi todetuista toimintatavoista. Opinnäytetyö tehtiin suomalaiselle Rockodile Games peliyritykselle.

ASIASANAT:

Kenttäsuunnittelu, kenttäeditori, suunnittelija, pelaajan ohjaus

CONTENT

PICTURES

LIST OF ABBREVIATIONS (OR) SYMBOLS

AI	Artificial intelligence
Contrast	The difference in color and light between parts of an image
Focal Point	Point of interest that catches the viewers eye

1 INTRODUCTION

The thesis was done for a Finnish game development company called Rockodile Games. The aim of this thesis is to research the topic of level design as a whole. The final part of the thesis uses the researched topics to examine an existing product to better understand level design. The thesis gathers basic knowledge on 3 major topics in level design. Included in the thesis there is also a list that gathers all the best practices that were researched during the thesis process. This is done to make the results of the thesis more tangible and easier to use when looking at new game development projects.

The first topic discusses what level design is and what level designers do. It also talks about 4 major level design principles:

- Composition
- Positioning
- Balance
- Contrast

Second topic takes a complete look at the design process to establish what is needed at each step of the way when forming an idea into a solid plan for production. Starting with the idea and then moving on to making it a design. Making a coherent overarching design document helps the whole team to communicate better and it ensures that all of the levels feel like the belong in the same game even though different designers would have made them.

Once a design base is made research takes over. Researching the key topics that your game utilizes is key in transporting feeling to the player. If your game takes place in 1920s you need to make sure to pick elements into it that give the player the right mindset. This is where the designers look for references where ever they can and see what the selected themes can bring into the level.

Next step is level history and it is term used to describe what the player can gather from the levels past when looking at it. This is more prevalent in certain genres like horror games but is still important in other genres as well. When a player walks into an abandoned hospital that has had its fair share of bloodshed it should be visible when walking around the hospital without the need to explain it with narrative.

Moving on to player guiding where the designer decides what are the different interest points the player needs to find or see and where he should walk to. There are a number of tools that can be used to guide the player. Finally, all the information is gathered into a top down layout that could be shared within the development team so that everyone can be on the same page when producing content for the level.

Level production is a large topic but in this thesis the focus is on different level editors and what are the differences for designers. It also includes a comparative chart which shows what aspects are done the best in which engines level editor. The final topic examines an existing product via 3 different angles: design, editor and production and what are level designs best practices and at what stages of a game development project are decision made regarding level design.

2 LEVEL DESIGN

Level design is the art and process of making levels, missions, maps, game environments or any space where the player of the game is interacting with the game world. (Shahrani, S. 2006.)

The difficulty in level design varies greatly but the biggest difference is seen when comparing 3D and 2D games. In 3D games level design is a lot harder due to the fact that there is an additional dimension to keep in mind. (Shahrani, S. 2006.)

2.1 Level designer

Level designer can freely modify his virtual environment with anything he wants. This is what differentiates level designers from a lot of other artists like landscape photographers. Level designer doesn't need to adapt to any existing elements but can instead modify everything to be the way he wants. (Piaskiewicz, M. 2015.)

Being able to modify everything allows for extreme precision when crafting experiences for the players but it is also a pitfall for level designers. Finding the balance in a scene and knowing when to stop tweaking is crucial especially in the games industry where timelines are strict. The key is to find the points that require most attention and focus during a project and allow yourself to make faster decisions with less iterations on the less meaningful parts. (Barchan, S. 2013.)

2.2 Composition

One of the basic concepts in level design is composition. Composition is a term used to describe the overall appeal in a piece of art. In game design composition includes everything to do with what and how and when the player will see and experience various parts of the game. (Gunson, L. 2013.)

Picture 1. Beautifully done composition in an adventure game. (Miozzi, CJ. 2011.)

Compositions can be broken into 3 scenarios. These scenarios are meant for the designers to better find the important parts in a game and to allow them to craft different areas individually. If there is a problem in a level the designers can assess which composition scenario could the problem lie in and focus on it specifically. (Piaskiewicz, M. 2015.)

2.2.1 Environment composition

Environment composition deals with the big picture. Every area that the player will move and play in and what he can see but can't go to. Backgrounds or far away mountains are a lot easier to make since they are often only viewed from one angle but towns and rooms the player can walk into need to take into account the possible ways there are to look at the area. (Piaskiewicz, M. 2015.)

2.2.2 Environment elements

Environment elements composition centers around the objects and details found inside levels. Designing with these elements takes a lot of time and effort. It takes a lot of time

to handcraft and entire office floor with books and coffee mugs. Details make a scene believable and help the player to immerse into a scene. (Piaskiewicz, M. 2015.)

2.2.3 Navigation composition

Navigation composition is used to make sure the player is guided properly. These assets allow designers to predict what a player might do and are an excellent way to tell the player where he should go next without ordering him to go somewhere. A typical way to use this is to highlight objects the player should interact with to guide him to otherwise small handles or levers that can be hard to see. (Piaskiewicz, M. 2015.)

2.3 Positioning

In level design, there are a lot of different aspects that the designers can potentially highlight. One way to do this is with positioning. Positioning is used mainly to showcase the dominant part of a scene. Positioning also affects what kind of a feeling the level is giving the player. With static positioning the dominant part is set in the middle of the scene. This creates the feeling of the scene being clean, synthetic and man-made. Asymmetric positioning has the dominant part on the side of the scene. This gives the impression of the scene being dirty, part of nature and organic. (Piaskiewicz, M. 2015.)

2.4 Balance

Balance determines how the pieces in your scene are placed to achieve a coherent picture for the player that is not too hectic nor too boring. To balance a scene, it is essential to be able to determine what the visual weight of each object is. Visual weight is something that can be felt when watching a scene. To be able to edit balance in a scene requires knowledge about the individual pieces. Comparing objects to one another is a great way to see which elements have a heavy visual weight and which have a light visual weight. (Bradley, S. 2015.)

There are a few simple key elements that help to recognize whether an object has a heavy or a light visual weight:

- Scale

- Amount of detail
- Color saturation
- Color intensity
- Contrast

Balance is mainly used to ensure that a game's levels have a unified complexity level and to make sure that the player sees all the dominant parts of a scene. Well done balance is achieved when the lower weight objects on the other side can counterweight the heavy visual weighted objects on the other side. (Piaskiewicz, M. 2015.)

