Asha: Using a mobile game to educate, support and monitor the medical adherence of children diagnosed with HIV.

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Course Code: WSOA8000A

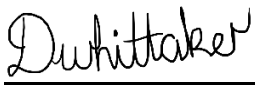
Ethics Clearance No.: H17/09/42

A dissertation resubmitted to the Faculty of Humanities, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Game Design.

Johannesburg, 2019

Declaration

I declare that this dissertation is my own, unaided work. It is being submitted for the degree of Master of Arts by Research in Digital Arts at the University of the Witwatersrand, Johannesburg. This submission has not been submitted before for any other degree or examination at any other University.



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Abstract

The focus of this research is in the area of using a designed pedagogical model, called the Educational Game Creation and Assessment Model (EGCAM), to inform the design decisions made to create the mobile game *Asha* to serve the needs of HIV positive children between the ages of 8 to 12. Asha does this by attempting to educate, support and monitor the medical adherence of the user through its gameplay. Such a study plays an important role due to the noted practice of parents of HIV positive children not involving them in their diagnoses or treatment due to the stigma that surrounds the disease. The research approach adopted in this dissertation includes creating and documenting the development process of the game *Asha* with an end result of conducting an informal qualitative play testing session whereby children that fell within the target market provided feedback on the game. The findings from this research provide evidence that the use of a mobile game is a viable means of educating children as results were positive and found the participants saying they learnt something new and would play the game again. The main conclusions drawn from this study are incomplete due to the small test group that was available. However, results do indicate a positive response to the use of the EGCAM model to create the game *Asha* as well as the use of said game having potential to be successful in its intended final outcome. This dissertation recommends that with the use of educational and serious games in other disciplines, a larger audience can be reached and their needs served.

Keywords

Game design, mobile gaming, educational games, HIV education and awareness, pedagogical models.

Dedication

To Michelle Whittaker, my mother and friend who taught me all I know. Thank you for always being there for me and supporting my passions!

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1) Introduction

Background

Games have become a recurring theme within today's modern culture as, the ability they have demonstrated of being able to teach, while still being researched, has proven to give positive results (Squire, Kurt, Gee, James Paul & Dondlinger, Mary Jo.). The topic of games and education is still very much in its infancy, however, over the past few years strides have been taken to identify facets of each that promote an active learning experience. Active learning as explained by Chris Evans and Nicola Gibsons occurs when a student plays an active role in receiving and processing information (3). Results suggest that games provide a digital space conducive for learning due to the basic principles they are structured upon.

A video game as defined by Katie Salen and Eric Zimmerman in their book "*Rules of Play: Game. Design Fundamentals*" is "a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome (20). It does this by providing an environment where new information can be introduced and the player/learner is given a sense of agency and are allowed to experiment with these variables at a pace, and in a manner, that is specifically user-centric. It is through this exploration that active learning occurs and, as a result, new knowledge is either created, or previously established knowledge is built upon or is replaced all together. In James Paul Gee`s paper, *Semiotic Domains: Is Playing Video Games A "Waste Of Time?" What Video Games Have to Teach Us about Learning and Literacy* (2003) [D1][r2]he explains the reason why games are able to aid in

such a process is due to their ability to "…situate meaning[1] [D3][r4]in a multimodal space through embodied experiences to solve problems and reflect on the intricacies of the design of imagined worlds and the design of both real and imagined social relationships and identities in the modern world" (26). In other words, games allow for a space in which information can be broken down and conveyed to the player via visual and auditory cues. These cues can be interacted with in the game in order to contextualise their meaning. The meaning formed by the player is linked to specific domains of knowledge and contextualised through experiences the player has had or can imagine based on interactions through dialogue or readings. It is by situating and understanding this information that a player is then able to solve tasks and puzzles related to fictitious or real simulations, and at the end reflect upon the components that make up the system.[D5]

The benefits of games have been widely recognized in multiple disciplines[D6][r7] and it is with this notion that more sensitive fields, such as the medical sector, have begun to experiment with incorporating it into their training and treatment regimes. Examples of these types of games in this sector include *Wind Runners (*2012*)*, which is a game designed to encourage the medical adherence of children with Asthma, *OrderUP!,* (2010) which helps educate adults on healthier meal options, and *ExP (*2016*)*, which supports and rehabilitates patients with pulmonary expansion deficit (Chacon et al, 2). Chacon explains in his paper that benefits associated with using a game within a medical setting is it improved patient motivation, distracted them during painful therapies and made performing therapeutic

[1] The act of situating meaning is to de-code and contextualise words, symbols, images, artefacts and actions in relation to the semiotic domain it is associated with. For example Gee explains this using the word "work". To say you have work to do when in an academic situation could refer to research, whereas, if the situation is linked to physical labour such as gardening it could refer to weeding or planting flowers. Both situations use the word in a viable capacity that carry their own meaning when placed in a particular context.

exercises easier (Chacon et al). Despite all the observed benefits, it is still a costly process to create and maintain such a tool. This could be seen as a reason against the widespread use of games in the medical sector, not taking into consideration that the research and development of such a targeted industry is in its infancy.

The South African medical sector faces many challenges, these include; “Extensive upgrading of State hospitals, new sources of funding, and the training and retention of more doctors, nurses as well as other health professionals, are crucial to a better dispensation for those using public sector facilities” (*Big challenges facing healthcare*[r8][D9], 2009). However, a more focused look highlights the prevalent pandemic of individuals diagnosed with Human Immunodeficiency Virus (HIV), as “South Africa ranks among the worst afflicted countries in the world” (Abdool Karim, 921-933). In fact Abdool Karim states that “despite having just 0.7% of the world’s population, South Africa was nevertheless home to about 17% (approximately 5.5 million people) of the global burden of HIV infection in 2007 (921-933).

South Africa is a developing country where a large portion of its population lives below the poverty line; many people cannot therefore afford to maintain a standard level of education or medical assistance (Delany et al, 120, Peltzer, 117). A large majority of South Africa`s population tend to be misinformed about HIV as there is still a level of prejudice within the townships towards the disease (Treves-Kagan et al, 1-3). There is an average estimate of 7 million people in South Africa living with HIV. Of that 7 million only 32% are on antiretroviral treatment (ARVs) which forms part of antiretroviral therapy (ART). It is because of this prejudice that some parents refuse to divulge their child`s HIV status to them once they have been tested due to the social implications that come with being HIV positive (Purcell et al, 2[D10][r11][D12]).

This poses many current and future problems. Firstly, the child is unaware as to the reasons they have to take medication and so tend to forget or skip taking their medication. The side effects of ARV`s also tend to make the child feel worse, adding to the resistance to taking their medication. Another concern is that, as these children grow older and enter their pre-teen years, they might want to begin to experiment with their sexuality, which poses the threat of them unknowingly infecting more people.

In developing the game *Asha*, the goal is to address these highlighted issues by creating a virtual portal that contains factual information that can be shared in a safe and private space. By targeting children using a game the hope is to inform our future generations by making the information understandable, accessible and unintimidating in order to prevent the future spread of the disease. This is done by informing them of the precautions that need to be taken in day to day activities. It is the hope by educating people about HIV that the disease will become less stigmatised giving individuals a sense of freedom to seek medical and professional help.

Much has been done in the way of trying to address the issue of HIV and education in South Africa;

> Mass HIV testing campaigns have been undertaken to decentralize and expand access to ART. These campaigns also aim to educate the public about prevention of AIDS, non-discrimination and care for people living with AIDS. South Africa now operates the world's largest antiretroviral program and has significantly improved access to condoms, HIV testing, and treatment. HIV testing is being integrated into primary care and ART is now available in almost all local health clinics and with broadened eligibility criteria. (Treves-Kagan et al, 2)

However, it was Dr. Ebenezer Kofi Okyere-Dede, a current research investigator at the Perinatal HIV Research Unit (PHRU), which is a research unit part of the University of the Witwatersrand (WITS), that conducts adult, paediatric and adolescent HIV treatment research, HIV prevention research and investigations into tuberculosis and other HIV coinfections, that a gap in the care giving process of HIV paediatrics was identified.

While working in a South African paediatrics unit the doctor observed that children weren't being included in their own diagnosis or treatment regimen. It was upon approaching the Digital Arts Faculty located at WITS that the mobile game *Asha* was conceptualized and a collaborative team was formed with members from multiple schools; Behavioural Sciences, Health Sciences, Information Engineering and WSOA (Wits School of Arts). All serving the goal of assisting disadvantaged patients in South Africa.

Within this paper the aim is to discuss and explore the concept and design behind the game *Asha*; a mobile game being used to help educate, support and monitor the medical adherence of children diagnosed with HIV in South Africa. The topic of games and education shall be further explored and related to the case study and practical component that is *Asha*.

The design of the game *Asha* centres around research that informed a previous long essay that explores the topic of why educational games should be incorporated into an educational curriculum and used as a tool to further enhance the learning process. It was from this paper a pedagogical model was designed and has been used to dictate certain design decisions made in the creative process of *Asha*. This paper aims to explore what pedagogical models are and briefly discuss previous models that have been created with the aim of comparing a model from a traditional educational background to that of one being

proposed or used within an educational game. This topic will then be steered to the analyses and discussion of the design choices and implementations of such made in the game *Asha* in relation to my proposed theoretical model, with a final note being to discuss how and if the model worked and changes that are needed. Of course with this analyses the development of the game forms a central part of the research process, the iterative development cycle will be tracked and discussed as well.

The analyses of the game will be done so using the MDA framework. The MDA framework, standing for mechanics, dynamics and aesthetics, was developed by Robin Hunicke and Marc Leblanc, and taught as part of the Game Design and Tuning Workshop at the Game Developers Conference, San Jose 2001-2004 (LeBlanc). It aims to bridge the gap between the multiple lenses that are used to deconstruct and analyse a broad range of game designs and artefacts (Hunicke et al, 1).

The game shall also be play tested with a section covering the methodology used and includes the ethics that surround such a sensitive process. The process is more sensitive than most due to the testing requiring players who fall within the target group, of children between the ages of 8 to 12 years old, and they will be asked to disclose their HIV status. The children will remain anonymous with their feedback and results recorded from the play testing session being reported in a section of its own.

A brief look into the intrinsic and extrinsic motivation used within games to encourage players to participate in longer play times shall be explained and explored with a specific relation back to how these methods have been incorporated into the game *Asha*. After which, a discussion relating to the improvements and future research that could be conducted will be explored.

The value of this research lies in its potential to build upon and add to the collection of game design theory and development works as well as could supports the notion of there being a pedagogical model that can be designed as a broad guide of what makes an educational game successful. It does this by offering its own version of such a model. Furthermore, there is little to no research having been done in relation to South Africa and the target market it serves. By having completed this research it will give researchers a better understanding of the receptiveness of games in a situated market being the township areas and specifically how medical, educational games could possibly be used to bridge the gap between patient and health care provider. This type of research also aids in understanding what the South African consumer expects from a game and how it can be tailored to serve the wants of such a customer in future.

The assembled team of different disciplines that is working on and informing the design of the game *Asha*, has the potential to result in multiple publishable papers and also perhaps allow for a bridge between disciplines for future researchers that can be negotiated and provide insight into.

1.1) Gamification, Educational Games, Serious Games and Simulation Games

The use of games as a means of education, training and public issue awareness has become a commonly researched practice, with many businesses and institutions now beginning to pursue the serious notion of implementing games as tools. Video games were originally created for entertainment purposes without regarding the educational potential they have, however, through extensive research and observation researchers have found that games create a virtual space in which players are constantly engaging with some form of learning.

A game can be defined as “a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome” (K, Salen, E, Zimmerman, 2004). Every game is comprised of a system that allows for an input and based on that input, an output is returned. The output is managed by the system and the rules that govern it. When a player begins a game they are agreeing to an unspoken contract in which the player understands there is a goal or specified outcome. As the player, they are granted a sense of agency in which to navigate the system and the rules that it is comprised of by inputting specific actions to reach this end goal or specified outcome.

In a similar vein, the same can be said for learning. The student enters into an education system of sorts be it primary or tertiary education or corporate training with the understanding there is a specified outcome or goal which is to complete the course. In order to graduate the learner is given a sense of agency in which they can navigate the system that is defined by rules. The learner has the agency to choose what information or variables they account for and to what degree they do so. This is comparative to a game system as it is up to the player to understand what variables there are and how to make use of them in a system where rules define what is possible and what is not. However, there has been raised awareness that the current pedagogical models being used within the general and public education systems are in need of modification.

The biggest issue that has been noted within classroom situations is the use of passive learning techniques where the learner is made to listen to a lecture and write down the relevant information. The learner is then made to rote learn the information after which a form of assessment is given to them. It is only a few days later do the learners receive their results with the teacher often not giving another form of assessment for the particular

section of work as they need to move on with the syllabus. Therefore the learners are not able to take in information at a pace that is suited to them nor are they able to test their understanding of the work in a safe environment that permits failure. Despite these listed negatives, the education system continues to use a lecture format as its main means of transferring information. Mayo describes the reason for this is "[c]ritics[D13][r14][D15] have typically asserted that the primary advantage of the lecture format is economical rather than pedagogical" (3).

Statistics from a 2011 census report entitled *A profile of education enrolment, attainment and progression in South Africa*[r16], show that a majority of South African children do not make it past high school. Out of a survey total of 47 202 936 only 27.56% of learners had achieved a high school education level and 2.72% having achieved a bachelor's degree. This left a total of 6.57% of children with no schooling experience at all. These statistics are further evidence of how the lecture format is not an effective teaching methodology, as approximately only 3% of the 27,5% of children who passed high school were able to continue with a lecture format method and obtain a degree thus showing that the length at which the method is practiced does not correlate with higher success rates. Furthermore, this does not even begin to account for problems notably faced by learners each year in South Africa, the main one being accessibility[2]. [D17][r18][D19]I believe that if mobile based initiatives of education that encouraged the use of game based tools within a pedagogy were created and promoted this could provide a possible solution to bridging the

[2] Accessibility is used as an all-encompassing term here to refer to issues such as a lack of schools in rural areas, children faced with poverty which informs a lack of funds to go to school regularly or sometimes at all, children being taught in English which is not their home language and learning disabilities. These are contributing factors that lead to the aforementioned statistics, and further provides reason for why the lecture format is not a good teaching methodology.

gap between the aforementioned statistics. In a paper written by Cabielles-Hernández et al they explored the use of a mobile application that could be incorporated within a classroom pedagogy to help autistic learners. The application aimed to evaluate the learner`s behaviour and modify it, modelling their behaviour during the performance of tasks within the classroom. Results obtained from the study proved to be positive and accurately evaluated the two participants whom were either moderately autistic or severely autistic. By using the application the teacher was able to gauge what necessary interventions were needed in order to model the student's behaviour to achieve the required learning outcomes. It is this form of interaction that can be seen in games as well, in terms of, both being multimodal and interactive, and having aspects that form the structure of a game. Bay-Hinitz et al`s paper, *Cooperative Games: A Way To Modify Aggressive And Cooperative Behaviours In Young Childre[r20]n* (1994) supports the notion of using games by explaining that "instructing children in the use of particular games is a simple strategy, particularly when compared to training a teacher to carry out a specific treatment plan using contingent reinforcement for certain responses" (11).

In a paper written by Kurt Squire (2004), he compares traditional schooling experiences to that of game based educational experiences and notes the difference between the two forms. His findings demonstrate that game based learning experiences are more beneficial for the students as they can decide how often they play a game and for how long, while in a traditional learning setting they are forced to go at a single pace and cannot manage the pace or content of the learning. He also describes how students are not able to work together or share information instead they work in isolation in a traditional setting. From these results it can be seen how games have their own pedagogical structure that promotes learning and allows the player to explore dynamic situations while operating on a

difficulty curve. This allows them to get accustomed to the basics before introducing a new concept or challenge allowing the player to apply their knowledge to dynamic situations.

These challenges can be viewed as forms of assessment, testing the players understanding and problem solving skills.

There are 4 categories in which games, that aim to have an effect on the education of an individual, can be placed; gamified resources or gamification, serious games, educational games and simulation games.

Gamification

Gamification can be described as the inclusion of game-based design principles into an activity with the aim of providing an environment in which the learner feels motivated and that there is a visible sense of reward in their progress. In a paper written by Juho Hamari et al, it is defined "as a process of enhancing services with (motivational) affordances in order to invoke gameful experiences and further behavioural outcomes" (3026). While Zichermann & Cunningham define the term in their book *Gamification by Design* as "the use of game-thinking and game mechanics to engage users and solve problems" (11). The definition of gamification is wide and varied, however, one thing to note is that gamification is used most often in non-gaming structures. Instead, it is used as a means to promote a sense of play within an activity and by doing so intrinsically motivates the participant to continue and do better, each time using a game-based system of assessment as its monitor of progression. Gamification is, in a nutshell, "the combination of various components which drive a sequence of desired mechanics to develop dynamics of interaction behaviours with the intention of supporting key business processes" (Werbach & Hunter, 1).

An example of where gamification has been implemented is within WeThinkCode; a South African based institution that operates using a French curriculum that is aimed at teaching young individuals how to code a variety of programming languages. The institution uses a level up system where students gain experience points (XP) for completing assignments and exams and upon gaining enough experience points the student increases their level. The notion is they continue this way until they reach level 21 at which point they have completed the course and can graduate. Gamification is not useful within the learning process but does help provide a means of extrinsic motivation for the students in this situation, to engage and continue through the course due to the visual aid that represents their progress. However, educational games are such a tool that can actively be used within the learning process.

Educational Games

Educational games can be described as games that aim to teach a specific subject. However, it must first be noted that there is a difference between edu-tainment and educational games; it was in the initial phase of incorporating games and education that products called edu-tainment were created. These types of games could be found in most homes and served as a way for children to practice learned skills using rote learning practices. Most *Disney* games aimed at teaching spelling, mathematics or similar concepts to children serve as example of edu-tainment. This form of learning is a good way of solidifying concepts for the learner, however, due to the lack of new and dynamic situations being introduced, they were unable to critically engage with the content making it hard to navigate scenarios that were structurally different and had not been presented to them before.

