Pedagogy of play

Enhancing student performance

Inaugural lecture by
Prof. SM (Grieta) Hanekom
25 October 2021

Faculty of Health Sciences
North-West University
Potchefstroom Campus
South Africa

1. Introduction

"It takes a village to raise a child" is assumed to be an African proverb that means that an entire community of people must provide for and interact positively with children for those children to experience and grow in a safe and healthy environment. So, the story of developing a game for learning can be seen in the same sense: it takes a "large" team to create a game for learning. This lecture will not discuss the inputs of all the role players, as this is not the scope tonight, but will at some stage refer to the other role players in this process of developing a game for learning…..…

2. What is pedagogy?

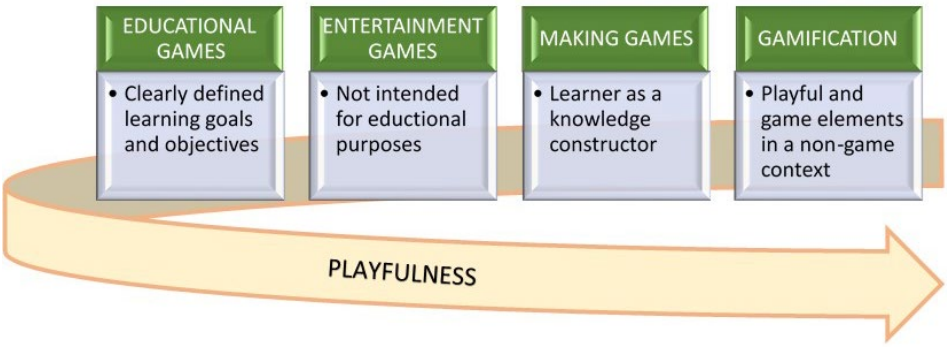


Figure 1: Game based pedagogical approaches (Nousiainen *et al*., 2018)

Pedagogy is a term concerned with what a teacher does to influence learning in others. The definition of pedagogy includes the function or work of teaching, and in other words, the art or science of teaching and educational instruction methods (Anon, 2017).

We live in a digitalized society where meaningful engagement with the student depends on our ability to structure the learning environment in new ways, merge new technology with a new pedagogy and develop social activities in the classroom that encourages cooperative interaction, collaborative groupwork and learning (Nousiainen *et al*., 2018). The pedagogical frameworks designed for integrating games and play into the classroom introduces the concept of educational design that includes learning objectives, the selection of subject-related content, planning and the organisation of learning processes in game-based learning (Forster & Shah, 2015; Sorensen, 2011).

In Figure 1, compiled by Nousiainen *et al*. (2018) it is indicated that playfulness is a mindset that cuts across all game-based approaches and the action is enjoyable and meaningful for its own sake. In settings embedded with playful engagement and creative gameplay, where games for learning are used, playfulness is crucial as it create familiar ground for collaborative

learning, creative learning, and focussed results in a technology-enhanced learning environment.

Because the terms play, playful and playtime are so culturally loaded and associated with child, children and childlike, there is a need to establish other terms for adult play. The pedagogy of play in the adult sense, is an exploratory approach to learning in higher education (> 18 years), that provides learning occasions and results which are experimental, playful, fun, and realistic (Leather *et al*., 2021).

3. Neuroscience

During the first 8 years of life, the metabolic rate of children's brains rises sharply through this entire period, which means that the young brain is biologically primed for learning. The "wiring" of the brain depends heavily upon the quality of early human and other interactions. The interaction between genes, early environment and experiences shapes brain development and influence lifelong learning, behaviour, and health (Anon. 2017). Children also use play to experiment and discover the world around them and teach them how to express emotions safely. Childs' play can potentially lead to increasing mature forms of knowledge, skills and understanding (Anon, 2017).

While play has been regarded as a critical element in early childhood development, evidence has also shown that children regularly left to their own devices for undirected free play, has shown the least effective (Anon, 2017). Studied as early as 1933 (as referenced by Forster and Shah, 2015) found that the role of creative play in assigning meaning to situations, are a valuable developmental process in children. Neuroscientists Bateson and Martin (2013) suggested that playful play (when the mood is positive and aims not decided), assists imagination by creating new ideas and thoughts, or by providing encounters that enable the consequent production of novel solutions to a problem (Forster and Shah, 2015).

4. Play-based learning and purposeful teaching

So, the first question will be what is play? Meaningful play and leisure-based learning can create a context for learning through which children organise and make sense of their social world, as the effectively engage with people, objects, and representations. It is recommended that all early childhood educators need to know what play is, why it's important, how to implement this and what their role in it is. For children play should be pleasurable, symbolic, active in the physical, verbal, or mental sense, voluntary, process-orientated, self-motivating (play is considered its own reward to the player) (Anon, 2017). Time, challenge, fantasy, and curiosity have been identified as fundamental components in (computer) games for children (Southgate *et al.,* 2017).

Many educators believe that play is a way for the child to experiments and discover the world around them, as a way of expressing emotions safely and where teamwork with others can develop. In contrast, evidence has shown that the least successful learning environments are often those where children are regularly left to their own devices to engage for long periods of undirected free play. This is particularly true for infants and toddlers (Anon, 2017). Children learn to play, learn from play, and develop the ability to use play in adult learning settings. An inconsistency in this situation was found, where a child come to play for enjoyment but ends up learning (Leather *et al*., 2021).

If play is such an important part of learning life-long skills of coping, adapting, critical thinking, strategizing, and more, why then do we discourage children to play as soon as they start with formal schooling? We can ask another question: *"Are we prepared to give up on a bit of control in the classroom and allow for promising and experimental learning outcomes through increased play among our children/students?*" (Leather *et al*., 2021). As adults we know that a bit of play can be beneficial to us, and we experience positive emotions while playing. We feel good! All I can say it that we need to allow our children/students to be playful in their leaning and that it can lead to a bit a chaos in the classroom! Deal with it!

Leather *et al*. (2021) said the following about the experience of students and staff during play: *playfulness shows a positive relation to improved academic performance, better stress coping, positive attitudes towards the work environment, improved job satisfaction, improved interprofessional teamwork and social interaction in the work setting*. Are these not reasons enough for us to invest and develop more play activities in our academic environment, for student as well as faculty?

5. Defining games for learning

Serious games, or (for our purpose) "games for learning" are generally considered to be educational games that use digital technology and can be played on desktops, video consoles, or mobile devices (Southgate *et al.,* 2017, Delimaa *et al*., 2017). These games usually have knowledge gain as a primary focus, but also the acquisitioning of skills and changes in behaviour (Southgate *et al.,* 2017). However, games for learning can also be used as a sub-discipline of the pedagogy to understand learning as a public socio-political process where a "wicked" problem of public importance stimulates players to think, react, take decisions and act while sharing and discussing views and beliefs (Delimaa *et al*., 2017). As pedagogy is about the study, and theory of teaching, digital game pedagogy is about the study and theory of teaching with games. It is a term not commonly used, but it is meant to highlight the distinction between learning from games and teaching with games. The two terms are closely related but are effectively conflicting sides of the same coin – one from the perspective of the learner and the other from the perspective of the teacher (Becker, 2021).