2.5 Contrast

Contrast is used to guide the player. Player's attention gets always focused on anything unusual in a scene or something that in contrast to other parts of a level seem to be different. This effect is great when used correctly but the opposite is true for the effect also. A player usually doesn't try to find anything meaningful from a dark corner that looks like every other dark corner in the game. Lighting and color both are great for creating contrasts. (Bogdanov, V. 2014)

Picture 2. Campfire in a dark forest to create contrast. (Games Screens. 2014.)

When creating contrast with lighting and colors the overall theme and visual rules of the game should be kept close in mind. The goal is to create contrast within the game's overall lighting theme and color scheme. (Piaskiewicz, M. 2015.)

3 DESIGN PROCESS

3.1 Idea for a design

The design process start with an idea. You usually get ideas in two ways. One is the spontaneous way where the idea just comes to you wherever you may be at that moment. These ideas are valuable and should be written down on a phone or a notebook for later examination. (Galuzin, A. 2016.)

The other way is to deliberately think of an idea for a specific need. This usually involves searching for inspiration from movies, pictures, comics or other games. Regardless of the method the best way to make level design better is to make what inspires you. Even in jobs where the creative process is controlled by a lead artist for example. (Galuzin, A. 2016.)

3.2 Refining the design

The ideas could be anything and do not need to have a predefined setting, location or a theme. These need to be examined before going further in the design process. Typically, this is the stage where you would get help from your game design documents about where the level should take place. (Galuzin, A. 2016.)

Crucial things that need to be decided are the physical location of the level, what is the specific place in the location and what is the overall theme of the level. Example of a level designed like this has the location as Africa, the place in Africa is a river bed inside a jungle with a theme revolving around being alone and surviving in the mid-summer heat of the African jungle. (Jonkers, D. 2011.)

Knowing why you want to make a level is something to keep in mind. It helps the design to stay focused and improves the end result. Designing with the goal of making a multiplayer level is vastly different to making a story driven single player level. (Hoogland, D. 2012.)

When designing a level for a game keeping the key features of the game in mind will make the level fit the game. The underlying features should tie every level together and keep the experience unified throughout the game. Game features are also a great way

to seek additional details that make the game's levels feel unique to that game. (Galuzin, A. 2016.)

3.3 Research

Researching and finding photo references for various aspects of the levels assists in creating believable worlds and levels that feel authentic and realistic. If the designer has planned the project in a coherent manner then searching for these references is much easier due to the fact of having the setting, location, theme, purpose and key features already at hand. (Galuzin, A. 2016.)

Depending on what type of game the level is made for the different aspects to research change but the underlying idea is to gather references of every visual aspect individually since it is difficult to search for pictures that would include everything needed and nothing out of the scope. Great guidelines are to look for environment, props, lighting, and overall visual style references. Some of these images can be pulled from the overall game design and should be looked at with everyone in the team that is influencing the levels content. (Stuart, M. 2003.)

3.4 Designing level history

Next step is to define what happened in the level before the player arrives there and what will happen now that the player is there. What happened before the player arrived, or in other words the levels history, is an excellent opportunity to convey story without a dialogue. Some blood stains on a wall or a messy operating table give the player clues on what has happened and boost the underlying mood of the level. (Galuzin, A. 2016.)

What the player is going to do in the level will influence the design in major ways but at this point the idea is to just focus on the rough idea and to keep in mind if the player is supposed to walk in the environment or fly over it with a helicopter. (Galuzin, A. 2016.)

3.5 Player guiding

Player can be guided using many different ways but the most used techniques are:

- positioning
- composition
- balance
- lines
- contrast

These allow the designer to create environments that naturally guide the player towards the desired direction without the need for barriers or blocked paths. (Brown, M. 2015.)

Taking into account the objectives, obstacles and events the player will face it the level is key in making meaningful and fun player experiences. Objectives are what the player needs to do in the level to progress. This could be anything from killing enemies to simply getting to location B. Obstacles are what the player needs to overcome in the level. These could be anything including puzzles, battles or finding an unmarked location. (Galuzin, A. 2016.)

Events can be just a set of sparks that trigger on an electric fence when the player gets near to indicate danger or a fully scripted cutscene. Obstacles are easier to keep track of but for the objectives and events a mind-map is strongly advised to keep everything organized and to see what are the possible paths the player might take during the level. (Galuzin, A. 2016.)

Picture 3. Example mind-map. (NG, T. 2014.)

In level design a useful but dangerous tool is the use of focal points. Focal points are locations in levels that draw the player's eye to them and they help players to orient themselves with the level. They are also used for visual appeal and to guide players. The locations could be anything but a key rule is to stand out of the rest of the environment via lighting or by some other means. (Weber, S. 2015.)

