UNIVERSITY OF HUDDERSFIELD

Can Video Games Technology be used for Educational Purposes?

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ABSTRACT

The question about the usage of video game technology to create successful educational games and learning tools has been extensively debated (Prensky, 2006). This research will explore these topics in order to develop a practical case study that could be used as a learning tool. There will be two main topics discussed and analysed, the first being the relevance of gaming in education, the second a quantitative case study of an educational video game prototype. In the 21st century, video games have grown more sophisticated as new technologies have advanced. Video games can be used for more than just home entertainment, as many recent games and projects have proven (Rosser et al., 2007). This research inquires on these successes and how to develop a project, which educates as well as entertains. The second major aspect of this research, which is the prototype, will implement these findings into a practical commercial product set with a prehistoric thematic featuring accurately researched extinct fauna and ancient biomes. Prehistoric visualizations, more commonly known as "Paleoart", are a respected development in the toolkit for palaeontologists. Paleoart is vital to scientists as it helps visualize prehistoric life millions of years ago (Witton, 2014). This prototype will combine and then expose Paleoart and educational gaming to the public.

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INTRODUCTION

It has often been thought that videogames have a negative impact on children, as Dr David Walsh (2001) writes 'Children (and adults) who play more violent video games are more likely to experience aggressive feelings, thoughts, and actions'. However,Prensky (2006) calls Walsh out on his comments stating that he 'deliberately frightens parents into thinking that their normal children might also be "addicted,".Prensky (2006, p.5) also states that most children will tell you that they know the violence in games isn't something one should, or would, do in real life, due to it being common sense to not act in such behaviour. 'It's just a game'. Some people still believe that videogames should only be played by children. As Adam (2015) says, in the eyes of some adults, playing video games makes you look immature, rather than appreciating the art and technicality that videogames portray.

In recent years however, video games have become more than just mindless games. They have developed compelling narratives with characters that the audience can feel attached to, and feature huge complex worlds and stories that players can become immersed in and explore. Video games like *Bioshock* and *The Last of Us*, the latter winning BAFTA Games Award for Story in 2014, are perfect examples of such games. They have devised complex and challenging puzzles, making players think and use their brains in order to progress further and uncover more, and have crafted beautiful in-game scripted cinematic scenes matching Hollywood quality movies, with believable characters that have true personalities and backstories that players can get inspired by and connect with. Even though videogames are still primarily sources of media entertainment, they are certainly not limited to just that.

The rise of educational gaming has accelerated greatly in recent years as video games are getting much more recognition and for this are seeing an increasing amount of use in classroom environments and being used as teaching aids or learning tools. The national report, From Print to Pixel: The role of videos, games, animations and simulations within K-12 education, has found that in 2010 only 23 percent of the surveyed teachers used games in the classroom. In 2015 this number increased to 48 percent. (Project Tomorrow, 2016). In addition, Project tomorrow says that 6 out of 10 (61%) teachers allow their students to play online games, all in service of various types of self-directed learning goals. The CEO of Project Tomorrow comments on these results, stating "Many more schools are demonstrating greater use of digital content, tools and resources today than six years ago and we believe that the increasing adoption of interactive, visual media in the classroom by teachers is the driver for much of that change" (Videocreation.tv, 2016). These results show a promising future for the use of video game technology for education. Debates on this subject area are ubiquitous, but as more recent games have demonstrated successfully, educational gaming should not be marginalized.

The popular game 'Minecraft' is a perfect example, as it has been used in classrooms on several occasions to help teach children and aid disabled students who struggle with traditional forms of learning such as reading and writing, and even has a full teacher resource version of the game named MinecraftEdu (2011) which allows teachers to create their own

puzzles for their students to work with. In 2013, it was reported that Minecraft was used by around 1,000 schools worldwide. By the end of 2013, this number doubled to 2,500, and this number does not count for the base version of Minecraft. (Hultstrand, 2015). This case alone provides ample proof to make educational games more legitimate in learning environments. Yet, Minecraft was not intended to be educational; instead it was originally developed as a commercial video game. This shows that if more effort was made to create educational minded games, and give them the same treatment of triple A games (major game titles e.g. *Halo*, *Call of Duty*), educational gaming could become a more prominent area and could benefit thousands of children and elders alike.

The main focus of this research project is to create a working prototype of an educational gaming tool. The concept behind it is to develop an effective teaching tool using a simulation of a prehistoric ecosystem, with featuring of various forms of information for players to expose themselves to and discover more about the prehistoric world. This product will be suitable for audiences of all ages to enjoy due to its varying difficulty and simple 'pick up and play' design. . In addition, research will be conducted into different teaching methods and learning styles that are used within classrooms to help children learn and to see how these could be implemented in to a videogame to boost learning input. Not every child learns the same way (Pritchard, 2009), and so examining these different methods may help in the production of this project.

The second focus of this research topic will look into palaeontology and paleoart, as the product being created here will be using prehistoric life as its theme. Several things should be considered with this topic, as the Smithsonian national museum of natural history (2005) shows, Paleoart is a difficult art form to follow, as it requires both scientific knowledge of living and extinct animals and plants, and a honed artistic skill. Paeloartists create illustrations of creatures based on scientific evidence, and then improvise by referring to modern life examples. For the areas that are completely unknown, such as colours or missing bones, scientific guesses are made, whilst also using one's creativity. One of the other major problems is that paleoart can quickly become outdated as more discoveries are made. An example of this is the well-known dinosaur *Spinosaurus*, which was the star dinosaur in the film 'Jurassic Park 3'. It is now known to look and behave nothing like its film counterpart. A recent discovery has shown that it had shorter legs and may even have had webbed toes like a duck, which means that the creature would probably have lived an aquatic life, most likely dining on fish and smaller creatures (Darren Naish, 2015), very different to the Spinosaurs portrayed in Jurassic Park . The concern of this project is that the prototype may one day become outdated due to the constant changing knowledge of the paleo world. As Paleoart is inherently an artistic discipline, this study acknowledges the need for constant vigilance on the developing scientific data.

The project accompanying this research will be an interactive video game featuring several virtual environments located on the super continent of Pangea during the Triassic period, 225 million years ago. At this time, all continents of Earth were connected together forming one solid land mass, which was known as Pangea (Fraser, 2006, p. 3). One of the primary ideas

for the prototype is that players will be able to explore various locations of this continent and discover a selection of terrestrial and aquatic creatures, in relation to where fossil formations of specific creatures were discovered. For example, the Ghost Ranch fossil formation found in North America was, at the time, located at the centre west of Pangea (Palaeos: Mesozoic, 2005), therefore in the game, the location of North America and the fossil formations would be found within this area, rather than having random animals and locations. Players will also explore and learn about what the environments and creatures may have looked like millions of years ago. The game is set to feature numerous facts for each creature as well as an in-game encyclopaedia featuring names of the creatures and other terms used throughout the project. Research from other learning methods and other educational games will help with implementing these into the game in some shape or form.

The purpose of this project is to create the foundations for a functional teaching aid that can be used as an educational tool. Research will need to be conducted regarding the different teaching methods and styles in which people learn, as well as what makes other video games, educational and non-educational, such a success in order to create a prosperous product. The chosen period of Earth's history also needs to be researched thoroughly in order to create an accurate portrayal of this time period. The Project's accuracy is one of the key aspects that, if not correct, would defeat the purpose of the game being educational.

LITERATURE REVIEW

Generating a working educational media tool will require reviewing the work of several different pieces of literature on educational gaming, learning theories and methodologies. Burrhus Frederic Skinner has done extensive research on the psychology of learning and the implications within the classroom. The Science of learning and the Art of Teaching (Skinner, 1954), showcases some of his experimental work in classrooms, using mechanical devices to aid in teaching. These were known as teaching machines, which presented students with a problem, and then the students moved levers on the machine in order to create the correct answer, which was to spell out the appropriate word matching an image shown on the device (Watters, 2015). Once students had answered correctly, a light appeared on the machine (Buck, 1990). His studies show early work of learning methods through technological means, rather than traditional learning of books and paper. In a way, this work could be considered the first building blocks to educational gaming, as some smaller online educational games already feature similar kinds of teaching processes, such as *Word-O-Rama* (2016), a game where players are given a question, and they select the correct answer from a selection of words, when they select the correct one, the word flashes green.

Other online learning games even more similar to, or practically the same as, skinners machines exist as well, showing players an image of an animal, and then are required to fill in the blanks to spell out the name. In addition to the research of Skinner, there are other numerous studies into educational media and technology, including the work of Thomas Reeves (1998) in which he discusses the two major approaches to using media and technology: 'learning with' and 'learning from'. In learning from students are exposed to messages from selected media, and provide feedback of what they have seen in order to understand what they learnt, whereas learning 'with' is the use of various media tools such as databases and spreadsheets to aid with learning. Reeves believed that technology and media in schools is beneficial and that 'it works' (Reeves, 1998). Mayo (2007) agrees on the use of technology and media in education and discusses the effectiveness of videogame media further, supporting the effectiveness of learning in this way, as well as the different methods in which video games can improve learning outcomes and enhance a person's brain chemistry.

Marc Prensky, an American writer and speaker on education and learning, has also written a number of essays regarding digital technology and education, his most noticeable ones being '*Digital Game-Based Learning'* and '*Don't Bother Me Mom' – I'm Learning*'. These articles provide a positive outlook on videogames and their effects on learning and how they are teaching children valuable skills (Prensky, 2006). This is still solid evidence for the effectiveness of games being used for learning possibilities. Mitchell & Savill-Smith, (2004) also discuss the effectiveness of video games and learning and outlines what an educational video game should feature learning objectives for the player or give the player opportunities for understanding through experience or investigation.

In addition, there has also been several debates on technology and media being used for more than just teaching children but for example aiding the elderly (Van Gerven et al., 2003), proving that multimedia-based work examples were more efficient than traditional methods. Forms of media for older audiences include simulation games to train surgeons for improved reaction times and warm up practices before actual surgery, (Jr et al., 2007). These training activities are still technically educational games, even when not used in a classroom environment, and they too are becoming much more widespread.

This research will not only examine educational games, but also take a look into learning styles and teaching methods, in order to gain an understanding of how people learn, and why videogames would benefit them. David Kolb (2014) believes people have their own learning styles, and learn in their own preferred way and by doing so, increase their learning input. Kolb created a model indicating four different abilities for effecting learning. Honey and Mumford (1982) expand upon the work of Kolb, identifying 4 learning preferences in which individuals prefer to learn with and use to increase one's personal learning, both their and Kolb's works are discussed more in depth further in this paper.

This project will be creating a product completely focused on the purpose of education, and it will be important to analyse several case studies to see why specific video games can be educational, and what makes them good learning tools. However, identified by Cassidy (2004), the amount of debates and uncertainty on the numerous learning styles makes choosing an appropriate one a difficult task, therefore finding what the most effecting teaching methods are to aid in the creation of this project will be a challenge upon itself.

Furthermore, comprehensive research into Palaeontology is a mandatory requirement for this project. It will be imperative that the educational product displays the correct information and data in order to be a successful learning tool. This research has looked at a number of scientific reports written by palaeontologists regarding fauna from the Triassic period such as the *Araucarioxylon arizonicum* trees from the petrified forest national park in Arizona (Ash & Creber, 2000), one of the locations located within the actual game being developed in this project. Reviewing more recent books and papers will be more beneficial than older books, as many older books may now be outdated due to the constant discovery of new data (Prothero, 2007) .

Much of the literature is focused on various species of prehistoric animals and foliage, and the locations of their fossils. Dixon (2011) in his fairly recent book outlines hundreds of species of animals and includes each creatures time period, era, fossil location and even the person responsible for the naming of the species. This book can aid in choosing fauna to display within the simulation. Another highly beneficial book to aid in this project will be '*Dawn of the Dinosaurs: Life in the Triassic*' (Fraser, 2006), a book full of knowledge on the Triassic period, the era of time this game will be set in, and will be working closely alongside this book throughout the games development. Scott Hartmen is a famous palaeontologist that will also provide valuable resources. Hartmen (2011) is well known for his skeletal reconstructions of prehistoric creatures and has supplied a number of life reconstructions for books and museums, and has a background in anatomy. Many other Paleo artists use his

skeletal constructions as a base for their work, and he has served as a consultant for many TV shows and films such as *Walking with Dinosaurs 3D*. He is also a publishing palaeontologist, with papers about specific species. His skeletal drawings will play a crucial role in aiding the construction of some of the species within this product as well.

METHODOLOGY

Initial data will be reviewed from secondary research sources, specifically from news and journal articles, and books.. Examples of such data include learning and teaching methods, current effects and successes of educational 'serious' games, different ways in which children learn, such as audio, kinesthetic, and visual, and also scientific books and papers regarding the Triassic Period. Various web pages will also wield valuable information to aid in this research, from basic forum discussions, to sites dedicated to specific topics in education and learning. Several research papers and books regarding palaeontology and ancient animal life will also be examined to assist in the creation of the prehistoric biomes. The knowledge collected from these sources will help in the development of this product, utilizing the data to shape and construct a successful teaching tool with accurate information.

Selections of different applications are going to be used in the production of this project. The Product will be constructed in the Unreal 4 game engine from the ground up, 3d packages such as 3DS Max and Zbrush will be used to develop the various assets seen throughout the game, and programs like Photoshop and the Quixel suite are used to create the textures for these assets. Photoshop will also be used in the creation of the interface which will allow players to navigate the games menus and view the various sources of data.

As the primary focus of this research, the end result will be a playable game prototype set during the Norian age of the Triassic period. This product will feature a selection of open environments for players to explore including varying methods of discovering facts and information, such as fact files, a built in encyclopaedia and other in-game features, in order to teach players more about this ancient world the animals, plants and the landscape that existed at this time. The creation of the game is going to require a lot of time and dedication to ensure that at the very least, a playable prototype will be completed before this projects end.

To conclude the success of the project, the game will be tested and shown to varying people of age and will be giving their input and feedback about the games performance, quality and if the game would serve the purpose of being informative and educational. Due to the scale of the game, it may be difficult to get people to test, especially at a prototype stage, so the best method will be to expose people to game play footage through videos, and exhibit the game through forums and social media. If players come out of the game having learnt more about the Norian age of the Triassic period, then the project is a success.

LEARNING AND TEACHING METHODS

To understand how to make a successful educational gaming tool, research must first be done on different topics, one of which is regarding different learning styles and teaching methods that are used within classrooms today and in general teaching environments. Utilizing the data gathered from this, it can then be implemented into different types of educational gaming tools, each with its own teaching style, or even multiple styles. Some may be used for self-teaching or group teaching. These results could help shape the outcome of the game being created with his project. Kolb (2014) has developed an 'Experimental Learning Cycle' that is typically represented by a four stage learning cycle, as can be seen in figure 1, in which the learner 'touches all of the bases'. The four stages are summed up as follows.

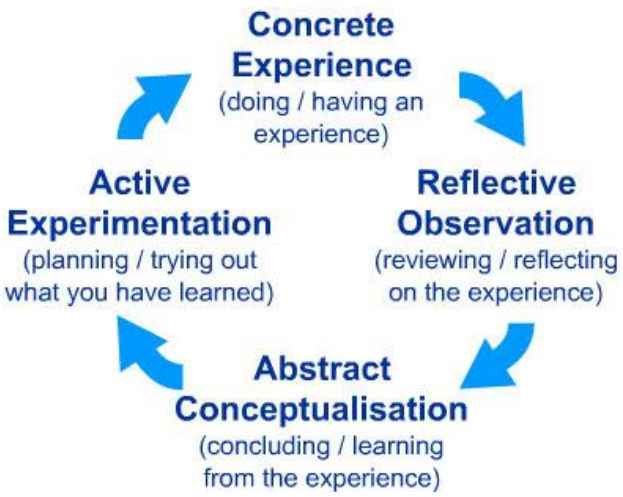

Figure 1. Kolb's experimental learning style diagram (McLeod, S. A., 2013)

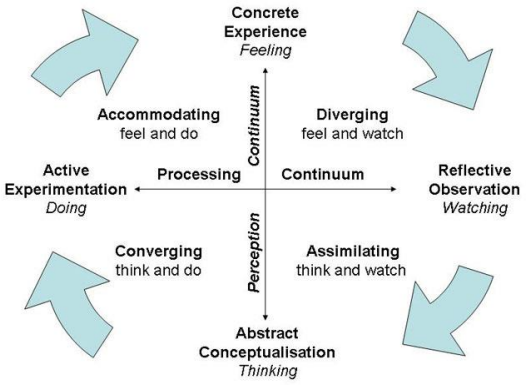

Figure 2. Kolb's two continuums (McLeod, S. A., 2013)

1. Concrete Experience – This is when the learner experiences a new situation, or when they experience a reinterpretation of an existing one.