Educational games on the other hand “require strategizing, hypothesis testing, or problem-solving, usually with higher order thinking rather than rote memorization or simple comprehension” (Dondlinger, 2). What makes these games successful (if done correctly) is their ability to embed the learning content within the flow experience of the game. Flow is based on flow theory, discussed by Csikszentmihalyi (1990), it can be defined as “a state of optimal experience, whereby a person is so engaged in activity that self-consciousness disappears, time becomes distorted, and people engage in complex, goal directed activity not for external rewards, but for simply the exhilaration of doing so”(Squire, 3).

[D21]However, this activity can`t be maintained for long unless the challenges presented to the player increase in complexity, this promotes their skill development, keeping the player invested and engaged in the play experience as well as the outcome of said experience.

This sense of engagement has been considered to derive from a form of intrinsic motivation; the concept of acting of your own will without outside influence to attain a specific goal or outcome. Dondlinger describes it as “the interplay between desire and pleasure – the desire to be competent and the pleasure one feels when one is” (23). An example of such an intrinsically motivating game is *Zombie Division* (2005). It was created as part of a study by Habgood and Ainsworth to examine the notion and impact intrinsic motivation had on the players who were playing an educational game.
Zombie Division teaches mathematical concepts centred on principals of division.

In the game the player takes the role of a soldier who navigates a maze-like dungeon defeating skeletal warriors using fractions that divide their opponent’s health bar. In the beginning of the game the player only has access to 3 different divisors, if they choose the wrong one to try defeat their opponent they lose health points as a penalty. As the game

progresses the skeletal-warriors become more challenging as they start to parry attacks making certain divisors ineffective. It is also at this point of progress within the game that the player has unlocked more divisors and so the game challenges the players to make use of these new divisors by making their attacks less obvious. The skeletal warriors also start to become more aggressive thus prompting the player to react quicker so as to not be attacked and lose health points.

Habgood and Ainsworth created 3 versions of *Zombie Division*; the first having the learning within gameplay, the second version was just the player having to kill skeletal warriors using any attack and once having completed the level a test relating to division awaited the player. The last version contained no educational aspect at all.

Results found that children performed better in their mathematic assessments after playing the game despite what version of the game they played. However, those who played the intrinsic version significantly outperformed their peers by increasing their average mark by 27% compared to the extrinsic group who increased their average mark by 10% and the control group increased by 7%. Thus it can be seen how intrinsic motivation aids in the flow of the game and delivers positive outcomes that can be relayed into real world tasks and environments. Habgood and Ainsworth further postulate that the students overall marks increased due to the students being excited and therefore motivated by the inclusion of the game as a tool within the learning process.

Serious Games

Serious games serve the main purpose of raising awareness of a particular topic. Serious game don`t necessarily have to teach a subject with a form of assessment being utilized at the end, instead it aims to introduce new concepts and ideas or build upon

already existent but shallow understanding of ideas by placing the player into a state of play. The website *purposefulgames.info* define serious games as being

> …[I]ntentionally designed to have a purposeful impact on the players' lives beyond the self-contained aim of the game itself. They are designed to offer a playful environment that provides "serious" content, topics, narratives, rules and goals to foster a specific purposeful learning outcome.

These games include *That Dragon, Cancer* (2016) which is an abstract, narrative walking simulator that aims at giving the player an experience rather than reaching an end goal or outcome. The game is about a parent`s love for their child and memorializes the life of Joel Green and the 4 yearlong battle he had with cancer. *That Dragon, Cancer* is a very personal and character-centric game, however, it does expose and bring awareness about the number of people having to deal with cancer and how it affects not only the patient but also their family. From a more academic view the game introduces players to new concepts and expands upon such information to the point that it can encourage players to do their own research to learn about the themes and topics that are shown. This kind of learning is noted as very productive and intrinsically motivated, as it is the player who seeks out knowledge for their own personal satisfaction rather than being asked or forced to. Another game of a similar nature is *Forget-Me-Knot* (2015) which is also a first person walking simulator. It places the player in the position of a character suffering with Alzheimer's and has them explore rooms and examine objects trying to piece together who they are and where they are. This game serves the main purpose of raising awareness about Alzheimer's and tries to educate the player by fighting against the stigmas surrounding such a disease.

Simulation Games

Simulation games have been found to be very successful and useful in training for practical circumstances, as the name describes; they are games which literally simulate a real life situation. These types of games have always been favoured as tools used to train veterans in the military. The military and related fields have been noted as being one of the first sectors in society to endorse the use of games due to their potential learning outcomes. An example of such games are *Microsoft Flight Simulator* (1982)*, The Sims* (2000)*, Zoo Tycoon* (2001) and *The Forest* (2014). Each tries to emulate a facet of life and uses real world physics and implications as their means of penalty. In *Microsoft Flight Simulator* if you don`t monitor your gauges properly you can end up running out of petrol and crashing, or in *Zoo Tycoon* if you don`t make sure to keep your animals healthy and happy, guests will stop attending the zoo or will leave dissatisfied. These are all consequences that have a relatable impact and allow the player to experiment with variables in a safe space. It is with this kind of learning and training that individuals will be exposed to a variety of circumstances that will allow them to be able to critically engage with the content.

Within serious, educational, and simulation games the game system demands that the learner engages with the content rather than rote learn it. This type of learning asks the player to actively participate in the receiving and processing of information thus engaging them in the process of active learning. It is due to this active participation that games can sometimes throw the player into unfamiliar conditions and ask them to perform before being competent to. This might sound like a recipe for disaster, however, it helps increase the player's deductive reasoning and tests to what level the player understands the content being presented to them. It also introduces the player to operating on a learning curb in

which new solutions have to be found as the level of difficulty increases as they progress through the game. James Paul Gee mentions this benefit as one of his reasons why games work so well as an educational tool, games ask of the player to interact or perform before knowing how to complete the task. This is done to support other principles such as learning on a difficulty curb as well as exploration (Gee[D22][r23], 2007).

The game *Asha* aims to fall into the educational games category by having the learning matter linked to the flow, and therefore, the fun of the game. It also aims to work on a difficulty curb enticing the player to play for longer while still feeling challenged and in turn engaged. The goal of *Asha* is to try aid in the understanding of the HIV disease and educate people to lessen the stigma that surrounds it, furthermore, it tries to act as a tool to aid in the short comings and difficulties faced by the health system in South Africa.

1.2) The[D24][r25][D26] South African Health Sector

The health system in South Africa is a fundamental sector in the country as it is to any country[D27] (Constitution of the Republic of South Africa, Chp 2, section 27, 1996)[r28]. In the paper *Structure of the Health System in South Africa* by Dr. Marjorie Jobson, she gives a detailed analysis and systemic breakdown of the health sector by explaining that

> "[t]he South African health system consists of a large public sector, a smaller but fast growing private sector and an NGO sector. The public health sector is funded by the state. 40% of all expenditure on health comes from the National Treasury. Public health consumes around 11% of the government's total budget and is allocated mostly to nine provincial departments" (Jobson, 3).

These numbers are evidence of how much disease and treatment of such affect and burden the country. It also indicates how the medical sector in South Africa is fundamental with the [D29]most noted disease that affects South Africa is the increasing rate of HIV and TB infections.

The initial spread of HIV can be accredited to the conditions faced by many black workers during the apartheid period. Over-crowding in informal settlements, underdeveloped or lack of health care and migratory work conditions lead to many men acquiring “town wives” who were woman that performed sexual services in exchange for compensation. This combination of factors created a suitable environment for the transfer of HIV to occur in a large and wide-spread manner with the devastating effects only noticeable years later.

Initial confrontation of the disease was met with denial and defacement of scientific evidence and practices by political leaders. It can be hypothesised that this public and avid display of denial aided in the stigmatised views of those who contract the disease, as many HIV positive individuals are socially ostracized even many years later. It was in only in 2008 after a change in leadership that a more constructive approach was taken in the issue of dealing with HIV and how to rectify the damage already done.

In the past 10 years campaigns have been set up and run to help educate individuals as well as provide better health care services and access to ART, as well as prevention methods such as condoms. In Abdool Karim`s paper he describes how education programs about HIV have been useful and what effect they have had on patients.

> These education programmes provide patients with detailed information on HIV infection, how antiretrovirals work, the importance of adherence and how to incorporate pill taking within daily routines and address the many social implications of their disease. In this way patients are empowered to take responsibility for their health and treatment and have ready access to advice and care when needed (6).

Jobson further reinforces how education strategies have impacted not only HIV positive individuals but the families that surround those individuals.

> Further achievements have been the development of the HIV/Strategic Plan to reduce the number of new HIV infections and its impact on individuals, families and communities through activities geared at prevention, treatment, care, protection of human rights, and monitoring and evaluation (8). [D30]

These implemented strategies have helped investigators see a decrease in the number of HIV infected individuals and a rise in the understanding of the disease and how it should not be stigmatised. However, despite these attempts there still isn`t enough being done as findings reported by AIDS Accountability International shows "South Africa is currently seriously under-performing in its efforts to control HIV. An international AIDS scorecard of country level AIDS programmes showed that South Africa was doing worse or no better than neighbouring countries" (Abdool Karim et al, 7).

The South African average life expectancy, according to the CIA World Factbook, is 63.80 years of age and ranks 190 among 224 other countries comparatively (*The World Factboo*k). This when compared to the results obtained from the paper *HIV infection and tuberculosis in South Africa: an urgent need to escalate the public health response* written by Abdool Karim et al finds that "the average life expectancy of individuals who are HIV positive are 48.4 years for men and 51.6 years for women" (4). The majority of South Africa`s population relies on the public sector for medical and health services, with clinics being the first available source of service. For those who find themselves living in the rural areas the closest clinic to their home is 5km away if not further (Jobson, 3). "Over a fifth (21%) of South Africa's children live far from the primary health care facility they normally use" (Hall

et al, 3), and when individuals do make the journey in search of treatment or medical assistance they find the clinics overpopulated, under-staffed and a limited supply of resources is available[D31][r32]. In a paper written by Jobson, it was reported that

> 3,356 clinics and community health centres…had facility managers, but nearly half of the clinics had no visiting doctors; 84% had no assistance from a pharmacist or pharmacy assistant; 11% had no lay counsellors; 57% had no administration support and 79% have no information management staff (6).

It is understanding these issues facing the health sector that by making and developing the game *Asha*, the end product seeks to not only try to educate children about HIV, but also act as a tool where general and medical information can be easily accessed from home and stored on the device to allow for doctors to keep record and aid in their diagnosis and treatment of their patients. It does this through providing factual information and incorporating a pill tracker that reminds the player to take their prescribed ARV`s. The game informs their doctor if they have done so or not through submitting a yes or no answer that is saved on the device each day for future analysis in doctors' appointments or clinic visits. This form of "home care" or extended informal treatment is much needed especially when (according to Jobson, 3):

> Most qualified health service workers choose to go into the private sector due to the increased rates they can earn and higher end working conditions when compared to the public sector…[T]his creates a deficit which is evidenced by there being one doctor for every 4,219 patients in the public sector compared to one doctor for every 243 patients in the private sector . [D33][r34][D35]

The impact of the disease has decreased but not to the numbers that would be ideal[3]. The HIV pandemic has predominantly affected woman more so than men[4] with reports finding that South Africa has among the highest levels of rape with 51, 895 reported cases of rape occurring in 2015/2016 (Mahlalela et al, 7). It is common in rape cases for no form of protection to have been used, thus woman who become infected or are HIV positive and fall pregnant carry the risk of passing on the virus to their unborn child through mother-to-child transmission. Of all children who died in hospital between 2012 and 2013, only 35% were known to be HIV negative. Twenty two percent were HIV exposed, and a further 18% were HIV infected. The HIV status of the remaining 14% of children was not known (Harper). These percentages speak to the number of HIV mother-to-child infections and comments on and makes reference to the perceived fear of stigma within the community that affects access to early infant diagnosis in rural communities (Adeniyi et al). [D36] From the study done by Adenyi et al, results indicated that mothers/ soon-to-be mothers had good knowledge about HIV infections in children, however, there were a lot of misconceptions about the procedures needed to be followed when dealing with the prevention of mother to child transmissions. The study reported that it was due to fear and stigma as well as a lack of education that informed these misconceptions, thus preventing individuals from seeking out treatment and care[D37].

With the high levels of stigma surrounding HIV many parents do not reveal their status or that of their children to family members for fear of being socially ostracized.

[3] In a publication released by Stats SA in 2015 where it was estimated that "…531 965 people died, with 162 445 or 30.5% of these deaths being Aids-related" (Jobson, 6).

[4] This can be reasoned as being due to the male orientated culture experienced in South Africa. This leads woman to being seen as lower than men and not having a say in relationships and sex, creating issues of having unprotected sex with an HIV positive partner, rape and sexual violence.

Anticipated stigmatization is a problem currently being faced as it has been reported as a reason for why HIV positive individuals either refuse to get tested, divulge their status when they are tested or refuse to go to the clinics or hospitals to collect their required medication. According to Chiu et al "[w]ithout ART, 52% of the perinatally infected infants and 26% of postnatally infected infants will die within 12 months". The attitude and knowledge of mothers towards knowing their child`s HIV status are mixed, with the majority of mothers not wanting to get their children tested for numerous reasons; "lack the courage to test their infants, fear, guilt, self-blame, hopelessness and embarrassment" (Adeniyi et al). [D38][r39]

A cyclical pattern begins to emerge, starting at a young age, children that live in the rural areas are exposed to an environment that stigmatizes sickness especially that which is related to HIV and TB. It is from this point that if the child is HIV positive they have to remain secretive about their status; this is assuming they have been tested and/or told about their condition. By remaining secretive or not knowing their status the child poses the risk of endangering other individuals as proper safety and sanitation might be ignored. Other issues occur when the child becomes sick due to not collecting or taking the correct medication for fear of being found out by their family or community. Individuals who are unaware of their status or lack the education related to safe practices associated with HIV pose the risk of practicing unprotected sex, thus aiding in the spread of the disease and possible impregnation which could lead to the chance of the child becoming infected if proper procedures aren`t followed. At this point the cycle begins again.

2) Introducing Asha

The game *Asha* was created with the purpose of being able to monitor and aid in the medical adherence of children diagnosed with HIV. The original concept was to create a game that could be customised to serve the general needs of any user with a particular disease by allowing them to keep track of their medication intake as well as teach them what foods were appropriate for their diet and educate them about their disease. [D40]However, due to *Asha* currently being developed as an initial alpha build with priority being to communicate proof of concept, particular goals were created for this build that differ from the final desired outcome. Development goals that were created for the initial build were:

1) It had to be suitable for the identified target audience.
2) The game had to be playable on a low end mobile device.
3) It had to demonstrate methods of information protection through the use of a password to access the game.
4) The creation of a pill tracker that could be monitored through the storage of information on a mobile device was a core function that needed to be included.
5) The game had to educate the player about facts related to HIV.
6) The game had to be designed with the EGCAM model in mind.
7) The education part of the game had to be tied to the flow of the game[D41].

South Africa`s two highest illness infections are HIV/AIDS and TB, with multiple nonprofit organizations (NGO`s) contributing around R5.3 billion toward efforts focused on assisting the health sector with these illnesses (Jobson, 3). It was through being approached by Dr. Ebenezer Kofi Okyere-Dede, a current research investigator at the PHRU, who had

observed that, despite the strides being made by the South African health sector to educate and reduce the infection rate of HIV, there was still a high amount of stigma and secrecy surrounding the disease. This was to the point that children were not being told about their condition and were being left out of their own treatment regime. Upon further discussions with Dr Okyere-Dede, information regarding what the children were being told about their condition revealed that some parents were telling their children that they had a monster inside them and had to visit the clinic to get medicine that would keep the monster under control (2017). Other parents would tell their children that the medicine was for flu, asthma or a condition that was not as stigmatized as HIV (Hornschuh, 2017). This leaves the children not wanting to take their medication for reasons such as their friends are not taking it or them thinking it`s not something that needs to be considered seriously. Other problematic instances that occur are when the child needs to take over their treatment instead of their parents overseeing it.

The game *Asha* tries to address these issues as well as a few others that were identified in a paper written by Karl Peltzer where he initiated a survey to ascertain the level of responsiveness provided by primary health care (PHC) facilities in South Africa and the patient experiences thereof. It was found that of the 2352 participants, “70% usually attended public health care services while 23.3% attended private health care services and 0.1% utilized traditional healers” (Peltzer, 1). Results from the survey indicated that patients were dissatisfied with the quality of PHC being provided as a rural community survey found that “78% felt that medical services were poor” (Peltzer, 2).

It is based off these results[ii] that it is believed the game *Asha* could be utilized as a tool not only for educational purposes and medical adherence but also to aid the medical

sector by being able to provide non-biased communication, shorter response time to frequently asked questions, predictive medication feedback to allow for better stock management and the game is more cost effective for both public and private PHC facilities and their patients. The South African government is constantly taking steps towards providing better infrastructure for its citizens and so this creates opportunities for technological advances to be made. It is with further research and development that the game *Asha* could easily serve the aforementioned needs. [D42][r43]

3) Embedding Pedagogic Models into Game Design

In the design and production of educational games multiple design principals and strategies from both a game design perspective and an educational perspective are used. These strategies serve as theoretical guidelines to try create a product that serves as a source of entertainment and teaches skills and/or theory about topics that can be used within a real-world situation and context. However, this has proven to be quite difficult as researchers have yet to understand how to optimize the use of technology and the increasing advocation for blended learning[5]. With this problem still being present, researchers from multiple disciplines are currently in a race to create a central pedagogical model that focuses on the use of blended learning and how to incorporate it into formal curriculums and to identify to what extent is can be used as a form of assessment. Multiple research papers also demonstrate the need to test, adapt existing models or create new ones. I observed this matter on a first hand basis when I attended the 2017 Irish Games

[5] Blended learning can be defined as "the thoughtful integration of classroom face-to-face learning experiences with online learning experiences" (Garrison, 2).