These games are designed to combine a "serious" (formal learning) purpose with an entertainment function (through gaming design elements) and include some of the characteristics of recreational computer games, such as degrees of self-directed action and navigation; challenge; competition; progression through levels of difficulty; time constraints; immediate feedback; ranks and rewards (Southgate *et al.,* 2017). During the process of play, students are also guided to acknowledge the positive in situations, to enjoy the journey of play and not to take failures too seriously, maintain an open mind, embrace challenges, increase their ability to deal with failure and adapt to change (Leather *et al*., 2021).

The wide variety of definitions available for all kinds of "games" make it especially difficult for teachers to decide what they want to use and when is a certain method appropriate. Becker (2021) gave an excellent description (Table 1) of all these options and elements of each method.

The researcher indicated that a "game" has the following properties:

- Interactive
- Has rules
- Has one or more goals
- Has a quantifiable measure of progress (or success)
- Has a recognizable ending

Table 1: Types of teaching and learning using games (Becker, 2021)

Distinctions between Types of Teaching & Learning using Games						
© K.Becker 2021	Game	Serious Game	Game for Learning (G4L)	Game-Based Learning (GBL)	Game-Based Pedagogy (GBP)	Gamification
Basic Definition	This term includes **BOTH** Serious Games AND Games for Learning	A game ***designed*** for purposes other than or in addition to pure entertainment.	A game ***designed*** specifically with some learning goals in mind.	The process and practice of ***learning*** using games. [From the ***learner's*** point of view]	The process and practice of ***teaching*** using games. [From the ***teacher's*** point of view]	The use of game elements in a non-game context.
Purpose	Can be for any purpose.	Change in behaviour, attitude, health, understanding, knowledge.	Normally connected with some educational goals.	**Not a game** - this is an approach to learning.	**Not a game** - this is an approach to teaching.	Often used to drive motivation, but can also be used to make something more playful and game like.
Primary Driver (why used)	Can be either play or rewards (or both).	To get the message of the game.	To learn something.	To improve learning. To increase learning effectiveness. **Note GBP & GPL are related, but not the same.*	To improve teaching practice & effectiveness. **Note GBP & GPL are related. They are like two sides of a single coin.*	Depending on how it's implemented, it can tap into extrinsic or intrinsic rewards (or both)
Key Question	Is it fun?	Is the message being received?	Is it effective?	Am I learning what I am supposed / need to be learning?	Is it effective?	Business: Does it improve profits? Education: Is it effective?
Focus	Player Experience *(how)*	Content / Message *(what)*	Content / Message *(what)*	Learning Objectives *(what & how)*	Learning Objectives *(what & how)*	User Experience *(how)*
Budgets	Next to nothing to 100's of millions.	Next to nothing to 100's of thousands.	Next to nothing to 100's of thousands.	Usually part of an institutional budget. Largely irrelevant to the user.	Usually part of an institutional budget. Largely irrelevant to the user.	Next to nothing to 10's of thousands.
Business Model	User Pays	Producer Pays	Varies	Institution Pays	Institution Pays	Producer Pays
Concept Catalyst	Core Amusement.	Message.	Performance or Knowledge Gap	Game is the lesson or is used as a part of the lesson.	Game is the lesson or is used as a part of the lesson.	When used in learning it usually impacts HOW things are taught and administered rather than WHAT is taught.
Fidelity	Self-consistent, otherwise irrelevant	Faithfulness to message essential	Faithfulness to message essential	Faithfulness to message essential	Faithfulness to message essential	Not Applicable. If a narrative exists, it need have nothing to do with what's being gamified.

6. The benefits of games for adults

It is known that almost 99% of young adults spend time on the internet for personal use on a weekly basis. At least 60% of children between the ages of 8 and 18 years are likely to engage in video games daily (Southgate *et al.,* 2017; Viudes-Carbonell *et al.,* 2021). Connectivity may, however, show a different picture in different populations and geography in South Africa. Despite evidence of wide online activity and gaming, it is unwise to assume that all learners are "*digital natives*". Although there is no generally accepted profile of the digital native as a learner, they are often assumed to prefer fast-paced learning environment, along with non-linear processing of information, multi-tasking, and collaborative learning (Southgate *et al.,* 2017).

7. Competencies expected from teachers

Literature agrees that the teachers' experience and awareness of the curriculum related game for learning is crucial for effective application (Southgate *et al.,* 2017). Although teachers know that their role regarding the use of new technology in the teaching environment has changed, not all are confident in their competencies and are unsure how to address these changes. The truth of our times forces us to connect with the social, political, and cultural levels that impact and inform the strategy and practice of education. We need to be inventive in the curriculum and have a clear understanding of the social, historical, and cultural structure of education that we inherited (Leather *et al*., 2021).

The teacher has four roles to play when implementing games for learning, namely

- instructor (planning and communication),
- playmaker (communicating tasks, roles, goals, and game dynamics),
- guide (support students during play) and
- evaluator (understands, explores, and provides response to the gameplay experience) (Nousiainen *et al.,* 2018).

The actual game-based learning process where students play an active role is also divided into 4 phases:

- orientation,
- creation,
- play and
- elaboration (Nousiainen *et al.,* 2018).

For each of these phases, competencies to specific game-based pedagogical approaches were mapped in Figure 2.

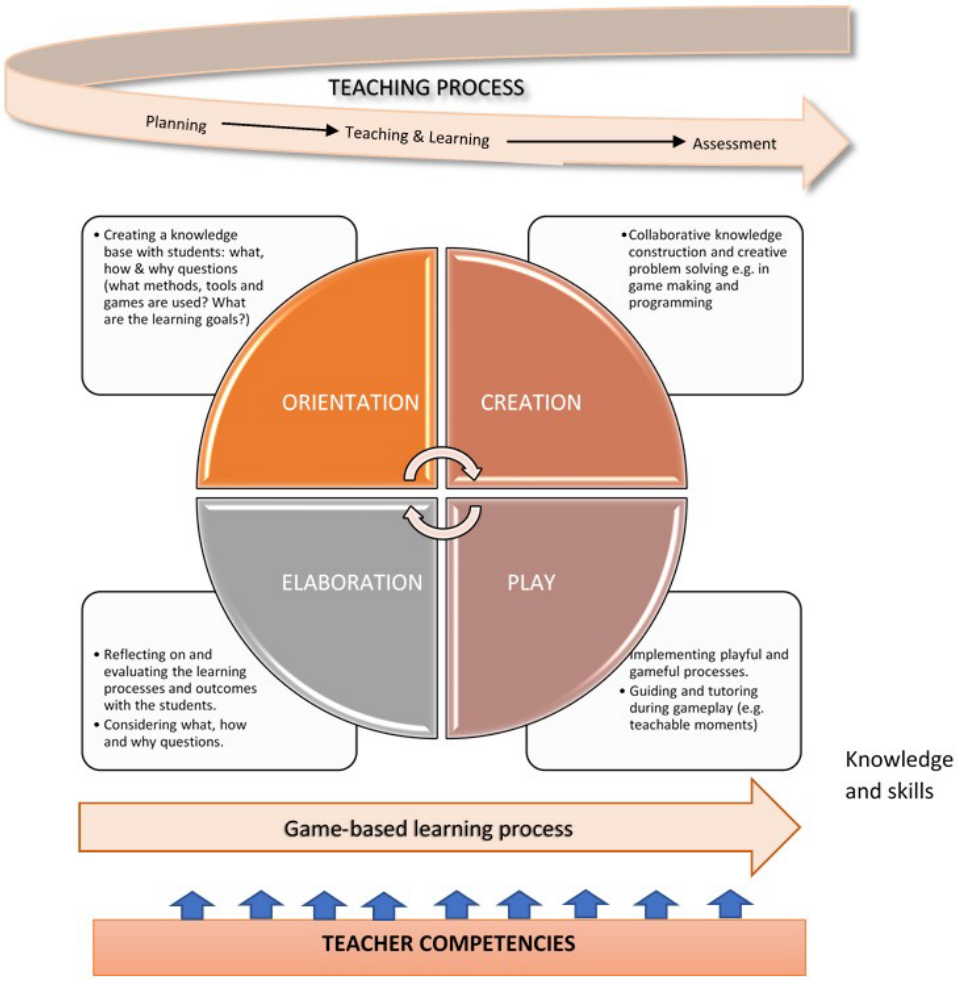


Figure 2: Pedagogical framework for game-based learning (adapted from Nousiainen *et al.,* 2018)