2. Reflective Observation – This is when the learner reflects upon the new experience. Areas of particular importance are any inconsistencies between experience and understanding.

3. Abstract Conceptualization – After the reflection stage the learner may evolve new ideas, or modifications to existing abstract concepts.

4. Active Experimentation – This is where the learner applies the new knowledge to the world around them.

These four stages give an idea on how the learner may perceive the educational gaming tool, and with this it is possible to shape the outcome and structure of the game. These stages are to aid in the creation of this project, which is to feature an open world exploration game. A

player first entering this new world would be a representation of the first stage of Kolb's cycle and is a "concrete experience" that the learner receives. With further work, time and tools, the 'reinterpretation' of an existing experience could be implemented by adding a procedurally generated world, which means every time the player enters the environment, it will be completely different from the last with different triggers, events, or even simpler mechanics such as different times of day. If the game is played with a group, for example; in a classroom, then perhaps the class can engage in group discussions after about what the players experienced and discovered during their time exploring the virtual world, which will help with the 'Reflective Observation' stage, as children sum up what it was they were playing, doing, or viewing, and what they learnt. These will help in the conceptualize stage as the player understands new information the game has exposed to them. Finally this new knowledge can help these players in the world around them, in this particular case palaeontology and evolution, and also perhaps animal behaviours such as food chains. Of course, different types of educational games will provide different results, the product in which will be accompanying this research will be themed on palaeontology, and so will not be beneficial to everyone. This product with its Triassic theme will primarily help younger audiences in a classroom or museum environment, and teach them about evolution and earths past or maybe any other person interested in wishing to learn more within this subject area. Other games with similar mechanics could be either more complex, simpler or have different themes. This could include increased difficulty in problem solving and puzzles, or perhaps different eras of time, such as an ancient roman settlement for example, which would be using the same gameplay mechanics being developed with this project, just in a different time period.

Expanding upon this learning cycle are the four learning styles from Kolb's theory which include feeling, watching, thinking and doing (McLeod, 2013). Kolb's learning theory explains that each person has their own preferred style of learning. His theory states that each learning style is 'actually the product of two pairs of variables' (McLeod, 2013), or just two separate choices that a person makes. Kolb presents these as lines of axis, with each one having conflicting modes at either end. A classic presentation of Kolb's learning theory shows these two pairs in a cycle. As can be seen in figure 2, the East and West are known as the Processing Continuum and the North and South are known as the Perception Continuum. Kolb believes that any one person cannot perform both variables on a single axis, for example thinking and feeling, and that a person's learning style comes from a product of one of these two decisions. Understanding a person's learning style allows the learning to be adapted appropriately to their preferred method. Everyone responds differently to the different learning styles one way or another and it is a matter of prioritising the ones that fit best. The educational product being constructed would be best suited towards the Converging (doing and thinking) and Assimilating (watching and thinking) learning styles. Converging is when the person is able to solve problems and find solutions on their own, preferring more technical tasks and solving puzzles, rather than social or interpersonal issues. The Assimilating learning preference calls for a more logical advance, favouring ideas and concepts, and prefer good clear explanations rather than any practical tasks (McLeod, 2013).

Converging is the primary learning style focused on within this project, and assimilating the secondary. Players with a converging learning style could benefit by having to use their own knowledge to single handily learn how transverse the landscape and gather information about the world inhabitants. The game could feature clues about the locations of each creature, this will allow them to use their own observations to solve the clues and discover the different species and their locations. Assimilating learners may also benefit from watching other players play the game such learners can also observe the landscape rather than explore it. With the possible addition of a cinematic mode these "assimilators" can watch a cinematic camera move through the environment and, rather than collecting information from within the world. A built in encyclopaedia is also something that would benefit these types of players, presenting a great deal of information clearly explained to them.

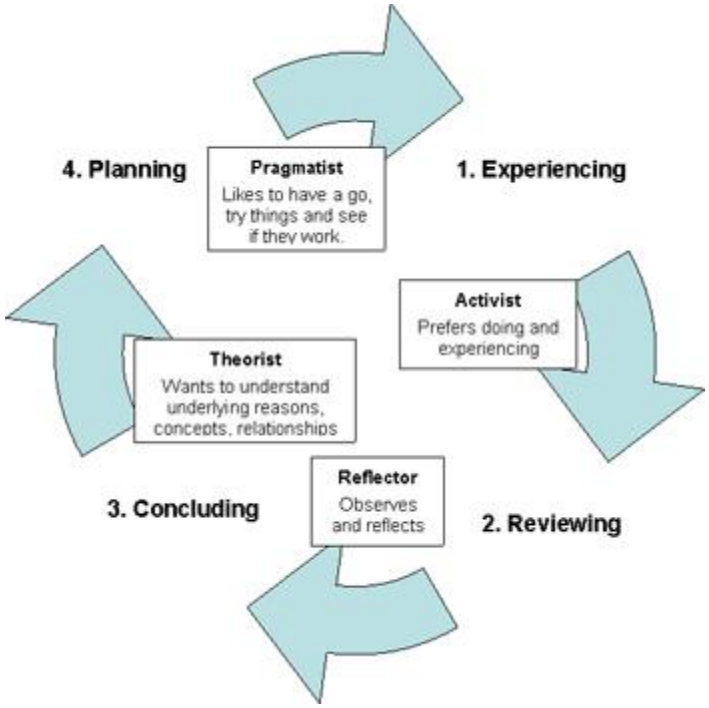

Figure 3. Honey and Mumford Learning cycle diagram (NPUA., 2006)

Honey and Mumford further expanded on the learning styles using the work of Kolb, and identified four specific learning styles, or preferences. These are Activist, Theorist, Pragmatist and Reflector (Honey, 1982) and can be seen in figure 3. These are the four learning paths that individuals commonly prefer and it is recommended that to increase one's own personal learning, they need to understand their own learning style, and discover more opportunities to learn using their preferred style (University of Leicester, 2001). The learning style that would be best suited for learning through the use of video games would be the activist. These people like to get hands on experience and have an open-minded approach to learning, getting fully involved in new experiences. Some activities of an activist are problem solving, puzzles, competitions and role-playing. These can be easily implemented into video

games, and many games already include most, if not all of these factors. Small games that cater to some of these styles already exist, such as *Luminosity* (Lumos Labs, Inc. 2016) - a mobile app used to train the player's brain by offering various challenges that requires use of memory, attention and problem solving.

Figure 4. The Talos Principle (Andrei Dmitrescu, 2015)

Some larger games featuring some of these activities are *The Talos principle* (2014) and *The Elder Scrolls IV: Oblivion* (2006). *The Talos Principle* is a first person puzzle and problem solving game. Players must navigate different levels solving puzzles that become more and more complex as they progress, requiring more thought process on how they proceed, using lasers, cubes, and more advanced puzzle pieces, Figure (4). The latter, *The Elder Scrolls IV: Oblivion* is a role-playing adventure game, Though not exactly educational in its own right, the game does require the player to put thought process into their character stats and levelling system, and some problem solving skills are involved, figure (5). Furthermore, competition could be an interesting aspect to be used within classrooms as players compete with one another. Competition can make learning more fun if it is in such a way that all players can win or that one does not win at the expense of all others (Division, 2002). Perhaps putting players in teams, or offering different types of rewards for different types of challenges that vary in difficulty. Teams can also encourage team building and communication, as players work with each other to complete tasks and challenges.

Figure 5. The Elder Scrolls IV: Oblivion (Backlog PC Games, 2011)

Because everyone has a different learning style, this also means that everyone learns at a different pace, and for the teacher, it's near impossible to attend to each person's learning needs (daily edventures, 2014). There are a number of factors as to why people learn at different speeds. Brain development, environment and experiences are just three of the things that affect a student's learning. To best reach all the students, teachers would need to look at

all the different factors so they can get an understanding of each individual child's learning style. Yet, if teachers attempt to teach every child in a classroom at the exact same pace, it will be almost impossible to be at a position where everyone is at the same point, and it will be guaranteed that learners will be lost in this process and fall behind (Deutsch, 2013). Therefore, one of the great benefits of digital base learning through video games is that each student can learn at their own preferred pace, progressing when they are ready, and using their learning styles to help them grasp and solve problems in their own unique way (De Luna, 2012) .

In previous studies, it has been shown that a student's learning performance can be improved if the correct learning style dimensions are taken into consideration and applied when developing adaptive learning systems (Filippidis & Tsoukalas, 2009) as an example, Graf, Liu and Kinshuk (2010) investigated the navigational behaviour of students that took an online course within a learning management system in order to look at how students that have different learning styles preferred to use and learn in a specific course, and it was discovered that students that had different learning styles used different strategies to navigate through the course than others. Videogames could also cater to a number of different children's learning styles such as visual learners, which according to Clarke (2006), approximately 40% of college students are visual learners, preferring to be taught through pictures, diagrams, films and demonstrations. Lack of visual instruction could cause some of these students to underperform. Seen as though videogames are a visual form of entertainment they could aid in the learning of these types of people.

Auditory learners are the second class of learners that could perhaps benefit through video games technology. Their method of learning is through sound, listening and remembering, especially from songs or melody's, and from films and image media that has accompanying audio (Colorado State University, 2008). Video games such as the ones developed by Telltale games may cater to the needs of these learners, as the gameplay is minimal and instead, the player watches and listens to the game whilst mainly pressing buttons or point and clicking and solving puzzles, such as *Minecraft: Story Mode* (Telltale Games, 2015). Games could be

developed for educational purposes in this style of gameplay to accompany learners such as these. Thirdly, there are the kinesthetic learners. These types of people learn with a more 'hands on' approach, favouring the use of physical objects like handling clay, or by partaking in physical activities (About.com, 2014). Videogames could be developed to aid in the teaching of these types of students, but even more beneficial to them would be the use of virtual reality. Virtual reality has progressed significantly in recent years and has already begun to make its way into education, seeing multiple uses within classrooms (Road Tovr, 2014).

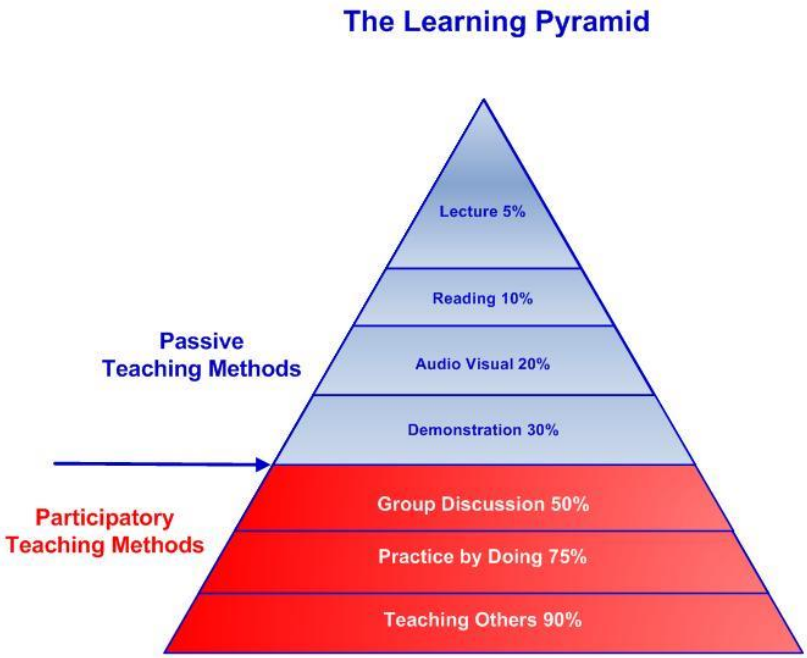

Figure 6. The Learning Pyramid (Atherton, 2013)

The learning pyramid is yet another diagram that shows the various methods in which a learner can engage in and shows information at a range of percentages of retention, as can be seen in figure 6. The Learning pyramid was researched and created by the National training Laboratories in Betel, Maine and it illustrates the percentage of learner recall that correlate with the various approaches (Atherton, 2013). The first four levels include lectures, reading, audio visual, and demonstration, and are known as passive learning methods. Meanwhile, the bottom three levels are known as participatory methods, including group discussion, practice by doing and teaching others. The learning Pyramid illustrates that the active participation of a learning process will result in a higher retention of learning input (Atherton, 2013). Based upon this research, Lectures would be the least effecting method of learning. In contrast, if people get actively involved with work and collaborate with others, their retention rate greatly increases. The difference between these passive and active methods could be due to the extent of reflection and deep cognitive processing (Atherton, 2013). If we apply This Learning Pyramid to video games, it's possible that a video game could potentially cover all of these methods, in some way or form. For example a video game can be presented within a lecture, include elements of reading, have audio visuals and can be used to demonstrate various practices through 3d generated images. These cover the passive teaching methods. As for the participatory teaching methods, practice by doing is clearly the main one here, but teaching others and group discussions can also be implemented into a video game. Teachers can play along with their students to help them get a better understanding as they play together, the teacher explaining certain elements and facts as they play along. They can then discuss their session as a group afterwards to reflect on what they learnt, also referring back to Kolb's learning styles. Of course not all games can be used to offer all these different

factors, but some definitely can, and this project will look into how many it can implement to allow for a more effective learning tool.

EDUCATION AND VDEO GAMES

This research has also looked into several topics debating how children struggle with learning in school, stating that they become bored easily, losing interest in what the teacher is saying, becoming distracted very easily and losing focus on their work. This research looks into what benefits educational video games could bring to these types if students. There are several reasons as to why a child may become bored in a classroom environment. The most common reasons being that children do not find that the work they are given is fun or exciting enough and they see it more as a chore or task, or for some others the work just isn't challenging enough and is too easy for them, not testing their skills or knowledge, as discussed by Taylor (2014). For some younger children, paying attention to a teacher talking at the front of the class for several hours is not the most entertaining way to learn, and they can easily become side tracked and lose interest in what the teacher is saying (Holt, 1969). This also does not apply directly to younger children, high school students and even some college students may also succumb to the same problem.

An article written by Mark Bauerlein discusses a survey that he conducted in 2006 where he asked high school dropouts about the reasons why they left school. The results portrayed that "47 percent of them claimed that school was boring and 69 percent said that school didn't motivate or excite them" (Bauerlein, 2013). This shows that it was not because their work was difficult, but because the work was uninspiring and dull. On the other hand, some students do actually just find that the work to be too easy and not challenging enough for them, as shown by Alison Brown (2007), a family therapist. In another article by Lawrence Leblond (2013) supports the fact that schools are not challenging enough and he also points out about how children like to learn though playing, as this is the most interesting and exciting way for them to solve problems, learn new things and also allows them to communicate between themselves.