Based Learning (IGBL) conference in Cork, Ireland. Quite a few attendees were presenting projects in which they wanted to have a final outcome that could be replicated, thus leading me to believe they were trying to find an algorithm or pedagogical model in which gamification and educational games could be modelled after. But first, to better understand what a pedagogical model is, a definition is required.

A pedagogical model is used as a “game plan” or “walkthrough” that outlines the steps needed to be taken in order to successfully reach a desired learning outcome. It allows for more appropriate content structuring, the methods used in teaching, the environment in which the content is situated as well as the assessments to monitor and gauge the learners understanding of said content with reliable results.

The definition of pedagogy is a debated topic by academics as the explanation of the word is argued to be compromised of contradicting terms, these being teaching and learning. In Beetham and Sharpe`s paper they go on to say “[i]n extreme cases teaching is seen as the act of denying the active nature of learning” (Beetham and Sharpe, 1). This is problematic because, as previously mentioned, it is this form of active learning that is vital for students to understand the material being presented and allow them to critically engage with it instead of just memorizing the information. The reading observed makes it seem like teaching and learning are in competition with one another. It`s not a competition but rather the goal of teaching is that learning takes place, they can be seen as interdependent on each other. The extent or depth at which this learning takes place is something that can be impacted. However, in regards to the previous statement observed by Beetham and Sharpe it can be interpreted as having been based on the common notion that the term ‘teaching’ is

directly associated with a direct teaching[6] method where the content being delivered is done so in a lecture-format. This demonstrates the practices that surround the notion of teaching and how traditional methods that make use of lecture based sessions and rote learning are still seen and used as a default option despite the proven long-term ineffectiveness it has on the learning process.

The meaning and background behind the term 'learning' is seen in stark contrast as it is defined as the acquisition of knowledge. For effective learning to occur the student first needs to understand the topic or content being learned I say learned instead of taught in this case so as to not allow for the opportunity for the two domains to cross while in a selective analysis of each. Active learning as the name states requires students to take an active role in the learning process and participate by asking questions, having discussions and interacting with the content. The debate surrounding the definition of pedagogy is justifiable as it highlights and questions what the underpinnings of a pedagogy aims to accomplish. However, it can be stated that teaching and learning are not mutually exclusive. Using alternative means of learning such as self-studying still places teaching within the process. There may not be a person with a teaching degree present when this occurs, but rather the 'teacher' takes on a new form. This form can be the social community that surrounds and supports a particular body of knowledge or the course coordinator that sets up the curriculum over a year ago. Another example of where this occurs is through

[6] Direct teaching is a low-tech format of teaching with assessments serving as an illustrative format of measuring a student's memorization skills rather than their understanding of a topic

vicarious learning[D44][7][r45], however, the subject that is being observed can be argued to be an involuntary teacher. Academics have chosen to place more importance on learning rather than teaching, as they believe too much emphasise was being placed on what was being taught rather than how the information was being conveyed and learnt. This paper is making use of the definition and understanding given by Beetham and Sharpe;

> 'Pedagogy' is used in the original sense of guidance to learn: learning in the context of teaching and teaching that has learning as its goal…The word can also be used in the sense of referring to the activities of learning and teaching as well as used to describe how we think and talk about, plan and structure those activities when not actually engaged in them (2).

With students playing a more active role in the learning process than ever before due to the development of technology and the easy access to knowledge and information afforded by such methods, the educational domain is still trying to contextualise such a paradigm shift into a pedagogy that is effective and optimal. In order to do this some individuals have begun to use current pedagogical models that look to implore that creators and designers of such technology use and consider implementing educational pedagogies into their design so as to make the incorporation of said devices into an educational setting easier. "'Pedagogy before technology' is a common catchphrase of reflective practitioners in this field, suggesting that – far from trying to create pedagogy anew – we should be in the business of locating the new technologies within proven practices and models of teaching" (Beetham and Sharpe, 3). This method requires technology to be the field that changes or adapts for the sake of the educational field, making the use of technological advancements[8]

[7] Vicarious learning is linked to social learning theory. Bandura describes it as the ability of individuals to learn by observing others (1977a). The consequences or perceived rewards an observed subject receives then informs the individual of what behaviour is condoned or condemned.

[8] It was in 2015 that the South African government made the decision to move towards a paperless classroom with tablets being given to students and a laptop being provided to every teacher in a classroom. It is

more accessible and customizable. [D46][r47]Other individuals have done the opposite and have begun to create new pedagogical models that centre their focus on using the current technology in a way that can be best taken advantage of to design curriculum and use said technology to assess these outcomes. This method requires the field of education to change or adapt for technology and the use of it. Then there is a third approach which describes how neither fields should change for the sake of the other. Instead it suggests that past models should make use of the current technological advancements and base their use on what is already known about how individuals learn. According to Beetham and Sharpe "like [D48][r49]previous innovations, they can be assimilated to pedagogical practice without altering the fundamental truths about how people learn" (4).

Beetham and Sharpe observe in their paper that "Biggs (1999) describes the task of good pedagogical design as one of ensuring that there are absolutely no inconsistencies between the curriculum we teach, the teaching methods we use, the learning environment we choose, and the assessment procedures we adopt" (14). However, in order to identify the possible inconsistencies between these facets, one first has to understand how individuals take in information and what allows them to learn. It is using Greeno et al (1996) identification of approaches to pedagogy that three clusters of explanations or perspectives linked to learning theory can be used to explain a range of different phenomena.

The associationist perspective is the first cluster, it explains that learning takes place in a bottom-up format which can also be described more broadly as trial-and-error. Our brains don`t recall information in isolation, instead ideas and experiences reinforce each

their goal that by 2018 every student has access to a government funded tablet with classrooms either having an interactive white board or the teacher using a laptop to conduct lessons (Mzekandaba, itweb.co.za).

other which lead us to group information together into one associative memory. The individual associates or links certain concepts or ideas together and through enacting a physical behaviour or sequence of activities relating to this, they receive feedback. (Beetham and Sharpe)

The cognitive perspective [D50][r51]is the second observed cluster; it believes learning or "the acquisition of knowledge is gained through a process of interpreting and constructing meaning" (Beetham and Sharpe). This particular cluster makes use of a mainstream cognitive approach in which emphasis is placed on assumptions derived from constructivist theory. These assumptions place prominence on the individual creating meaning through interacting with the world and creating a framework which can be changed based on the meaning extruded from these interactions. Before continuing, clarification is needed; the cognitive perspective and the constructivist perspective are not the same, but they do share the same starting point. Both believe that individuals learn through interacting with the world. It is the processing of said interaction that is different as the cognitive approach views humans as computers that make use of only their intellect and logic during the learning process. While the constructivist approach views humans as using both intellect and emotion in the learning process. Continuing on, this paper follows Beetham and Sharpes process of explanation of the cognitive perspective, through exploring the constructivist approach due to their initial similarities.

Part of the constructivist approach relies on the individual having previous knowledge which can be built upon using constructive and directive activities. "Collins et al (1989) argued that we should consider concepts as tools, to be understood through use, rather than as self-contained entities to be delivered through instruction" (Beetham and

Sharpe). Jean Piaget is noted as the father of constructivist theory. In his book "Development and Learning" he explains how this method of learning occurs and makes sure to emphasise and explain how the process of development also plays a role in learning.

Piaget defines development as "a spontaneous process tied to embryogenesis". Embryogenesis occurs from the time an individual is born until the period in which they are classified as an adult (Piaget, 1997). It is during this time that the nervous system, as well as specific cognitive functions, develop and mature. These functions take place within four chronological stages within an individual's life before stagnating upon reaching adulthood[9].

Learning can be defined as "being provoked by external situations. It is provoked in general, as opposed to being spontaneous and is linked to a single topic or structure" (Piaget, 1997). Learning is a result of development, as it is only through development that knowledge can be obtained. Knowledge is gained through critically engaging with a subject, it is by doing so that the individual creates a mental structure in the form of an operation. An operation is a group that forms part of a lattice in which a collective knowledge about the world is stored[D52], in other words it can be described as a structure that affects mental concepts[r53]. From a pedagogical point of view, learning uses a stimulus and response structure, however, for this stimulus to be noted and thus made effective one must first have an operation structure in place. It is within these operations that knowledge can be added, subtracted, joined to or separated from other operations.

Factors that affect the transformation of these operations can be split into four groups: Maturation, which is the continuation of embryogenesis; experience, which is "the

[9] These four stages compromise of: the sensory-motor, pre-verbal stage, the pre-operational representation stage, the concrete operations stage and the hypothetic-deductive operations stage.

effects of the physical environment on the structures of intelligence"; social transmission, in the broad sense, is education, linguistic transmission etc." (Piaget, 1997); and lastly, self-regulation, a factor that plays a pivotal role in effective learning, the ability to "critically engage" with a topic. Piaget describes it as compromising of a succession of levels upon which equilibrium must be reached in order to progress to the next level. Each level marks progression in obtaining facts about the topic with an eventual conclusion being drawn at the last level.

Therefore, learning is not just compromised of stimulus and response, rather it includes operations and self-regulation. It is only when an operation already exists that one can identify the stimulus and assimilate it with the operation that the stimulus is activating. To assimilate something, as Piaget defines, is to "integrate a concept into a structure" (1997). It is this active assimilation, Piaget states, that is fundamental to learning. Effective methods of learning through assimilation builds on an elementary structure and increases in complexity.

In an example provided by Piaget, he discusses a 5-year-old playing with play dough. The concept of what play dough is has been introduced before, it is by having this operation in place that the child can respond to the stimulus of the play dough being presented. Once the child begins to play with the play dough, they roll it out and concentrate on one aspect of the play dough, being the length. However, when the concept of the dough being thicker when shortened is pointed out to the child, they begin to self-regulate this newly presented problem. By the child experimenting with these facts, they begin to reach equilibrium on one level and so move to the next level. Being, they understand that the length of the dough

corresponds to its thickness. This understanding is then assimilated and the operation is modified.

To summarise, a structure is first introduced to the individual. From this, development of cognitive functioning allows them to begin to deduce certain logical facts. It is at this point that a stimulus is provided that allows the individual to self-regulate this information and assimilate it by drawing to a conclusion. This conclusion is then either confirmed or modified into the existing operation or a whole new operation is created. It is through this active assimilation, which comes through interacting with one`s environment, that learning is possible. This statement extends to and supports the aforementioned notion of active learning where interactivity is a vital component in the learning process.

Some video games use this format in a learning model called experiential learning which encourages the player to create a hypothesis and then test and modify these ideas based on the feedback that was given to them by the system. Relating this back to the cognitive perspective, each player was introduced to a topic thus creating a solid foundation for their learning to be based upon. It was from here by experimenting with the virtual environment that their understanding grew or adjusted depending on the feedback. This type of learning permits failure and allows the student to grow from it, creating an environment that is conducive to learning.

The situative perspective is the final cluster; it takes the social approach to understanding how individuals learn. It explains that individuals will always be influenced by their social and cultural background as they are inducted into a community that has situated practices and beliefs which inform their interactions and understanding of the world. “Underlying both the situated learning and constructivist perspectives is the assumption

that learning must be personally meaningful, and that this has very little to do with the informational characteristics of a learning environment" (Beetham and Sharpe).

> Lave and Wenger (1991) characterized learning of practices as processes of participation in which beginners are initially relatively peripheral in the activities of a community and as they learn the practices their participation becomes more central (Beetham and Sharpe).

According to Barab and Duffy (2002) there are two categories in which the situative perspective occurs; the socio-psychological view of situativity and the concept of a community of practice. In the socio-psychological approach, students are taught within a training environment that simulates real working conditions as close as possible. This is done so as to make the learning context-dependant and allows the student to be able to link and apply the theory and skills learned in the training environment with the social context and implications of the activities when in a non-simulated situation. Here importance is placed on the activity and how it falls into a wider field of practice. In the concept of a community of practice, Lave and Wenger describe a second concept related to this idea which is the importance placed on the individual and the relationships they make with people that form part of a community. "[There is] an emphasis on the individual's relationship with a group of people rather than the relationship of an activity itself to the wider practice, even though it is the practice itself that identifies the community" (Lave and Wenger, 1998).

Another form of an interactive online community of practices is that of e-learning. E-learning[D54] is an example of said reconstruction and refinement of learning strategies and principals or according to Ching-Hong Liu it can be defined as "[using] the Internet and or other digital content for learning and teaching activities…" (2010). E-learning has been around as early as 1924 with the first testing machine being invented, it was a device that

allowed students to test themselves[D55][iii][r56][D57]. However, it is only recently in the past 18 years or so that e-learning has greatly expanded, becoming available within households and aiding in the learning process. It contains aspects of blended learning that emphasizes elements of all three perspectives of learning theory. According to Mayes and Fowler "it is tempting to regard these perspectives not as competing accounts but as stages in a cycle" (1999). When reading through the chapters found in Beetham and Sharpes`s book, I found myself coming to the same conclusion before coming across Mayes and Fowlers statement. It is appropriate to think of each perspective/theory as addressing a different stage of learning as an individual moves from one level of proficiency to the next, with the goal towards mastery of knowledge or a skill being the final outcome. The situative perspective addresses the motivation behind an individual's reason to learn while the associative perspective focuses on the detailed nature of performance, and cognitive addresses one`s understanding and reflection on an action (Beetham and Sharpe). If learning is to be seen as a cycle it can also be thought of as being an iterative process, however, this is not to say that upon successfully passing a form of assessment that the cycle is completed. Instead, the nature of the pedagogy changes, suiting the individual's skill level with their performance adapting with continual practice. This is where technology has been looked to as a means to make better use of the different pedagogical models at the different stages of learning.

> Fowler and Mayes (1999) attempted to map broad pedagogies onto types of technology, distinguishing between the technology of presenting information (primary), the technology of supporting active learning tasks and feedback (secondary), and the technology of supporting dialogue about the application of the new learning (tertiary) (Beetham and Sharpe, 21).

However, e-learning tries to suggests its own pedagogical model that can be placed into two categories; the first, allowing institutions to be able to set the standard for the

virtual learning environment. The second, on the opposite end, is the learner being able to take control of their learning experience and take in information and progress through the course at a pace that best suits their needs and abilities to the point they are able to make their own design decisions. The latter is the currently popular notion - e-learning provides a vehicle for communication with both categories connecting like-minded individuals and through learning relationships individuals are able to gain access to both direct communication and the sharing of relative information (Beetham and Sharpe, 21).[D58]

Having established the different ways in which learning occurs and concurring it is useful to think of these categories rather as a cycle than separate or competing parts the medium of video games has managed to incorporate a lot of these facets and has shown positive results in not just teaching a topic but also promotes and encourages learners to continue learning outside of the presented content. Through the player`s growing understanding of the information being provided to them they begin to associate their actions with a reaction. It is here that Piaget's theory on learning and development is useful. By observing that the player is creating an operation and modifying it, it can be seen that the player is self-regulating the information that they receive. Through self-regulation the player creates meaning based on giving context to the content of the game, this is called "situated meaning[10]" (Gee, 2006). [D59][r60][D61]This occurs through experiencing the interaction of the gameplay and understanding the multimodal information being provided by the system.

[10] Situated meaning as referenced earlier can be understood as the act of de-coding and contextualising words, symbols, images, artefacts and actions in relation to the semiotic domain it is associated with. In games the player is thrown into an environment where they are given new information, some which can only be found and contextualised in reference to the game. An example of this is *Candy Crush* (2012), in the game there are special candies which act as boosters. For the player to understand what these special candies are or what they do, they first have to derive meaning from this newly presented information and to do so they situate the meaning of the objects in context of the game and how they might operate.

> It is using situated meanings and design grammar of the game to understand and produce appropriate meanings and actions that active learning can take place. Thinking about the game as a system and designed space opens up the game for critique. It is with this that critical learning can be established as one reflects on the internal and external grammars (Gee, 2003).

Gee describes how critical learning involves thinking of semiotic domains as design spaces that manipulate the participant, and that the participant can manipulate in return (2003). This directly reflects how meaning is conveyed through a mode[11], or multiple modes, while always changing based on cultural influences. It is this meaning that makes one act, feel or think in a specific way.

When navigating these semiotic spaces, one begins to associate certain internal and external design grammars with a specific domain. An internal grammar can be described as "the principles and patterns in terms of which one can recognise what is, and what is not, an acceptable or typical content in a semiotic domain" (Gee, 2003).While an external design grammar can be described as "the principles and patterns in terms of which one can recognise what is, and what is not, an acceptable or typical social practice and identity in regard to an affinity group associated with a semiotic domain" (Gee, 2003). Both these design grammars support one another's structure and in turn transform each other.

It is by engaging with multiple semiotic domains, and understanding the internal and external design grammars of those domains, through which one can begin to think critically

[11] Mode can be understood as one taking action with the intent of trying to communicate in a socially or culturally acceptable way. As Gunther Kress defines it, "mode is a socially shaped and culturally given semiotic resource for making meaning" (2001). These semiotic resources can take the form of words, images, graphs, sounds, facial expressions, equations, gestures, movement, objects or even the clothes one wears.

and understand how these domains are clusters that are inter-related. This type of reflection and interaction with a semiotic domain is deemed as critical learning and thinking.

Within games this results from the player having participated within the process of creating an operation by interacting with the game and self-regulating the situated meaning created by it, as well as the internal and external grammars associated with that domain. It is through understanding the meaning of these grammars that the player is able to take appropriate action and therefore active learning takes place. Thus it can be seen that video games have the potential to enable players to learn new semiotic domains based on the exposure and interaction they provide. Gee goes on to explain (2003);

> Video games are an interrelated extension and connection of multiple semiotic domains, thus providing a more accessible way of thinking for the multimodal generation, allowing them to access and induct themselves into these interrelated clusters of semiotic domains.