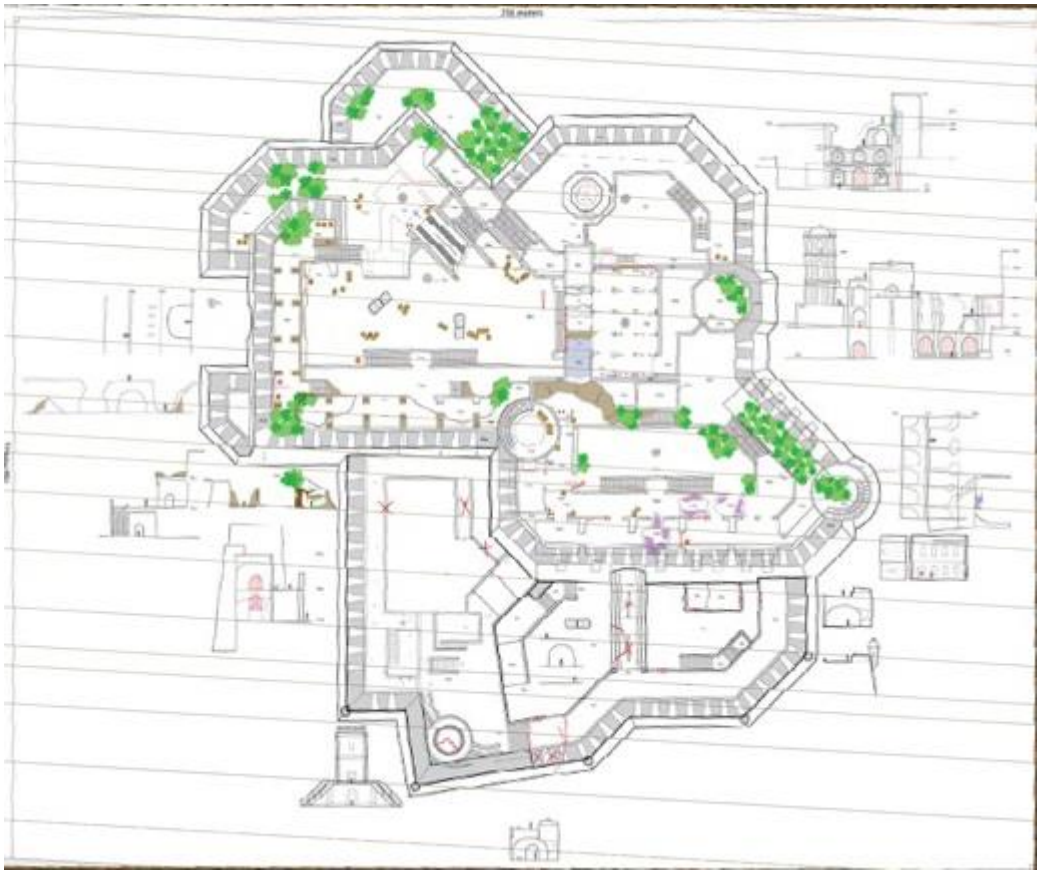
In open world games where the player is free to roam wherever they would like, focal points provide easily recognizable locations so that the player can locate themselves more easily in the world. Focal points can also be bad if the player gets sidetracked from where they should go and start traveling to an unrelated focal point. These situations are avoided by blocking the player's view and guiding it to one focal point at a time. (Weber, S. 2015.)

3.6 Top down layout

Top down layouts are a way to visualize what the level is going to look like and how the level will play. Top down layout should contain the following contents:

- buildings
- landscapes
- level boundaries
- player starting locations
- focal points
- AI positions
- player's traveling routes
- spatial relationships to gameplay flow

Top down layouts are mostly created with pen and paper or a drawing board. They provide a rough view of everything in the level but should not be followed perfectly. Levels live constantly and when a level is built and play tested the layout will change also. (Jonkers, D. 2011.)

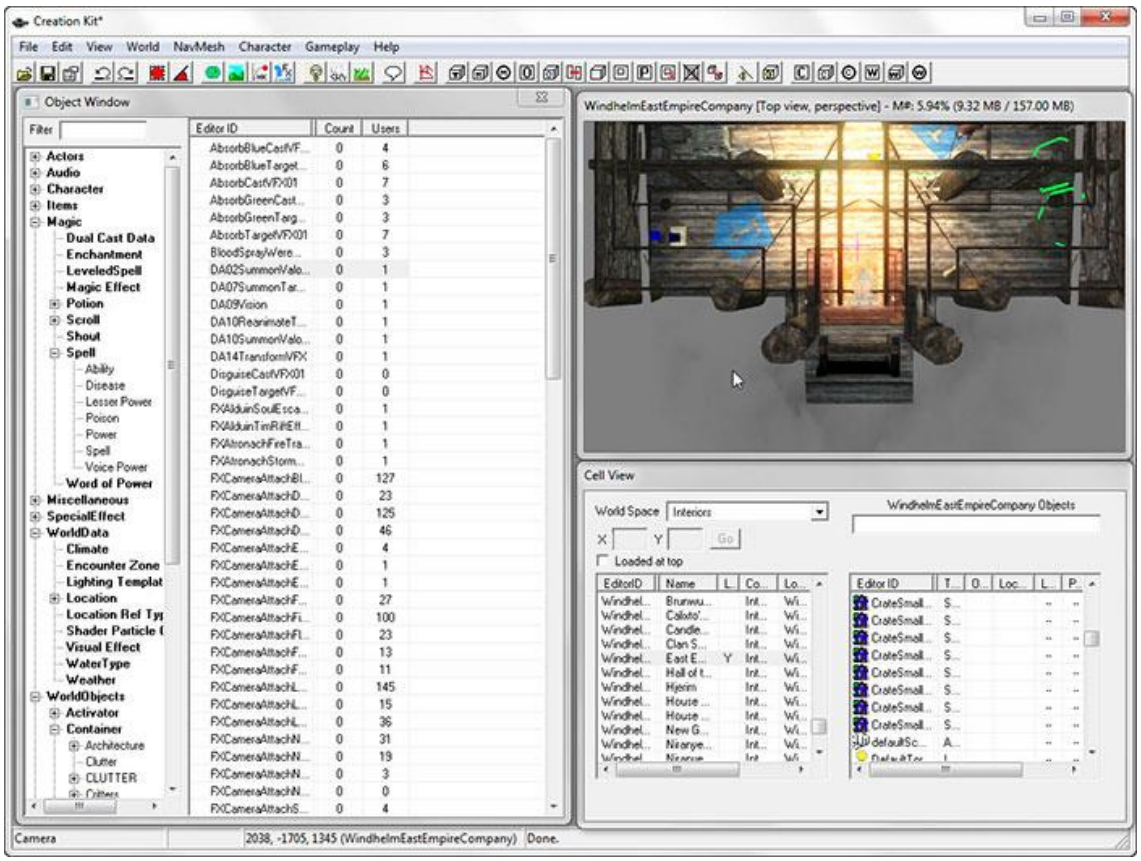


Picture 4. Top Down Layout of a level. (ZI, P. 2013.)

4 LEVEL PRODUCTION

4.1 Level editors

In level design, there are a lot of different editors available for creating levels. Most bigger companies use their own editor for their games and some of these editors are also available for customers. The editors allow level designers to create levels for specific games. (Liviu, 2016.)



Picture 5. Creation kit editor used by Bethesda Game Studios. (Wekenborg, J. 2012.)

Some commercially available engines also include a level editor and these editors allow you to create maps for almost all of the games that were made using the engine. Most widely used engines at the moment are Unreal Engine 4, Unity3D and CryEngine 3. All three of them include their own level editors. (Nexon7, 2013.)