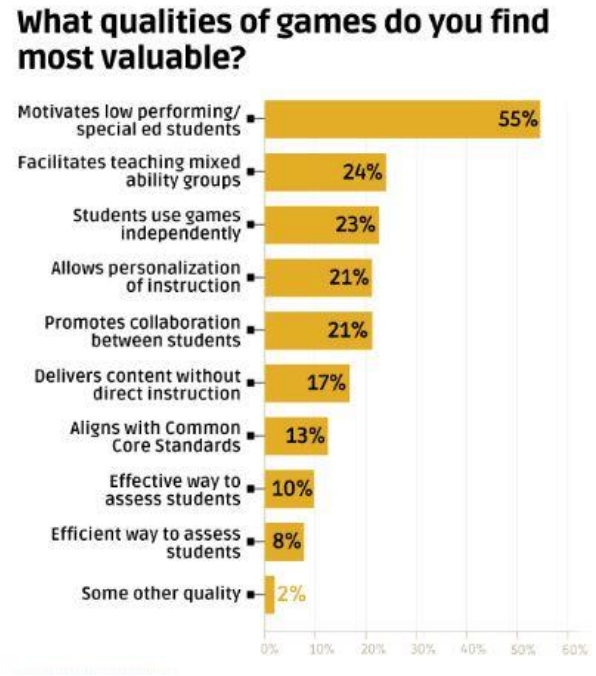

Figure 7. Teacher survey on games value (games and learning, 2014)

A method to help bring more excitement and fun to the classroom could be the addition of videogames. Figure 7 Shows some of the valuable qualities that video games provide for a classroom environment. The most popular clearly being for motivation of low performing and special ed students. A series of sample education lessons using videogames was conducted where students played the game *Sim City*, in an effort to make learning more fun and inspire the children, stating that 'school is boring kids to death' (USA Today, 2013) Some examples of the lessons children had to do using the game were prioritize public works projects and explain their reasoning for their actions, and figure out how to get electricity into a pre-built city. Lucy Bradshaw of Maxis Games, the publisher of *Sim City 4*, says "Being able to touch something, being able to experiment with it, I think, really can make a difference in a kid's life" (USA Today, 2013). Children these days are spending more time playing video games as shown by a survey from 2008 found that 97% of teenagers play computer, console, portable, or mobile phone games for at least an hour a day, and also showed that gaming wasn't only restricted to boys with 99% boys and 94% girls playing video games (Pew Research Center, 2008). Implementing games technology into schools could greatly benefit the learning ability of students of all ages, as video games can be made into any shape or form and be used in a flexible amount of ways and also lean towards a person's specific learning style.

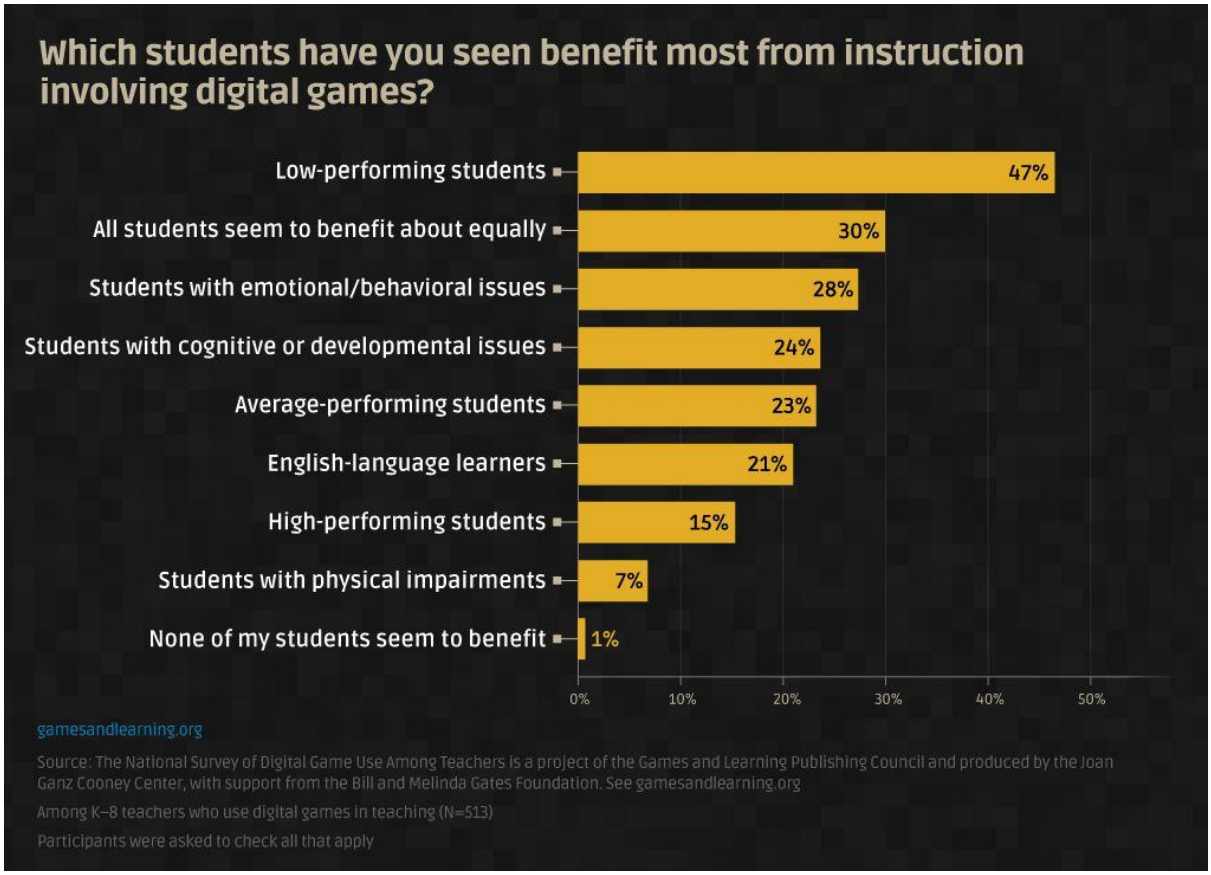

Figure 8. Teacher survey on students benefit from games (games and learning, 2014)

As previously discussed, some children prefer to learn through watching and listening. Perhaps a point and click style game, or a game with a more cinematic approach with text based dialog and voice overs giving a more cinematic experience, similar to the Telltale games as mentioned before, could make school a more interesting place for these types of people. Or what about learning through solving puzzles? Most video games already feature puzzles for their players to solve and games could be implemented with a selection of curriculum specific challenges to be completed. A range of difficulties can also be added to a test a person's skill and give them something to work towards and allow them to achieve a sense of accomplishment by making challenges more difficult as they progress. Figure 8 shows the types of students that benefit the most from playing video games. Low performing students is again the highest, as similar to the results from Figure 7, but is also followed closely by all students in general, which is then also closely followed by students with behavioural and emotional issues. The last result, showing none of the students benefiting from games, is only 1%, which shows that video games benefit such a wide range of learners.

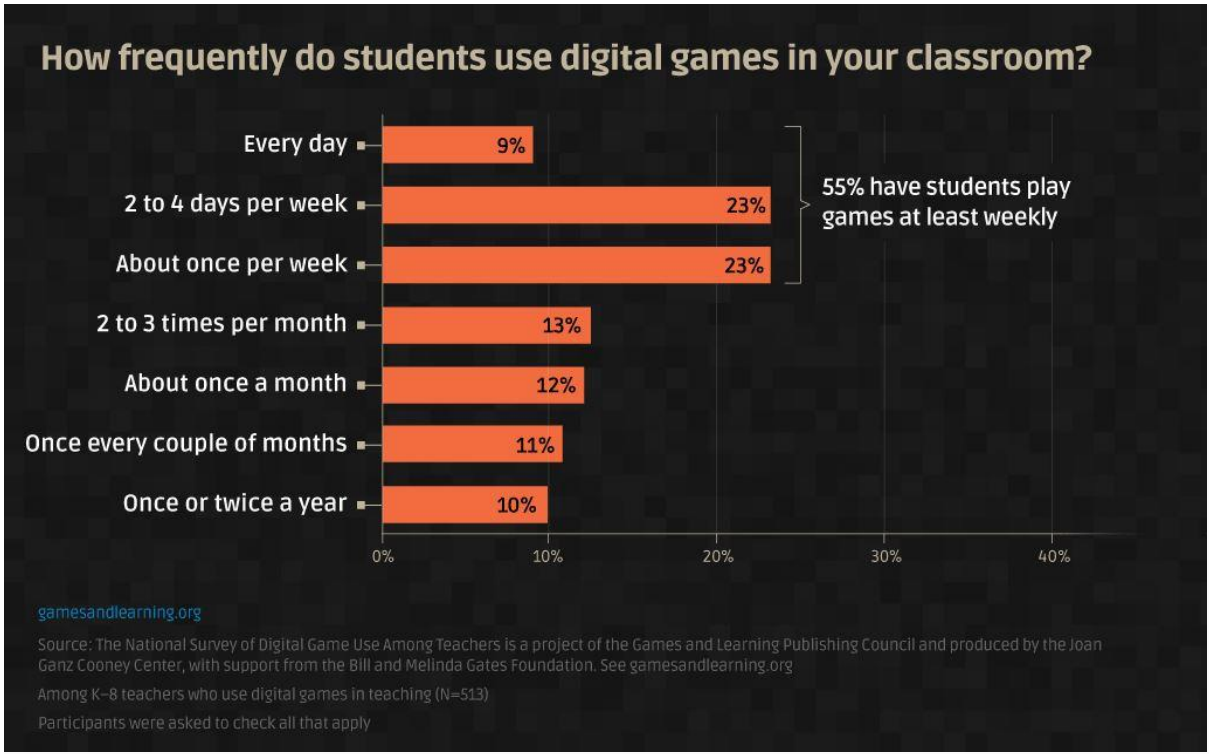

Figure 9. Teacher survey on frequency of videogames used (games and learning, 2014)

Video games being used for educational purposes have become much more popular within recent years. The GLPC (2013) survey discovered that a 72 percent of teachers nowadays use desktop computers to play games, while 41 percent is using interactive whiteboards. Figure 9 also shows how often video games are used within the classroom. 55% of students are shown to play video games weekly, which is over half of the amount surveyed. This is a number that will likely increase in time. Although video games have been used for teaching and learning before, there wasn't much real focus on them. Most games were either small flash games found on internet sites such as BBC Bitesize (2009), or very simple and basic pc games that were usually games focused on answering questions and revising specific topics with fun and cartoony characters hooping about the screen, such as *Treasure Galaxy* (The Learning Company, 1994) and *Scooby-Doo! Mystery Adventures* (The Learning Company, 2000). Some companies that made, and still make, such educational games are known as The Learning Company and LeapFrog. The learning company published a total of 61 games, and developed 47. The majority of these games were simplistic 2d point and click games, where players had to solve puzzles or discover clues to progress. They weren't very technical. LeapFrog is a company based all around children's education and are still going strong today. There work does not limit to video games technology however, they also make other products. Their videogames are quite technologically superior, developing special Ipads for their games, known as a LeapPads, and other handheld devices, even motion sense products where the player is the controller. Some of their older games, known as the JumpStart series, had a large variety of educational video games for younger children, featuring different key

stage levels and topics, such as maths and English. These games were similar to the game produced by the Learning Company, such as the Scooby Doo games, except they were more concentrated on the school curriculum of maths English and science. These games were excellent revision exercises to help children prepare for tests, or to boost their general knowledge of select topics.

Another method that could aid in teaching through games could be a progressive gameplay and rewards system. Expanding on the challenges and difficulty, rewarding players for their progression throughout the game could encourage younger players to continue on with the game, giving them a feeling of success after achieving certain challenges. This is shown in the study done by Miia Ronimusa,c, Janne Kujala b, Asko Tolvanenc and Heikki Lyytinen (2014). It was shown that a reward system did encourage the children's desire to play longer sessions. However, this began to deplete in later sessions as the children lost interest due to the games lack of features. They suggest more game features would be suitable to keep them engaged and could provide a higher interest. The product being developed with this research should perhaps feature various types of challenges and features to keep things interesting. Rewards could also encourage players to engage in the game more.

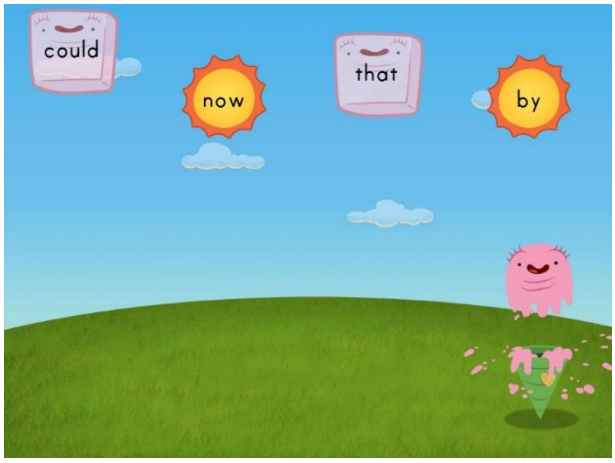

Figure 10 Sight Words Sun Attack(Education.com, 2016)

Many common video games for younger children focus on reading and audio visual, as well as practice by doing. The retention percentage for these can be seen back on the learning pyramid. However, these are much smaller and simpler types of video games. One example of a reading game that is actually aimed towards teaching people to read, and learn words, is called *Sight Words Sun Attack* (Education.com, 2016). This is an online flash game and is similar in style to the classic arcade game, Space Invaders, in which the player controls an ice cream cone that shoots ice cream, and the player must race against the clock to identify common sight words that are falling from the sky, depicted as suns. This can be seen in figure 10 If the sun reaches the cone, they fail. In order to survive, when the player is given a word, they must 'shoot' the corresponding word to freeze it. The more words they freeze, the more points they get. However, freezing the wrong word will cause them to fail. This game aids in the child recognizing certain words, as well as how to pronounce them and spell them. Some other games similar to this are the games from starfall.com (Starfall, 2005). This site has a large variety of games which aid in the learning of reading and spelling for children. In an example of one of these games, the player is shown an image, and a partially spelt word of the provided image. The player must then listen to the pronunciation of the missing letters and select them from the list of letters to complete the word.

Figure 11. Cake Monster (Funbrain, N.D)

Online games such as these are the most common types of computer games used within the classroom. They are easily accessible for everyone and don't require the need for disks, hard drive space, controllers, consoles and usually a low-end PC is enough to play them. Some of the most popular game sites, according to techlearning.com, that have been visited are Funbrain, Game Classroom, and gameaquarium. All typically featuring games in all subjects as well as videos and eBooks as well as other teaching resources. After playing several of these games, it can be seen than many are similar to each other in some shape or form. Lacking complex gameplay mechanics or any in depth plot. This can clearly be seen in Cake Monster, in figure 11. The game has a measurement of 0-10 (depending on key-stage level can be higher) and then given a number at the top where the monster is. The player then has to work out where the monster is on the ruler. There is nothing else to the game than this, and so this can become pretty boring fast. But that is also the point, they're simply made for their easy accessibility and easy play. Which is also why probably why such games are so abundant on the internet. Although simple however, they at least offer something to the player to assist in learning or revising. For example, after playing the game Escape Planet X it's clear that this game is more of a revision based game. The player simply has to work out the correct equation to build a rocket ship (Figure 12). There isn't much of a game here, and it's basically just the player answering questions with some moving graphics.

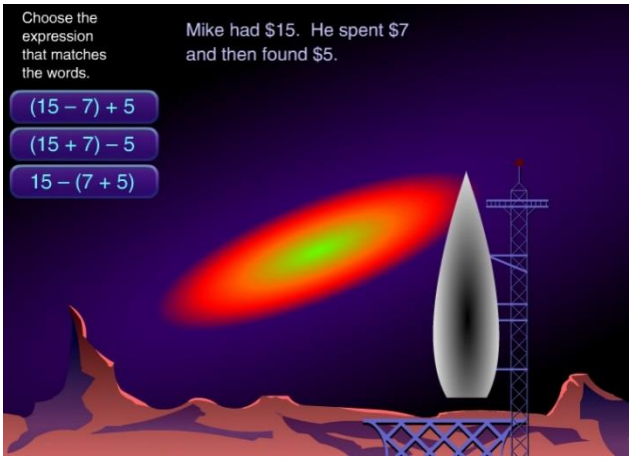

Figure 12. Escape Planet X (Harcourt School Publisher, N.D)

Figure 13. Spherox (BBC Bitesize, 2009)

All of these online games are so simple and basic that they eventually become rather stale. One example of a slightly more fleshed out online game is Spherox, available on the BBC bitesize page (2009). This game is a great way to revise, offering multiple topics, more gameplay mechanics such controlling the ship and navigating through levels, and even features a level editor where players can create their own missions. Players are asked

questions related to their topic at certain checkpoints and need to answer correctly to move on (Figure 13). This game offers much more than the simple click and question games seen earlier.