8. The relationship between games and learning

A game classification that differentiates between game forms and functions based on narrative (Naul & Liu, 2020), repetitive gameplay, and simulation is indicated in the development of games. There is a wide range of game types, which make the design process complex. Some games are therefore explicitly produced for reasons beyond entertainment, for example, games for learning (Ravyse *et al.,* 2017).

Games for learning have been available as a mode of technology-enhanced learning for several decades already and the potential to promote student engagement and deeper learning has attracted much interest (Southgate *et al.,* 2017). Games for learning are not purely designed for entertainment (Silva, 2020) as is illustrated in Table 2.

Table 2: Relationship between learning techniques, learning activities (adapted from Silva, 2020)

Learning Techniques	Leaning Activities
Practice & feedback	Questions, memorization, association, imitation
Learning by doing	Interaction, practice, drill, imitation
Learning from mistake	Feedback, problem, reflection
Discovery learning	Feedback, problem, creative play
Task-based learning	Understand principle, graduated tasks
Question-led learning	Question, problem
Situated learning	Immersion
Role playing	Imitation, practice, coaching
Constructivist learning	Experimentation, questioning
Learning object	Logic, questioning
Coaching	Coaching, feedback, questioning
Intelligent tutors	Feedback, reflection, problem, continuous practice

Games for learning can provide the social and cultural context that can facilitate learning something meaningful in a real world chosen topic. These games can provide continuous valuable feedback about their progress to individual learners which they then use to reflect on regarding their choices made during the game (Hanekom & Botha-Ravyse 2019).

Games for learning are ideally suited for new generation learning as they require the development and use of cognitive flexibility and other problem-solving skills (Southgate *et al.,* 2017).

9. Designing a pedagogical game

The process of designing a game for learning is not easy because it involves the input of several professionals, such as game designers, programmers, and subject matter experts (Ravyse *et al.,* 2017). Sometimes, communication between these professionals is not simple because they use a different vocabulary and have different perspectives on the game. Most of the time, they are not even in the same town, or even country. For example, a game designer wants to create a fun experience, while subject experts are more focused on creating a learning tool. However, pedagogy must be subordinate to the story, meaning games for learning must first be fun, or the player will not want to play it (Ravyse *et al.,* 2017).

The framework mostly used to develop a game for learning applies the standard knowledge domains of education:

- learning (learners);
- pedagogy;
- curriculum; and
- assessment,

with a further addition of technical context and its ethical implications (Southgate *et al.,* 2017; Naul & Liu, 2020).

This can be executed in the following way:

- Use of fantasy and narrative to engage students in the learning experience;
- Visual and aural stimulation through multimedia elements;
- Having clear and meaningful goals with challenging and increasing level difficulty;
- Incorporating timely feedback mechanisms with a focus on progression;
- Providing students with opportunities to make decisions that influence the learning experience;
- Encouraging social interaction between learners by providing opportunities for collaboration, discussion, and reflection.

10. Adaptive game difficulty

Game difficulty can be generated through dialogue delivery by a non-player character, who explains how the game will adjust variables within the game itself such as difficulty, level, varying the amount of funds available, and other assets used. Combined with this there need to be a dynamic development of story and characters (Hendrix *et al*., 2019). In choosing or developing a game several issues need to be considered, namely:

- Socially and developmentally appropriate content;
- Curriculum-alignment;
- Expense and/or licensing issues;
- The capacity to play the game over short periods of time in class;
- Suitability of the game for the institution's digital platform;
- Level of student engagement.

All the elements discussed so far will now be discussed further by means of examples of the process to develop a game.

ExMan3D ®: Management through Example is a business simulation game aimed at teaching fundamental management principles to aspiring entrepreneurs or learners undertaking management studies and/or training courses. This will eventually show how we embedded the elements for a game for learning and how it engages students to learn in the process.

The type of game was selected based on the problem solving and communication skills (Connely *et al,* 2012) that managers would need for making decisions in their everyday management tasks.

11. The design of ExMan3D®: Management through Example

11.1 Narrative and creation

The storyline (narrative) refers to the story behind the game-world in which the player finds themselves while immersing in the play of the game (Figure 3). During this time the player tries to reveal the story to progress in the game. Although the graphics or video material keeps the students' attention, it is the story or plot that keep them engaged and motivated to re-engage with the game after the newness of sound and graphics has worn off. The narrative engaging the student in the learning material is therefore very important and need careful and serious planning. Learning must be "*sneakily*" joined with an interesting storyline to not distract the student's emergence in the game. Careful planning is needed to minimise the distinct breaks between learning and playing activities, as this only contribute to player frustration and lack of interest to play more. This can be bridged by ensuring that the associated real-life skill is emulated by the knowledge or skill required for advancement in the game narrative. A certain way to get to the desired learning outcome is to link it directly to the game's reward system (Naul & Liu, 2020).

Students also enjoy creating their own narrative, in which they are not playing the game in a linear fashion by moving from one static scene to another, but by making their own choice of how they want to proceed. This creates excitement for the student because they can choose different "*paths*" through the game and create different results, which may be right or wrong. Either way, right answers will imprint the correct principles and wrong answers will create curiosity to get to the correct answer, and this elicit learning to take place. The storyline of the game must closely reflect the learning content and fit the learning outcomes, otherwise it will only confuse students, and they will stop playing.

The external motivation to play a game, apart from in-game rewards, progress metrics and status, drives the will to play as much as internal motivation. If students know that playing a game will give them course credits, they are more likely to engage with the game, and may in the long run attribute increased academic performance to playing the game (Silva. 2019).