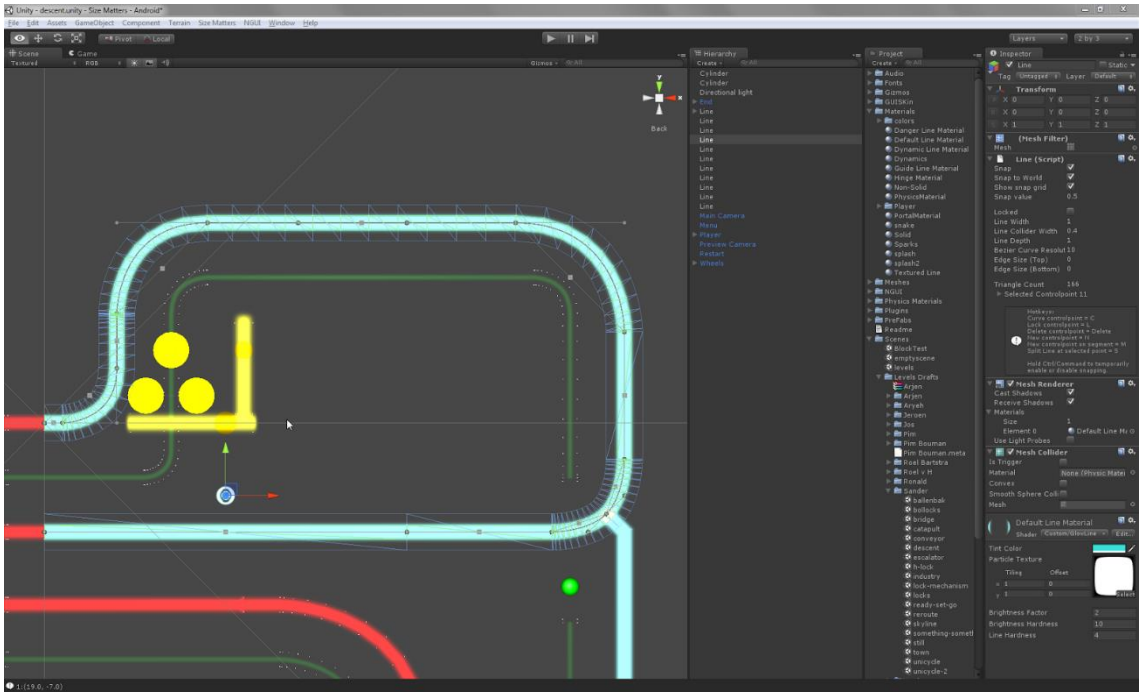
4.2 Unreal Engine 4 Editor

Unreal Editor allows flexibility accompanied with ease of use. Results with Unreal Editor are in great quality. Unreal Engine has a wide variety of tutorials to help with the editor. These tutorials are primarily made by Unreal itself but there are community made tutorials also. The editor also supports direct play in the editor to allow for quick level testing. Art pipeline is well done and it can be customed to fit the needs of any development team. (Nexon7, 2013.)

Picture 6. Unreal Engine 4 level editor view. (Unreal Engine. 2017.)

4.3 Unity engine Editor

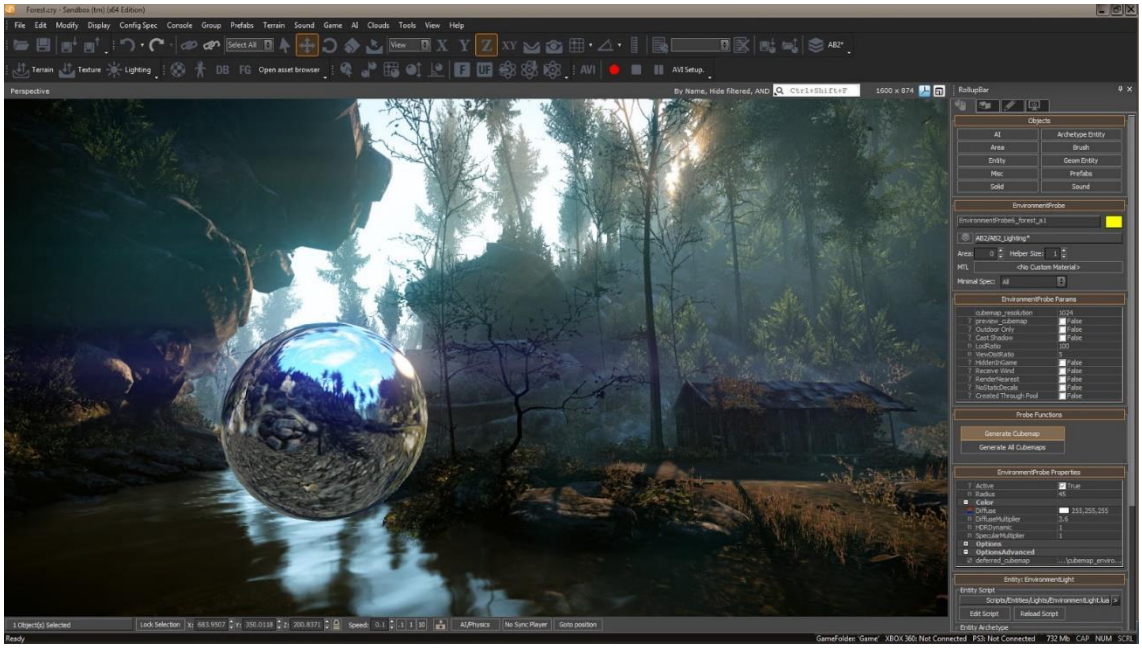
Unity is faster to learn for beginners and it allows for fast level creation but the final result can lack in quality. Unity's editor is excellent when making 2D or 2.5D games. For prototyping use the amount of free assets and the ease of use of the free assets that are available for Unity can speed up early production significantly and by extension reduce the overall cost of a project. (Pluralsights, 2015.)



Picture 7. Unity engine's level editor view. (Verbeek, S. 2013.)