Though these are very basic types of games, they already show the benefits they have on teaching. These types of games tie in back to the learning pyramid, specifically, reading, audio visual and practice by doing. A number of studies have demonstrated that the use of games aids in the improvement of ones learning process (Munz, Schumm, Wiesebrock, & Allgower, 2007), as demonstrated by Randel (1992) and Mayo (2007). Randel reviews the more instructional effectiveness of games compared to the conventional instruction used within the classroom. The overall discovery resulted in students learning slightly better using the games and simulations compared to that of traditional classroom learning. Following on from the survey, the results showed that the students who had used games and simulations had a better time remembering what they had learned.

Making successful educational videogames can be a challenging process. Videogames are a form of entertainment and are, usually, not exactly aimed towards learning. Some videogames do try to incorporate some form of education however. One of the games that has been studied is Zoo Tycoon 2 (Blue Fang Games, 2004). Zoo Tycoon 2 is a zoo simulation game, where the main premise is to build a zoo. However, they must create adequate habitats for their animals or they become unhappy, this includes correct terrain, foliage and food. The game features 3 modes of play. Freeform mode, challenge mode and campaign mode. Freeform mode allows players to build the zoo of their dreams, with their imagination as their limit. Challenge mode is similar to freeform, in which players can build their own zoos however they like, except they have to manage money and fame. The more famous your zoo becomes (represented by stars) the more animals and buildings you unlock. In addition to money, the player also occasionally gets challenges and awards for completing them.

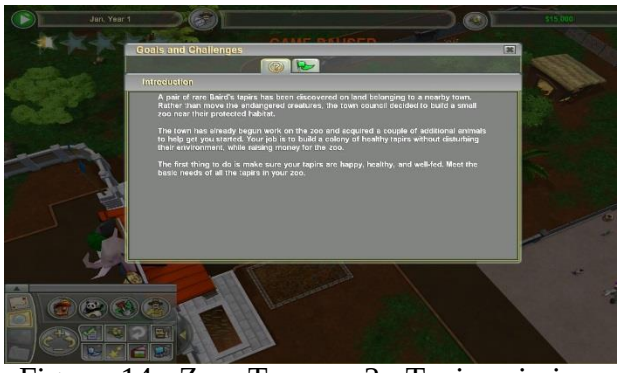

Figure 14. Zoo Tycoon 2, Tapir mission (Blue Fang Games, 2004)

Figure 15. Zoo Tycoon 2, a happy Tapir (Blue Fang Games, 2004)

Examples of such challenges including taking photos for a school to help teach children about food chains, or to breed endangered animals that are critically endangered. Upon completing these challenges players earn a reward or certificate ingame, which also helps increase zoo fame. The above images, figures 14 and 15 shows some examples from a campaign mission in which the player has to protect a conservation area featuring a pair of Tapirs. The player then needs to breed the tapirs to get a health population of 5. During this the mission also has some type of plot, and also attempt to teach about the importance of animal conservation.

Figure 16. Zoo Tycoon 2, When Nature Calls (Blue Fang Games, 2004)

Figure 16 also show the animals ingame with their information windows, showing their health, hunger, ect. This is easily accessible to the player, as is the rest of the games UI. A user friendly UI is one of the many important aspects for a game too, allowing the player to navigate the game with ease.

Figure 17. Zoo Tycoon 2, Encyclopaedia (Blue Fang Games, 2004)

The games encyclopaedia can be seen in figure 17, listing every animal, plant and object in the game with incredibly detailed information, especially for the animals which includes locations, genus class, fun facts, family order and even its conservation status. This feature is an interesting idea and could be something that works the same could be used in this games project. Zoo Tycoon 2 is a fun and creative game that helps teach children about animal

biology and conservation as they play, in attempt to make them more aware of endangered species and how to protect them. Microsoft even partnered with the World Wide Fund for Nature, donating money to the charity, and in turn the charity promotes the game whilst providing educational facts about the various species within (Gaming Excellence, 2005).

Another example of a games with similar features to this is *Wildlife Park* 2 (Deep Silver, 2006), which is an animal park simulation game that features educational facts about animals and plants in the form of an in game encyclopaedia. Some types of video games can already help teach people in their own specific ways, they allow players to apply their knowledge to several complex and varied contexts that would not be available in a classroom based learning exercise. One of the examples of this is the popular game *Portal 2* (Valve Corporation, 2011). In this, players are challenged to analyse the constraints of the environment they are in to solve spatial puzzles in order to progress, this experience influences the players knowledge of physics, and to be able to apply this observation to the game. (Connect: IT at NYU, 2012). Similarly, the video game *LittleBigPlanet 2* (Media Molecule, 2011) introduces the use of tools, such as a grappling hook, and provides a vast range of situations where the players must correctly learn how to use the given tools in order to progress.

Figure 18. Dinosaur World Inventory (Asylum Entertainment, 2002)

Figure 19. Dinosaur World (Asylum Entertainment, 2002)

One game with a similar style of play as the product aiming to be created with this project is the BBC game *Dinosaur World* which was released as a beta in 2002 and never finished. *Dinosaur World* is based on the BBC television series Walking with Dinosaurs. Set during the Jurassic Period, players explore a series of environments, discovering animals, plants and other points of interest, such as pools of water or geysers, Figure 18 and 19. In addition, the players can also place down cameras and then view the cameras from the inventory screen, then teleport to the cameras by the click of a button. The games main goal is to discover everything in the game, and at the end a secret area is unlocked where the player can spawn their own dinosaurs in a larger environment and observe them. As the player discovers each item on their check list a narrator speaks about the specific item, giving detailed information and facts about them. Some of these features link back to those from the learning theories and learning styles, such as audio learners and is a feature that could be beneficial to the game with this project. Because *Dinosaur World* was never finished and is also fairly dated, it isn't the best looking game is also rather buggy, but it was an attempt at an educational game with decent looking graphics for its time.

Using these types of video game interactions, players can be put in authentic experiences whilst expanding and applying their practical knowledge. Along with this, it is also suggested that these types of games can increase important skills such as spatial visualization by manipulating two and three dimensional objects in virtual space (Subrahmanyam & Greenfield, 1994) yet; education is not the primary focus on these types of games. They're made for entertainment. Furthermore, instead of giving players an individual standard experience that would only cater to a specific type of learner, most video games can have their gameplay adjusted based on the past actions and choices that the player has made. The players experience can be altered to favour their preferences and performance. Players can not only change the game options to suit their style, but also some games can actually change the difficulty and the rewards the player would receive, based on how well they are doing. This can be shown in the role-playing video game *Dragon Age* (Bioware, 2009) Players will have a different experience depending on their chosen character and the decisions they make

throughout the game, which affects how the rest of the game plays, and alters what happens within the games world. (Connect: IT at NYU, 2012). So if these games already succeed at some form of learning, and feature so many unique options, games primarily developed for an educational purpose should, in theory, be even more successful. So why has this not fully been utilized yet?

One answer could be that, especially in children, playing a game with the conscious of knowing that you are learning versus playing a game with your own free will, without an intention to learn may be one indication of why edu games are not so successful yet. Children enjoy playing and having fun, however if they are told they are going to be doing a current activity for the sake of learning, they may not want to take part in the activity anymore as they know they will now be learning and may not see it as fun. A humorous take on this is shown in an episode of *The Simpsons* (Groening, 2003) when Bart goes to a toy store he starts playing a videogame and is shown to be enjoying it, however he then suspects that the game is educational and that it's trying to teach him, in which he then throws the controller down, accuses the game of trying to teach him, and walks away. This episode was aired in 2003 where educational videogames was still fairly new and was not so widespread and the technology within videogames was not as advanced as today. Videogames were simpler and were mainly focused for entertainment. There was also a lot more controversy about the effects playing videogames had on children. Many people viewed games as having a negative impact on younger players (Prensky, 2006), and that they 'rotted the brain' of those that played them, and so an educational use of videogames was out of the question.

The field of educational video gaming is beginning to become more accepted and incorporated into the current curricula as a complementary content, thanks to increased investment in this area (Marchior et al, 2011) and the research that has been made to discover what the factors are in game design that have an impact on a video games effectiveness to be used as a learning tool. Although educational gaming has become more abundant, it is also important to understand the difference between educational games and edutainment games. Edutainment games follow a practice in which the player practices repetitive skills, or has to rehearse memorized facts (Dondlinger & Dondlinger, 2007). An example of such a game would be *Metamorphabet* (Vectorpark, 2015). This is a simple game designed to help children memorize letters. The player can interact with letters, and then the letter moulds into a shape that it represents, such as the letter 'A' morphing into an Arch, or the letter 'B' growing a beard. Upon morphing, the game announces the name of the object that the letter has changed into, and shows the word on the screen. Players can also move the object around and click to progress, as well as interact with other smaller items on screen such as birds or insects.

Meanwhile, educational video games require strategizing and hypothesis testing or problem solving and usually include more cognitive processing instead of memorization or simple comprehension. Some of the key components of these games usually feature a rewards system with goals to motivate players, narrative background to set the scene and create the

rules, learning contents that are suited to the plots narrative and interactive clues that encourage learning and offer feedback (Dondlinger & Dondlinger, 2007). One example of such a game would be *Endless Ocean* (Arika, 2007). In this game the player explores the world's oceans and waterways whilst learning about aquatic habitats and fauna. The narrative for the game is that the player takes control of a diver of an expedition team with unique characters as they search the oceans for treasure and aquatic species. These games were primarily targeted towards children of 10 and over but people of older ages can also find enjoyment with this game. The game also features a 2 player mode so parents can play alongside their children as they learn about the oceans wildlife together. The differences in both games can clearly be identified by these 2 examples. The first being a more simplified game for quick tests and revision exercises, and the latter being more of an educational learning tool. This said, edutainment games have still shown impressive improvements in student learning.

A study made by Lee, Luchini, Michael, Norris, and Soloway (2004) showed that a maths game for second grade students which was given to a classroom on handheld devices wielded better results than traditional paper exercises over a period of 19 days. The students using handheld computers completed more questions than the students that were using typical worksheet questionnaires, nearly three times as many. To add to this, the students that were using handheld computers were given instant feedback on their devices after their questionnaires, rather than having to wait for a teacher to grade their papers as you would with traditional paper exercises. In addition, students were also voluntarily increasing the games difficulty without being informed to, which increased the speed of which questions appeared on screen, and due to this the amount of questions answered by students had also doubled. This also supports the idea of games with increasing challenges and difficulty, as previously discussed.

Making a game educational, and also keeping it fun is one of the more interesting factors of educational gaming. As seen with many of the online games, making them fun and educational is difficult. After playing many of the games, it is clear that the majority of them will become boring and repetitive after a short time, especially in games like Cake Monster and Sight Words sun Attack. Other more fleshed out games like Spherox provide slightly more complex scenarios and allow for longer periods of play, with different topics to help keep the player interested. These games themselves however don't exactly teach the player anything. Players would need to know this knowledge beforehand in order to get the answers correct, which is why they benefit more as revision games. Some of these ideas can be taken into consideration when developing Triassic World, perhaps something similar at the end of each level to allow progression to the next.

Some of the more complex games that offer educational aspects such as Zoo tycoon 2 do offer something in the way of teaching. Players can learn about the different animals species, and discover new species and a great deal of information about them. The game also teaches about conservation and animal endangerment, but as with similar games, this would only be beneficial to this exact topic. Animal conservation and endangerment is something that's

rarely covered in schools as is, and so a game like Zoo Tycoon 2 would most likely not find relevancy within the classroom. Games like Minecraft are more popular, but again, still has its limitations. It has been proven its usefulness in teaching students with learning disabilities and concentration problems, but again, it can't teach a whole class an entire module on algebra alone.

Educational games still have their limitations. The main aspect of using video games in a classroom environment is to help bring productivity and fun to school, and although it has shown this can be achieved, thanks to games like Minecraft, sim city and portal, how much farther can it be taken until it becomes boring learning through games. These games aren't purely education based, and are actually just video games with a slight learning boost, Minecraft having a higher learning value. Portal is about a woman escaping a facility with a crazy rampant ai out to kill her. That’s not something that is *exactly* suitable for children to play in school, yet it does offer the complex narrative to create a fun game. Educational games typically lack these elements to make them interesting. Can a game with a narrative and gameplay as complex as Halo be used to teach a students how to do Algebra? Or how to use correct grammar and sentence structure? If games likes this were possible, how would they go about being fun without reverting back to traditional teaching methods and becoming boring again? There’s also the important factor of not everyone enjoys playing video games, so a full classroom playing video games could become tedious for those that do not wish to play games. There is still a great deal of study required in making more efficient and effective educational games.

VIRTUAL REALITY

With the ever increasing popularity of virtual reality, educational video games could become even more immersive and exciting. One such event using this technology took place at a school in the Czech Republic. Students were given Oculus Rift virtual reality helmets where they entered an immersive and educational experience (Road Tovr, 2014). In this particular exercise, the students were given a virtual biology and anatomy lesson. Through the Oculus Rift, the students were taken to a virtual classroom featuring a 3d skeleton model that had interactive parts such as bones and organs in which the students could manipulate and interact with, whilst learning about the different parts of the human body. This type of interactivity can greatly benefit educational video games, as it adds a whole new level of practice by doing, and would greatly benefit certain types of learners, especially those that enjoy learning through interactivity.

Another recent project, similar in design to the game being produced with this project, is *Stonehenge VR* by Voyager VR (2016). This game allows players to explore the Stonehenge monument in virtual reality, whilst learning about its history. As they explore, information is displayed and exposed to players though visuals and audio. Virtual reality could become and amazing addition to educational gaming if done correctly. If it could be implemented into this project it would boost the immersions and create a much more interesting and fun experience. Using virtual reality technology in video games similar to the design built here could create several fun and interesting scenarios and allow students and their teachers to visit places they would probably never get the chance to in the real world. For example, an addition to *Stonehenge VR* could be used to allow all students of a class to enter simultaneously. A virtual trip to Stonehenge would be an exciting experience for all people involved, and would make learning more fun and engaging. However, even more exciting would be going to much more interesting and larger places.

For example, the project being developed here could be used by a science class to take a ‘virtual field trip’ to the Triassic period, as they explore the environments together, learning about this prehistoric world, or another example can be a history class taking a ‘virtual field trip’ back to ancient Rome or Egypt to observe life an ancient city, or watch the construction of the great pyramids. The possibilities would be endless, and if following a similar game structure to this project, and perhaps even more advanced features, would allow for an exciting and immersive learning environment. This type of technology also doesn’t need to be limited to just schools. Exhibits in museums could use this technology. An example could be an exhibit featuring whales, and next to it could be a virtual reality game environment in which guests enter an ocean environment with whales related to the museums exhibits as they watch them swim around in their natural environment. This can also work alongside other examples such as modern or extinct animals. Similar technology could also be used for research purposes for scientists, arachnologists or palaeontologists, helping them simulate and understand what the past may have looked like. A similar, but less complex, example comes from the BBC virtual reality sauropod visualization (BBC, 2016), in which the user equips a VR helmet and is taken to a visual demonstration of a large titanosaur dinosaur as it

walks through an environment. David Attenborough is also present as he talks about the creature and gives information about what the user is experiencing. This is a recent project and could progress into larger and more complex simulations with different animals and larger environments. Virtual reality is still very young and the future of this technology holds a lot of benefits foe education and entertainment.