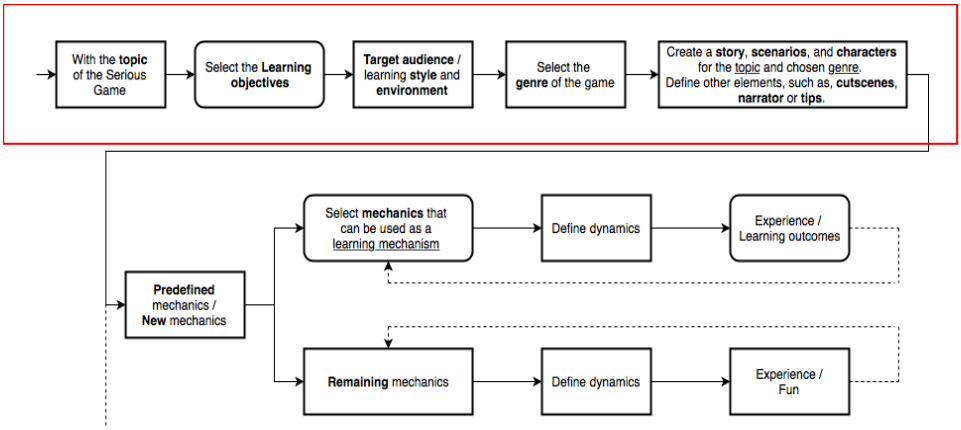


Figure 3. Steps defining game development (Silva, 2019)

A general framework with a grounded pedagogical support to choose an effective game, includes the following domains:

- The *learners* and how they learn based on their developmental stage, individual needs and motivation, sociocultural background, and experience in gaming;
- *Pedagogy* including planning of learning activities, teaching strategies, and the evaluation of the effectiveness of the teaching approach;
- *Curriculum* or what is being learnt and the various ways of knowing, encountering, and investigating this; and
- *Assessment* or formative and summative evaluation of how and when students meet the learning outcomes; and
- *Technical context* which includes platforms, connectivity infrastructure, and expertise in the school to support serious game use and content creation (where applicable) (Southgate *et al.,* 2017).

Games for learning need to be tailored to the competencies and characteristics of different players to replicate a pedagogical best practice and best suit for the players, while the target demographic is often the problem they seek to address, rather than a specific segment of the gaming community. Game design is a process of building, refining, and improving a product that consists of three main steps: design, prototype, and play testing (*beta-testing as we call it*) (Ravyse-Botha & Hanekom, 2016).

Only the design steps will be addressed (Figure 3) as the rest falls outside the scope of expertise of the presenter:

11.2 Developing the game

Feature Set

General Features

- 3D game world
- Serious Game tied to the coursework done in the Dietetics program
- Recorded Dialogue to give a more authentic feel
- Contextual experience for players with some background in the food services industry

Gameplay

- Isometric game view to allow player to see not only their character, but also how it interacts with the world.
- Mouse control to allow users to interact with the game with minimal movement (for use in classroom situation).
- Movement through the game world, with Dialogue based interactions to track knowledge gained from course.

ExMan is a business simulation game aimed at teaching fundamental management principles to aspiring entrepreneurs or learners undertaking management studies and/or training courses.

The game was set in a graphic novel for the food service industry, but the underlying design is context-free (Hanekom & Botha-Ravyse, 22019). That is, a new skin or business context can be placed over existing code with minimal code alterations. The game will be single player with multiple artificial intelligent non-player agents (NPAs) in a combination of 3D and 2D game mechanics. The core level of the game revolves around the establishment of a catering business with the opportunity to develop add-on levels (e.g. a serving level) at a later stage. Some of the key learning content addressed by the core level includes budgeting, communication skills, human and other resource management, conflict management and quality of work-life.

Various techniques have been used such as adding pre-defined elements to a scenario, adjusting the behaviour of the artificial intelligence, and using case-based reasoning (Hendrix *et al*., 2019). Realistic simulation in the game provides a safe and secure environment that allows students to have experiences that in real life would have been difficult or beyond their resources (Southgate *et al.,* 2017).

Anderson *et al*. (2001), a former student of Bloom who is recognised for his taxonomies of learning, published a revised taxonomy for learning and developing of skills (Anderson *et al*., 2001). This adapted version comprises the basis of the cognitive processes imbedded in ExMan that range from the lower order thinking skills of remembering, understanding, applying, to the higher order thinking skills of analysing, evaluating, and creating. The digital use of Bloom's revised taxonomy, provides an example for the cognitive process of applying, running, and operating — the actions of initiating a program or operating and manipulating hardware and applications to obtain a basic goal or objective. Anderson also states that programming (also comprising game development) is the application of the creating cognitive process. identifies the cognitive processes of problem-solving, previous learning in a new situation, and transfer, which should take place when one uses prior knowledge to solve a current problem. These processes also explain the conceptual framework within which ExMan was developed.

11.3 The Game World

Key Locations

- Office: when notifications are triggered, the desk is where the player needs to travel to, (their laptop) or answer the phone for example. This is the "*start*" section for whatever the event is that is in progress.

- Front door: Exiting the front door will allow the player to exit for the day and move the in-game clock a day forward.

World Layout

The layout of the game world reflects the fact that all the game play will take place within the FSU that the player is attempting to manage. The whole world is there for reflected mainly in the layout of the FSU:

The objective of a game is for students to have access to educational software to learn certain soft skills applicable to real-world situations (Hanekom & Botha Ravyse, 2019). During the design and development of ExMan it soon became clear that it is related to the features of a business game in which the principles of running a business are applied, but also incorporate competitive aspects, such as producing products better and cheaper than other companies, serving customers better. Business games provide opportunities for individual competition, and the teamwork part of the business world of food services management (Ellahi et al., 2017). ExMan includes various scenarios that recurrently occur in real world food services. The aspects of situational simulations linked directly into the design of the game are among others communication, conflict management, harassment, client satisfaction, budgeting, employee counselling, team coaching, using human resources and the selection and employment of employees (Hanekom & Botha-Ravyse, 2019).

The main aim of this game was to simulate real life situations within the food service unit (FSU) to practice the soft skills that students will otherwise only be able to obtain by spending at an existing FSU, and this plays out in an FSU through 4 main areas:

- Kitchen
- Food service manager's office
- Storeroom,
- Loading bay
- Reception

The game is very linear at the start of the game, and once a few scripted sections are passed, slips into a game loop where random events are triggered that will allow the player to interact with different scenarios during every play. The topic of the game and learning objectives to be addressed are chosen. The target audience can either be a single grouping or a wider audience, depending on the initial objectives of the game. If the audiences using the end-product differ, the learning style, environment and type of game should at least be similar, for a single game to address the needs of a larger group of users. The story is created using a storyboard (Mou *et al*., 2013) which will have a detailed description of the characters (just as for a story book), the scenes in the story (or scenarios) are unpacked in further detail for the specific genre. Other details such as cut scenes, easter eggs, unintended incidents, non-playing characters, need to be developed true to the genre of the game. This part of the

development is done by the team of subject specialists before any programming will start. Programming falls outside of the scope of this lecture and will not be discussed.

The game designers employed a decision tree scenario for the game that branches out in depth rather than width to reach the most favourable outcome (Westera *et al.,* 2008). The scenarios were written based on theory but from a place of storytelling which has proofed deep immersion when tested with eye tracking and cognitive evaluation (Blignaut *et al*., 2015). The game has further made use of the following principles:

- Learning activities and academic content are placed within the game, maintaining the balance between fun and learning.
- The academic content is integral to the game, with content specific tasks embedded within the fictional content and rules of the game.

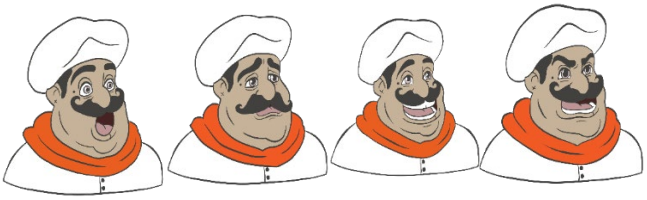
Five main characters the player interacted with:

Hilary is the main and the only selectable player character.