4.4 CryEngine 3 Editor

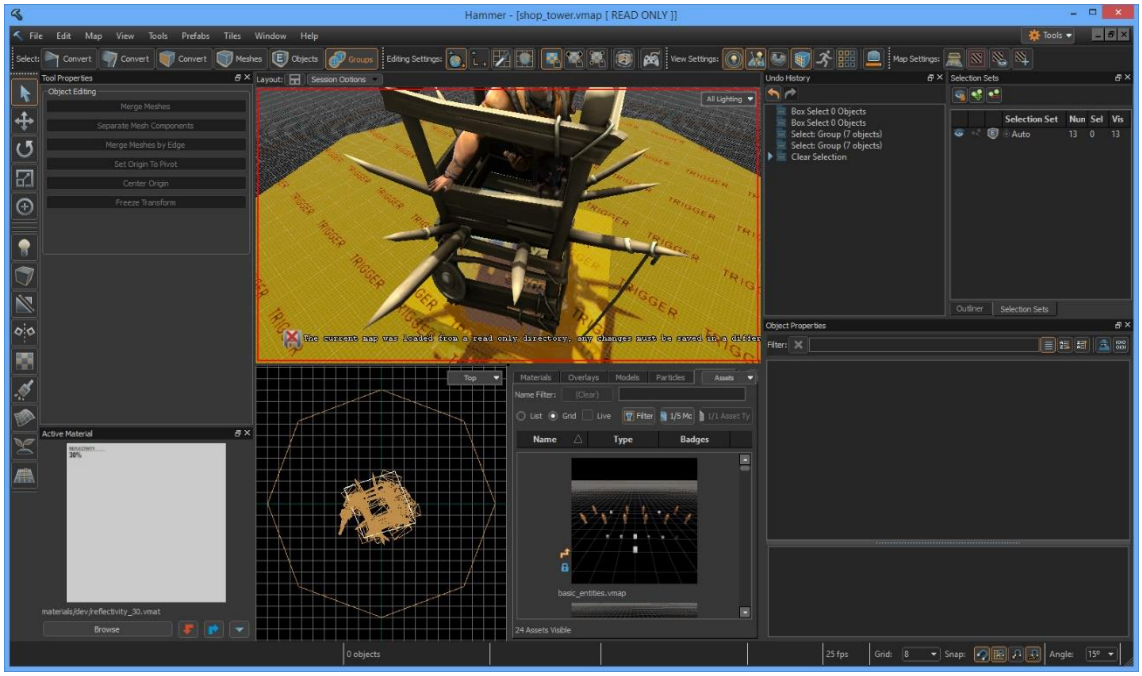
CryEngine 3 Editor is more difficult to use but the results are in excellent quality. The editor is not as intuitive as its competitors. CryEngine doesn't offer much tutorials to help with the use of its editor. CryEngine's editor lets the user to test levels in the editor similar to Unreal's editor. For a level designer, the experience between Unreal engines editor and CryEngine's editor is not drastically different but the shard learning curve is something to keep in mind if there are less experienced designers in the team. (Pluralsights, 2015.)



Picture 8. Level editor of CryEngine 3. (Lince. 2014.)

4.5 Hammer Source Level Editor

There are also a lot of games where the community of the game can make maps using the level editor that game was made with. One of the biggest editors that can be used in this way is Hammer Source Level Editor. It can be used to create maps for a vast variety of games that support directly uploading and sharing the user made maps with other players. This editor can only be used for source games which limits its potential when working in a game development company. (Valve. 2017.)



Picture 9. Hammer level editor. (Anthony, S. 2014.)

4.6 Results

Here are showcased the results of this comparison between the 4 different level editors. The picture show how the editors rank compared to oneanother. There are some editors that are tied on some aspects. This was done so that when comparing the engines those aspects that are of equal rank can be dismissed out of the factors for concideration since both of them will yield the desiered result. The need will vary greatly from project to project but this can be used as a quick way to rule out some editors at the beginning of the decision making.

	Learning curve	Testing	End result quality	Power consumpiton	Adaptability
Unreal Engine Editor	2.	1.	1.	3.	1.
Unity Editor	1.	2.	2.	2.	2.
CryEngine Editor	3.	1.	1.	4.	1.
Hammer Source Editor	4.	3.	3.	1.	3.

Ranked from best to worst where the best is 1. and the worst is 4.

Picture 10. Showcase of the comparison results between the editors of each engine.

5 LOWGLOW

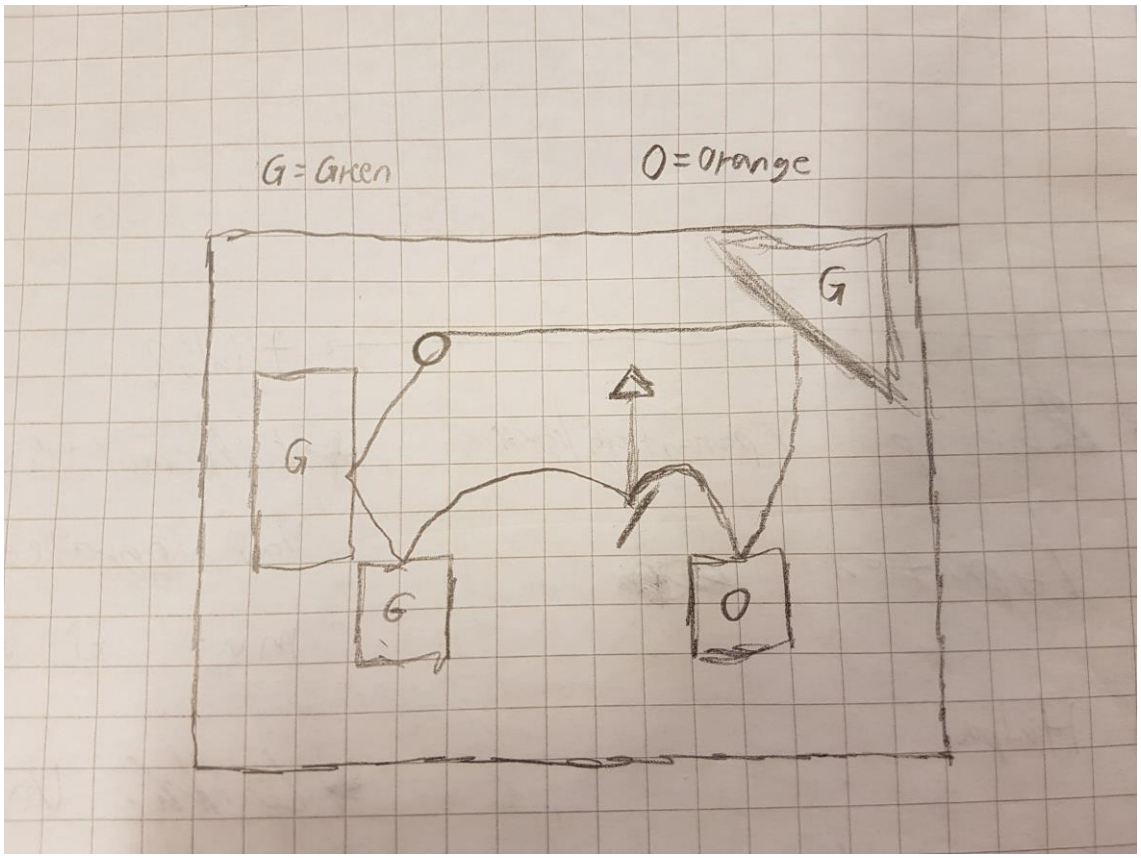
Lowglow is a physics based puzzle game for mobile and pc platforms. With Lowglow the goal was to make an audio visually unique game that has a very relaxing theme. The development of Lowglow began on March of 2015 and it was published on 3.12.2015 for Windows and MacOSX platforms. Lowglow will be published on iOS and Android platforms at a later date. My focus in this project was game design and level design.