RESEARCHING THE TRIASSIC ENVIRONMENT

It is important to understand what biomes may have looked like at the current period of time chosen for this project. As this project is all about education, it needs to be ensured that the actual product is educational and has correct facts and information displayed. Palaeontology and paleoart will be the place to start, as these are the main subject areas the game focuses on. Palaeontology is the study of the history of life on Earth as reflected in the fossil record and shows us about the different ecologies of Earths past and the evolution of life on Earth, up to the place where humans fit in. Palaeontology merges the knowledge of biology, geology, ecology, anthropology, archaeology and also computer science, in order to understand the various processes that led to the origination and the inevitable destruction on the number of organisms since life started out (University of California Museum of Paleontology, 2001). The game itself will teach players some aspects about palaeontology, mainly biology and geology. The project will concentrate more on the actual animal species that inhabited the world at this specific time and show players what these creatures may have looked like and how they may have behaved, as well as other various forms of information.

The other focus is on paleoart. Paleoart is an interesting art form. It mixes both scientific knowledge, imagination and even forensic sciences (Eon Epoch Productions, 2010). When creating representations of living animals and environments, you can simply look at a photograph, or even possibly go see the real thing and create it as you see it there. However, when creating Prehistoric art, it's not quite as simple. The animals and environments no longer exist, and the only images you can get of them are paintings or sculptors created by other people, and even they were only scientific guesses from looking at the fossilized remains. When creating Paleoart, you need to take the remains, and then 'assemble them and add the muscle and flesh, this aspect alone makes paleoart one of the purest forms' (Eon Epoch Productions, 2010). Then, once you have the basic form of the creature, scientific guesses are made as to how it may have behaved, what colour it may have been, and what its posture could have been like. Usually, we have to look at modern day animals to help complete the picture. By seeing how modern creatures look and behave, we can take this and add it to the prehistoric creatures.

For example, the dinosaur *Baryonyx Walkeri* may have had a diet primarily of fish, as evidenced by its snout, claws and the remains of fossilised fish found in its stomach. (Choi, 2008) The skull is also similar to that of a crocodile, or a Gharial. New evidence, through computer generated models, has also shown 'while Baryonyx was eating, its skull bent and stretched in the same way as that of the gharial (Choi, 2008). From what we know here, we could safely assume that Baryonyx may have lived and behaved similar to a Crocodile or a Gharial, waiting in rivers and streams to catch fish and passing by small animals, or maybe even similar to a how a bear waits in the rapids to catch passing fish. We could also scientifically guess that Baryonyx may have had a similar colour scheme as a crocodile, as it would have most likely lived in similar environments. These are the types of things that need

to be taken into consideration when creating the creature's and environments for this project, as realistic representations of prehistoric fauna which could possibly be used for educational purposes need to be created, meaning there will have to be a lot of research on the various species to ensure that they are to a realistic standard. If the creatures were made from random guesses with no scientific backup, it would defeat the purpose of this product being educational. Paleo artists make an image of a creature or a plant based on the scientific findings of archaeologists and biologists.

It is important to understand that paleo artist's representation is not the only "correct one" due to the complexity of a subject, every paleo artist can have something different. One of the examples would be Velociraptor: in the beginning scientists thought that *Velociraptors* had lizard like skin, looking more like a reptile, however latest findings have shown that *Velociraptors* were covered in feathers and looked more like birds, as with the rest of the theropod family (Naish, 2014), and which paleo artist have now started to adopted and incorporate into their latest works.

The period of time chosen for this project is an age from what is known as the Triassic Period, which lasted from around 251.0 to 199.6 million years ago (University of California Museum of Paleontology, 2009). At this time, all of the continents of Earth were formed together to, creating a super continent known as Pangea (Fraser, 2006, p.3). This continent began to break apart towards the end of the Triassic. At the end of the Permian, the period prior to the Triassic, one of Earths most dramatic and mysterious extinction events took place which was known as 'The Great Dying' (PBS, 2011). Over half of the Earths families of living specimens died out, and as many as 90-96 percent of the planet's marine species were lost and its estimated that perhaps 70 percent of the lands reptile, amphibian, insect and plant species became extinct (PBS, 2001). Following this extinction event, the remaining survivors spread out and recolonised, and from this one of the greatest animal species of all evolved; the dinosaurs.

Each time period is split into different ages. For example, the Triassic period is part of an era known as the Mesozoic, which includes the time periods Triassic, Jurassic and Cretaceous, Cretaceous being where the non-avian dinosaurs became extinct. Then, each time period is split into ages, also known as stages. The Triassic is formed of 7 ages (Dixon, 2011). Starting with the Induan and ending with the Rhaetian. When developing this project, the different periods and ages were examined to decide which one would be the most ideal choice. The choice was finally settled on the Norian age of the Triassic. The Norian was an important time in the history of life on Earth as it saw the rise to prominence of several numbers of Mesozoic organisms, and the decline and disappearance of others. Some of the animals that exist today first started to flourish in the Norian era including Turtles, frogs, birds and most importantly, the mammals (Palaeos: Mesozoic, 2005).

The next step was deciding which continents to pick and showcase. Although the whole of Pangea was connected, different species lived in different areas and different areas of Pangea had different climates. For example, the central area of Pangea was a much hotter and drier place than the areas around the edges, covered in vast deserts and rough landscapes void of

life, except for certain creatures specially adapted for this harsh climate (Science Views, 2010). In contrast, the edges, areas closer to the oceans, were dominated by large fern forests and it was here where life flourished (Science Views, 2010). Pangea was split into 2 continents, Gondwana and Lauraisia. Which were the 2 super continents that formed together to create Pangea during the end of the Permian. Gondwana was the name given to the southern area of Pangea, and Laurasia the northern. (Fraser, 2006, p.4) One of the well-known locations from the Triassic Norian is the Arizona Petrified Forest National Park that was once the location of a large Triassic forest containing a variety of different species (Arizona Leisure, 2007). This will be the prime location for the North American environment and a representation of this location will be created in the northern section of Pangea in Laurasia. The second environment is set in South America, located on the southern side of Pangea on the continent of Gondwana. This area will be slightly different than the North American environment featuring *Araucaria* (Monkey Puzzle) trees as the main tree plant. This environment will also be wetter and be covered in a selection of fern plants such as *Dicrodium*. This area was home to much larger animals including some of the first sauropod dinosaurs (Fraser, 2006). In order to keep things different and not too repetitive, the third environment is in Europe, featuring creatures from areas such as Italy and England, and is a coastal area featuring a beach that extends back into a forest. This area would be lush with large trees and fern, as well as a large selection of plants and animals featuring creatures such as the pterosaur *Preondactylus* that lived in such coastal habitats (Dal Sasso, 2003).

ANIMAL SPECIES

After researching numerous species of extinct animals, a selection has been made to be featured in the game. Only 2 of the species chosen are dinosaurs, in an attempt to keep the animals more diverse.

1. Kuehneosaurus: *Kuehneosaurus*, meaning Kuehne's lizard, was a small reptile, about 65cm (26in) long. It was discovered in Southern England and was named by P.L Robinson. *Kuehneosaurus* may have glided on the hot air that rose from the arid limestone rocks. It had wings that were made from bone and extended out from the sides of its body. They were articulated and were able to fold back when they were not used. It may have resembled the modern 'flying dragon lizard' from Malaysia. (Dixon, 2011). This creature will be featured in the European environment during the day and will be one of the more challenging of the animals to spot, hiding on tree trunks and rocks.

2. Coelophysis: *Coelophysis*, meaning Hollow form, is one of the best known from the coelophysid group with hundreds of skeletons discovered; some even complete and articulated, and was one of the very first dinosaurs to have evolved. *Coelophysis* was around 2.7 meters (9 feet) in length and was discovered in Arizona, New Mexico and Utah in the USA and was named by Edward Cope in 1889. It was a slimly built predator, and most likely hunted in packs. (Dixon, 2011). This is one of the two

dinosaurs within the game and is featured in the North American environment during the both day the night level.

3. Metoposaurus: The *Metoposaurus* belonged to the big headed amphibian family, the metoposaurs, and were a very successful group of animals. Their remains had been discovered worldwide. It was a large aquatic amphibian with a flat triangular head with its eyes on top of its head, similar to that of a crocodile, and featured very small limbs. It was around 2.5 meters in length (9 feet) and was discovered in the US and Europe. It was named by Richard Lydekker in 1890 (Dixon, 2011). *Metoposaurus* will be featured in the European environment, lurking in streams and pools of water.

4. Riojasaurus: The *Riojasaurus* is the best know prosauropod from South America belonging to the melanorosaurid family, there have been more than 20 skeletons of the creature discovered from different ages giving a good idea of what this animal may have looked like. It was around 11 meters in length (36 feet) and named by José Bonaprte (Dixon, 2011). *Riojasaurus* will be in the South American environment living in a small herd with animals of different ages. This is also the second dinosaur in the game is one of the easier animals for players to locate.

5. Megazostrodon: *Megazostrodon* was an early mammal from South Africa. They were one of the first ever mammals and were about 10 to 12 centimeters long (Prehistoric-Wildlife, 2006). Although this creature is from South Africa, it will be presented in the South American environment, this is not exactly incorrect as South America and South Africa were connected to each other during this time and it is possible for animals to 'bleed' over into different continents, and so is possible this animal lived in this area as well. One example of this is the dinosaur *Iguanodon* from the early Cretaceous which has been found in England, Germany, USA, Spain and Belgium (Natural History Museum, 2005). It is also known that other species of animal do this as well, and can also be seen in modern wild animals such as the Grey Wolf. This shows that most animals were widely distributed and not restricted to a certain area.

6. Morganucodon: *Morganucodon* was another early mammal like *Megazostrodon*. Remains of this animal have been found in Wales, China, Europe and North America, also showing wide distribution as discussed above. It was also similar to that of *Megazostrodon*, small with a gerbil like body and a shrew like head (Encyclopaedia Britannica, 2011). This creature will be displayed in both North America and in Europe. The reason this will be displayed twice is due time constraints.

FOLIAGE

The foliage will be a challenging aspect of this game. First off, grass did not exist at this time (BBC Earth, 2001), and so there will be none within the game. Getting the correct plants from the correct era and location will be a difficult task and will require a lot of research to find the appropriate foliage native to the chosen regions. The main plants known and featured will be the huge *Araucarioxylon arizonicum* trees that dominated the Triassic forests, especially in the Northern regions. These will make up the main foliage in North America and Europe. The primary ground foliage will be typical fern plants, some of these will be *Dicrodium* ferns from the south and *phlebopteris* in the north (Fraser, 2006, p.185 & p.153). Araucaria will also be a vital tree in all continents as these were vastly widespread across Pangea. Other small ground plants include *Calamites,* horsetail like plants, and *Pelourdea*. These grew near water and will make up the vegetation around sources of water and wetter areas. Some other plants include the *Leptocycas,* a primitive seed plant from Gondwana, and bennetitales. These were a common plant from the Triassic through to the Cretaceous (M.J.B, 1988). The bennetitales will be located in the North American and European environments. The remaining foliage will be various sized and shaped tree ferns that will populate the forests.

DEVELOPMENT OF THE GAME

After the initial research and examining other educational medias, production of the project can begin. The game is using the Unreal 4 game engine and the assets are to be created in separate applications including Autodesk 3ds Max for model building, Zbrush for creature sculpting, and Photoshop for texturing. Some assets will be created differently depending on the circumstance, for example, the creation of an animal may be primarily made in Zbrush by sculpting a high poly mesh that may consist of several million polygons, painting the colours and textures onto it, and then Retopologizing the model to create a lower polygon count, usually down to the high hundreds or low thousands, so it will be better suited for use in a game engine. 3DS Max will be used for minor tweaks, as well as Photoshop for texture tweaking or creating variations, however the bulk of the process is done within Zbrush. The other method that may be used when creating assets, such as foliage, sees the use of 3ds max as the primary modelling source, creating the model and then using Photoshop to create the textures. Development images will accompany this paper located in the appendix.

Some important factors that need to be noted before development are:

- What is the games functionality?
- How will players navigate the game world?
- What are the objectives of the game going to be?
- What will the gameplay be like?
- What will the visual style be?
- Should the game be difficult and challenging?
- Will the game be easy to pick up and play?

It is important to figure out the answers to these questions before production. Functionality describes what players are able to do within the games world (Nitsche, 2008). Players need to feel like they have a lot to explore and discover, but they need to have some form of path to follow as to not have them get lost. Open world games such as *The Elder Scrolls V: Skyrim*, a game set in a fantasy universe featuring a vast open world populated with forests, mountains and small villages (Bethesda Game Studios, 2011) and *Fallout 4*, an open world post-apocalyptic role-playing game set in the distant future (Bethesda Game Studios, 2015), often feature Primary objectives to give the player an idea of where to go, and there are typically paths for players to follow. This allows players to not end up being lost with no idea on what they are doing, but at the same time they can still go out and explore the world as they see fit. Some form of path may be an interesting idea to add to the game. Although this game is aimed to be a realistic representation of a prehistoric environment, it may be necessary to break immersion slightly in order to allow easy gameplay. Paths for players to follow through the forests will give them some sense of direction, although they still may stray away from these paths and get lost, but that gives players freedom to explore where they like and to see what else there is to discover. The addition of landmarks may also allow for easy navigation

of game worlds. These can help show how an environment can gain significance and quality or ‘place’ (Nitsche, 2008). Players may become frustrated if they cannot figure out where they should be going or what they should be doing, so a clear objective should be given to them so they know what they need to do. This will prevent players losing interesting and giving up. This can be solved by giving players an objective list that can easily be accessed at the press of a key. This is a common feature seen in many video games that were tested, such as *Zoo Tycoon* and *Dinosaur World*. A system similar to that of Dinosaur World could work, featuring 2 sets of objectives, one for the dinosaurs and one for other features such as environmental interests. The primary objectives can be the animals found in the environments and the player is given a clue as to where they may be, such as near specific landmarks or locations. This gives players a clearer objective on what they must do. Then, the secondary objectives would be the other points of interest, and rather than giving the player clues, do not, and instead have a small description of what it is they must find. This persuades players to explore the world on their own more and also adds a new level of difficulty, as shown in the study by Lee et al., (2004), children enjoy the addition of a challenge. This was also shown in the study done by Ronimusa et al. (2014), where the children enjoyed being rewarded for completing harder challenges. Some type of reward for completing thsese secondary objectives is something to consider, to follow through with this research. However, to stick with what Nitsche (2008) said, the game is to feature a ‘points of interest’ option that, when activated at the press of a key, will highlight the secondary objectives for the player. This makes it slightly easier on the players behalf, however they still need to actually have the required items in view in order to see them highlighted. One of the features of *Dinosaur World* is the addition of a map, showing the area layout and the locations of dinosaurs. *Triassic World* could also also feature a simple map of the whole area that can be opened at the press of a key, and show the landmarks and provide clues to the objectives locations in a similar manner. This map will only be basic however, and so won’t give players all the answers, and instead help the navigate the world

Visualization vs gameplay is also an important area. As a single person developing this game, a lot of work will need to be put into this project and certain elements of the product will be prioritized over others. For instance, the animation of animals will be less important than the educational elements of the game. Animation is a long tedious task and should only be implemented if time is available to do so. The primary factors are to first make sure the game as a whole works smoothly, with the main foundations set. This includes launching and quitting the game, a fully integrated user interface that allows players to navigate to different windows, and at least 1 level available to play within that successfully loads and quits as expected. This level then needs to feature at least 1 species of animal with a fact sheet available for it, with the correct information displayed. Incorrect information will defeat the purpose of this being educational. Once this has been completed, the rest of the game can begin building up from this stage, adding more content and playability.