However, without critically engaging with the content of a game the player is unable to access these benefits that video games provide. Therefore, Gee suggests that active and critical learning can be facilitated by encouraging individuals to think and talk critically about the contents of a game, as well as the semiotic domain it resides in (2003).

Linking back to the initial statement of this section and how researchers are continually creating new pedagogical designs; the field of learning and development is continually evolving, (this is due to new discoveries related to learning and teaching, evolving technology and new initiatives), and it is understandable why researchers and theorists have different views and approaches on how learning takes place. This reason forms part of why there are multiple pedagogical models, as each serves a highlighted facet which is grounded in the creator's academic background or interest. Yet as concluded and

agreed upon earlier it is best to think of learning rather as a cycle than independent approaches.

I need to include in here that although games have managed to combine these factors they have done so with the main objective being for entertainment reasons and not educational or curriculum driven reasons unless stated otherwise. Educational games have been made before with noted success, the steps that need to be approached and are currently being dealt with in order to move forward are creating a system that optimizes the game making process. This is why researchers are creating a multitude of pedagogical models as they are trying to pinpoint what elements within a game should be used to form the basis of creating a successful educational game. They are also trying to implement recognizable learning pedagogies within these models so that games can be used as a tool within the classroom and have straightforward assessment criteria.

3.1) Background into Past Models

Many variations of pedagogical models have been designed and implemented trying to achieve better teaching outcomes and optimize the learning process, each focusing on what aspect of learning they believe to be most important and rooted within either game design theory, psychology, education or engineering. Each model is founded within its own right, however, designing an educational game with a balance found in all disciplines has been proven to be difficult. In the paper *Educational Games (EG) Design Framework: Combination of Game Design, Pedagogy and Content Modelling* written by Rosalina Ibrahim and Azizah Jaafar, they compare and analyse a few frameworks centred on how to create an educational game.

The main concern when designing an educational game as stated within Ibrahim and Jaafar`s paper is creating “games that are fully entertaining as games while maintaining good pedagogy to ensure learning success” (3). It is before introducing the various models aimed at exploring the criteria of making a successful educational game that Ibrahim and Jaafar first present the “EG Design Framework and Methodology” created by Hirumi and Stapleton. Hirumi and Stapleton believe that the design process of an educational game should involve individual parties that design sections of the game that are related to their field of expertise. Leaving game designers to handle the fun aspect and technical outcome while content experts manage the learning process. “If the development is left to educators, the resulting games may be neither fun, nor engaging; in contrast, if entertaining game designers dominate the design process, the games may fail to apply key pedagogical principles that are vital for effective learning”(Ibrahim & Jaafar, 3). In their model they create phases in which to follow and suggest roles for the game designer and content expert involved. Hirumi and Stapleton continue to explain that the development could lead to the phases changing their order and the framework being approached in a different manner, but the phases will still remain a constant.

Table 1. Relationship between Id Tasks and Game Development

ID Process and Tasks	**Game Design and Products**
Analysis Phase	**Concept Development Phase**
• Assess needs and identify goal(s) • Analyse goal(s), learner and context	• Prepare pitch document • Prepare game concept document
Design Phase	**Pre-production Phase**

• Generate, cluster & sequence objectives • Determine learner assessment method • Generate instructional strategy • Select medium	• Create game design documents • Prepare art bible and production plan • Create technical design document
Development Phase	**Prototype and Production Phase**
• Acquire materials or outsource developments • Create flowcharts and storyboards • Generate prototypes • Formatively evaluate and revise materials	• Develop analogue or low fidelity prototypes • Develop tangible prototypes • Produce Alpha Version • Produce Beta Version • Produce Gold Version
Implementation and Evaluation Phase	**Post-Production Phase**
• Deliver and manage instruction • Plan and conduct summative evaluation	• Generate and release subsequent versions • Generate and release upgrades/expansions

This framework is helpful in analysing and suggesting a pipeline process for making games, however, due to the abstract and high level lens it has chosen, it does leave much to be desired in the way of details but the model serves well as a guide and does outline the steps needed in designing a game as a team effort. It also serves to show the amount of work needed to be put in just on a conceptual level when designing an educational game

further communicating that it is a difficult task and it is understandable why there is little evidence on prolonged studies when it comes to creating, testing and adapting a pedagogical model for educational games in a practical component despite other contributing factors such as money, time, test subjects ect.

The first model referred to in Ibrahim and Jaafar`s paper is the Adaptive Digital Game-Based Learning Framework (ADGL) proposed by Tan et al. This model was composed after analysing and comparing four other available frameworks; The Design Framework for Edutainment Environment proposed by Embi (2005), the Interaction Cycle for Games by Barendregt & Bekker (2004), The Engaging Multimedia Design Model for Children by Said (2004) and the Game Object Model (GOM) by Amory (1999). All these models/frameworks greatly emphasise interaction elements and based on this Tan et al identified two major components upon which to compare the models being the pedagogical aspect and game design aspect with each containing multiple criteria. The ADGL model adopts these two components as their main focus as well. The pedagogical aspect focuses on the learner and suggests criteria that should be met to encourage the learner to take an interest in the learning object. Tan et al explains that this would make the learner more willing to learn and increase the pace of the learning process. The first facet of the criteria derived from their analysis, proposed that the psychological needs of the learner need to be met, describing that if the learner felt in control of the game the learner might develop an interest in it and continue playing for the learning aspect. The second facet suggested as part of the pedagogical component was designing a game for the cognitive capabilities and development of the targeted group. Tan et al breaks this down by categorizing ages two to seven years old as being able to participate in tasks that looked at memory skills and use

their imagination to understand some subjects, however, their thinking is limited to not being entirely logical and non-reversible. Thus games targeting this age group would have to base their methods of teaching around these understandings. Seven to 11 year old were categorized as being able to think logically about objects and events, and those older than 11 years old were categorized as being able to think logically about abstract propositions and test hypothesis systematically (4). The last component identified and associated with the pedagogical aspect is learning behaviour which is based partly on Slavin`s 9 prinicpals of behavioural learning which in a broad sense deals with feedback and interaction. A game needs to provide feedback by either positively or negatively reinforcing the actions taken by the learner so as to create a better learning environment, allowing the student to perceive what is required of them and making the learning process more effective. By doing this it could also make the learner more willing to learn.

Moving on to the game design aspect of the model, it focuses on how the game interacts with the learner by having a multimodal criteria requirement. Tan et al places subheadings into this section by making sure to mention the interface, narration and interaction needed within a game, but first allow me to explain what a multimodal platform is or rather multimodality. Gunther Kress defines multimodality as “being a theory or framework that examines the use of multiple modes within a single medium in order to communicate or express oneself”.

Multimodality is a beneficial resource for education due to its use of multiple modes in which it communicates a concept. Communication with regards to education is vital as, in order for one to learn and take in information, one first has to understand the concept of that information, and how that information is being relayed. This is why multimodality is a

beneficial teaching tool as it allows individuals to interact with more than one resource of information and access different channels due to the stimuli being provided.

Bezemer and Kress argue that students understand information differently when text is delivered in conjunction with a secondary medium, such as image or sound, than when it is presented in a single format. “This is due to it drawing a viewer’s attention to both the originating site and the site of recontextualization” (Bezemer and Kress, 169).

Based on this understanding Tan et al mentions the interface within a game and describes that it should be simple but highly meaningful. The interface helps focus the player’s attention without getting confused and helps immerse the player and adapt to the game environment.

Interaction or interactivity as defined by Tan et al as essential and defines how the learner controls and learns from the game. Yacci states “Instructional interactivity occurs from the learner's point of view and does not occur until a message loop from and back to the student has been completed” (2003). This is due to the process of learning being contained within the individual.

> Two distinct types of effects can occur through interactivity: content learning and affective benefits. Content learning is described as purposeful learning directed toward attaining an instructional goal. Affective benefits are described as emotions and values toward instructional artefacts that are dampened or amplified (Yacci, 6).

Tan et al describes interactivity as being useful as it keeps the learners attention and keeps them motivated due to the level of control they have which feeds back into the pedagogical aspect on psychological needs as well as learning behaviour which is a causation

of feedback. Thus a small loop is what actually occurs as the components feed off of one another when done successfully instead of being seen as separate parts to mark off.

The second component that forms part of the game design component is tasks, this refers to the activities or challenges posed to the player to figure out and complete. This component requires clear instructions and using a difficulty curb upon which the tasks start easy encouraging novices and progressively get harder so the seasoned player still feels challenged by the game. These tasks as described by Tan et al help the learner absorb the learning content.

The last component in the game design aspect is feedback which was mentioned earlier. Feedback gives the player clues on how to solve the task presented to them and is available on demand. This feedback extends into the realm of rewards and achievement giving the player a sense of accomplishment and the motivation to carry on learning through the game.

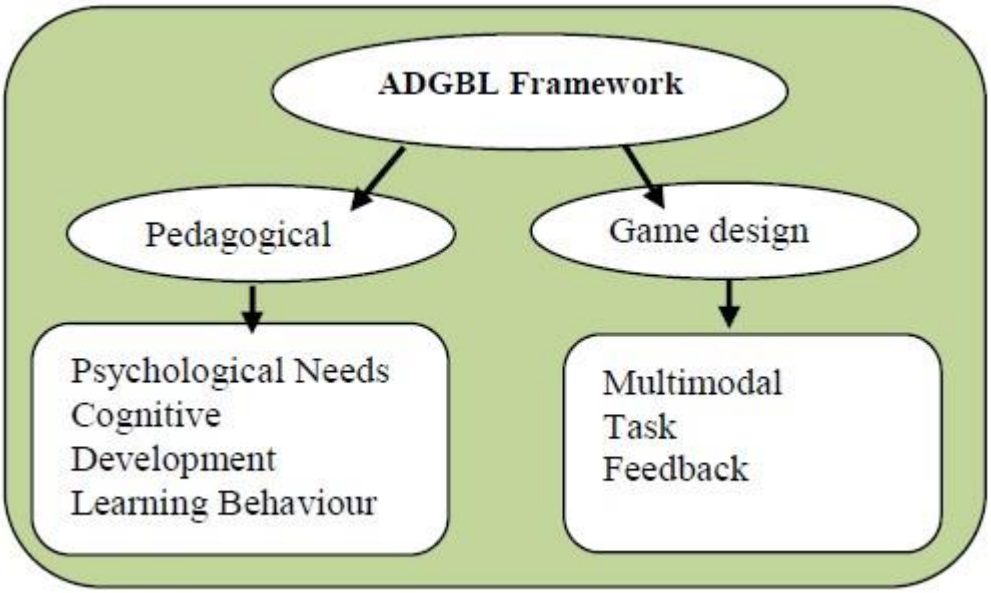

Figure 1: Adaptive Digital Game Based Learning (ADGL) Framework (Tan et al, 2007)

The second model is the “Three Layered Thinking Model of Web-based Educational Game Design” proposed by Fong-Ling Fu and Sheng-Chin Yu. Fong and Sheng created this model based on the observation that web-based games were still in its infancy compared to other educational games, and they felt that by tackling the idea of what made for a successful educational web-based game that it could lead to further insights in regard to educational game design (2). The creators of this model continued to rationalise their chosen field of investigation by describing that other forms of educational games tend to have higher budgets and are more cost-consuming when compared to web-based games. This is an aspect which web-based games cannot compete with and so it creates a gap in the knowledge surrounding the design principles needed when creating such a game.

Fong and Sheng`s model is influenced by four perspectives that they believe a game should take note of in terms of its interactions; “ the particular context in which learning takes place, the characteristics of learners, the internal representational world of the game and pedagogic consideration”(3). When they refer to the context in which learning takes place this can be understood as relating back to the situative learning perspective and understanding the advantages and disadvantages that web-based games contain while being delivered through a stationary medium with possible, unknown environmental impacts. However, in their paper they only refer to the students being able to use a FLASH like software and the large bandwidth of Internet provided by most universities, making the access to such a tool more available.

The characteristics of learners as described by Fong and Sheng is referring to how games should adjust their method of deliverance in terms of learning style to suit the progressing and targeted generation. It is in their paper that Fong and Sheng provide a list of

mechanics, methods and theories that were once favoured by an older generation and has now been replaced to suit the current or e-generation. An example of this is seeing how graphics are now held in a higher position of value versus text or the narrative of a game, or a game having connection and sharing capabilities compared to being a standalone software. The internal representational world of a game refers to the multimodal resources presented to the player to "reinforces the players' augmentation skills in reading visual images, thinking, rule-discovery, language development, and triangulating divided attention" (4). Fong and Sheng mention the interface and storyline in particular and describe how it also creates a sense of immersion that assists the player in relating concepts and skills back to the intended field of study. "It encourages learners to engage in active learning by making mental connections between the story and structure of the problems" (4). It`s this form of feedback that reinforces a well-structured pedagogical model or methodology, which is the last point that Fong and Sheng inspect. Their model is heavily influenced by an experiential learning perspective as they use it to define the role of the player as being one to explore their environment in the pursuit of knowledge and use hypothesis testing to support or contradict their actions and understanding. In their pedagogical considerations they also look at Bloom`s six levels of knowledge in the cognitive domain and combine it with Prensky`s game style suggestions in order to draw up a table that serves as a way for teachers to link their learning activities to a type of genre that a game could use in order to attain effective learning outcomes. They also make use of Siang and Rao`s seven levels of a hierarchy of needs demonstrated by players as well as incorporate Lionel Tiger`s four types of pleasure framework to inform their pedagogical considerations. This facet ultimately aims at increasing the player`s knowledge while also enhancing their current skills (4).

In Siang and Rao`s seven levels of needs the bottom level is comprised of player`s gathering information so as to understand how the game works using the rules that make it up. The next level has the player seeking to make use of this new found information by trying to control the game. After which, the player feels challenged to operate within the system confined by rules and to overcome tasks that are assigned to them. However, the player too can assign themselves their own goals within such an environment and it is not always left up to the system, an example of this is when players operate within a sandbox game where they set themselves goals to achieve. The level that follows this is the need for aesthetics in which the player demands visual and auditory cues that serve to provide information and give feedback to the player. In Fong and Sheng`s paper, they note how in the next level where game-play is needed, the need for aesthetics is greater than the need for challenge in relation to it. I disagree with this statement and believe the opposite to be true. Ironically, in the next sentence Fong and Sheng describe that a good game should be sufficiently challenging and congruent with the player`s current skill level so as to amount in a flow experience. Flow is a term that was introduced by Csikszentmihalyi (1975) and he defined it as the state that occurs when one is totally engrossed within an activity with the end goal being their main priority. It is a psychological state that can be induced by a game when the player feels challenged but also possesses the necessary skills to be able to overcome such a challenge. Fong and Sheng describe how this state promotes addictive behaviour among player`s and since their end objective is to accomplish the goal set before them, the last level in Siang and Rao`s seven levels is the player completing the required tasks in order to achieve the required learning outcome (4).

Lionel Tiger`s four types of pleasure framework informs part of the model by offering insight into how different aspects of pleasure contribute to creating a successful game. The first pleasure is physiological which is derived from sensory organs such as touch, taste and smell (4). The second pleasure is social which can be satisfied through interacting with another or feeling part of a group. The third pleasure is psychological which is derived from accomplishing a task. The last pleasure is ideological which is experienced by those who feel they are participating in a highly difficult task and infer a high value of importance upon the task.

The three layered model takes these four perspectives and uses them to inform and address the stages of designing a game and the process that is required. Fong and Sheng divide these layers into game style, game task and game interface and describe how before any of these aspects can be determined that it first depends on the curriculum goal. Once this has been decided it then needs to be translated into a pedagogical sense and applied to setting the game goals. This leads into the table mentioned earlier that combines Prensky and Bloom`s suggestions together in order to decide what genre would best suit the required learning outcomes. This makes up the game`s style. It is the game`s purpose to increase the player`s knowledge as well as enhance their previous skills. By interacting with the tasks presented by the game the player is challenged and upon completing these challenges they are offered a sense of reward through being awarded a trophy or progressing through the game. Flow experience is emphasised in this section of the model as it is was keeps players immersed as well as what leads them to feeling a sense of fun. It is here that Lionel Tiger`s framework of pleasure is evident as the multimodal aspect of the game serves the player`s physiological needs and the progression or rewards earned in the

game serve the psychological needs of the player, thus it acts as a means of positive reinforcement on a subconscious level by influencing the player to keep coming back. The game interface design is the final facet within the design level and through good design helps the player to concentrate and respond to feedback, enabling them to complete the tasks and so progress towards and achieve the required learning outcome.