5.1 Level design

Lowglow's level designs are all deliberately thought of and not something that can spontaneously come to the designer. The abstract nature of the world's theme makes the levels look and feel like nothing in the real world. When making levels, there were situations where an idea would show itself while working on another level. The designer had to weigh whether the new idea should have its own level made around it or to fit the idea into the one that was currently being worked on.

Consulting game design documents before starting production was done every time before starting any work on a level. This prevented unnecessary levels from being made and ensured that all of the content in the game was done using the same guidelines.

Lowglow has 5 different locations in its world. Each level fit one of these locations based on the game design criteria. One of the key factors on what mechanics could be used in a level were based on where the location of the level was inside the game. As the game progressed the player would go from one area to another and the mechanic he used in the previous area would carry over to the next one. Each level was designed to be unique in the way the player had to think about the puzzle.



Picture 11. Level design done with pen and paper as a top down layout.

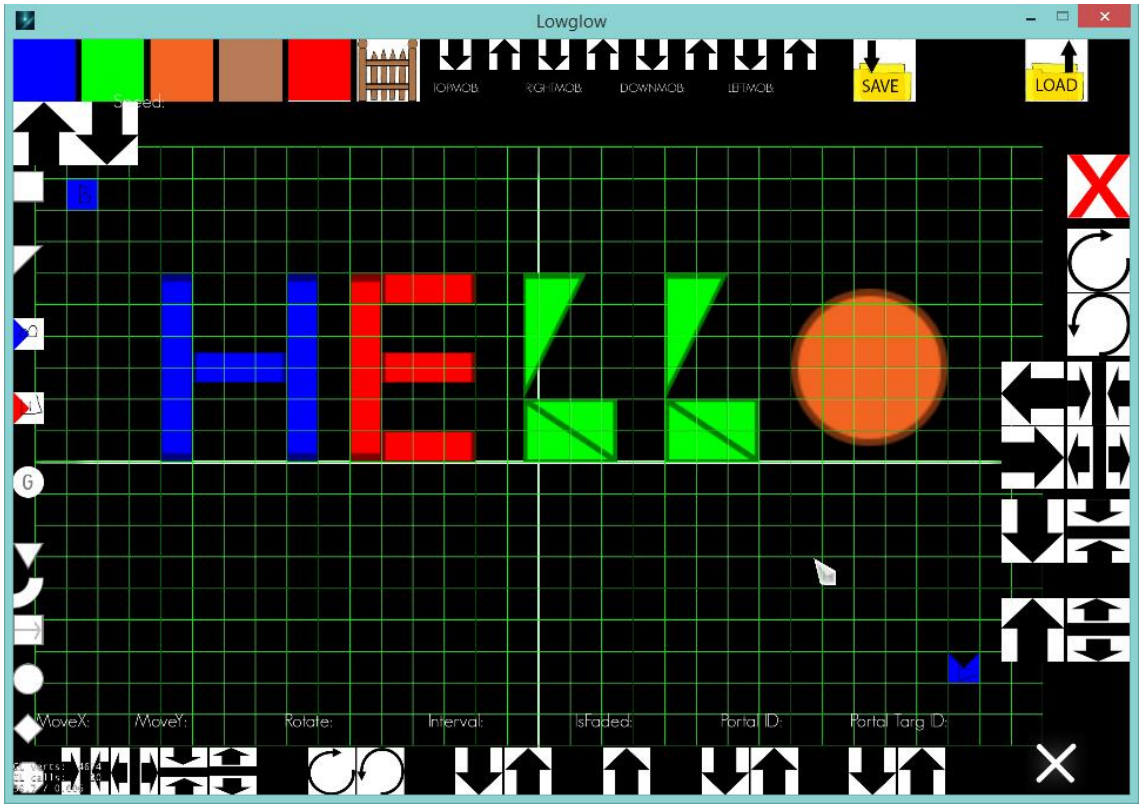
Lowglow is not a story heavy game so most of the levels were not meant to tell a story. Some levels had history built into them by making them resemble broken architecture or a watchtower but it was never a major goal. To make balancing the game easier the levels were categorized. Inside these categories the levels could change position without the experience suffering. When play testing the levels the team got feedback on how hard the levels were and reorganized them accordingly.

5.2 Level editor

Lowglow's editor was custom made for the game. This allowed the team to create levels as fast as was possible for a small team. The editor doesn't have any functions that were not essential. The editor's user interface is not user friendly, but was adequate for the team's internal use since it wouldn't be released to the public.

Unlike in most editors Lowglow's editor does not show any in game art inside of it. This is due to the fact that most of the game's art is done via shaders and could not be reproduced in the editor. Instead the editor uses simple color coding to guide the user.