Difficulty of the game also needs to be taken into consideration and has room for flexibility. As discussed throughout this research, game difficulty is a factor that needs to be managed carefully when developing an educational game. Certain aspects of the game could be made

easier than others, for example, certain animals may be much easier to discover than other animals. A large sauropod herbivore will be far easier to spot in the middle of the day compared to a small rodent creature in the middle of the night. As proven within the research, children enjoy things that challenge them and it makes learning more fun (Taylor, 2014), (Brown, 2007). Challenges also make players feel good when they are able to overcome them (Habgood & Overmars, 2006, p.88) This said, it has also been shown that if the challenge is too difficult to complete, then the players may be put off from playing, lose interest or just give up, and that can cause them to feel bad. (Habgood & Overmars, 2006, p.88). This is something that needs to be noted. As this game is an open environment, the challenges should not be too difficult. Due to lack of time, many of the more advanced features of the project will not be implemented. Some of these topics would be completing certain objectives' in one area before being able to progress to the next, and one of the more important ones that would have been useful to include would be animation. This way the player can be clued on where a specific creature would be, or what it would be doing, and then this would be represented in game. For example, the clue regarding Metoposaurus would be something along the lines of finding the creature hiding in shallow waters waiting to ambush unsuspecting prey. The player would then know to keep an eye out for these creatures lurking near water sources and also be able to witness them attacking their prey. This would benefit the Visual learners immensely, as they would be watching and learning about the animals behaviours within this project as shown by Colorado State University (2008).

In regards to difficulty, the previously mentioned primary and secondary objectives play a large part in difficulty variation, the primary objectives being the easier challenges to complete, and the secondary the more difficult, yet the points of interest and the map can be used as an option if players are finding the game too difficult. Woking from the research on the topic of other educational games, more specifically, how players navigate world space, such as the studies by Graf et al (2010). It is important to give guidelines for players to follow a path, as to not get lost in the virtual world, but at the same time, they need to be offered the freedom to explore and do as they please, so they are not fixed to certain objectives and limitations. To solve this, players have the choice of following a path through the environment's that leads them to the main objective areas within the world, taking them to the more important animals and sites. However, players can still wonder away from the path and explore the area as they please, discovering things on their own and learning at their own pace, another benefit of educational gaming. This also gives players more of challenges as the extra objects to discover are much more difficult to find than the main ones.

Furthermore, a feature that was not fully implemented due to time constraints was the ability to complete objectives with rewards and unlocks. As a final game, this project would start with only the North American area unlocked, and have primary and secondary objectives. The primary objectives would be to discover all of the main creatures in a given environment. The secondary would be to discover all the hidden points of interest items. Once players discover all of the primary objectives, the second environment would unlock, which would be Europe. Europe would also have primary and secondary objectives, then when the primary objectives for Europe were finished, South America would unlock. If the player was able to

complete all the primary objectives and secondary objectives of all areas, they would be awarded a bonus environment that would be set in the ocean and feature large marine creatures in which they could swim with and discover, and perhaps even control. This would tie into the previously discussed play and rewards features, and working towards something to unlock would encourage the player to complete the objectives to unlock the bonus (Ronimus et al, 2014). This was not properly implemented into the game however, and only a very basic structure was set up to act as a demonstration of what could be in a final product.

This project originally aimed to have 5 environments, but due to time restraints was cut back to just 3. The original planned areas were:

- North America – Desert landscape with oasis (eventually changed to a more lush area)
- Europe – Coastal area with large conifer forest
- South America – Swamp like forest (eventually changed to have a less swamp like atmosphere)
- Underwater area – tropical reef
- Central Pangea – vast desert
- Ocean – Pelagic ocean

These were cut to the top 3. The last 3 areas would have been too much to create with the limited time and man power. The reef environment would have featured some of the Triassics strange and beautiful marine life, from corals to early fishes, ichthyosaurs and plesiosaurs. Inspiration from *Endless Ocean* was taken into consideration when planning this environment and would perhaps have been similar in some way. Though the game as it stands doesn't allow the player to interact or photograph creatures, this mechanic was also considered and can be read more about further down. The desert area would primarily be an empty landscape with very little life, similar to the Sahara desert, to show the contrast in climate change. The ocean would be the bonus level that players would unlock for completing everything would allow the player to take control of the largest animal to have existed at this time, a large Ichthyosaur. The 3 environments that were chosen went through a massive amount of changes, ranging from the types of animals, plants, and the general layout of the whole landscape. These can be seen below as each environment process was documented. Progression images can also be located on the disk accompanying this paper and also in the appendix are videos of the different stages of the games development, from earliest versions to latest for a better look into the making of Triassic World.

ENVIRONMENT 1: NORTH AMERICA.

The first environment to be created was the North American area. This environment went under a drastic amount of changes from the start of the project. The original layout for this area started out as a large open space situated within a large valley surrounded by mountains, similar to something seen at Zion national park, USA. The terrain was an arid and sandy with minor foliage and water. The terrain was quickly generated with a program known as World Machine, a tool that allows the creation and generation of terrain on large scales which can then be imported into game engines.

The first draft of the environment was very simple and yellow. After revising the area, a more natural sand colour pallet was implemented, along with some basic trees. The foliage that was populating the area was known as a *Bjuvia* tree, a Triassic cycad like plant from North America. This plant however didn't make it into the submitted product and was replaced with the more common typical tree ferns due to not enough evidence to support the fact that this plant did indeed exist at the current time the game took place in. The open canyon continued receiving makeovers and layout adjustments until at a certain point the whole level was scrapped and restarted.

As The large open space seemed too much of a task to fully populate and make look attractive, as well as filling it with enough things for the player to do, the area was started over into a far smaller environment. Keeping with the desert and arid theme, the new area was much smaller, featuring a single tight space located within a canyon. This area was also revised dozens of times, replacing and designing new textures, creating different types of assets for the cliff walls and terrain, and changing the lighting and atmospheric effects, even the general layout and position of the stone assets. After a couple of months this area expanded outwards from the canyon to a small oasis surrounded by sand dunes. Situated around this oasis were fern trees and small shrubs such as *bennetitales.* Expanding upon that, the environment expanded even further with an added forest featuring giant *Araucarioxylon arizonicum* trees. In time, this environment eventually transformed from the initial design, removing the arid desert theme, and making the area lusher, featuring more foliage and less sand. This is a more accurate representation of the area of North America the environment is set in (Fraser, 2006, p.144). As this area is located near Arizona, reference was taken from the Petrified Forest National Park that covers an area of 93, 500 acres (National Geographic, 2009). The area now is an arid landscape featuring large fossilized tree trunks, but about 200 million years ago, the area was home to an enormous forest featuring an incredible range of fauna (Arizona Leisure, 2007). The North American environment is an attempt to recreate this area and to show players what it may have looked like at that time. The primary reason that the area was desert themed was to keep the different environments slightly varied from each other, North America being arid, Europe being temperate, and South America being lush and wet. The recreation of the Petrified Forest National Park is a far more interesting

substitute however. The night time version of this level is basically the same as the day time version, except its dark.

ENVIRONMENT 2: SOUTH AMERICA

This environment also went under a number of changes through the games development. This area started life as a swamp like area, featuring lots of algae, moss, pools and large trees and ferns. The main change that happened within this area was the primary tree that populated the space. The original tree used in the earlier versions of the game was a *Glossopteris tree*. Searching for valid information about this era was challenging, especially from the southern continents regarding foliage. *Glossopteris*, which means "tongue fern" due to the shape of the leaves looking 'tongue-shaped', was the largest and best-known genus of an extinct order of seed ferns known as *Glossopteris*. Although the *Glossopteris* was from South America, there was no conclusive evidence of its existence in the Triassic. Unfortunately sources found during this this research about *Glossopteris* as a Triassic plant were contrasting, and so to play it safe were not included within the final. The book about the Triassic period, *Dawn of the Dinosaurs* wielded information about Araucaria trees that lived in South America during the Norian of the Triassic (Fraser 2006 p.190), and these ended up replacing the *Glossopteris*. Although the *Araucarioxylon arizonicum* trees lived in the south too, there weren't any added to this environment as to have it vary from the other two in foliage. Having the same trees in all 3 locations would become quite stale. The swamp feel still remained in the final version of the level however, due to the river flowing through this area and the number of pools located through the environment as it also added some variation to this location. Another change was the weather. Originally, due to first revision as a wet environment, the weather was cloudy with rain. This was later removed and changed to a sunny clear day instead. However, the night time version of this level still features rain with a cloudy sky, and also features thunder and lightning that really makes this environment atmospheric.

ENVIRONMENT 3: EUROPE.

This environment didn't have as many changes form the initial design as the others, if any. The main focus of this environment was to be set in a coastal area, featuring a beach, ocean and a large fern forest. The fern forest within this area was to be populated with various animals wandering through the denser undergrowth. The 2 creatures that are in this environment are the *Metoposaurus* and *Kuehneosaurus*. The large Forest is another reference to the Petrified Forest National Park; however the animal life would vary from its North American version. The introduction of a coastal area also makes the environment more unique than its North American counterpart, adding the exploration of the shoreline to discover dead marine life such as skeletons and smaller animals that have washed ashore. This area also allows different animal species as to those that would be in a central forest area, animals more adapted to a coastal climate can populate this area. The night time version

of the environment is also mostly the same, apart from the tide is raised, meaning that access to the beach has been removed.

AUDIO

Creating audio for the game was a challenging subject, especially with the forest ambience. Finding free audio sounds of forests without any birds was difficult, as there were no birds during the Triassic period. The majority of sounds featuring in the game are that of frogs and cicadas as well as the sound of wind and water, and various custom made dinosaur calls. All of the sounds used in the game are taken from free sound FX sites, such as *Freesfx* and *SoundBible*. The sounds of the dinosaurs were created using the program audacity and are the sounds of various birds slowed down. This was simply done by collecting the sounds of different birds, such as black birds or peacocks, and then lowering the speed in the program *Audacity* to various levels depending on the scale of the dinosaur. For example, the peacock was used to create the calls of the large pro-sauropod dinosaurs and was slowed down more than the sounds used to create the small theropods, which were black bird sounds. So, the larger the animal, the more the speed was slowed down. In addition, pitch was also adjusted slightly and the audio was amplified to give a deeper sound. This idea was taken from the documentary *David Attenborough's Natural History Museum Alive*. In this they talk about the sounds dinosaurs may have produced and how they may have sounded, and demonstrate this for the Diplodocus by altering the sounds of a bird by lowering its speed and pitch (Attenborough & Smith, 2014). They also explain how, the larger the animal, the more deep the sound would have been, and demonstrate this with ostriches and emus, that have deeper sounds compared to smaller birds, that are more high. This same method was used to create the dinosaur sounds of Triassic World, using bird's sounds such as Eagles, Peacocks and Blackbirds. These sounds make for a much more immersive and atmospheric experience and make the world feel more alive. An example of the sound creation can be seen in figure 5.

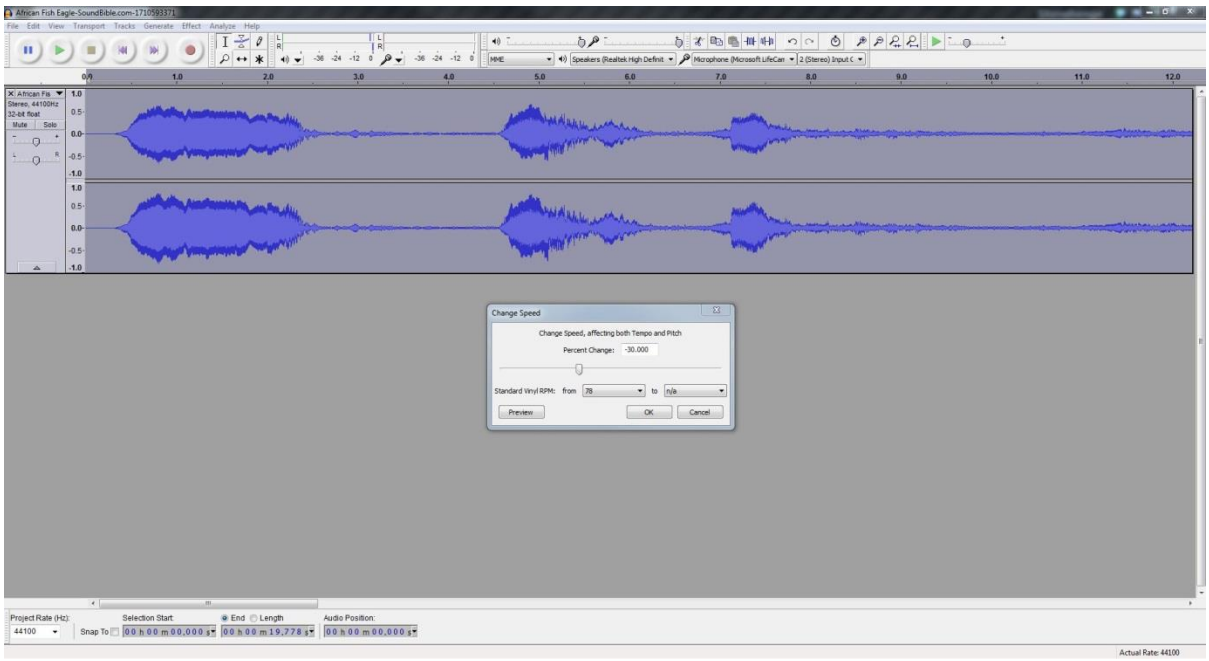

Figure 20. Creating the audio for the dinosaurs

OPTOMIZATION

Optimization of the game is an important aspect as it must be ensured that the product will work on a majority of different machines. This is a challenging task, as it's not possible to know what machines the game the game would be running on, or what the machines specifications would be. There are some of precautions than can be taken to ensure the game will be playable on a larger range of machines. Some of these include:

- LOD (Levels of detail) generation: Creating LoDs for all of the assets is one way to help increase game performance This works by creating copies of the same model, each new one having fewer polygons or triangles than then last (polygons or triangles are what make up a model, example can be seen in figure 6. The white wireframe around the model makes up the triangles/polygons). Then, when this model is placed within the game world, the various levels can be controlled to when they should be displayed. For example, if a model is very close to the player/camera it would display the model with the most amount of detail (highest polys), then as the player/camera moves away from the model, the model switches to one of the different meshes that has less polys, and the further away the player/camera moves, the more levels it displays, depending on how many levels of detail are created. This allows for increased performance by having fewer polygons rendered in the game world at the same time. This has been done for all the assets in Triassic World to get the best performance out of the game. An example of this can be seen in figure 6 on the *Araucaria* tree.

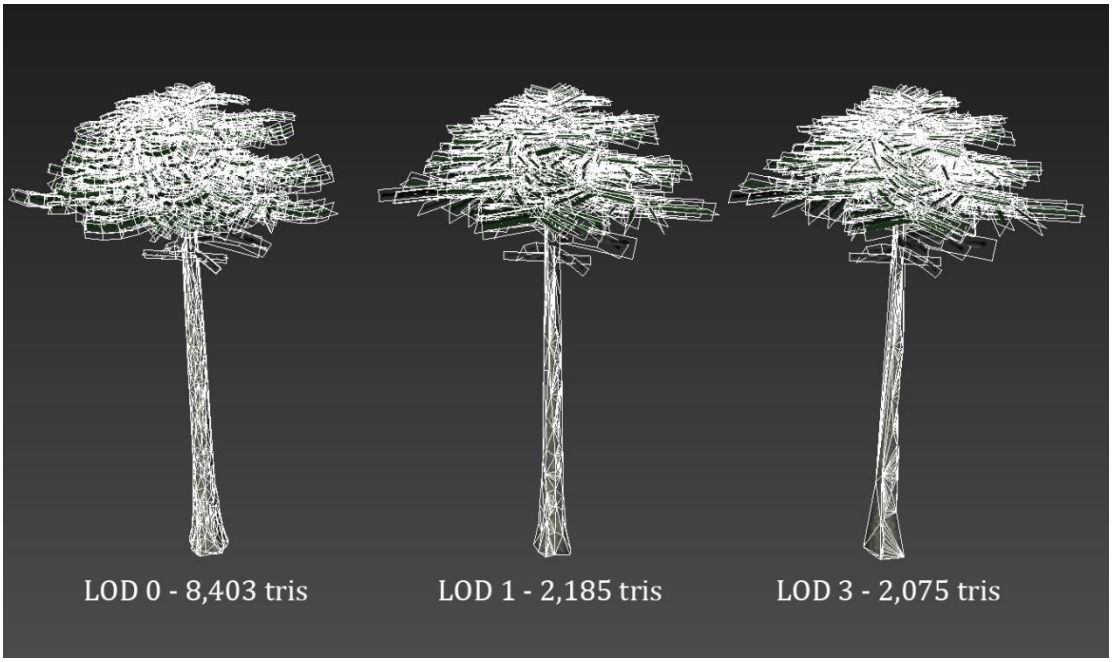

Figure 21. LODs for the Araucaria

- Draw Distance: Draw Distance works similar in a way to the LOD generation, however instead of showing lower quality models at a distance, draw distance controls whether they render at all. So, after a certain range from the camera/player, the object will not render at all and not be visible, greatly improving the games performance at a cost for visual looks. This works best on smaller plants like grass or ferns, rather than larger trees, as it's not as noticeable on smaller objects, but larger object such as trees would be very noticeable as they disappear from view, or suddenly spawn into view, after a certain distance.