Hilary: surprised, sad, happy, and angry

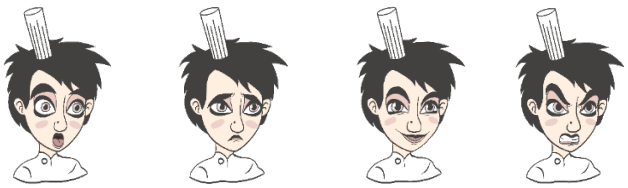
Chef Antonio is the main chef in the game (for the moment, the only selectable chef).

Antonio: surprised, sad, happy, and angry



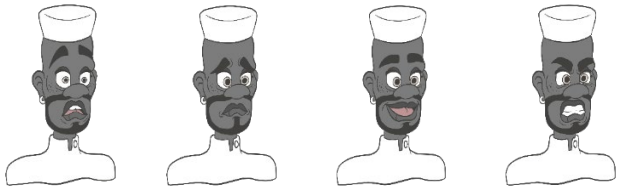
Chef Gina is one of the alternative chef characters

Gina: surprised, sad, happy, and angry



Chef Thabang is one of the alternative chef characters

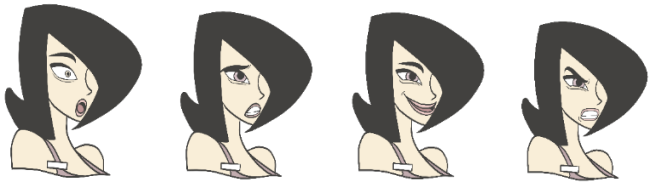
Thabang: surprised, sad, happy, and angry



Waitress Jackie is a Non-Playing Character (NPC) that mainly features in the sexual

harassment scene

Jackie: surprised, sad, happy, and angry



The following 2 diagrams (Figure 4 & 5) will explain the game flow:

The first scenario (Figure 4) is the start-up of the business where the owned visits the bank manager asking for a loan. These first choices will always influence the flow of the game, as there are several choices to be made, and a student may make different choices each time they are playing the game, giving a different outcome. This is mainly possible because of the AI build into the game.

Time flow in the game *is not linear*, but rather, the passing days mark off the amount of time passed since the last relevant event that the player has interacted with. Each day contains a single event and overcoming that event and exiting the building will cause the game clock to move one day forward. This needs to be considered by the player as salaries and rent are paid on a fixed monthly schedule.

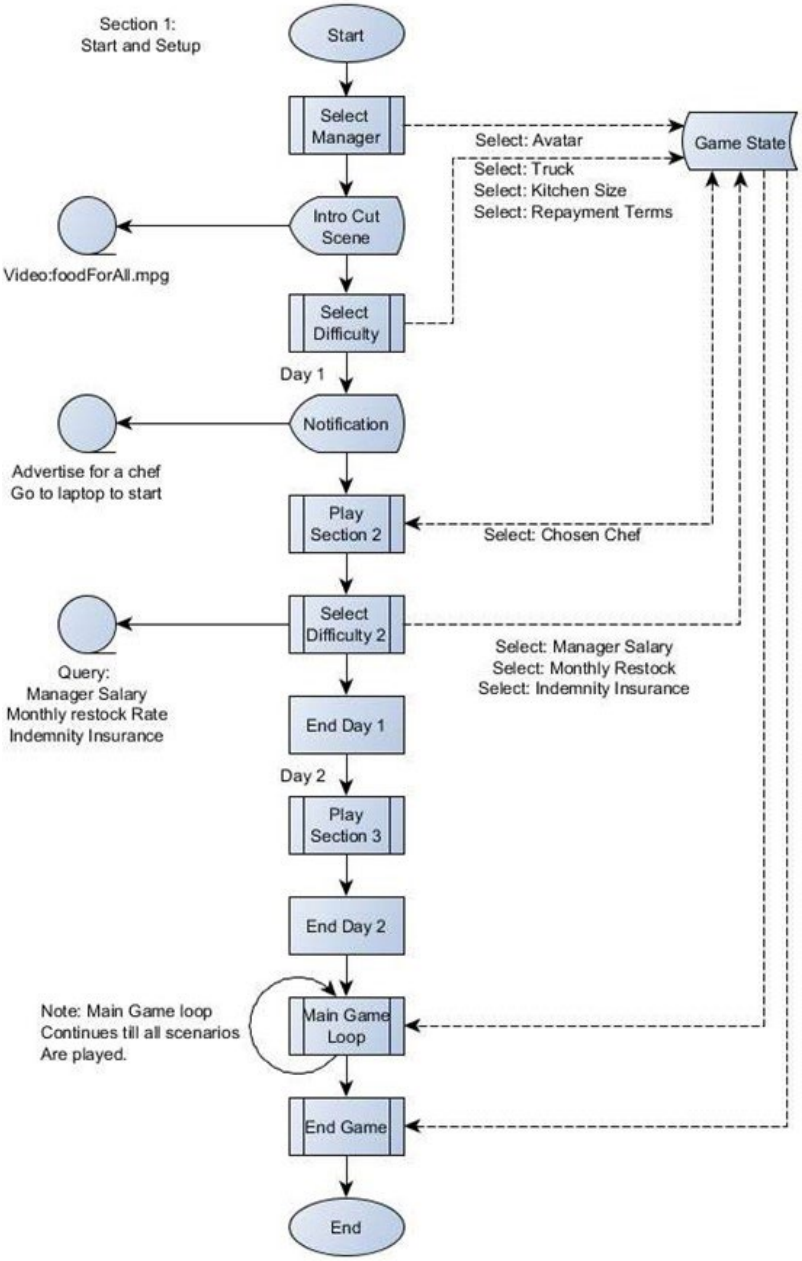


Figure 4: Section 1: Game flow – Start and set up of the business

In the second scenario (Figure 5) the choice for a chef is made, which will also have an influence in the development of the gameplay later.

The main interactions that the player will participating in is dialogue based and will be between the head chef that the player has selected, the clients and the waitress Jackie. Dialogue interaction is done by having the player (student) listen to the spoken audio from the character they are interacting with, and then selecting an appropriate response from a selection of 4 possible answers.