The editor supports basic functions such as different shapes and sizes as well as scaling, rotating and placement functions. It also allows the creation of moving parts. Level testing is done inside the game itself and requires the user to import level files into the engine for testing.



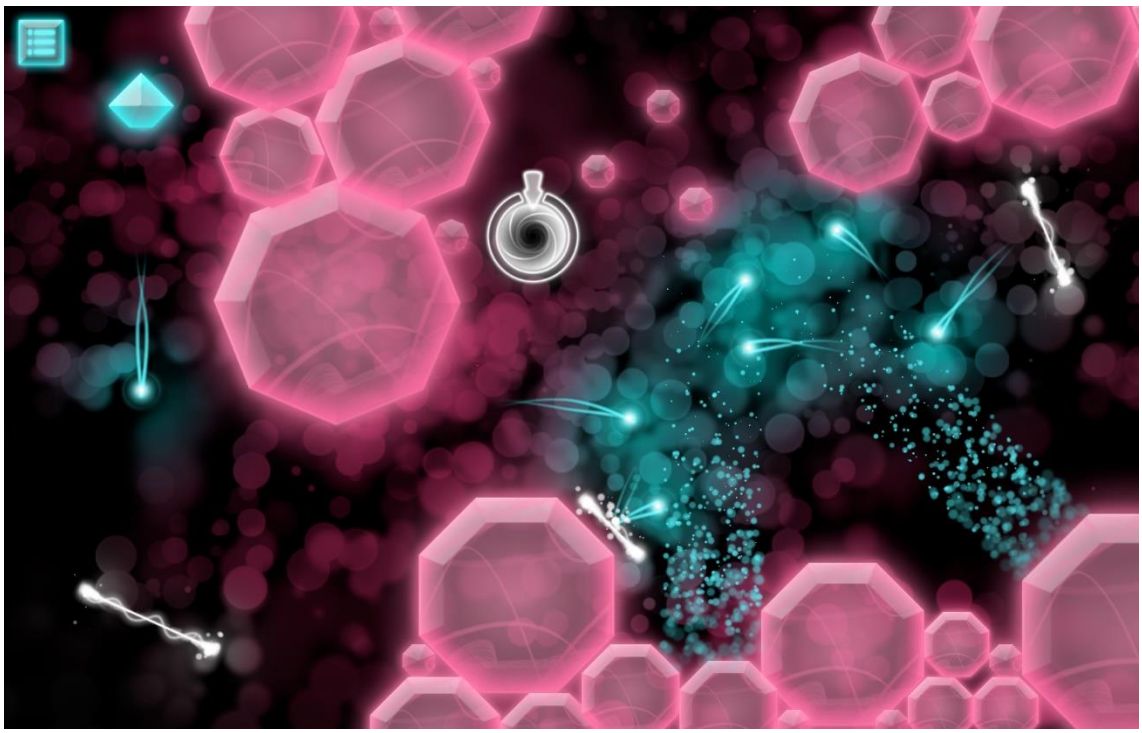
Picture 12. Screenshot of Lowglow's editor.

5.3 Level production

Level production in the project was done in short bursts and was planned carefully due to the limited time the team had to work on the project. The levels always followed rules that were established in the game design documents and to ensure that none of the levels would be too similar the team also took screenshots of each of the levels to have reference images at hand.

Creating puzzles with only a handful of mechanics and a limited play area were great for producing creative levels. Without any limitations real creativity is a lot harder to find. (Ashleigh, A. 2013.)

The short learning curve of the editor allowed for the whole team to participate in making levels every time there was any spare time within the project. This is what allowed the team to make around 300 levels for the game of which around 120 are in the published product.



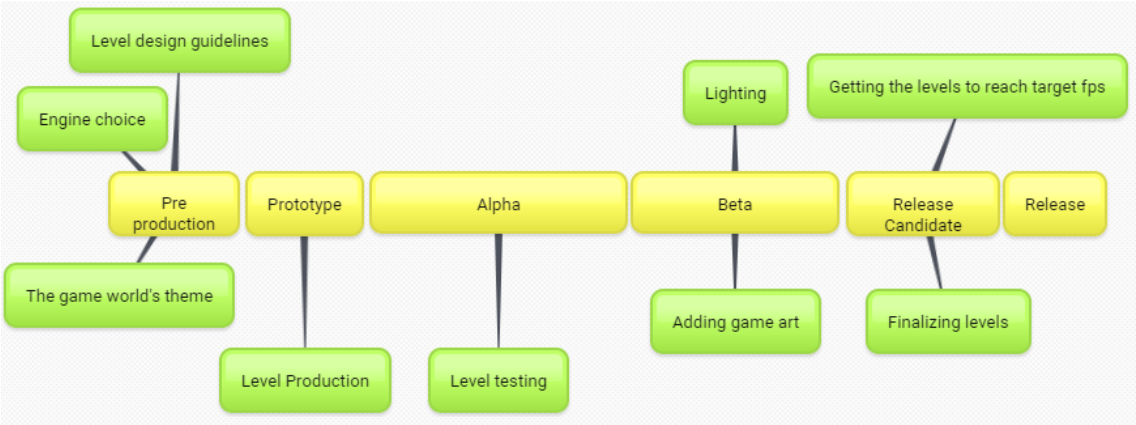
Picture 13. Finished level for Lowglow.

5.4 Level designs best practices

The thesis was done to produce a list of best practices for level design that could be followed in a project to project basis. It helps the company to evaluate projects and choices within these projects from level design's perspective. Comparing the found results with an existing product is done to show a real world example. A concrete example makes it a lot easier for the company to benefit from these best practices. The best practices are as follows:

1. Finding what are the key elements in levels and focusing on those as to not waste development time.
2. Player guiding can be done in many ways, but you should pick which ways to focus on in each project to ensure the player learns to regodnice these guides.
3. Communication with the level design team and the rest of the development team is crucial. Keeping everyone on the same page reduces the iteration amounts and saves a lot of headaches. Learning to communicate yourself clearly to other people in your team is a valuable asset to have.
4. Use a design process to guide you in your design work. It is not always the best idea to follow it point by point but keep it as a guide to ensure a certain level of quality.
5. When an engine choice has to be made for a new project. Keep in mind what your teams capabilities are and make sure to let the project manager know ahead of time if there are any expected learning periods that the budgets need to account for.