- Texture Size is pretty straight forward. Having smaller texture sizes increases performance, and certain objects will require certain texture sizes to have great quality and also great performance. For example, having small plants like ferns with 4k texture maps would kill performance, as there would be so many of these types of plants rendering 4k textures simultaneously. Whereas having large objects such as the trees with small textures like 256x256, would make the objects very unappealing. The smaller objects like small stones and ground foliage will be ideal with having textures around 256x256 or 512x512. Larger objects can get away with perhaps 2k textures. Another method would be to create smaller texture sizes for the different levels of detail, so for example the large tree closest to the player/camera would have its highest level of detail displayed, and perhaps a large 2k texture. This would make the model very appealing to look at. Then as the player/camera moves away from the object, the lower levels of detail will begin to render, and instead of using the higher 2k texture, it would display a smaller texture at perhaps 512. Such a high resolution texture would not need to be rendered at such distance, as the player/camera wouldn't be close enough to appreciate its quality.

KEY EDUCATIONAL FEATURES OF TRIASSIC WORLD

In order to give the product more educational value, a number of varying mechanics were to be added to the game. The game itself already had the benefits of a ‘practice by doing’ method, featuring the 3 large open environments for players to self-explore, and a guided path to help them locate the main areas and features. This path has been added into the game for a more practical approach, rather than realism. Without these trails, players may become lost in the environments, and then getting lost may result in boredom for not being able to proceed. On the other hand, some player may prefer the ‘blind’ route and instead take an interest in venturing off path, in order to see what they can discover. To appeal to these types of players, there are items and points of interest hidden throughout the world, located away from the main path, for them to discover.

Despite this, just exploring an open environment wouldn’t alone be enough for a full educational tool, without enough information to gather. Therefore, the 2 main educational aspects are the built in encyclopaedia and the fact files. The encyclopaedia is to feature information about the various topics visited on the player’s adventures, that wouldn’t fit in anywhere else. This includes information on cases like *Theropods*, or *Panthalassa*, terms used in the game but not explained in the fact files. This information can be easily accessed with a few clicks of a button, detailing the information needed to explain these terms, and an image to go along. This also helps address the visual learners. In addition, those that prefer to read will also benefit from this area as well, as they will with the Dino fact files. The encyclopaedia is also, in a way, an easy way to learn about many of the things about the Triassic, and the prehistoric world, but it doesn’t provide all of the learning value of Triassic WorldThe Dino fact files are the key aspect of learning within Triassic World. An example of

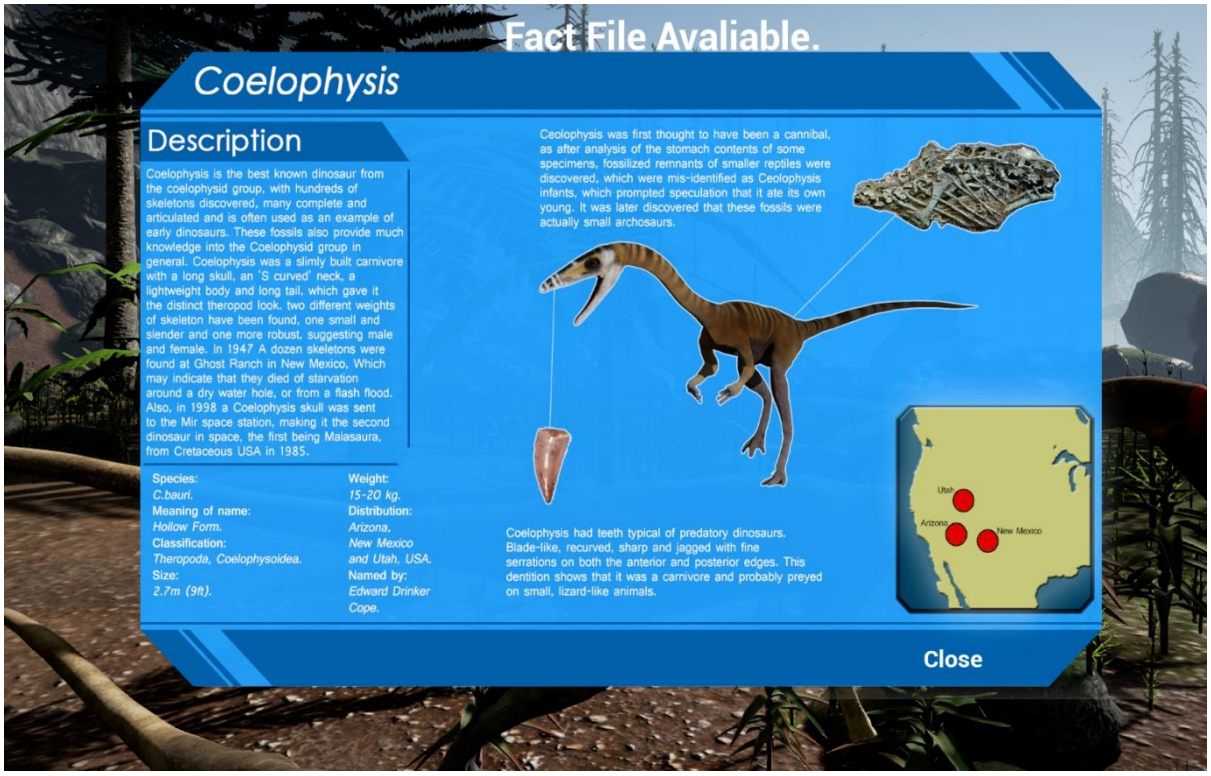

Figure 22. Coelophysis fact file

one can be seen in figure 7. The dino fact files take inspiration from zoo tycoon 2's and wildlife parks animal sheets, in the way they display information and images. A nice an appealing UI layout makes it more interesting to look at. These are scattered throughout the environments, situated where the corresponding creature is and are the games 'primary objectives'. On the objectives menu, the player is given a clue as to the whereabouts of the specific creature to help them locate it. The player must then actively search out the animals. This is inspired by the mechanic used in *Dinosaur World* for finding facts. *Dinosaur Worlds* system was slightly more polished however, and with more time and experience something more appealing could be added. When players find the animals, the fact file can then be activated by standing near the creature's general location and pressing the corresponding key, which is 'E'. This is also shown in game, when the player is near a fact file a message is shown at the top of the screen and the key required to press is, as shown in figure 8. This fact file then features a brief description, images, and various forms of information such as the palaeontologist that named it, the location it was discovered and so on. This builds upon the learning by reading and visual again, but now has more of an impact on the 'practice by doing' as players now have to work to acquire the information. As an addition to fact files, there are also 'world information facts', these are presented through the game as floating blue 'i' icons, as shown in figure 9, and are positioned in key locations that, when activated, display important information about the environments features, overall fauna, and other interesting sources of data. They work in a similar way as the dino fact files, except these are not hidden and are positioned near the starting area of an environment.

Figure 23. Fact file location example

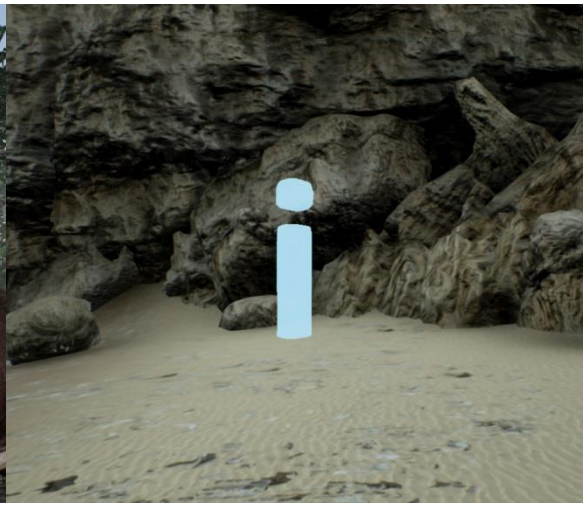

Figure 24. World information fact location

The games 'secondary objectives' are known as 'points of interest' and are more of a challenge to discover. Unlike the primary objectives, the secondary objectives do not offer the player clues to where these objectives can be located. These items give information on other interesting objects throughout the world. Due to these items being more difficult to locate, an object highlights feature has been added to the game. Pressing the corresponding key, which is 'H', will activate 'Points of Interest mode', in which objects that can be

accessed for data will flash blue, making it easier to locate, as seen in figure 10. This of course is optional and is only there if players find it too difficult to discover all the items. These 3 mechanics refer back to the difficulty of educational games, the world information facts being the easiest to locate, dino fact files being a more medium line of difficulty and the hidden points of interest the more challenging pieces of information to collect, whilst also keeping in mind that, as mentioned earlier in the paper from Habgood & Overmars (2006), the game shouldn't be too challenging as we don't want players to lose interest if they cannot find the objectives, which is where the highlights feature comes in. The searching of these facts also has a higher impact on the learning style of 'practice by doing', as the players are actively searching the environment for these items using their own knowledge. A good example of this is the secondary objective on the European environment. The objective is to locate an Ichthyosaur skeleton. Although there are no clues, if players have read the encyclopaedia on ichthyosaurs, or already know a bit about these animals, they will know that they are large marine reptiles (Fraser, 2006, p. 32) and so the most logical place to search would be along the beach. This is also similar to the online games that require the player to know certain facts before playing the game, and encourages players to study more themselves in order to progress.. As an extra feature, to keep things interesting and not too repetitive, the information windows for these points of interest include a 3d model of the inspected item that rotates in 3d within a window on the fact sheet, rather than just a static image. This makes things a little more refreshing and unique.

Figure 25. Points of interest mode in action

As a form of review, to test player's knowledge of what they have learnt, the main menu will feature a quiz page that will have questions for players to answer ranging in difficulty.

Players will be able to answer all of these questions after fully playing the game, as all of the information required to answer them will be available throughout. This is also similar to many of the flash games seen online that are revision based. With further work, the quiz page could be much more engaging with animated graphics and models, such as dinosaur work cycles, fossils, and other relevant images. The quiz is aimed towards classroom based learning, where the students can take part in the quiz, and then come together as a group with their teacher to discuss the results and see who answered correctly. This relates back to the Learning Pyramid regarding group discussions and Kolb's Learning theory as well on the active experimentation stage. This part, along with the features discussed earlier about unlocking the environments and bonus area, was not fully implemented and only a basic version has been added. This would act as an after play topic, where players answer the questions that the learnt from playing the game to test their new found knowledge. The answers to the questions on the quiz page can in fact be found by playing through the game. These key educational features also coincide with what Mitchell & Savill-Smith (2004) express what an effective educational game should include, being learning objectives for players and the ability to understand through experience or through investigation.

There are still tons more features that need to be added, and as the game stands, it's almost as unfinished as *Dinosaur World* is. The idea of cameras used in *Dinosaur World* is something that could be an interesting idea to be used in this game, and if the dinosaurs ai was added, would make this more effective. In *Dinosaur World* the camera can only be used in set locations and is the same every time. With unpredictable behaviour, these cameras could be more interesting to use. Narrated audio was also considered, this would help more with the auditory learning style, narrating the game similar to that of a documentary, especially if the games cinematic modes were working as well.

TESTING AND FEEDBACK

Acquiring Testers and getting feedback was a challenge on such a large project, especially when the product itself is still only in the Alpha Stages. The best area to get feedback was from YouTube video updates, exposing the public to the games development and seeing people's comments on the gameplay and features. The game was received positively and people were expressing their excitement for such a product, with some even offering to support the game in some way or form. One such interesting comment was "Amazing. I have a very hard time imagining what the world might have looked like in this time but you have a real talent for making these environments feel lush and truly alive" This comment shows the game delivering one of its intended purposes, to show people what the world may have looked like during this time. Another area for receiving feedback was through forums, posting about the project on forums with similar interest to the game being created, where it was also received positively. One of the positive comments was "The Triassic is such an underrepresented time across all forms of media, and it's great to see that someone's finally giving it some attention". All of these comments can be seen from the actual videos, found in appendix A.

Further towards the end of the project, one of the smaller companies that were contacted responded to feedback request. They are knowns as Everything Dinosaur and are based in England. Everything dinosaur is primarily a toy shop set in Chester, UK; however they do several activities and workshops, co-operating with schools throughout the country to educate younger children about palaeontology. The group is made of amateur palaeontologists, teachers and general fans of prehistoric life. After getting into contact with them they recommended advice on books and sites to read, and offered some tips and feedback to go with the project. They also posted a blog page dedicated to the game, a Facebook comment and a forum comment, helping advertise the game and to bring in people who would be interested in testing. After several days, over 30 people had gotten in contact via email offering help, support and feedback for the game. People from all over the world and from different professions, including Geologist, palaeontologists and graphic artists, as well as People of differ rent ages, from younger children to adults. These people were sent copies of the first Alpha build of the game to have a play and see what they thought. A couple people responded with their thoughts and opinions on the project which helped shape the game's outcome. These people concluded that the game was proceeding nicely, and that it was looking great. They also pointed out bugs and glitches that they came across and expressed how they would like to see the game progress further. Some of the more notable emails can be found in appendix 4.

If the project could be taken further it would have been great to release later versions for more public testing, and perhaps even make the game bigger. It is a shame that there couldn't have been more players testing the game, but as stated, the aim was to produce a prototype version that worked. The comments received in other forms however were positive enough

that the game may get some good attention, and the majority of people were excited and looking forward to seeing an initial release that could either be purchased or downloaded free. Either way, the positivity the game received was very high.

CONCLUSIONS

The purpose of this research has been to investigate the effects video games have on education, by exploring different learning styles, previous studies into educational video games and by building an educational video game to try out some of the found results. The conclusions are drawn from the analysis of educational gaming and the practicality of the product created with this project.

The question regarding Video Games Technology being used for educational purposes has uncovered a great deal of positive points and, although perhaps not being answered for definite, has a lot of strong points favouring the used of gaming technology within the classroom. Several studies have proven the effectiveness video games have on teaching, and as many surveys have shown, it is continuing to grow in popularity and proceed to show its potential within the field of education. Video games technology has come a long way over recent years and will continue to exceed our expectations as technology advances, especially in terms of virtual reality, which is becoming ever increasingly popular. It is already seeing wide use in schools and is beginning to work its way into school curriculum.

Many of the videogames examined in this paper show positive aspects of education. Older games like *Zoo Tycoon 2* clearly have education in mind, as evident by the encyclopaedia and focus on teaching children about animal conservation and endangered species. Minecraft has also proven its place amongst education, already seeing wide use in schools and aiding many students, especially those with disabilities, keep up with school work and keep them motivated. Surveys from a wide selection of teachers proves this and it is clear that the numbers will increase in due time. Other games such as *The Talos Principle*, *Dinosaur World* and the ever increasing number of online games will also continue to show some use in education in different shapes and forms. Games like *The Talos Principle* are excellent for motivating children and keeping students engaged, and Online Games will continue to provide excellent revision practices for pupils, and to give them a break from traditional learning methods.