The player starts the game selecting their *Avatar*, sees the introduction video and then selects their difficulty level. Difficulty is selected by choosing:

- The size of the delivery truck
- Size of the kitchen area

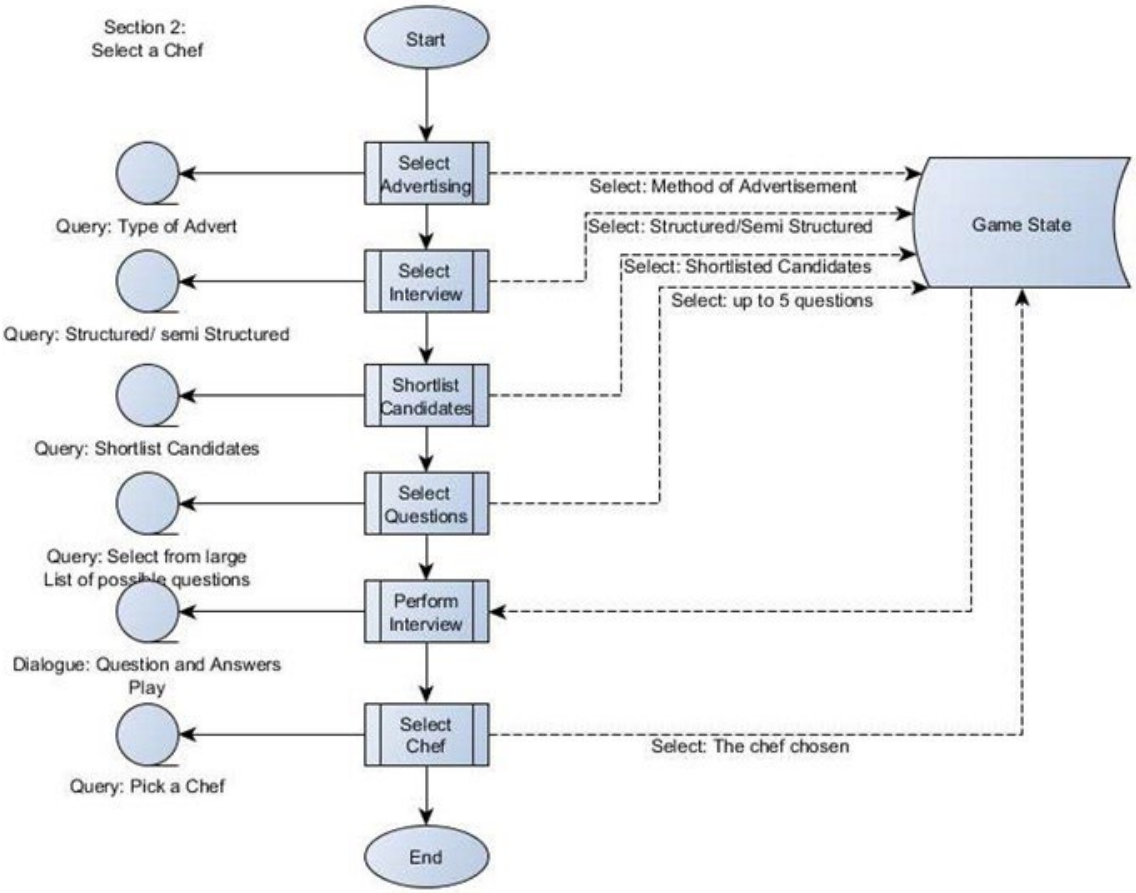


Figure 5: Section 2: Game flow – Hire a chef

Repayment terms of the bank loan are specified *after* initial difficulty settings is selected, and the next step requires the player to select a head chef.

The player can select several different advertising methods and interview methods and once shortlisting of candidates based on the CVs received is done, they will set up the interview. This is done by selecting 5 questions from a long list of questions available, which then plays the interview question/answer session back to the player in the form of a dialogue with the chef candidates. From this interview process, the player then selects the head chef they wish to employ. After selecting their head chef, the player then must select a second round of modifiers in the form of the *manager's salary, monthly restock rate* and *level of indemnity insurance*. Once all the modifiers are chosen, the "*first order*" section is entered

Based on the responses given to dialogue driven game play, players were awarded with points which ultimately translated to a rating which was constantly visible to the player as they played. Once all 4 of the main events have been completed, the player is rated on their actions by considering the staff satisfaction, client satisfaction and financial position of the company. This is what determines whether the player has successfully "*beaten*" the game in the End game step.

This game was intended for use by final year dietetic students on the verge of their first job as novice entry level managers in the field of food service management. These students are part of the so-called millennial generation of the Y-generation (Table 3) that present characteristics such as demanding more choices, have high expectations, thrive on audio and visual stimulation, and are easily bored (Rony, 2019). During investigation of the expectations of this generation, it surfaced that these individuals constantly look for entertainment, have low propensity to read, and thrive on social interaction. They have information at their fingertips using the Internet and do not accept everything at face value. They expect quality and fidelity (game aspects as close to real life as possible). This aspect correlates to students' expectation that expert game fidelity enhances learning and have the game fidelity that Y-generation students expect.

Table 3: Characteristics of Generation Y at Work (Rony, 2019)

Positive Characteristics	• Intelligent technology • Accustomed and appreciate diversity
Negative Characteristic	• Less foundation of basic literacy • Have a short attention span
The behaviour in the workplace	• Superior in integrating technology in the workplace • Want fast feedback and recognition • Expect to have a leader who take the time to discuss performance

Realism/fidelity

Realism identifies how close a game replicates or resembles real life. Realism is defined as the physical (graphical and audial aspects), functional (simulation accuracy and non-player

character response) and psychological (noise/interference, emotional content, and time pressure) dimensions of fidelity (Petridis *et al.,* 2012; Ravyse *et al.,* 2020).

The core design of the game was based on mirroring situations typical of food service management units to teach students higher order thinking skills and techniques that include conflict handling and problem solving, budgeting, day-to-day management, and so on. Simulations replicate real-life situations in a safe environment without suffering collateral consequences of real-life situations. The closer the scenario is to real life the more learning it will yield for a novice learner with no practical experience. Some students shared the following comments:

> *'We don't know what actually happens daily in a food service unit and this helps you to better understand all the underlying factors' and*
>
> *'I like the fact that you lose money and clients when you do something wrong, it makes it more real' (Botha-Ravyse & Hanekom, 2016).*

Other design elements relating to real-life were that students liked the fact that "*you can meet your staff*" before the game starts. The students enjoyed the interaction with clients. This resulted in development of better understanding how their choices impacted clients and made them sensitive towards dealing with diversity. When students played poorly or made the incorrect decisions the number of clients decreased, and students felt excited, as they experience this to "*made the game more real*."

The two themes that supported the fidelity in ExMan the best were immersion and curiosity. Curiosity is more closely related to fidelity than immersion (Botha-Ravyse & Hanekom, 2016). This indicates that fidelity of a game is obtained better by triggering the curiosity of the student. Curiosity in games is stimulated on a cognitive level by a challenge that needs to be solved. The elements in the game which related to curiosity were propensity to read, surprise, consequence, inquisitiveness, engagement, and the reality of a scenario. This showed that curiosity can be suggested by making people think their knowledge structures are incomplete or inconsistent. An example of this was that students were very confident in their decisions, which sometimes led to unexpected outcomes. *'I lost my company*!' was a student's horrified exclamation after he had selected to fire the chef, not realizing that he needed to follow a certain set of steps and procedures before someone could be dismissed. The feedback that are available can give the student a reminder of what decisions they took, and they can learn from this to do it differently next time (Botha-Ravyse & Hanekom, 2016).

The definition of engagement is varied and flexible, but it is assumed to mean simply that the students feel as if they are part of the simulated "*universe*" rather than just using a computer. Human experiences of virtual reality are like lived reality experiences and include students' thoughts, sensations, feelings, actions, and meaning-making practices (Botha-Ravyse & Hanekom, 2016).

Some of the elements pointed out by the students during the beta-testing phase of the first and second wire frame edition of the game which they feel could be improved, included the following:

- The audio-visual implementation of a game, in other words the use of sound and voice overs, background noises or different voices for different characters. *'Real life is noisy so if I really want to get into it, it needs to be more real.'*
- Students indicated that they did not like to read the information passages as presented in the speech bubbles in the first games and skipped this to play the game.
- The game should match the students' expectations and feeling of presence in a virtual world using the increasing demand on working memory, and
- Increased difficulty levels.