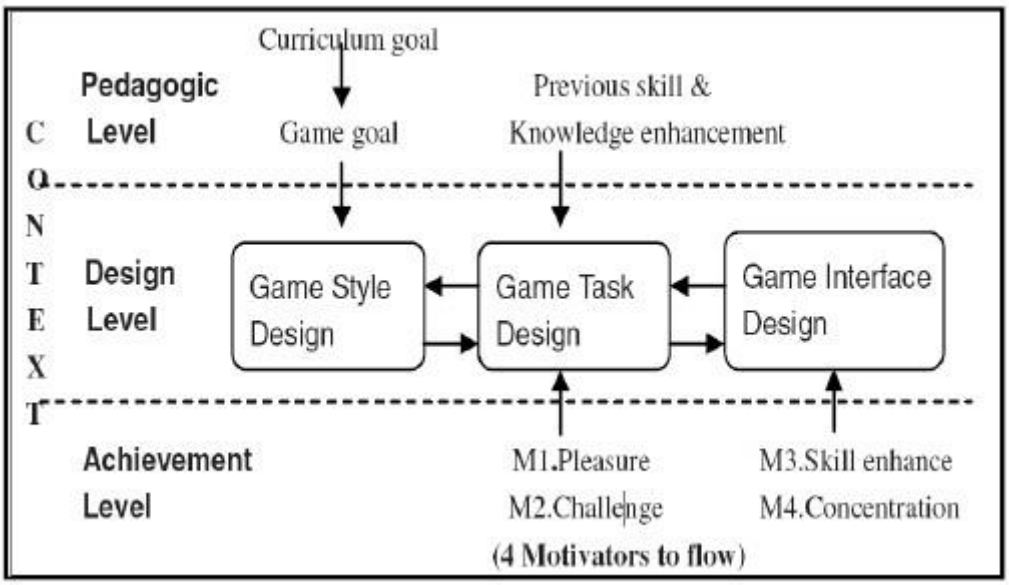

Figure 2: Three Layered Thinking Model of Web-based Educational Game Design (Fong & Sheng, 2008)

The "Experiential Gaming Model" was created by Kristian Kiili. It was created as a means to link educational theory to game design and serve as a way to be able to analyse and design educational games. Killi noted how educational games had been proven to be effective within the learning process, however, when it came to learners who had grown up with technology they needed more stimulus in order to motivate them to engage with the game and keep interacting thereafter compared to individuals who had had to adjust to the use of technology in its growing period. This framework is based on experiential learning theory and aims to stress the importance of balancing challenges in a game in order to

provide an environment for an optimal flow experience as described by Csikszentmihalyi (1975). However, the model does not focus on the precise moments that flow can occur within a game, rather it highlights factors that contribute to the experience of flow.

Killi describes the model as functioning in a similar way that a human heart would. “The challenges based on educational objectives form the heart of the model. The task of the heart is to sustain the motivation and engagement of the player by pumping appropriate challenges to him or her” (Killi, 6). Killi goes on to explain that it is through interacting with the game that the learning process takes place as it is not just a cognitive experience, but is a behavioural activity and so she describes that activity is needed for the player in order to learn. From the previously mentioned perspectives of learning this model takes an associationist and cognitive approach. It does not include nor focus on any aspect related to a social or situative perspective.

The model makes use an ideation loop, an experience loop and a challenge bank (Killi, 6). It begins with the player being presented with a challenge or problem derived from a learning objective needing to be met. It is from here that the player generates ideas which are categorized into either the preinvative idea generation loop or the idea generation loop. Killi`s paper describes the preinvative loop as usually being the first to be addressed as this is where the individual creates ideas that serve as solutions, but she describes these ideas as being almost childish as they don`t consider rules or limitation of any kind. “It can be described as an unstructured and chaotic phase resembling the play of children” (Killi, 6). These ideas albeit impractical in certain situations do lead to innovative solutions as Killi explains. After the preinvative idea generation loop comes the idea generation loop where constraints are taken into consideration and applied as well as what resources are available.

Killi describes this process as being most fruitful when done in groups.

Once an idea has been chosen it is applied and tested within the experience loop and the outcome is observed. Killi describes the use of the ideation loop as being important as it promotes the creation of new solutions and cleanses the experience loop of old solutions. This method can be linked back to Piaget`s theory of learning and development which allows for schemata, or operations as previously discussed, to be created, modified and linked. In games it is important for feedback to be immediate and easy to understand to allow the player to adjust their understanding and thus modify their schemata at the same time. This kind of testing is what makes up experiential learning as the player is able to keep testing their hypothesis and from what they know and understand adjust their solutions. Difficulty curbs derive their operation from making use of schemata and forms part of flow theory which is what Killi is aiming to achieve parallel to the defined educational outcomes. The player improves their skill level through the increasing difficulty of the challenges and hypothesis testing but if the game only challenges and makes use of one solution then it is only strengthening a single set of schemata relating to the solution. This creates an imbalance in the game world and the model as Killi describes that the heart of the model gets exhausted which is likely to lead to a reduced sense of motivation in the player, making the achievement of learning outcomes more difficult to achieve through the continued use of the game. Killi describes that it is impossible to predict the rate at which the player`s skills develop and is part of the reason why it is so hard to design a successful educational game. It is from this point that she begins to explain how adaptive games can be useful and should be implemented to allow for both students who struggle with concepts and those who grasp things quickly to feel they are challenged without it becoming frustrating or boring. In

summary, Killi`s experiential gaming model as stated in Ibrahim and Jaafar`s paper, aims to highlight the following aspects that should be included when structuring and creating an educational game: specific goals, established procedures, appropriate tools, avoiding distractions, a sense of high engagement and high density of interaction and feedback (5).

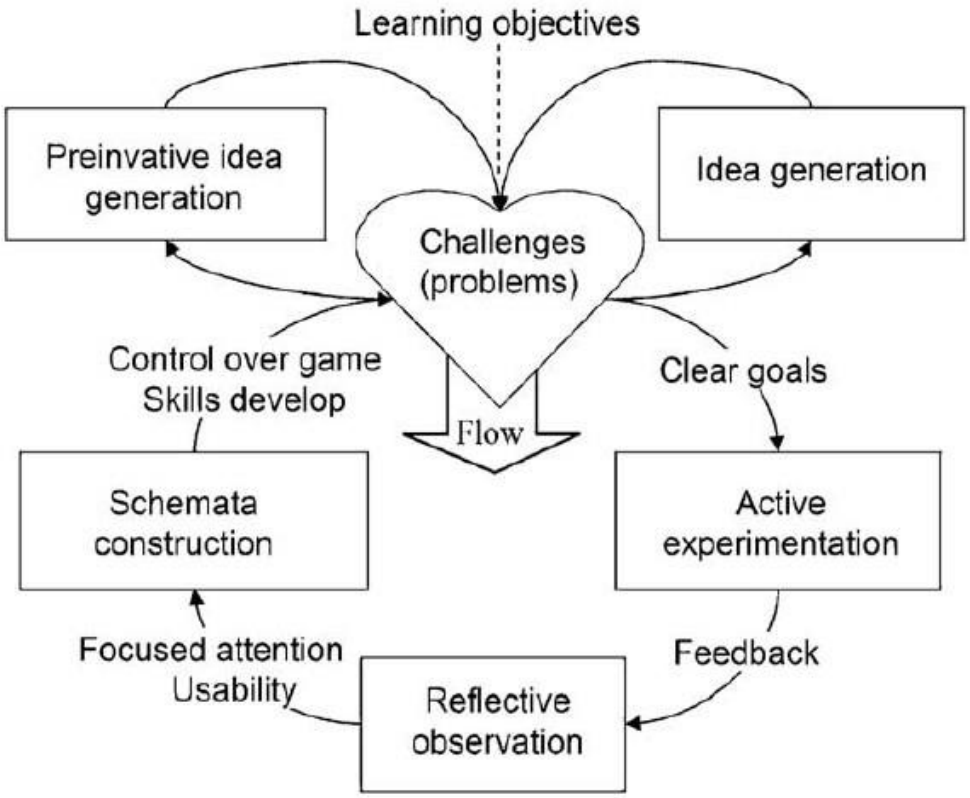

Figure 3: Experiential Gaming Model (Kiili, 2005)

The last model that is discussed in Ibrahim and Jaafar`s paper is their own proposed pedagogical model called “Educational Game Design Model”. They make use of the previously mentioned models as a foundation upon which to base their own model. In their paper they mention that despite the growing amount of researchers emerging in the field of educational games and the research linked to them there are still areas that are lacking in inquiry and solutions. These areas as described by Ibrahim & Jaafar are “authentic learning outcomes, games usability, multimodal perspectives and effectiveness of games for

longterm usage" (5). "Our main intention is to develop an educational games design model that combines three factors; game design, pedagogy and learning content modelling, with emphasis on usability, multimodality, fun, problem solving and syllabus matching"(Ibrahim & Jaafar, 6). It is in their model that Ibrahim and Jaafar try address some of these areas.

The game design component of their model firstly looks at usability of a game and makes use of the ISO 9241 as requirements for its testing. It looks specifically at satisfaction, efficiency and effectiveness. It then establishes that multimodality is a requirement needed within a game, this is where images, sound, animation, videos and aspects of interactivity are included. However, that is not to say that multimodality exclusively includes interactivity as a whole. Lastly, they include the aspect of fun as a requirement and make use of Prensky (2001) to support and describe that if a game is fun then it can provide engagement and motivation to the player. This section of their model is influenced by the (ADGL) Framework created by Tan et al, its incorporates their view of multimodality as well as interactivity on a learning curb which serves as a basis for flow which forms the fun aspect found in games. This is supported by aspects of the Three Layered Thinking Model of Web-based Educational Game Design by Fong and Sheng as they place importance on assigning tasks that are both challenging yet pleasurable.

In the pedagogy component they describe how learning outcomes are imperative as the design of a game should be situated around the outcomes that need to be attained with a focus on the knowledge, comprehension and application related to the subject of said outcome. It is by implementing the practise of instruction in the form of a game that motivation is included within this model. Ibrahim and Jaafar make use of Motivation Theory to evaluate how the game affects the student's motivation compared to traditional

methods. This model is catered towards self-study and so has been designed in a way that allows for students to make use of it outside the lecture times and incorporates selfassessment modules to allow learners to gauge their progress and understanding of the subject. This is where the facet of problem solving is included and aims to promote high order thinking through the influence of Killi`s model and the use of idea generation loops.

The last part of the model which is what Ibrahim and Jaafar felt needed to be placed in its own category is learning content modelling. It is in this component that they stress the goals of the game should align with the teaching outcomes required by the syllabus being used to inform the educational games subject matter. Personally I believe this ties into the learning outcomes facet in the pedagogy component as for the learning outcomes to be achieved it is implicit that the game needs to take into account the teaching subjects syllabus. Ibrahim and Jaafar explain that the learning content modelling component is important in order to navigate the model to target self-learning, they also relate this component to the fun element due to it taking a different teaching approach and therefore they feel it will motivate the player to learn more. The experiential gaming model created by Killi informs and supports this notion through their explanation of the student creating their own ideas and understanding of the topic and through self-study and experimentation it leads to them exhibiting control over the game. This sense of agency is what further motivates the player to carry on wanting to learn.

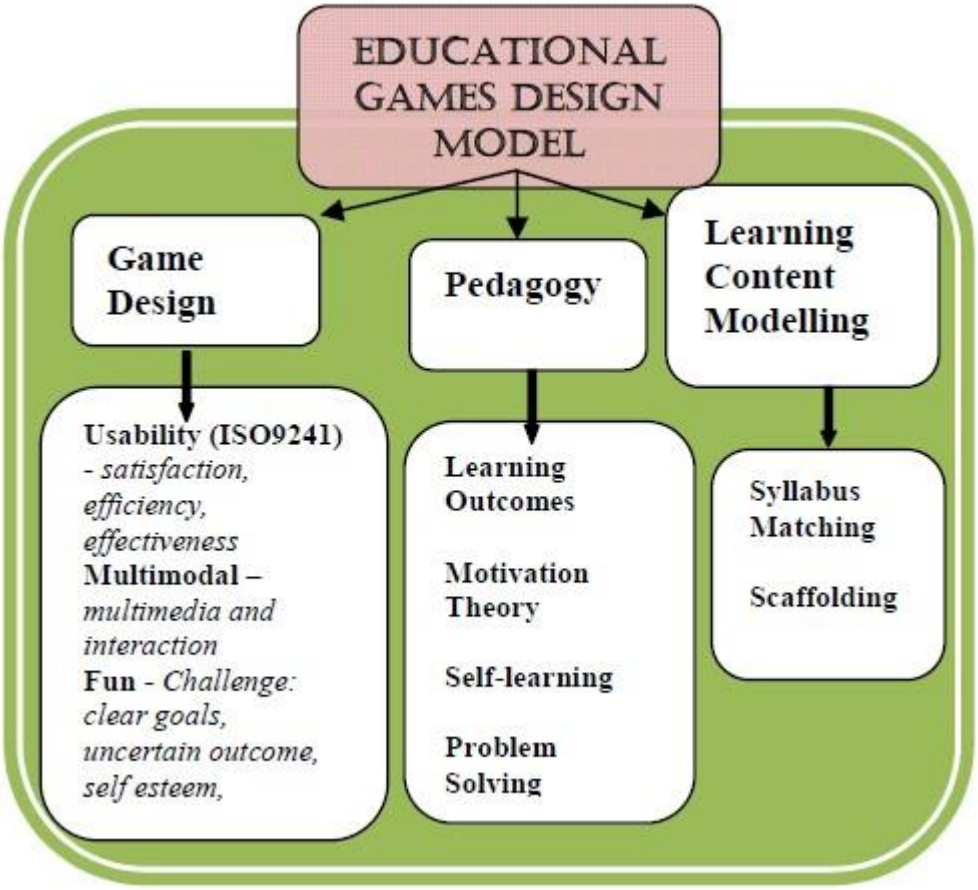

Figure 4: Proposed Educational Games Design Model (Ibrahim & Jaafar, 2009)

3.2) The Proposed Model

There are many pedagogical models that have been created in the past, each focusing more on a particular element than those before it. Before I continue I do feel it should be stated that all games have teaching capabilities as they all expose the user to new terms or modifies the way a term or action can be viewed and used. Having stated this I shall proceed to unpack and discuss the following theoretical pedagogical model. This model, the Educational Game Creation and Assessment Model (EGCAM) was informed by previous research that looked at incorporating games as a tool for teaching in an educational curriculum. The EGCAM model was created and chosen over other pedagogical models due to its framework being structured around the notion of learning making use of

multiple learning methods that work in a cyclical pattern rather than using a singular learning method to define the process. The aforementioned models and others like it have taken preference to using a single teaching approach and based on that choice have derived and built the framework of their pedagogical models around said approach. I find these models to be incomplete as they tend to ignore components seen in other teaching methods due to them not adhering to their chosen learning approach. The EGCAM model tries to fix this and lends from situative, associative and cognitive learning perspectives as well as looks at the aforementioned pedagogical models and tries to incorporate what I feel is important within a game that tries to teach. The EGCAM model[D62][r63] is by no means the only way to create an educational game, however, I feel it serves as a good base for what should be implemented in the procedure of a checklist and illustrates how a game can be used as a form of assessment.

The Educational Game Creation and Assessment Model begins by stating that a good game is required. A good game within the context of this model can be defined as one that has the following aspects included into its design: i) multimodality, ii) interactivity, iii) a guided experiential learning approach, iv) customization, v) operates on a learning curb, vi) promotes risk taking, vii) gives feedback and viii) has goal driven challenges. This facet forms part of two core sections of this model and what I believe permits a successful learning process to be achieved.

I. Multimodality as defined by Gunther Kress is “a theory or framework that examines the use of multiple modes within a single medium in order to communicate or express oneself”. This statement can be unpacked by breaking

down the core concepts of mode and medium. Mode can be defined as “a semiotic resource for making meaning”, and medium can be defined as “the form which carries the sign” (Hall, 1997). Thus by re-assessing the definition of multimodality it can be understood that it is a theory or framework that makes use of multiple semiotic resources or ways of communication (modes) through a single medium.

It is from mode and medium interacting to form an instance of communication that one can understand how individuals can exchange thoughts. It is with these exchanges of ideas and hypotheses all thoughts of a specific type or subject can congregate and in doing so, semiotic domains start to emerge. Semiotic domains are, as Gee describes, “groups in which information of a certain nature is known by the members of such group”. However, in O`Halloran`s paper (2009) he refers to these semiotic domains as multimodal discourse and describes how through “cluster analysis” one can see how these domains/multimodal discourses interact in a scalar hierarchy of multimodal items which construct meaning across these levels (Baldry and Thiabult, 2006).

By using mode and medium within these ways specific to classifying it as multimodal, it affords a media environment where users can engage in information processing through multiple sensory channels.

Bezemer and Kress argue that students understand information differently when text is delivered in conjunction with a secondary medium, such as image or sound, than when it is presented in a single format. “This is due to it drawing a

viewer's attention to both the originating site and the site of recontextualization" (Bezemer, Kress, 2008). Meaning is moved from one medium to the next, which requires the audience to redefine their semiotic connections. By recontextualizing the original text in other media, a different understanding is enabled which can be controlled by the types of media used.

"Empirical research suggests high-level ambiguity requires richer media to deliver the information" (Sun P and Cheng H, cited in Dunne 2005). Here Dunne states that the more complex a subject the more information or stimuli is needed in order to fully understand the topic. Thus, by being provided with various resources, uncertainty is reduced in the understanding of a topic.

II. Interactivity in its simplest form can be described as a system which takes place between two participants in which an input is provided by one participant and a response is provided by the other participant. This definition, however, does not do justice to what interactivity is, and is contested. A better sense of the term can be given using Claude Shannon`s communication model (Yacci, 2003). The model provides a structure that lists the components which make up interactivity.

> Interactivity is a message loop. Instructional interactivity occurs from the learner's point of view and does not occur until a message loop from and back to the student has been completed; Instructional interactivity has two distinct classes of outputs: content learning and affective benefits; Messages in an interaction must be mutually coherent (Shannon, C cited in Yacci, 2003).

Yacci argues that interactivity occurs dependent on the perspective of the entity involved. When relating this to a learning environment, he describes how a message loop is only complete between a student and teacher once the student has commented on the information being presented by the teacher. This is due to the process of learning being contained within the individual. To better break down this statement Yacci continues to explain

> [That] two distinct types of effects can occur through interactivity: content learning and affective benefits. Content learning is described as purposeful learning directed toward attaining an instructional goal. Affective benefits are described as emotions and values toward instructional artefacts that are dampened or amplified (2003).

