

Designing a 3D Serious Game about Career Pathways in the Games Industry

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Abstract

The aim of this paper is to give a detailed overview of the development of a 3D serious game that informs game students about career pathways in the games industry. The paper provides a scoping review on the key principles related to serious game design. These core design issues are reiterated in relation to how the development of the game has adhered to them. The paper illustrates the game's audit trail in terms of implementation providing a development blueprint for other educators to follow when developing an educational game. The learning outcomes of the game are also accentuated and how the implementation of the game has catered for them. An important aspect of the paper is to highlight how the underlying aspects of game design can accommodate intrinsic content and motivation whilst accommodating the various pedagogical frameworks embedded in the gameplay. The characterising goals of the game have adopted a linear and cyclical approach that allows the player to progress through the gameplay completing formative and summative assessment challenges. The serious game was developed using the Unity game engine adopting a hub and spoke design. A key challenge when designing the game was how to ensure that the game remained endogenous when designing the game's levels. The design considerations presented in this paper provide a solid implementational framework about how to implement principles of learning and assessment associated with employability skill sets with a specific focus to the games industry.

Keywords: Serious Games, Games industry, Graduate skill sets, Employability, Career pathways.

1. Introduction

There appears to be no unanimous definition of what constitutes a serious game. Serious games can be defined in the way they have been developed and also how they are to be played (Dörner et al., 2016). Furthermore, the categorising of games and their intended aims and objectives from a gameplay perspective can be achieved in relation to their primary purpose. For example, according to Connolly et al. (2012), when classifying a game, it is beneficial to reflect upon the precise purpose of the game. For example, many of today's AAA game industry releases are predominantly developed for a player's enjoyment, to have fun and accommodate recreation. By way of contrast, games-based learning and serious games are more predominately related to learning and behavioural change. Various definitions of serious games exist in the academic literature. Dörner et al., (2016, p.3), define serious games as "...a digital game created with the intention to entertain and to achieve at least one additional goal (e.g., learning or health). These additional goals are named characterizing goals". Whilst this definition does imply that serious games have to provide an element of entertainment for the player they should be designed with an additional purpose. A common design component of serious games is the aspect of learning or more specifically the learning outcomes of the game. Van der Linden and van Joolingen (2019, p.16) state that "A serious game is a computer game with the aim of facilitating learning in addition to entertaining users". This definition coincides with the one proposed by Dörner et al., (2016). Ravyse et al., (2017, p. 32), the primary challenge of a serious game is to "... *find a balance between the ludic and skills or knowledge transfer goals so that neither a dominant game mode nor learning mode is present*". This definition summarises one of the main challenges when developing a serious game, namely, which relates to the aspect of game balance. This definition relates to one of the salient principles of game design, namely that in order for the game to be fun, there must be a degree of choice and self-determination for a player to make progress within a game. One of the main challenges when

conceptualising an idea for an educational serious game is determining what the role of the educator is within the serious game design and development (SGDD) process (Dimitriadou et al., 2021). This paper provides a case study on the development of a 3D serious game to teach game development students about career pathways in the games industry. At present, the paper does not provide any empirical results but is intended to give an overview of the SGDD process and the justification of the decisions made towards the game's development. In addition, the paper provides a reflective account in relation to the role of the educator in the design process, the impact of creativity regarding the design team and future recommendations.

2. Serious Games Design Models and Frameworks

It has been argued in the academic literature that there is not an overall uniform approach for developing games for educational purposes (De Freitas and Oliver, 2006). For example, according to Westera et al., (2008), some frameworks focus predominately on the technical aspect of the development as opposed to combining this with the educational elements associated with the design. For example, several game design frameworks exist in the literature such as Schell's (2020), "elemental tetrad" which focuses on the components of technology, aesthetics, story, and game mechanics. The game mechanics relate to the main aims and objectives of the game and the boundaries of the game in terms of what the player can and cannot do. In this framework, it is important that the technology you utilise can support the mechanics, aesthetics that illustrate them to the player and a story that materialises in accordance with the game mechanics of the game. The Mechanics, Dynamics, and Aesthetics (MDA) framework proposed by Hunicke, LeBlanc and Zubek (2004) provides a differing perspective on how a designer and a player view a game. Players of a game have a tendency to focus on the game's aesthetics whilst designers predominately focus on the mechanics of the game. It is advocated that when considering the components of games, it is useful to reflect upon both designer and player perspectives. One of the challenges when developing a serious game is how best to underpin the game with pedagogical theory that are associated with its learning outcomes. Some educational game design models have advocated ways to achieve this such as the experiential gaming model (Kiili, 2005). The aim of this model is to bridge the gap between educational theory and game design with flow theory adding to the overall immersion and player experience of the game. Ibrahim and Jaafar (2009), have presented an educational games design framework. The model blends together game design, pedagogy, and content modelling though at the time of writing, has not been empirically evaluated. The primary aim of the model is to provide an effective design methodology and guidelines for development teams when creating educational games. Mitgutsch and Alvarado (2012), developed a Serious Game Design Assessment Framework (SGDA). The framework stresses the importance of reflecting upon the purpose of the game when undertaking its conceptual design process. The focus of the aim, purpose and impact of the game is central to this framework.