These were all addressed and improved in the final version of the game (Hanekom & Botha-Ravyse, 2019).

It is a well-known fact that increased engagement in games for learning, increases the transfer of learning (Iten & Petko, 2016). The students pointed out that they would be more likely to engage with the game if there was more direct competition against other opponents or a comparative leader board. This, however, is difficult to implement in a game for learning, but could be approach differently when two or more students play the game as a team and make decisions as a team. This may also improve the learning experience as they will learn from each other when they must explain why they make a certain choice. The interactions observed during gameplay showed that students were committed to finding a solution, not only on a cognitive level but also on an emotional level.

This was illustrated by the fact that they got quite upset with the difficult bride in this game:

'This bride is impossible I wish I could shut her up!'

Interaction/Engagement

The element of interactivity set games for learning apart from other forms of edutainment (Dele-Ajayi & Stracham, 2016; Iten & Petko, 2016). The game interface should be simple for students to understand what inputs they need to make and for the feedback given after gameplay to be useful. If a student does not understand the available game map or inventory, they will lose interest or get lost in the game, without reaching the expected outcomes. The researchers aimed to use real scenarios relating to a food service unit to simulate real life situation as closely as possible. The closer the scenario is to real life, the more it relates to fidelity. The results of this study were modelled on the theory of which illustrates that fidelity increases engagement, which influences the transfer of learning.

11.4 What learning took place in the end?

Research indicated that fantasy triggers both affective (emotional) and cognitive engagement and that learning takes place the moment that a learner is engaged (Iten & Petco, 2016; Hanekom & Botha-Ravyse. 2019).

These elements relate to the sub-clusters observed, namely desire to learn and meaningful learning. Students are obliged to prepare for class and are tested on their preparedness. The game added some extrinsic motivation for students by finding easier ways to prepare (Hanekom & Botha-Ravyse. 2019). Some participant comments underlined the aspect of extrinsic motivation to play the game and learning through engagement:

- *'It will definitely help me to prepare for class;'*
- *'I would have wanted this game to help me practice the right way to handle a situation;' and*
- *'I would much rather play the game and then go to the textbook to find answers than just read the book….., boring!'*

The players fostered a relationship with the education objective of successfully managing a food service unit (Hanekom & Botha-Ravyse. 2019). Another aspect of the desire to learn that was observed was the comment made by the students to one other:

- *'You must try all the options as it has different outcomes and then you can kind of see how your different choices will have a different effect.'*

Fun also influences the desire to learn. Fun and enjoyment elicited by gameplay that results from sensory delight, suspense or thrill, achievement, control, and self-efficacy can contribute to learning. Also, fun encourages students to play the game more often:

- *'I would want my family to play it as well as it would be fun to see if I really know more' and*
- *'This is a fun way of seeing if I know my work'.*

Learning is defined as the ability to use past experiences in the service of the present. Meaningful learning is generally described as learning that produces organized, coherent, and integrated mental models that will allow people to reach conclusions and apply knowledge but is also thought of as being robust and enduring (Landers, 2014; Hanekom & Botha-Ravyse. 2019).

Meaningful learning also teaches other skills such as the awareness that there is more than one way of getting to a solution:

- *'I didn't realize that, even if you make a mistake in the first part if you choose something else you can actually still get to the desirable outcome.'*

Intended learning is what the teacher wants to happen, and it relates directly to the learning objective. The concept of a game for learning is not only to have learning relate to learning objectives, but to trigger other factors of learning, for example, how actions have consequences (Landers, 2014).. The intended learning objective was achieved as students noted that they would have loved to use the game as preparation for exam as it could have helped them to better answer the case-study based questions which are the core of this subject (Hanekom & Botha-Ravyse. 2019)

Incidental learning takes place when students learn or gain extra skills and knowledge outside of the intended learning objective. It stems from the scholarship and practice centred in learning from experience (Marsick & Watkins, 2018). An example of incidental learning was when a student remarked that:

- *'I didn't know what kosher is; now I know Parma-ham is not!*

Although games for learning is not intended for player interaction, it became apparent during class that students like to share gameplay tactics and solutions with each other and make collective decisions where to go next. This created opportunities for students to turn a single-player game into a collaborative effort where they interact with the game and the academic material, stimulating learning and reaching outcomes (Hanekom & Botha-Ravyse. 2019).

11.5 AI and adaptability

Game Engine

The main sections of note in the game engine are:

- AI – this mainly controls the selection of events and the calculation of the score that the player will gain from the way they interact with the dialogue options.
- Dialogue – the dialogue system will show the player's portrait alongside the character they are interacting with and will play the audio files that correspond to the correct point in the conversation for each of the characters.
- Video – the game has a built-in video player that will play cut scenes that have been pre rendered at the appropriate times.
- Player input control – is done almost exclusively with the mouse.

Artificial intelligence (AI) can influence games for learning by programming to react immediately to players action and change the game in a direction not expected by the student, or to manipulate the game to a pre-set objective and outcome. There is little research done on AI in games for learning and this element can mostly be found in large games played for fun and hosted by complex interfaces (Ravyse *et al.,* 2020).

While the student plays the ExMan game, the activities are tracked and recorded in a database that is used to later give feedback to students on the decisions they made and the consequences thereof. This recording runs in the background and does not intervene at all in the engagement of the student in the game. The objective of this feedback is to guide students in re-visiting the game or subject specific matter, to improve their knowledge the next time they play. Every time a student plays the game, and a new choice is made, a new outcome will be reached. In this way students can re-engage with the game for learning and make better choices, due to gained knowledge.

Although few publications could be found on this matter, it is indisputable that formative learning takes place after observing students re-engaging with the game (Hanekom & Botha-Ravyse, 2019; Westera *et al.,* 2020). To keep students from straying outside of the boundaries of the subject matter, multiple choice interactions are build is, of which one or two usually are the most correct action to take. Students who are serious about learning, may also engage with formal study material to search for an answer or correct method, before playing the game again.

11.6 Findings and discussion of the analysis of the qualitative walk-through methodology of the game

The themes that strongly emerged from the walk-through were the diminished propensity for reading, the need for audio and visual stimulation, a definite and clear-cut need for more options and choices within the game. The walk-through participants described their experience as positive but maintained that the game should be much more challenging (Botha-Ravyse & Hanekom, 2016).

During the walk-through the participants noted that *'It will be more real if there was less reading and more visual stimuli. 'I would rather choose the options for the menu from a storeroom or refrigerator than to pick from a list that is just not how it is in real life,' highlighting their propensity not to read.* They pointed out that in the game, although structured as a business simulation game with learning in mind, there were quite a few things that were important to ensure motivated player engagement: *'I think it is important that you can choose who you want to be, or that you can choose your staff' and 'It is nice to see something about them, but I would like for them to introduce themselves using maybe a voice-over.'* These comments once again relate to the generation-Y characteristics of wanting more game options and audio.