III. A guided experiential learning (GEL) approach has been noted as the preferred and more effective way of designing an educational game. In the paper *Examining the pedagogical foundations of modern educational computer games* written by Mansureh Kebritchi. An investigation was conducted whereby multiple game designers were questioned as to what learning theories and instructional strategies they used when designing their educational games. Each game designer answered differently and had their own approaches, all proving useful in training specific topics. However, it was a GEL strategy that proved to be more effective in providing a successful learning experience. The gaming environment is built to emulate a non-virtual environment and in so doing allows the player to interact with real life experiences within a virtual world. The student's exposure to this environment addresses and makes use of the learning cycle discussed earlier. By

being placed in a simulated environment the context-dependent aspect of the situative theory is addressed. The student is then implored to manipulate the space within the defined system where no real world consequences can take affect thus promoting a positive space for failure and a trial and error approach to learning can take place. This addresses the associative theory. Lastly, by the student being able to experiment and explore the operations in their brain in regards to the topic being dealt with can be re-created, modified or destroyed and so addresses the cognitive theory within in the cycle. Kebritchi believes "…learning is not transmitted but generated through experiences" (5) and so it makes sense to use an experiential approach. The fact that its guided means "each lesson is designed with goals, reasons, concepts, processes and procedures" (Kebritchi,5) making it easier to incorporate curriculum outcomes within a game without too much difficulty aiding in the use of games as a tool and making them more assessable.

IV. Customization within games serves as a two-fold process, as it affects the appearance and difficulty of the game as well as the motivation of the player. Gee explains "games cater for different learning abilities thus they have the option of level difficulty. This customization allows for players to learn at their own pace and doesn`t pressure them into solving difficult tasks before mastering easy ones". On an appearance basis, players can then customise their experience within the game by altering their world and character, which can lead the player to relate more deeply to what the game is trying to teach as well as provides a sense of intrinsic and extrinsic motivation. This motivation causes the learner to play longer and

encourages them to engage with the information being provided to them by the game in order to achieve goals set by themselves and/or the system.

V. A learning curb is important to have within a game as it is a main contributor to the creation of flow. When a game operates on a learning curb it introduces new information to the player and through the game providing challenges, the player is able to test their understanding of this information. With each new task the player is implored to solve the problem in a new way, thus avoiding repetition and rote learning and instead encourages the player to critically engage with each new problem.

VI. The promotion of risk taking as mentioned earlier is a positive component of games as it aids in an associative learning approach and is less likely to discourage players from trying again if they get it wrong. Whereas in a classroom if the student answers incorrectly on an assessment they often don`t get another chance to redeem themselves, making it a frustrating and disheartening experience. The continued experimentation as Gee describes aids in the player "…gain[ing] feedback and in turn solidifying their understanding of the rules which govern the system" (3).

VII. Feedback is given by the game in order to reduce misunderstanding and is given just in time or on demand. Feedback also takes the form of rewards and achievements thus aiding in the learning process by motivating the player to continue and reach the required learning outcomes.

VIII. Goal driven challenges are essential in order to meet curriculum based outcomes. It is this section that has been influenced by Jaafar and Ibrahim`s model and requires the game designer to situate their design around the outcomes that need to be attained. By doing this it not only allows the learner to make use of the game outside the classroom without a teacher to contextualise content into the curriculum but also makes the game assessable in terms of allowing the teacher to use it as a tool for education and assessment.

Once a game has been created that has been designed with the aforementioned criteria in mind the pedagogical aspect of the model can begin. The EGCAM diagram hasn`t been split into or labelled as a game design section and pedagogical section, albeit referred to at times as though it were. This is due to the fact that the process that occurs between the game and the learning that arises during and after interacting with the game is so closely interlinked, it can be seen as difficult to separate them without sounding repetitious or excluding an implied but critical to state facet.

When a game begins, the player is already entering into the **multimodal process** [D64][r65]of decoding meaning from signs, symbols, kinetics, animation and sound. It is at this point that in order for anything to make sense the player has to be literate in order to decode these representations. The game starts to introduce new information often explaining the challenge, rules and what is needed to reach the goal. A game can choose to do this in one of two ways; either by using a tutorial and directly

communicating these facts which is the method used in the game *Cuphead* (2017) to teach the player about controls and abilities. Or the game can choose to throw the player into the middle like the game *Pitfall: The Lost Expedition* (2004) where you begin the game by having to defeat the final boss. Part of Gee`s observations is how some games require action before competence, and so are thrown into situations where they can experiment within a virtual space and test their hypothesis. It is at this point **operations** within the brain are created, modified or destroyed based on the individual's previous experiences and knowledge. As previously mentioned this is a **guided experiential learning** approach some games make use of. It is defined as guided if there is a feedback system in place that offers hints when prompted or just in time when the player needs it. *Pitfall: The Lost Expedition* offers hints in the form of Harry (the character you play as) talking out loud about ideas of how to solve puzzles presented or items needed before continuing.

Through the player **interacting** with their virtual environment they are able to reconsolidate concepts that the game has introduced through the **feedback** being provided to them by the system of the game. It begins with the player having to **critically engage** with the content, Gee describes this process as "[t]hinking of semiotic domains as design spaces that manipulate us in certain ways and that we can manipulate in certain ways…They attempt through their content and social practices to recruit people to think, act, interact, value and feel in specific ways" (47). Players who are familiar with how games operate have already been inducted into the specified semiotic domain by understanding that information is given to them by the system and it is the player that uses and manipulates this information to reach a goal. Value is placed on these goals

and the way the system rewards the player shapes them to think and act in a specific way. Furthermore, individuals within this domain start to understand how words and phrases that's are specific to it are used in the space, such as, mana, HP (Health Points) and AFK (Away From Keyboard). From understanding information can be manipulated to reach a specific goal or set of goals, the player **creates a hypothesis** in which they may test their understanding of the information being given to them. The creation of a hypothesis can be prompted by the game system or the player with both serving as **goal driven challenges** that can be applied in various ways. A basic example of this is using the game *Super Mario Bros.* (1985). When the player begins on level 1 in world 1, they start without any information except for there being an image of a pixelated character and world in which he resides in. The player is aware or becomes aware there is a controller in which to input an action, knowing this they act upon the operations they have formed in their head from previous interactions and information attained from said interactions. From this point they hypothesis that by pushing the buttons on the controller the character will do something. The player **tests this hypothesis** with the necessary actions and finds it to be true based on the feedback given by the system of the game thus reconsolidating their understanding of how games work and creating new operations of what action is related to the button pressed.

However, before operations can be modified or reaffirmed, the act of **active learning** needs to take place. Active learning, as described by Chris Evans and Nicola Gibbons in their paper *The interactivity effect in multimedia learning*, is

> …the process [of] learners constructing their own individual knowledge of a subject on the basis of their prior knowledge and new information that they receive. When they learn the students play an active role in receiving and processing information. When required to interact with a learning system, learners have to make decisions about when to receive information, and what information they receive. They thus have an active relationship with the material (2007). [D66]
>
> [r67]

From this definition, the facet of active learning can be understood to occur multiple times, at different levels. Thus, it could be said that by looking at the diagram, active learning is the main facet that occurs after interacting with the game instead of it occurring only as a result of reconsolidating information. It would instead encompass the cyclic pattern that takes place as well as remain a part of said pattern due to the player having to first agree to taking in information and again when trying to process it. At this point the diagram diverges into two possible outcomes which are dependent on the answer obtained after the assessment of the player`s hypothesis. If their understanding of the information was correct then they would have yielded a positive result and would not have to modify or create a new operation. It is at this point that the game either continues to progress and in turn the **difficulty curb** increases leading the player to repeat the same steps or it reaches its eventual end whereby the player then moves into the debriefing phase.

The debriefing facet is the second aspect of what forms the core of what I believe to make this model successful. It is using Gee`s suggestions of aiding critical engagement in the form of surrounding the learner by people who will encourage reflective metatalk, thinking and actions that this section has been included. By allowing the learner to discuss the content learned within the game, they can contextualise its value and application within a more

relatable setting. In the paper written by Habgood and Ainsworth they note, that by having a debriefing at the end of every play session of *Zombie Division*, the results in accordance with previous research (Squire, 2004) "support the idea that teachers have a critical role to play in maximizing the educational potential of…games" (34). The teacher also is able to get a sense of what level the student`s understanding is at based on the level they reached as well as how easily they are able to apply theory to other situations. This form of high level assessment would not be as easily available if the game was not modelled on goal driven challenges that align with curriculum outcomes. It is at this point that formal assessment is required so as to report results obtained by the child

As noted within this paper, the model has not yet been perfected but is based on a theoretical review of a multitude of contributing authors to the field of education and video games, as well as my personal experiences and understanding with the field in relation to game design practice and theory.

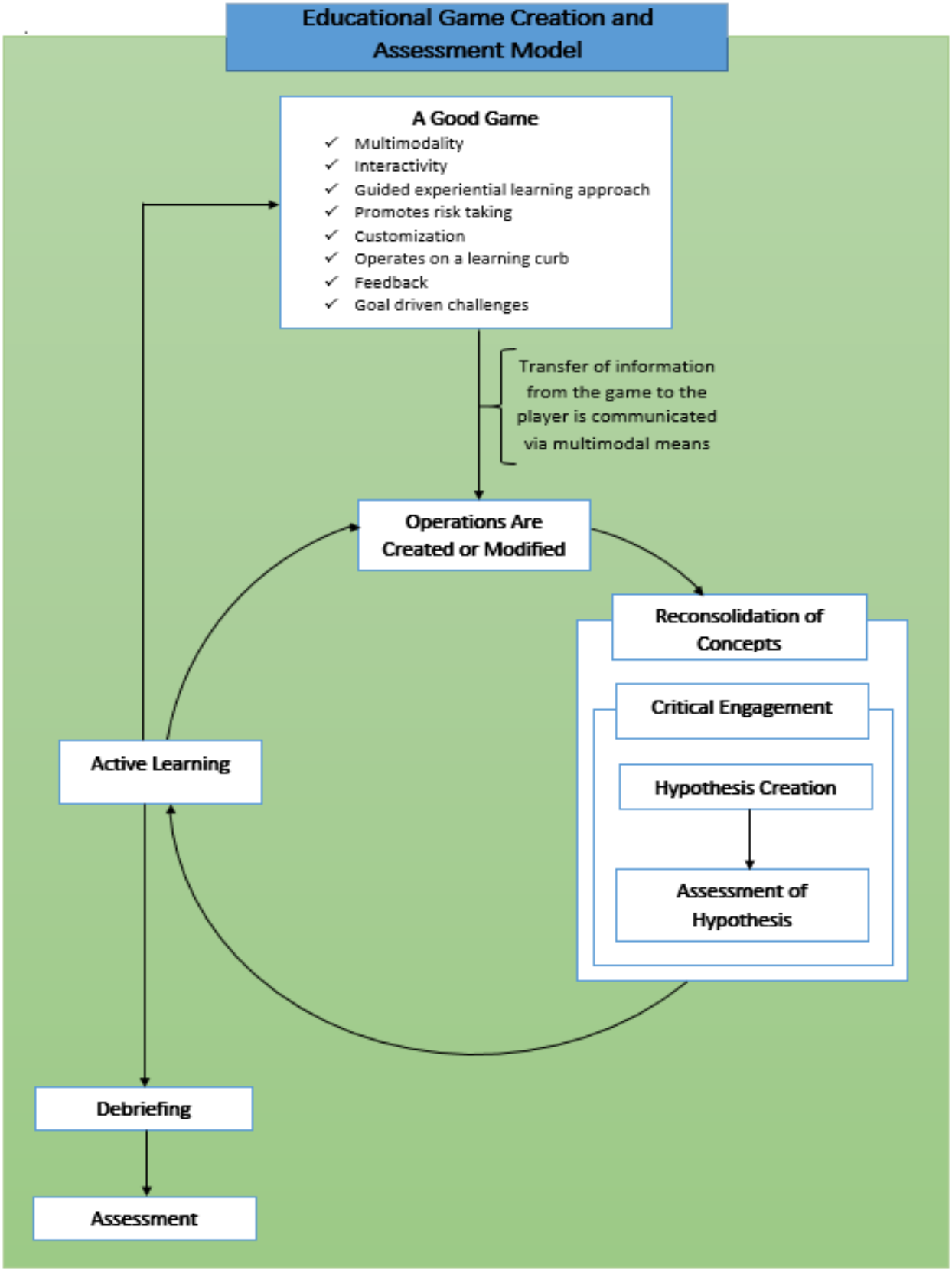

Figure 5: Educational Game Creation and Assessment Model (EGCAM)

4) Methodology - Implementation and Testing of the Model [D68][r69]

The intended methodology in which to put this model into practice, as well as gain results that are significant or determinable of its affect, are to split the testing into two phases. The initial plan was to have only one testing phase upon alpha release but due to time constraints and lack of resources changes were made. These changes were implemented in order to acquire feedback that could serve as a leading indication of results for future testing and provide some insight for the purposes of this paper.

The game *Asha* was created with a specific target market in mind and so it would make sense to get individuals who fall within those parameters to play and give feedback on the game. The first phase of testing concentrated on obtaining individuals who met the age requirements that characterised the target market, as their HIV status would not affect the quality of the results obtained[D70] in terms of if the game was easy to understand and if it was fun to play. The reason age was set as a higher priority of requirements within the initial testing phase was due to their being a lack of access to individuals who were HIV positive. Access was affected by lack of resources in both a financial and personnel sense, as funds were lacking to pay staff who could recruit HIV positive children from the Chris Hani Baragwanath hospital. The initial stage of playtesting also focused on and placed a primary importance on the game mechanics and if it was fun to play while being able to convey the desired educational material. However, it must be stated that individuals whose HIV status is positive might have a different outlook or opinion on the educational material in the game due to being so close to the subject and having prior knowledge on the disease. Only upon further testing and investigation can this statement be confirmed.

The participants acquired for first phase testing were recruited through my private contacts using verbal methods of communication where they were asked if they would be interested in playing and testing the game *Asha*. Parents of the participants were asked for permission before communicating with the children and verbally gave consent to such testing.

Testing took place within a private room in the children`s home where both parents were present. The participants did have prior knowledge surrounding the game before being presented with it but were informed of the details of the testing phase through verbal communication upon the day. The participants were told they would be playing a mobile game that was made with the intention of being for children who were HIV positive as a way for them to learn and understand aspects of their disease. They were informed of the testing procedure that involved them playing the game, on a mobile device provided to them, where no assistance or explanation would be given until the participant felt they had played enough or needed help understanding what to do. Before a second round of playing the game ensued, the participants were told how to play the game and the intention of each mechanic that was used. The participants dictated the length of time that they played the game and after the second round of play testing were told they would be asked to answer some questions about the game. The participants were told that if at any point in time they felt uncomfortable answering a question or no longer wanted to participate in the playtesting they could refuse to answer or leave without there being any penalties or consequences.

The parents and participants were also informed of the potential use of their answers and the data collected within the phase one session in an academic paper where

their identity would remain anonymous. They were informed that a digital copy could be accessed via the Wits online library or a printed copy could be presented to them upon request.

The parents and participants were asked again verbally if they consent to playing the game having understood what would be involved in the testing thereof and if they had any questions.

The questions posed in the questionnaire were read to the participants with their responses being digitally recorded and stored on a password protected laptop that remained in my personal care, thus making sure the information was kept safe and confidential. Each participant was given a numerical label so as to ensure their anonymity.

Second phase testing will commence shortly upon the submission of this paper. Testing will take place over a period of a month using a qualitative mixed-method approach with all data collection being handled or supervised by accredited professionals affiliated with the PHRU at their facilities.

All play testers and participants will be recruited by members affiliated with the PHRU. It has been speculated that the first set of testing will be done with up to 40 participants all ranging between the ages of 8 to 12 years old and all of whom are HIV positive. Each participant will play the game and after having done so will be asked to complete a questionnaire. The participants will then be separated into groups where a focus group discussion will be conducted and audio recorded. Of the 40 participants that played *Asha*, 10 participants will be chosen to do a 4 week home trial with a fortnightly visit to the PHRU to conduct a semi-structured interview to discuss their experiences.

Parents of the participants will also be asked to play the game and participate in an in-depth interview afterwards. The data collected from the interviews will be used to assess the reception and feasibility of the game *Asha*. This will be used to decide whether the research should be continued. The data will also help the researchers gain insight into what the parents go through when living with an HIV positive child and the challenges they face.

The instruments being used consist of participant observation, participant audio and video recording, questionnaires, semi-structured interviews and focus group discussions.

Questionnaires will be used to collect playtesting data. This is where participants will be asked questions related to the game *Asha* and what they thought of the game. It is understood that there might be some flaws in using a questionnaire as the questions to the participant might be written in a leading manner, thus influencing their answer.

Semi-structured interviews will be conducted fortnightly where peer-group discussions will be held at the PHRU and recorded using audio equipment and will be transcribed verbatim and then digitized. Issues surrounding the use of semi-structured interviews include leading questions, the interviewee feeling intimidated due to the face to face format and the interviewer making sure to clarify answers and to ensure the interviewee has understood the question. Clarification of answers is important due to qualitative data being harder to assess and find trends in it.

Video recordings using a cannon camera and/or cell phone camera will be used to record the participant's reactions to the game as they are playing. It will also be used to record in-depth interviews with consenting parents of the children that participate in the research project. This information will be used as part of the feedback process for improvement of the game as well as data collection related to the reception and feasibility of *Asha*. With the parents' permission the video recordings collected from the interviews with the parents will be used in a documentary that will be released into the public domain. Anonymity of the parents can be requested within the documentary. If this is requested the parents faces will either be blurred or taken out. It is understood that there might be flaws in collecting data using video recordings as the participants may react to the game and answer the questions differently compared to if they were not being recorded. The participant takes on the role of an actor when they are self-aware of their responses.

Audio recordings will be used in in-depth interviews of consenting parents as well as in focus group and peer group discussions in order to collect data and allow for future reflection. The same flaws can be stated when using audio recordings to collect data, as the participant is aware of their answers and how others might respond to them, making them change their answers compared to if they were not recorded.