However, educational video games still have their limitations and cannot replace traditional learning methods completely. Most educational video games only work as teaching aids or revision practices and don't allow perfect teaching on their own. Many games that feature challenges and puzzles usually require the player knows the information before playing, and other games usually just require the player to think, which while does provide great brain exercise, doesn't exactly teach the student anything. The popular game Minecraft definitely helps with teaching students and helping those with learning difficulties, but it cannot replace traditional teaching completely. *Minecraft* cannot teach a child to read and write. *Zoo Tycoon 2* cannot teach players how to do Maths, and *Dinosaur World* won't help students in any other topics except the Jurassic Period, and even this game is now outdated and most of its facts are now incorrect by several years. Online games like *Sight Words Sun Attack* and many games from starfall.com offer many challenges and puzzles that test the player, but they don't *exactly* teach the player. The player must know some type of basic maths and English before

playing such games, which can only, for the time being, be taught through traditional methods, and only work as revision exercises. Perhaps games need to be developed with more of a traditional teaching method in mind if they are to truly take off, rather than just being puzzles and challenges. But then this brings us back to the whole point of video games being fun, and teaching children to read and write and do maths in a video game can be difficult to implement in a fun way, without reverting back to traditional teaching methods. Or perhaps traditional teaching methods within a gaming environment is the next step? Virtual technology could definitely make this possible, and only time will tell if such ideas take off.

The product developed along with this project has come a long way and has shown great promise. The game was originally intended to be a prototype but exceeded these expectations and made it into the Alpha stages. The main foundations for the video game have been set and the remaining primary features that are needed are a working unlock system, animal A.I and animation, and more interactive puzzles and interfaces. Once these remaining features are added and the game gets some fine tuning, it would be suitable for an initial release. As the game did not get any thorough testing, it is impossible to say for definite if it has met its purpose with 100% accuracy. As with educational gaming in general, further study and research needs to be conducted to gather more solid evidence.

However, the project did aim to meet certain expectations hypothesised by the initial research. This being the primary audience of the game being converging and assimilating learners. As discussed further in the research, these types of learners would benefit from the active playing of the game, exploring the environments and discovering the creatures, as well as reading the facts and encyclopaedia. This is also similar in the way *Dinosaur World* was created and works in a similar way. The Encyclopaedia also assists in the Assimilating learners, and was largely inspired by the use of the Encyclopaedia seen in *Zoo Tycoon 2*. The initial framework for the project was to create a prototype simulation of a prehistoric world featuring explorable environments with various animals species placed in them to discover. These goals were met and exceeded with 3 nicely sized environments and a small selection of species and items to discover in each.

Although the game is a bit slow and lacking due to limitations, the original goal was still met, to create a prototype for an educational simulation game. Further testing from players would have wielded even greater results and could have provided a more concrete answer of the games success. With only a small number of responses from game testers, there isn’t enough evidence to conclude its success, and the game can only be judged for what it features now and how these features reflect the learning styles and other educational games research throughout the paper. The select feedback from testers and other people that have viewed or seen this product in action was very positive and all express that this game is a great educational tool, able to teach people about its dedicated purpose. The game could see good use in museums or classroom environments as a fun new way of learning and understanding new topics. *Triassic World* could be used as a basis for other topics of education, applying the same game mechanics and learning system to other areas like History, biology and sciences.

The game provides an example of what could be possible if more work was put into make educational games and if they were treated with the quality of a triple A game, they could be much, much more.

Due to the limitations of the project, there were many things that were intended to be included with the product. Animated creatures being one of the primary ones. Lack of knowledge of rigging and animating was ones of the limitations of this, but also the fact that rigging and adding animations to characters takes a lot of time, and as this was not a priority focus for the project, had to be moved to the side. In addition to animation, artificial intelligence was also on the table. Having the animals behave on their own, moving around the world, interacting with each other, hunting, mating, sleeping and feeding would have provided an incredibly immersive world, and is something that would have been great to have. There was also intended to be more puzzles and challenges for the player, rather than just aimlessly wondering the environments. Players would be able to find clues, interact with the environment, place cameras and use the map for live tracking. These ideas were also similar to the mechanics used in *Dinosaur World* and would provide for a much more interesting experience.

Some other features that was considered was a more interactive world in general. As the game stands now, the player has no story and no apparent effect in the world. They just move around the world as a camera clicking creatures to bring up an image of a fact sheet. Further work would see this whole design changed. Larger worlds and a day and night cycle, rather than small confined environments where the player chooses day or night, and the player would have an actual impact within the world. Creating camps, tents, fires and bait to attract animals, hiding from carnivorous predators and an interesting mechanic that was considered was photography. The player could then explore the worlds, creating lures to attract different species for the perfect photograph, or observe a predator hunting its prey and snapping images during the process. A more interactive fact sheet menu was also planned. Instead of an image, there would have been animated screens and windows, showing the different species with walking cycles and the ability to see them with their skeleton, muscle tissue or in full colour. A journal was also on the drawing board, as an even more immersive and interactive way to learn. As the player discovered more about the world and the creatures and plants in it, the information would be added to the journal for players to read. The journal could then also be used to make notes on specific species and how to find them. The original scope of the project was largely oversighted however, and perhaps if instead of making a game, a demo of a small environment featuring one or 2 animals with more of the above features could have been more beneficial. But then again, the game would have also not featured the open world exploration that was intended for the project. Either way, this product has great potential, and could progress into a series of similar games following the same mechanics, as well as implementing the mechanics originally intended. If more people were able to work on such a project, then perhaps something more successful could be created.

To end this then, it is clear that further study needs to be made into educational video gaming in general. Further testing of games used within the classroom needs to be conducted, as well

as making more of an effort to create games with the intention of education in mind. Seeing triple A games make more of an impact on the educational scene is something that would be great to see and the addition of virtual reality will take it to next level and is something to definitely look forward to.

APPENDICES

APPENDIX 1

Triassic World Stage Builds via YouTube (in order of publishing). These videos were uploaded over the course of the games development and can be seen how the game changed each during each build.

1. MRES_Triassic_Education_Game_Test_1: https://www.youtube.com/watch?v=nMv2-rtnoMM
2. MRES_Triassic_Education_Game_Test_2: https://www.youtube.com/watch?v=ydxxR3AgVko

3. MRES_Triassic_World_Education_Game_Test_3: https://www.youtube.com/watch?v=ZKsq767q2KQ

4. MRES Triassic World Oasis fly through WIP: https://www.youtube.com/watch?v=OrL5rgDTBXY

5. Triassic World: Coastal Environment WIP: https://www.youtube.com/watch?v=5J9LvxRxd64

6. Triassic World Alpha Gameplay: https://www.youtube.com/watch?v=0Ze2V0lenc4

7. Triassic World Alpha 2.0 Gameplay: https://www.youtube.com/watch?v=5UDQDZtPfQA

8. Triassic World: Scenes from the Triassic - North America: https://www.youtube.com/watch?v=COFs4qm0czQ

9. Triassic World Trailer: https://www.youtube.com/watch?v=Yaq-oMT5qEc

10. Triassic World Alpha Gameplay 3: https://www.youtube.com/watch?v=6yc75wAyq1E

APPENDIX 2

Links to Blog post from Everything Dinosaur and forum topics regarding Triassic World. Also the Triassic World Facebook page used to showcase the games progression.

1. Blog Post by Everything Dinosaur: http://blog.everythingdinosaur.co.uk/blog/_archives/2015/10/22/volunteers-needed-to-explore-the-triassic.html

2. Zoo tycoon 2 round table forum: http://thezt2roundtable.com/topic/11379221/1/

3. Dinosaur Toy Forum: http://dinotoyblog.com/forum/index.php?topic=3986.msg116371;topicseen#new

4. Facebook Page: https://www.facebook.com/TriassicWorld/?fref=ts

APPENDIX 3

References of websites where items such as images and sound used within the actual product were from.

1. Theropod family tree photo: http://www.palaeocast.com/wp-content/uploads/2014/11/BrusatteEdinburghDinoBirdFig2CreditSteveBrusatte.jpg
2. Pangea Earth Template: http://fossil.wikia.com/wiki/Triassic
3. Coelophysis fact file bones: https://en.wikipedia.org/wiki/Coelophysis
4. Coelophysis fact file tooth: http://www.rhyniechert.com/triassicsanmiguel.html
5. North America fact file petrified wood fossil photo: http://www.americansouthwest.net/arizona/petrified_forest/national_park.html

All the sounds from Triassic world were taken from these free sound effects sites.

1. Free SFX: http://www.freesfx.co.uk/
2. Soundbible: http://soundbible.com/free-sound-effects-1.html

Emails from some of the Triassic world play testers.

Danny

Date: Sat, 5 Dec 2015 12:54:36 +0000
From: aggeliki [redacted]
To: bobc [redacted]
Subject: Triassic Wolrd Game Review (played on laptop Toshiba 64bit, windows 8.1)

Daniel Carter,

Hello. I apologize for replying late, I was busy lately. The game looked overaly cool! I noticed some things and maybe I have some ideas! (Note: those observations may be reffered here little bit messy, because it is much information!).

First of all, the theme at the begining (start menu) was good, but you could also put some soundtrack there, for an interesting opening! Secondly, a miniscule typo mistake there (in the Triassic World chart) the word "environment", it is spelled like "enviorments" (just mentioning it because maybe you haven't or anyone else noticed it). Next, as far as the sound is concerned I had some problems. I don't know if it was only me, or the sound is normal. I mean, at North America location the sound was like intermitent and it gets annoying after a while. But the sound of splashes when walking into water was good and sounded real! At the other two lications I didn't hear any sound, and I checked my volume several times. For example, at the second area, South America, it would be nice to here the sound of the rain, since it has a wet climate and mabe some leaf-falling sound. (If you want it to be such detailed) You could also add some dinosaur roars, because it was lonely without anything to show that something lives there. Moreover, you could make the dinosaurs move a little, but maybe slowly, so as it gives you the impression it is more alive and maybe a sense that you "chase the animal so you can study it" or just in it's normar act when being in its natural habitat. (However, they already look a little bit scary, so not something too much in motion and sound). Another techinical problem that I found out, and again I don't know if it is only on my Laptop, was that the camera(mouse) delays to turn and when it turns, it does it fast and suddenly. This makes the control of movement really hard and difficult, and after a while it becomes tiring.

At the South America location, I didn't find both species that are mentioned. I only found Melanorosaurus. Another little detail again that you could improve or something, is in South America when you find Melanorosaurus, close to them there's a tree trunk that haw a hole and you can pass through it bur not till the other side. It would be nice that you pass to the other side (based to my opinion always).

At the Europe area, I couldn't find the second species there either. I found only Metoposaurus. (Unless they have not been put yet, so that's why they are not there!) But maybe I could not find it because of the dense vegetation and the difficulty in movement I mentioned earlier. I got lost many times there, I couldn't find my way.

Some other observations: -I figured out that there's a map. I think you should also add the the point where the player is. Map of Europe was much clearer and understandable though, the others not that much.
-You should also add a jump key/button, because you may get stuck in a place, through rocks etc.
-Lastly, the Encyclopedia does not open at all. I don't know it usage, won't open another window or something. Should it be opening yet?

That was all I could notice and some ideas I had while playing it! I hope it was helpful and I wish good luck with the rest of it!

Sincerely,
Anagnostopoulou [redacted]

From: sa[redacted]
To: bob[redacted]
Subject: RE: Triassic World Tester - Steve[redacted]
Date: Sun, 25 Oct 2015 19:18:22 -0400

Hey Daniel,

So I've played through the game for a bit now. I like the overall feel of the game, and am looking forward to what will be added next. The environments are very nice looking, with a few issues (expected for it being an alpha, though).

I've attached a few screenshots from me playing the game to help illustrate things I wanted to mention.

With screens 1 & 2, there is above the water and below the water views. As you can see, once below the water, there isn't really any way I'd know that I'm below the surface.

I really like the textures in the North American region (screen 3), in particular the rocks. There's a small texture gap on the rock in screens 4 & 5, which looks like a blue line in-game. As of yet, that's the only texture gap I've seen in the game.

Screen 6 is illustrating the trigger range of the fact file being a bit large for the amphibian. I'm not actually very close to it, but it still shows up from a distance, initially leading me to looking around confused. Mind you that amphibian (I forgot what species at the moment) seems like I could be buddies with it and is cool looking.

In screen 8, the trees are an interesting design, but between them and the other foliage, they create a huge lag spike when walking through them or even looking at them from a distance.

I managed to get to the location in screen 9 in the Europe region by following an invisible wall on the hill behind the amphibian, going right, until I found a hole in it and then walking over to the area pictured. The water kind of just cuts off, but I assume eventually there will be a waterfall or something similar.

Screen 11 shows off one of the other dinosaurs I ran into. Looking forward to seeing them animated.

The rest of the screens take place in the third map. I found this region much better in terms of performance when it came to foliage. It seems those trees must have a lot less geometry to load. The egg clutches were a nice touch.

I'm excited to see what there is to come for this game!

-Steve

RE: Triassic World Tester - Dhiego

Date: Tue, 10 Nov 2015 18:11:02 -0200
Subject: Re: Triassic World Tester - Dhiego
From: cs.dh[redacted]
To: bobc[redacted]

Hi,
Nice to know about it.
So related to the game, i'm a hardcore gamer. And i know a good game when i see one. And this is becoming amazing man.
The three enviroment are totally awesome. I few things repeat but its imperceptible, and necessary i guess. I notice that only the north America enviroment have sound, but you probably are working about it.
So the game it self is going pretty well, i hope keep helping you in whatever necessary.

Regards, Dhiego.

2015-11-09 12:06 GMT-02:00 Daniel Carter <bob[redacted]:

> Hey,
>
> No worries!
>
> Thats great news! Opinions form your professors will greatly benefit the games quality
>
> The focus is mainly on fauna yes, as the game is aimed towards teaching about the animals.
>
> The plans are as curate as I can get them. Finding foliage correct for the time period, age and location has been challenging. I have several correct plants such as Dicrodiu, Araucarioxylon arizonicum, Leptocycas and Pelourdea (Pelourdea has just recently been added)
>
> I have Dawn of the Dinosaurs. Life in the Triassic, is my main book. But I have visited a number of websites and have a collection of different articles, usually about specific animals or plants.
>
> The platform will be Pc, possibly Mac if I can get my hands on one for building the game on. Release date I do not have. As I'm the only person working on this, na d as its part of my university course, It will take me a ton of time.
>
> Haven't decided on language, as I only know English myself, so at this stage it will only be English. Also due to time, as mentioned above.
>
> I am from the United Kingdom, studying at the University of Huddersfield.
>
> Thank you for testing! Do you have any other suggestions regarding the game itself? What could be wrong or needs changing?
>
> Danny
>
> ---
>
> Date: Sat, 7 Nov 2015 19:17:03 -0200
>
> Subject: Re: Triassic World Tester - Dhiego
> From: cs.dh[redacted]
> To: bob[redacted]
>
> Hi Daniel.
> Sorry about the delay, I'm doing my finals.
> So, i played the game several times and showed for my paleontology professors. Their reaction was: "WOW! What a game!"
> In my opinion and their you are doing a great job, only a few doubts about the game persist..
>
> How accurate do you intend to be? You'll work only in the fauna ?
> The plants in the game, you did they ? Or are just generic ? Same about the minerals.
> What literature, I mean book, sites, article are you using ?
> What platform you intent to distribute the game ? And do you have in my a release date ?
> Its possible the game have more than one language ? Portuguese for example.
> And one more thing, where you from by the way ? State, and college ?
> I think its it for now. And again, many thanks for letting me help you improve this amazing project.

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