The walk-though evaluation participants also made positive observations: *'The game has taught me a lot about all the underlying factors that do happen in a food service unit, and I feel that this can prepare me better for life out there.'* Other comments related directly to the amount of fidelity and how engaging it was: *'I think this game has a lot of potential, but I would personally want it to be more engaging by adding more choices and, more involvement from the player so that I can really feel as though I am part of the unit. "Overall, however, I did get*

quite upset when I made the wrong selection and lost my company, so it might just engage me enough to want to beat it!' (Botha-Ravyse & Hanekom, 2016)

11.7 Feedback and debriefing

The game makes use of a feedback system in several ways such as game elements (client satisfaction, staff satisfaction and revenue) and feedback at the end of each played out decision that give the student immediate feedback on their game play. This is based on the experiential learning theory tied in with a behaviourist approach (Morris, 2020). However, the way in which the game will be applied and implemented in the classroom will follow more of a constructivist approach (Karpouza & Emvalotis, 2019).

Debriefing is an opportunity for students to process and consolidate their learning experience (Bradley, 2019). The ExMan game has the functionality to create several reports after gameplay took place. The first one is a report on the choices that the student made during play and the second one is a report on the implications of those choices and reaching of outcomes. It is important to realise that games for learning should supplement the learning environment and not replace it. Students also do not want to be interrupted or corrected by a lecturer looking over their shoulders when they are playing. This may have the opposite effect of learning, namely disinterests and a feeling of failure, which may lead to the student not wanting to play anymore. Keep debriefing to the point and do not point out mistakes made by specific students.

12 THE ROLE OF THE TEACHER IN IMPLEMENTATION OF EXMAN®

The role of the teacher while using the game would be more of a facilitator rather than that of a teacher and the following objectives are set for the implementation of the game (Bradley, 2019).

- learning from mistakes
- social and emotional interaction
- active use of experiences available in the class
- re-thinking and restructuring of teaching/learning materials
- active student involvement
- decision making
- sharing of ideas and opinions

The implementation of the EXMAN® game can be summarized in four stages (Figure 6):

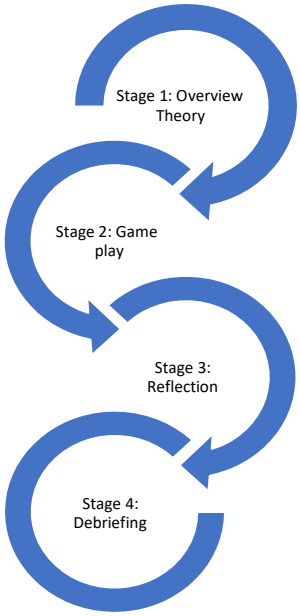


Figure 6: Overview of the implementation process

Stage 1: Overview Theory

Through the research with the EXMAN® game it was clear that students preferred an approach of learning to play rather than playing to learn. This would mean that content must be covered first before the play of the game. It is therefore important that the teacher has a clear understanding and knowledge of the game itself as well as the game progression to plan the content around the game. As this is a constructivist approach to learning (Karpouza & Emvalotis, 2019) we would suggest that the student will cover most of the content themselves with the game being an application to the theory. Best case would be a broad overview of the theory rather than an in-depth study for the best learning experience.

Stage 2: Game play

This stage would allow the students to play a certain level of the game, and once the content has been covered by the lecturer, they should be encouraged to then play the game. The game will provide immediate feedback reflecting of the choices that the student made while playing the game. Students can replay the scenario various times until a satisfactory outcome was reached.

Stage 3: Feedback - Reflecting on what happened

The students already have an opportunity to reflect by receiving the immediate feedback from the game. They should then make a short summary of their learning as part of the reflection on their game play. The second level of reflection should happen in class. The lecturer is required to facilitate a knowledge sharing activity to where students can share their learning experience and voice their opinion on the different outcomes

Stage 4: Debriefing - Revisiting of the theory behind the game

This stage is very important part in the learning experience of the implementation of a game (Nascimento *et al.,* 2020). During this phase the lecturer gives an overview on the various outcomes from the gameplay and links this back to the theory discussed in the beginning. It is important that the student have a clear understanding of how the theory forms the basis of application through the game. In this step the teacher will add extra activities and tasks either linked to outcomes from the game or additional.

13 Lesson Planning

To truly make a game part of a learning experience lesson planning should centre around the game and learning activities should (if possible) include the game. A typical best approach will be to make sure students know what content will be covered by what section of the game and clear indication given to when debriefing will be and what section of the game and theory it will cover.

For best practice assignments should be link to the game for example:

- Students start their own food service unit – FSU (restaurant, coffee shop etc). They set the vision and mission and do a SWOT analysis as part of the assignment.
- They then start playing the first level of the name where they must choose the size of their kitchen linked to the amount of investment which will determine their repayment.

An example of an assignment would be to draft a business plan with their vision, mission and SWOT analysis and then a breakdown of what their FSU would look like (based on the game) with a reason why they selected the specific chef (ie based on CV, experience, interview etc) and what they think this chef will bring to the unit. This is an important step in understanding the concepts of a Foodservice unit, as later in the game the chef might need an intervention and students can then go back to this assignment to evaluate their decision. The game elements play an integral part in the assignment.

Theory will continue with the selection and hiring process and interview skills will briefly be covered while student continue with gameplay to hire an appropriate chef for their FSU.

14 Does playing games elicit learning?

Learning from serious games are enhanced through other instructional and contextual features of the learning situation, such as the use of supplementary teaching methods, multiple training sessions, and group work. It is important to distinguish between learning directly from playing the game and learning from teacher-led activities associated with the game (Southgate *et al.,* 2017).

15 Recommendations for improvement

As the ExMan game was designed with using recognised design frameworks from literature, the authors expected the first wire frame prototype to be a success (Botha-Ravyse & Hanekom, 2016). There are however, as users pointed out, numerous aspects to be addressed. The findings from both the qualitative and quantitative results showed that the first wireframe prototype of ExMan game had fidelity elements that triggered curiosity and created a sense of immersion. A certain degree of motivation to learn, and meaningful learning, were also observed. However, the first wireframe game did not have sufficient elements of fidelity to increase learning to the desired cognitive level. The elements of fidelity that the target population suggested will impact on the further design of the game. When weighing the recommendations from participants against the cost of further development of the game, it is a tough dilemma as to where to draw the line. We must point out that learning takes place regardless of the increase in fidelity, but the cost keeps on rising as fidelity increases. To increase fidelity means adding more real-life features and detail such as movement, animation, sound, sound effects, lighting, texture—and mapping these to all assets and characters. This increased fidelity requires more programming, processing power, increased storage, and sophistication of the application (Botha-Ravyse & Hanekom, 2016).

To develop games for entertainment typically requires a game designer, developer, artist, sound engineer, and other role players. Digital learning games, on the other hand, require two more team members, namely an instructional designer for the educational foundation and a subject matter expert. This brings additional complexity to the team because every team member needs to be conscious of each role to be played in a digital-based game development environment—the conventional game development team needs to understand the dynamics of developing a digital-based game grounded in a solid educational design framework, while the instructional designer and subject matter expert need to be considerate of the complicated nature of game development (Botha-Ravyse & Hanekom, 2016)

Since the first wire frame of the game was develop, several addition stages took place, which leave us now with a third version named ExMan3D®. This game will be commercialised and gather income for the developers and the university.

We are never too old to learn…… and no one is too old to play. Extensive research was done to show the benefits of play to learn new skills, languages, hobbies, but also the importance of games to improve memory, delay the onset of Alzheimer's disease, improve fine and large motor skills, to name but a few.

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