The ethics involved in this project highlights that the participants will be under 18 years of age thus making them a vulnerable category, and they will also be revealing their HIV status increasing their vulnerability status. Concerns related to the testing of *Asha* with the targeted group include taking advantage of the child`s age or the language barrier that might be present between the informant and the child`s parent and not informing either of the process involved in testing the game. Intimidating or bribing the participants into giving positive reviews or releasing information about the participants HIV status to the public.[r71] However, it is by making use of a secure and confidential environment located at the PHRU and having accredited professionals supervising the project, it is the hope that most concerns can be negated. Furthermore, strict confidentiality of the information provided will be maintained and anonymity where possible. Any distressed individual will be referred to a counsellor at the Bio Behavioural Research Division clinic or the paediatric treatment clinic at the PHRU. [D72]The staff linked to the project will also be in constant contact with community advisory boards (CAB) that will monitor and ensure the guidelines associated with medical testing and handling of information are followed and enforced. It is in the best interest of the project as well as everyone involved to create a safe, secure and conducive testing environment, thus all precautions and guidelines will be followed and enforced.

All participants will be told that by participating in the research, no material or financial gains will be promised or provided to them and that they can refuse to be part of the research at any point in time. They will also be told that if they feel distressed at any point they can be referred to a counsellor at the Bio Behavioural Research Division clinic or the paediatric treatment clinic at the PHRU. Consent and ascent forms will be provided to participants interested in taking part in the research, along with a participant information sheet. These forms will be given on the premises' of the PHRU. Participants will be read the various forms if they cannot read and if any questions are posed by the participants these will be answered. If needed a translator will be made use of if there is a language barrier.

Confidentiality will be maintained by making use of the facilities at the PHRU in which a room will be used to communicate confidential information between the participant and investigator. During the focus groups confidentiality cannot be guaranteed but shall be emphasised at the beginning and end of each discussion.

Anonymity will be maintained by using participant numbers as an identifying feature within future papers as well as during the collection of data. However, anonymity cannot be guaranteed within the focus groups conducted/held at PHRU.

The data will be protected while research is in progress by being collected in a confidential setting under the supervision of accredited professionals in one of the rooms at the PHRU. The data will be recorded using multiple methods all of which will be digitised and stored on a password protected computer. Any written information will be destroyed after it has been captured. Participants identities will be protected by using a numerical label and not any identifying features or personal information. The data will be stored in a personal password protected computer as well as uploaded to an access restricted repository being Google Drive. In both cases, the digitised data will make use of participant numbers as identifying features with no other personal details that could be used to identify the individual.

It also has to be stated that there is a potential conflict of interest if the project produces positive results and the PHRU are able to secure sponsorship, there would be a monetary gain. This monetary gain would be extended if the project is released into the public sector. Concerns related to this include false representation of the game,

manipulation of results through physically tampering or bribing individuals all in an attempt to procure financial gain. However, procedures have been put in place such as using a code to identify participants and not their personal information, using multiple transcribers and data analysts not affiliated with the project in any way, besides constructing analytical reports, to handle the results which would be stored on a password protected computer that can`t be accessed by the public. Again, it is the hope that by working with and being under the supervision of accredited professionals affiliated with the PHRU that any concerns linked to this can be negated. [D73]It is by following ethical procedures that concerns can be negated as those found suspicious or guilty of misconduct would be reported and dealt with by the correct heads of department.[r74]

5) The Creation and Framework of Asha

The design process of the mobile game *Asha* involved many varying approaches on how to address the topic of monitoring and educating children with HIV. Appendix A is evident of this as it illustrates the first game design document that was drafted for the project and the intended plans and scope of the game. However, due to time constraints and other challenges that were faced, the design complexity and scope had to be decreased over time. As mentioned before, the game *Asha* in its current form acts as proof of concept and by no means is a complete, and can be argued, an effective product. The game is in the development phase and this section addresses and describes the decisions made and steps taken to get it to a playable state.

Initially 3 design genres were considered, a side scroller, a platformer or a city builder. Figure 6 shows the planning phase of the design and ideas that surrounded the development. The design decisions made were in-part informed by the EGCAM model as well as the analyses of other successful educational games. Due to the game being a proof of concept an iterative design methodology is being implemented, thus the game and game

genre can still be subject to change upon playtesting and feedback. The city builder design method was chosen in the end as it offered a base upon which further development could easily be built upon, as well as transparently fulfilled the EGCAM`s requirements for guided experiential learning and customization. This is enforced through the player being able to build a town that is their own and through interacting with the system understand how the mechanics work.

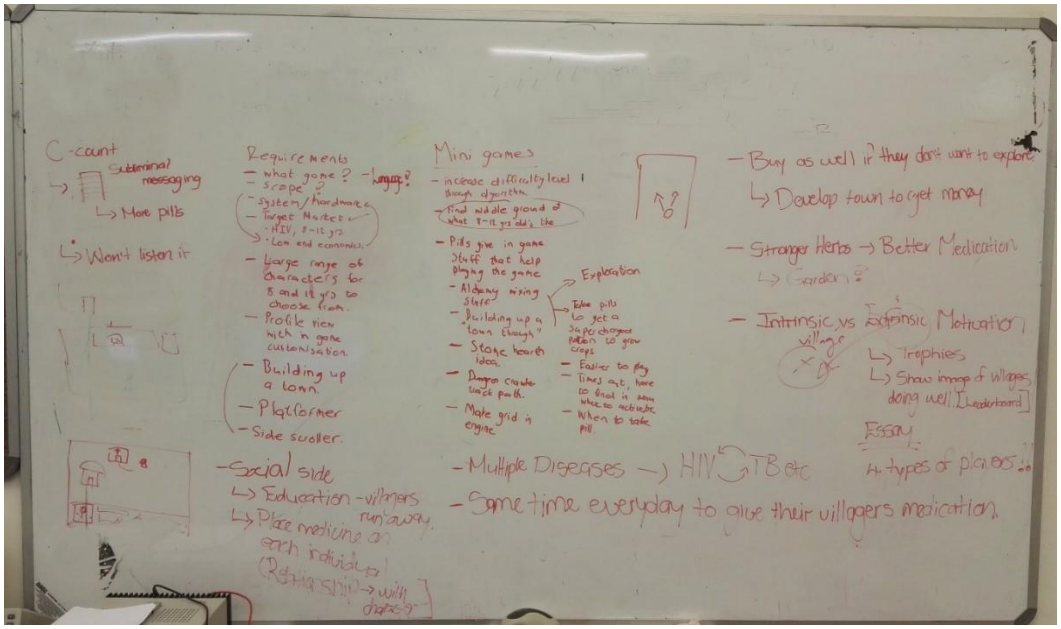

Figure 6: A drawing board filled with ideas and requirements that needed to be considered for the game

Upon deciding a city builder would be used, there were grand plans to incorporate a farming aspect into the gameplay so as to allow the children to feel like they were taking on a nurturing role by growing herbs for medicine and crops for food to keep their citizens healthy. It also contextualised the content being presented to the children within a realistic setting that could be applied outside of the game and possibly lead to the children wanting to learn more by doing external research to understand how food is grown and how medicine is made. This thinking was informed by Gee`s book *What video games have to teach us about learning and literacy* in chapter 2 where he discusses semiotic domains and how video games encourage the player to induct themselves into clusters of interrelated semiotic domains through interaction and exposure. For further details into the initial laid out plans please refer to Appendix A.

Asha can be described as a 2D pixelated mobile game with its main mechanics being city building and resource management. The narrative and concept that surrounds the game is that the player is the mayor of a newly-founded town. As the mayor, it is the player`s goal to create and grow a thriving city by purchasing buildings, collecting tax and making sure their citizens are healthy and well fed. The player ensures the health of their citizens by participating in the mini-games and assigning the relevant resources to the houses that hold and represent citizens of their town.

The game begins with the player being greeted by a login screen where they have to insert their credentials in the form of a username and password. This was requested as an additional facet to the game by the research investigators at the PHRU due to the societal implications of knowing the game is targeted towards those who are HIV positive. After having inputted the necessary information (see Figure 7) the player is greeted by the main menu. If the player ever forgets their login information, it can be reset with admin permissions while still keeping their current gameplay state.

Figure 7: Login screen of the game *Asha*

The main menu contains a generic character upon first launch of the game, when the player returns from having played the main game they will find the character they have

created to be present instead. This feature tries to re-enforce character attachment as well as show the player that their decisions have agency and matter even if it is rooted on an aesthetic level. The pill tracker keeps a record of the days the player has taken their medicine as well as the time they inputted said information (see Figure 9). It collects this information through a prompted question that displays each time the player enters the game (see Figure 11). The question will only stop showing for the day if the player answers yes to having taken their medicine.

Figure 8: The main menu of the game *Asha*

Figure 9: Display of the pill tracker record that forms part of the game *Asha*

On initial launch of the game, when the player presses the play button they are led to a character creation screen (see Figure 10) in which they may customize a 2D pixel avatar as they see fit to represent the mayor that forms part of the narrative that informs the game. This aspect of the game was included to allow for the children to identify with a character as well as customise their experience, this form of association/identification with a fictional character within a video game is known as character attachment. Character attachment as defined by Weber et al is "an individual's feelings of (a) friendship and (b) identification with a video game character when an individual (c) is willing to suspend disbelief, (d) feels responsible for the game character, and (e) feels in control of the game character's actions"(2008). Due to the player creating and identifying with their character it intrinsically m[r76]otivates[12] them by placing value on their character as the town`s care taker, and in in doing so makes them feel responsible for their characters actions making them want to create a thriving town without being given instructional goals to do so.

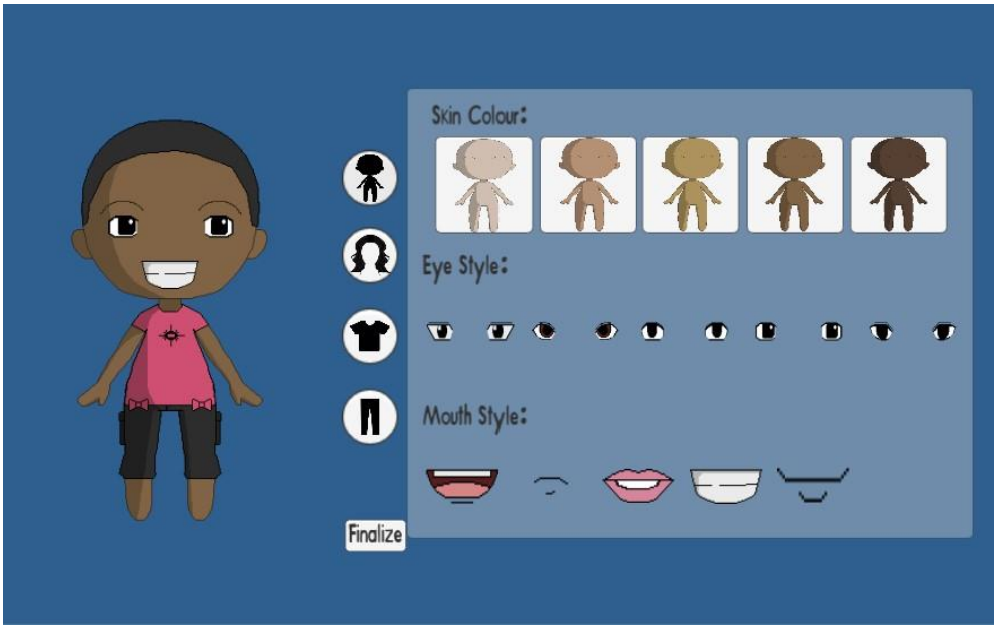

Figure 10: Character creation screen in the game *Asha*

[12] Bowman et al describes how character attachment "…has been found to be positively associated with game enjoyment and time spent playing games and motivations to play games for…fantasy, diversion and social interaction purposes"(2012). These factors are linked to both intrinsic and extrinsic motivation as fantasy and diversion are driven by an internal want to do something for one's own sake. While the social factor can be seen as both intrinsic by wanting to communicate for one`s own sake and extrinsic by being driven by an outside goal of wanting to participate in a community of practice and be seen as a skilled or relatable player.

After the player has created their character, they are taken to the main game (see Figure 11) and are prompted for the first time to answer the question of whether they have taken their medication that day by answering yes or no. Upon answering the question the player is greeted with an open green field, a population number equal to 1 and 1000 tokens available. By purchasing a residential building and placing it on the map the player increases their population count and can now collect taxes from said residence, thus allowing the player to collect tokens over time (see Figure 12). Another method of collecting tokens without taking the tax route is to sell buildings, however, the buildings are sold for a small percentage of their original cost making it an ineffective strategy, but does allow the player the ability to customise their town at any point.

Figure 11: Main game screen with medicine prompt

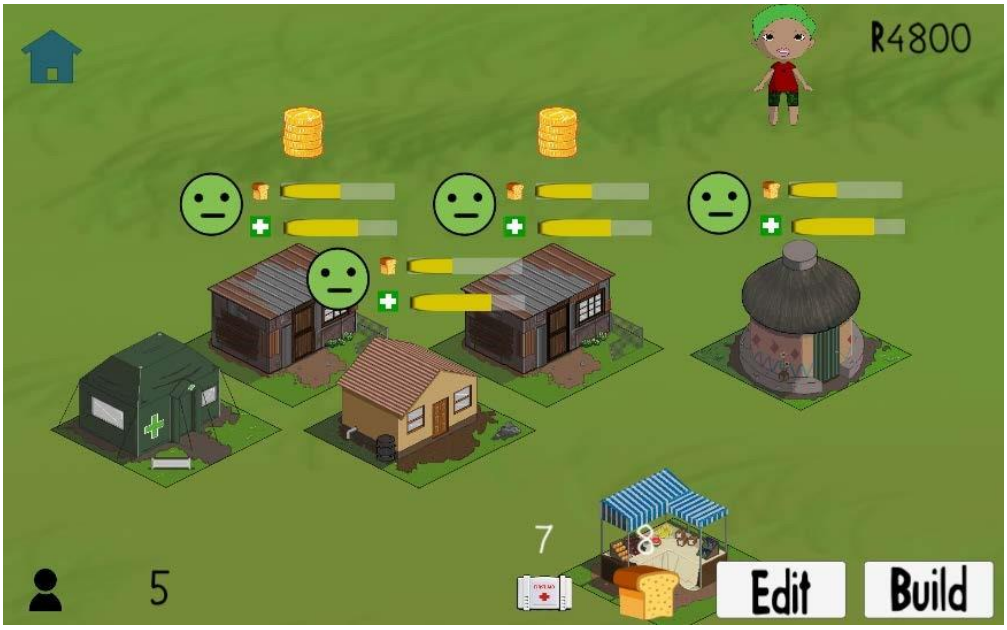

Figure 12: Main game screen with buildings having been placed and their status bars depreciating and tax tokens ready for collection

Once a residential building is placed the health bar and food bar begin to decrease over time (see Figure 12). Immediate feedback to the player in the form of the information bars and other user interface (UI) components, such as the number of resources and people, fulfil the EGCAM`s requirement of feedback. This approach was taken in terms of an educational perspective as a way to try get the player to correlate their own health and wellbeing to that of their citizens, and understand if their citizens are well fed and get the proper medication they need, then, by inference, they as the player can do the same to remain both happy and healthy. The EGCAM model influences this form of critical engagement by promoting external stimulation and reflection through the reconsolidation of concepts process where hypotheses are created and assessed which lead to active learning. The process of critical engagement is partly prompted by debriefing where guided discussions within a safe space can occur. In order for the citizens needs to be met the player has to make use of the mini games in which resources can be collected to fill both

status bars. The player accesses these mini games by placing food buildings and medicine buildings in their town, with the total amount of each adding to the amount of final resources gained after a round of gameplay is completed in each mini game.

To initiate play of one of the mini games, the player clicks on the associated building and pop up appears prompting the player to press the play button to begin (see Figure 13 & 14).

Figure 13: A display of the popup to initiate the medicine mini-game

Figure 14: A display of the popup to initiate the food mini-game

The premise of the food mini-game is to serve as many customers as possible the correct meal and failing to do so means the player does not receive a food resource point that can be spent on partly restoring a chosen residential food bar. [D77][r78]The mini-game works on a timer so the player is pressured to find the correct button to press to assemble the order and hand it to the patron (see Figure 15). This kind of mini-game was implemented with the notion of the children being able to recognise food available within their local shops. Corner shops were targeted specifically as the source of food procurement as they cater to a lower income market most of whom live in poverty. There is an understanding that one's level of poverty does affect the food choices one makes but by displaying healthy food that are commonly eaten by disadvantaged groups there is still the possibility of creating habitual healthy eating by the player and their family.. By doing so this might prompt the player into wanting to eat the same kinds of food or at least pair up similar foods as part of their own meal plan. The meal plans were co-ordinated by dieticians the PHRU recruited in order to present an accurate representation.

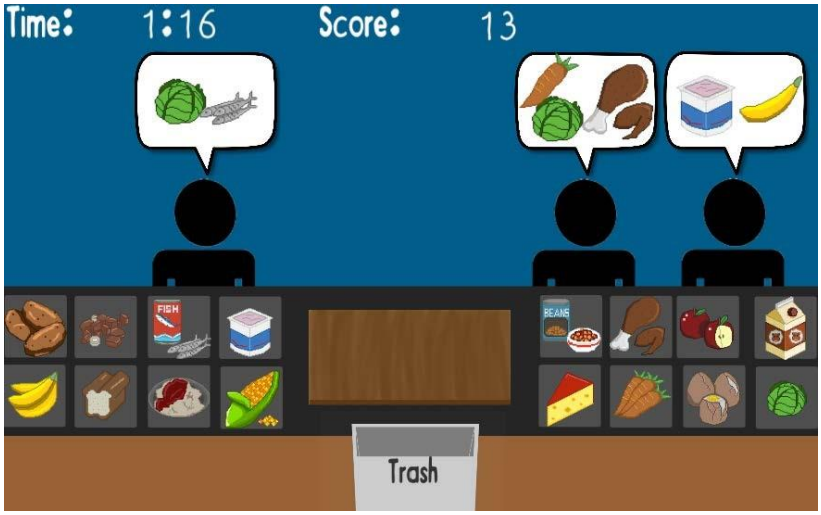

Figure 15: A display of the food mini-game with patrons placing their order

The medicine mini-game involves the player answering HIV related questions with either a true or false input (see Figure 16). This form of learning and gameplay can be seen as repetitious but it is through this exposure to familiar questions that the hope is the player takes in and understands the information, with debriefing of the game to aid in contextualisation. By answering correctly the player is rewarded with a medicine resource that can then be used to partly restore a chosen residential medicine bar.