There are a lot of different stages in a game development project. Decisions need to be done through out the development process. By compiling a timeline on what stages during the development the team needs to make decisions regarding level design it is easier to plan the projects efficiently.



Picture 14. Project timeline highlighting level design decision stages.

6 CONCLUSION

The aim of the thesis was to research what level design is and what are the best practices in level design. When the research was complete the aim was to analyze the company's existing product and see how level design was done for that to gain a better understanding of level design through a concrete example. The purpose of this thesis was to give the company a solid base knowledge into level design that could be used in future game development projects.

Overall the thesis was successful in gathering information about the topic and portraying it in a coherent manner. Through the thesis the company gained valuable knowledge into level design and better understood their existing product. As the result the thesis also gave valuable insight into what game engines the company should choose in the future by showing the perspective of level design and level designers.

In making the thesis I learned a lot about level design as a job and an artform. The amount of control the level designer has over the product is vast and is a huge responsibility. Gaining knowledge on the tools that are used for level design is a major asset for myself and I intend to enforce the practices in this thesis for all future projects. Level design is a passion for me and I hope I can continue working and learning to be the best level designer I can be.

REFERENCES

Shahrani, S. 2006. Educational Feature: A History and Analysis of Level Design in 3D Computer Games. Referenced 3.2.2017 http://www.gamasutra.com/view/feature/131083/educational_feature_a_history_and_.php?page=3

Galuzin, A. 2016. How to Plan Level Designs and Game Environments in 11 Steps. Referenced 24.11.2016 http://www.worldofleveldesign.com/categories/level_design_tutorials/how-to-plan-level-designs-game-environments-workflow.php

Piaskiewicz, M. 2015. Composition in Level Design. Referenced 13.1.2017 http://level-design.org/?page_id=2274

Pluralsights, 2015. Unity, Source 2, Unreal Engine 4, or CryENGINE - Which Game Engine Should I Choose? Referenced 18.1.2017 https://www.pluralsight.com/blog/film-games/unity-udk-cryengine-game-engine-choose

Liviu, 2016. Game Designer 101 — Everything you need to know to make a video game. Referenced 28.2.2017 http://liviu.cc/game-designer-101-everything-need-know-make-video-game/

Nexon7, 2013. UNREAL ENGINE 4 VS CRY ENGINE 4 VS FROSTBITE 3 VS SOURCE 2. Referenced 19.2.2017 https://nexon7.wordpress.com/2013/09/03/unreal-engine-4-vs-cry-engine-3/

Brown, M. 2015. Why Nathan Drake Doesn't Need a Compass | Game Maker's Toolkit. Referenced 27.2.2017 https://www.youtube.com/watch?v=k70_jvVOcG0

Weber, S. 2015. The difficulties of open world design. Referenced 7.5.2017 http://www.makinggames.biz/feature/the-difficulties-of-open-world-design,9493.html

Valve. 2017. Valve Hammer Editor. Referenced 7.5.2017 https://developer.valvesoftware.com/wiki/Valve_Hammer_Editor

Ashleigh, A. 2013 Why placing limitations on yourself is the key to creativity Referenced 7.5.2017 http://www.digitalartsonline.co.uk/features/creative-business/why-placing-limitations-on-yourself-is-key-creativity/

Games Screens. 2014. Alan Wake in Forrest by Night. Referenced 20.5.2017 http://gamesscreens.com/uncategorized/alan-wake-screenshots-from-a-survival-horror-video-game/attachment/alan-wake-7/

Miozzi, CJ. 2011. Our Skyrim Travels – In Photos. Referenced 20.5.2017 https://gamefront.online/our-skyrim-travels-in-photos/

Wekenborg, J. 2012. Skyrim Creation Kit. Referenced 20.5.2017 http://www.giga.de/spiele/skyrim-creation-kit/

NG, T. 2014. Game Design Mindmap Reference. Referenced 20.5.2017 http://ianlnng.blogspot.fi/2014/04/game-design-mindmap-reference.html

ZI, P. 2013. Naughty Dog’s Uncharted Level Design Process. Referenced 20.5.2017 http://zipeters.com/home/blog/

Unreal Engine. 2017. Level Editor. Referenced 20.5.2017 https://docs.unrealengine.com/latest/INT/Engine/UI/LevelEditor/

Verbeek, S. 2013. Creating a spline level editor in Unity. Referenced 20.5.2017 https://sanderman0.wordpress.com/2013/02/06/creating-a-spline-level-editor-in-unity/

Lince. 2014. Opinión: Los juegos creados por los fans Referenced 20.5.2017 http://www.vrutal.com/noticias/1578-opinion-los-juegos-creados-por-los-fans

Anthony, S. 2014. Valve quietly releases Source 2 engine, Source 2 version of Dota 2, and new Hammer map editor. Referenced 20.5.2017 https://www.extremetech.com/extreme/187723-valve-quietly-releases-source-2-engine-source-2-version-of-dota-2-and-new-hammer-map-editor

Hoogland, D. 2012. My level design process. Referenced 21.5.2017 http://www.tophattwaffle.com/my-level-design-process/

Stuart, M. 2003. An Architect's Perspective On Level Design Pre-Production Referneced 21.5.2017 http://www.gamasutra.com/view/feature/131257/an_architects_perspective_on_.php

Jonkers, D. 2011. How to design levels for a platformer. Referenced 21.3.2017 http://devmag.org.za/2011/07/04/how-to-design-levels-for-a-platformer/

Bogdanov, V. 2014. Five game level design tricks. Referenced 28.4.2017 http://intersog.com/blog/tech-tips/five-game-level-design-tricks/

Barchan, S. 2013. Life of a level designer. Referenced 4.5.2017 https://www.gamedev.net/resources/_/creative/game-design/life-of-a-level-designer-r3121

Gunson, L. 2013. COMPOSITION TECHNIQUES AND PLAYER DIRECTION. Referenced 18.5.2017 https://shapeofplay.wordpress.com/2013/06/25/composition-level-design/

Bradley, S. 2015. Design Principles: Compositional Balance, Symmetry And Asymmetry. Referenced 19.5.2017 https://www.smashingmagazine.com/2015/06/design-principles-compositional-balance-symmetry-asymmetry/