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[r79]

Figure 16: A display of the medicine mini-game with a question being asked

As the game progresses the difficulty curb increases, serving the needs of the EGCAM model, as the player needs to be mindful of what resources are needed and the status of each building needs to be monitored. This makes the player plan ahead as well as feel challenged to keep growing their town while still maintaining the happiness of their current citizens. It is also by adding more buildings that the player is encouraged to take risks and understand by doing so it will lead to them generating more tax income at the cost of having to serve more citizen needs which could potentially lead the game to being too difficult for them to keep up with the pace. This form of risk taking serves the implementation of the EGCAM model in the attempt to make a good and fun game.

Despite the multiple use of mechanics that evoke different aesthetics, a unifying theme can be found in the game allowing for an overarching aesthetic to be felt and allow for flow and ease of understanding. This of course can be improved upon through more playtesting and better UI and feedback design. Unfortunately the mentioned changes were not possible to include within the presented version due to challenges experienced within the design and development process.

These challenges included over scoping on initial design as well as having to reduce the design team from two people to one due to technical and personal difficulties. This held up the project in terms of development, as the code, design and art of the game fell upon myself to complete. My limited coding skills and lack of experience exporting to a mobile device as well as saving information to the device increased the development time as these skills needed to be researched and learnt. It was during this development time that an attempt to contract an outside artist to reduce the work was made, however, this ended up

not succeeding as the artist stopped responding to emails and left the project without notice. [D80][r81]

Despite these challenges, a playable prototype was produced and delivered within an appropriate time frame. The consequences of the prolonged development period did affect alpha testing with participants at the PHRU, however, this phase of testing will still occur once financial aid has been required and results will be recorded and reported in the near future.

5.1) Intrinsic and Extrinsic Motivation

Many papers have discussed and explored the notion of motivation and how it can be actively altered using various strategies and methods. The most noted literature on the topic being Deci and Ryan`s paper (1985) where they identify and explore three types of motivation; intrinsic motivation, extrinsic motivation, and amotivation.

Intrinsic motivation can be defined as that which "…energizes and sustains activities through the spontaneous satisfactions inherent in effective volitional action" (Deci & Ryan, 32) or as Dondlinger puts it, it is "one's desire to perform the task for its own sake" (3). When applying this to games the action of intrinsically motivated tasks is often noted within the gameplay where players actively perform tasks that are not set by the system and instead create their own challenges and goals without any expectation of reward besides that of being competent within that action.

In the game *Asha*, intrinsic motivation factors in through the EGCAM model stipulating that customization should be an element incorporated within the design. The game meets these requirements by allowing the player to create their own character and modify it to their

personal preferences. Another aspect of the game that does this is where the player is given the option of what buildings they want to put down, as well as where they wish to place them thus influencing the design of their town. It was during the design process that the idea of a city builder was considered as it held the connotations of being partly intrinsically motivated as well as possessing the potential for extrinsically motivated strategies to be implemented to keep the player entertained and challenged. [D82]The intrinsic connotations of a city builder include the player picking and assigning the placement of buildings as well as [r83]deciding how resources will be spent. An example of this type of gameplay is shown in *SimCity* (1989) where the player creates roads and manages an intricate system of networking buildings and cities which serve the needs of their citizens as well as the design goals of the player. The extrinsic connotations linked to *Asha`s* city building aspect is the possible competition of designing a better or more interesting looking town, where competition is the driving factor to do better.

Extrinsic motivation is defined as the opposite of intrinsic motivation as Dondlinger describes it as something "that pulls us to act due to factors that are external to the activity itself, like reward or threat" (3). In a paper written by Juho Hamari he explores the notion of motivation and how games make use of intrinsic and extrinsic motivators to direct users attention towards gameful experiences and behaviour. Hamari centres his paper on the implementation of badges within a gamified environment giving the user the choice to fulfil an optional goal and be rewarded as such. Results found that users were more active after the implementation of badges with users completing specific tasks they hadn`t before. This form of extrinsic motivation was considered in the initial design, and can be seen in

Appendix A, where the notion of leaderboards and trophies were considered. An example of goals linked to the collection of trophies as a reward for achieving a set out goal included, having a specific number of buildings or creating an aesthetic meter, where the player could debate about spending resources to purchase vanity items instead of using it on food and medication. However, due to time restraints these components were not incorporated into alpha build version one. The idea behind the use of trophies mimics that of badges as it asks the player to complete a task with the promise of a reward. This form of extrinsic motivation not only takes the form of validation through UI feedback but also on a hierarchical social level, as it was thought players could compare the amount of trophies collected, and in turn motivate each other by challenging each other to collect more. This extended into the idea of implementing a leaderboard upon which players could view one another`s towns and want to outdo each other based on various variables such as replicating their own town or creating a beautiful or interesting design. Other variables could look at competing for overall town happiness and how healthy each other's citizens are. This form of extrinsic motivation could promote a competitive and strategic dynamic for players when designing their town. This form of engagement would also benefit the game in terms of making it more interesting to interact with and potentially more fun making players invested and want to play more.

Amotivation is a term suggested by Deci and Ryan as a means to fully analyse and describe the various states of motivation.

> When amotivated, individuals experience a lack of contingency between their behaviours and outcomes. Their behaviours are neither intrinsically nor extrinsically motivated. Amotivated behaviours are the least self-determined because there is no sense of purpose and no expectations of reward or possibility of changing the course of events (1985).

In a paper by Guay, Vallerand and Blanchard they quote Abramson, Seligman, & Teasdale by saying that amotivation is a form of learned helplessness. From my understanding of the

aforementioned description of amotivation it can be related to games as being the mode one enters when in a state of play. There is no goal and is a space that is entered into consensually where there is no reward nor reason/motivation for participating besides the pleasure of partaking in the act itself. An example of this is when one plays with their keys. The individual does so not expecting a reward nor do they set a goal giving the action purpose thus making it self-motivated. Rather the individual plays with their keys for the mere act of doing so and in turn can be described as amotivated. This in my opinion does not constitute a sense of learned helplessness but rather an exploration into manipulating the rules which bind the all-inclusive system society operates in. An example of this which could present itself within the game *Asha* is when the player decides to move the buildings around just for the pleasure of doing so.

Motivation within games are both used as a method to create challenge as well as is a biproduct of said challenges. The source of the challenge is what changes dependent on the motivation as both intrinsic and extrinsic motivation make use of the system and the rules that govern it to define the outcome and how to achieve it.

6) Results

Results were obtained from a qualitative review of the game which took the form of a questionnaire (see Appendix B) as well as commentary that was observed while the participants completed the alpha testing. The questionnaire was completed on behalf of the play testers. All results (see Appendix C) are the direct recording of the answers provided by the participants and has not been altered in any way.

Table 2. Observed commentary by participants when playing the game

Type of Comment	Participant #01	Participant #02
Positive	• This game is fun! • I`m gonna save up for a bigger house. • I like the medicine game. • Oooo I can get the big house! • Oh shoot! I haven`t been paying attention to the one house.	• It was fun. • I would play it on the google play store.
Negative	• It glitched again! • It`s not giving me coins. • I can`t build cause the medicine tent is in the way.	

The overall feedback received was mostly positive as both players found the game fun [D84][r85] and answered the questionnaire by saying they would play it again and that the graphics looked good. The players commented on liking the fact they could customize their

own character and said “it`s cool to see them [represented] on the main menu”. They also liked the town building aspect as the interactivity of collecting coins that generated above each house was an appealing activity and allowed them to purchase more buildings. The use of mini-games was also noted as a positive aspect of the game as both participants liked the idea of being able to do a lot of different things in the game.

Negative comments [D86]generally pertained to the lack of a tutorial and bugs that exhibited themselves upon mobile distribution. Bugs included inaccurate touch controls so the buildings couldn`t be dragged on the screen the same way that is exhibited on the PC build. Also, once a mini game was selected it was still possible to interact with the buildings in the background through the game description UI shown in figure 13 and 14. Both players were unsure of how to interact with the game at first and found it difficult to understand the overall message that was trying to be communicated without assistance. One player did find themselves asking for another mini game in which the characters within the game could possibly be able to interact with each other.

The initial participant was a lot more vocal compared to the second participant and played for a longer time with play time being estimated at an hour longer than the second participant.

Both participants have had prior experience with digital games in the form of console and mobile games and still found the mobile game to be entertaining and graphically appealing. For a first alpha test that hasn`t been reworked, these results indicated that aspects of the game could be considered to be successful. However, elements of the game do need attention such as the main game component as it was observed that player`s got bored within the beginning segment of the game having to wait for their building to

generate tax and so couldn`t do anything else until they had enough tokens to purchase a new building. Another observed issue would be the user interface layout as well as lack of sound. Both did not inhibit the game in any way but they would certainly increase ease of use and appeal. Further issues that were noted were players got bored after a while when playing the food game due to the length of the timer and replication of actions that have no reward for interacting with such as sound or UI animation. The medicine mini game had differing results as one participant really enjoyed the format while the other participant found it slightly annoying and just tried to speed through it.

Looking back at the goals that were stipulated for the initial alpha development, the game was required to be i) suitable for the identified target audience; the use of friendly imagery with bright colours and informative facts about HIV ,with an identifiable form of assessment met the basic criteria needed to serve the intended target market. However, lack of instructions and narrative made the game hard to play and engage with the overall story trying to be communicated. This is due to the player never being told they are the mayor of a new found town nor that they had to build a city to look after their citizens. The testing mechanic served to meet the demands of ii) educating the player about HIV with an attempt at iii) incorporating it into the flow of the game by merging it into the story and gaining a reward in the form of resources for answering correctly. By providing factual information to the player, the stigma associated and surrounding HIV can be reduced by informing and educating a future generation of why it should not be stigmatised and showing that there are many misconceptions about HIV positive people. Unfortunately, one participant found the testing of HIV knowledge in the form of true and false questions to be boring, despite this knowledge can still be gained but alternative assessment is needed to

gauge how much the player learned and retained. The game was iv) playable on a low end phone and was tested upon multiple emulators during the design phase to make sure the game would run. The game needed to have v) a form of information protection which was accomplished with the implementation of a username and password, which was much needed with the requirement of a vi) pill tracker that could store and date when the player had taken their medication. Lastly, the game had to be designed with the EGCAM model in mind as it aims to list and describe what is needed to make a successful educational game. It can be said that most of these goals were achieved with the exception of it being completely suitable for the target market due to the lack of communication to the player and the medicine game not being incorporated well in the flow of the game.

7) Improvements and Future Research

The game *Asha* has demonstrated to hold much potential both theoretically and practically, however, there is still room for improvement. Again, *Asha* in its current phase is a proof of concept and is still in development with components subject to change. From the feedback received and observations made improvements are needed these include; better [D87][r88]UI design as the current UI can be considered primitive yet adequate for initial alpha testing. These improvements would be implemented in the form of creating animations for when buildings are placed and removed, the portrait of the mayor would be re-drawn and placed in a better location that flows with the rest of the interface. The food game could make use of an image that replaces the individual components once combined on the serving board, and the medicine game would have images to communicate the information being presented. Background images and sound need to be reworked and added to allow for better immersion and multimodal

integration. Other aspects that could be improved upon are game complexity so that the player feels less like they are just an observer in the early phase of the game and to perhaps incorporate another mini-game as suggested by one of the play testers. The play tester reported wanting to have a way of characters being able to interact with each other, previous designs looked at making the mayor a movable character in the world who completed quests surround HIV content. Perhaps this could be explored in the next build, as it could improve the game by allowing the player to feel like they are personally walking around the town they created, as well as make them feel more immersed in the world and place value on helping citizens they`ve made a relationship with. The refinement of motor reception on mobile devices needs to be looked at as well as the possible implementation of kinematic feedback to the user by making the phone vibrate when the pill notification pops up or when the player places down new buildings.

With further development the implementation of a mood tracker could be created using a sliding scale for the participant to report and track their moods. Depending on the input given by the player, a pre-written result could be presented to the player giving them suggestions on how to improve their mood, either in the form of natural remedies or to seek professional help by consulting with their clinic doctor.

More improvements would occur based on the reception of the game as well as what requirements would be put forward by the PHRU and similar institutions to make this game an easily integrated tool within the treatment regime for both the patient and doctor.

Future research would look at taking steps towards testing the game with a larger and more diverse group of children to provide a more accurate observation of the reception towards the intended target market. It is upon completion of this essay that reported

interest has been presented by multiple SETA`s (Skills, Education and Training Assessment) for the investment and further development and research of this project. The outcome is yet to be known, however, this fact indicates that the project could potentially have an impact in terms of its intended scope and utilisation within the health sector. [D89][r90]

8) Conclusion

The research and development of educational games to be used within a classroom setting has provided positive results and has prompted other disciplines to explore the use and implementation of games to teach various skills and bring about awareness in a fun and engaging way. The health sector is one said discipline, with the Chris Hani Baragwanath Hospital searching out new forms of digital health to reach the disadvantaged and aid children diagnosed with HIV. It was based on this pursuit that the concept of *Asha* was created. This paper aimed to discuss and analyse the use of educational games and the various pedagogical models that have been created as a response to trying to incorporate games and blended learning into the classroom. It also discusses the design and development of the game *Asha* as well as the testing methodology implemented to play test the game. It was upon creating the mobile game *Asha* that a new pedagogical model was implemented with past models informing part of its structure. The EGCAM model was used to break down and analyse the learning process that occurs within an interactive multimodal environment with the targeted media base being video games. The analyses of various learning methodologies informed the final discussion of learning taking place in a cyclical pattern rather than a single, linear process. The EGCAM model bases its framework on making use of these various learning procedures. Based on the game produced and the results reported from the informal play testing of alpha version one of the game *Asha*; findings proved to be

positive with the participants expressing an interest in wanting to play the game again and finding it fun in its current form. However, there is still much room for improvement in the refinement of graphics and layout of UI, furthermore game complexity needs to be adjusted to allow for deeper immersion and aiding in the flow of the game. How *Asha* impacts HIV positive children and their medical adherence is yet to be realized, however, this testing will occur in the near future with hopes of continued research and development pending investment or financial aid from outside parties.

Despite the results not reflecting the implications of the game *Asha* being used in conjunction with a prescribed medical regime for HIV positive children, the research conducted and recorded is still thought to have contributed to the field of game design in South Africa and the use of serious games within the medical sector. The paper reinforces the benefits of using video games as a teaching tool as well as explores the conceptual implementation of how they could be used to address a wider audience with needs that stem from serious topics. Furthermore, the pedagogical model presented incorporated the knowledge of multiple disciplines to provide an analysed structure which could be implemented and reviewed for future game development along similar lines.

[r91][r92]

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Appendices

List of Figures

Figure 14: A display of the popup to initiate the food mini-game

Figure 15: A display of the food mini-game with patrons placing their order

Figure 16: A display of the medicine mini-game with a question being asked

List of Tables

End Notes

[i] Multiple disciplines have researched and recorded the benefits of games. These benefits as described by Granic et al include cognitive, motivational, social and emotional gains (2014). Games like first person shooters that require twitch skill have been said to contain cognitive benefits by promoting "faster and more accurate attention allocation [due to filtering out irrelevant information], higher spatial resolution in visual processing, and enhanced mental rotation abilities" (for a review, see C. S. Green & Bavelier, 2012). Motivational benefits come from players having to face failure multiple times yet still replay the same event in the hope of achieving meaningful goals and once accomplished rejoice in the small moments of triumph. The real life transferable skill of facing challenges with a charged motivation can lead to long term educational and work achievements. Games that promote a sense of team work rely on the player being able to socialise and in turn communicate effectively and work in a group. James Paul Gee mentions this benefit as beneficial when facing projects as a team in the work place as the aforementioned skills are needed when working towards a shared goal. The last benefit that can be seen is the emotional impact games have on players by promoting relaxation and warding off anxiety (Granic et al, 2014). Furthermore, games promote emotional flexibility by providing a safe space for failure and practice of coping techniques.

[ii] The major reasons for dissatisfaction with the public sector hospitals and community health centres were long waiting times (41.5% and 38.1% respectively), staff attitudes (22.8% and 25.9% respectively), non-availability of prescribed medication (15.8% and 17.7% respectively) and shortages of staff (doctors/pharmacists). Major reasons for dissatisfaction in the private hospital/clinic sector and private doctor were also long waiting times (26.7% and 7.4% respectively), staff attitude (18.0% and 7.1% respectively), and cost (15.2% and 24.8% respectively)" (Department of Health, 2007).

[iii] In 1924 Sidney L. Pressey invented a series of machines, one which was named after him called the *Pressey Testing Machine*. They were used for "the automatic testing of intelligence and information" (B. F. Skinner, 1958). The tests would be in the format of multiple choice. The student would press a number on the machine that correlated to the question and if the answer was correct the machine would move onto the next question, but if it were incorrect the machine would tally the score and only continue once the student had chosen the correct answer. Pressey pointed out "[such machines]…could not only test but also teach" (1958). It was later in 1932 that Pressey expressed disappointment in that his machines hadn`t taken off the way he had envisioned and had hoped for the coming of an "industrial revolution in education" (1958). It was at this time the machines were seen as a failure but this was not only due to the public not taking to them but also faults with the machine.