3. Serious Games and Pedagogy

A primary aim of serious games is to ensure that the learning goals of the game are underpinned by the appropriate pedagogical theories for the player to achieve these goals. Learning outcomes for a serious game could be cognitive, skill-based, or affective (Braad, Žavcer and Sandovar, 2016). Benjamin Bloom's taxonomy (1956) is sometimes often affiliated with pedagogical considerations when designing serious games. For example, the cognitive domain of the framework focuses on knowledge construction, the understanding and application of that knowledge, analysing, synthesising, and evaluating it. The application of the cognitive domain, it can be argued, is applicable to the foundations of the learning goals of most serious games. Dependent on the genre of the serious game, problem-based learning (PBL) is a pedagogical approach that facilitates critical thinking and student-centred learning towards solving realistic challenges and problems. For this to be supported in the context of instructional design, and for learning to take place, the learner has to be firstly motivated to learn. For example, self-determination theory, as conceptualised by Deci and Ryan (1985), posits that intrinsic motivation occurs when you do something because it is inherently interesting or enjoyable. It is predominately associated with cognitive and social development. In contrast, extrinsic motivation relates to undertaking an activity because it is associated with an ulterior motive such as obtaining an external reward of some kind.

4. Games Industry, Employability and Serious Games

The games industry comprises a diversity of job roles in the context of games design and development. These are exemplified in figure 1. A challenge educators face is how best to educate and inform game development undergraduates about the necessary career pathways and skill sets required to work in the industry (Baxter et al., 2022). It is the view of the authors that the development and use of a serious game has the potential to address the 'knowledge gap' in educating game development students on the diversity of career paths within their chosen industry.

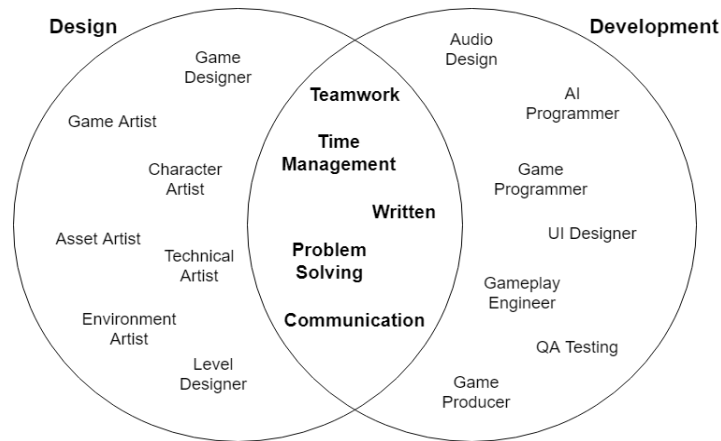


Figure 1: Soft and Hard Skills required in the Games Industry.

Adapted from CG Spectrum, Game Development Careers (2022). Available at: <https://www.cgspectrum.com/career-pathways/game-development>.

5. Design of a serious game to teach about skill sets for games industry

5.1 Thinking and logic behind game design

Serious games and digital games played for entertainment developed in the AAA games industry both adhere to certain game design concepts such as gameplay and mechanics. However, serious games are often designed to educate individuals on subject areas such as health and safety awareness to enhance the user's knowledge and understanding of the subject. The aspect of pedagogical content integration and how to achieve this was an important consideration regarding the game's development. It was decided that in relation to the game mechanics, that as opposed to the utilisation of extrinsic content, that the learning content would be integrated within the framework of the game. The embedding of intrinsic content would ensure that learning and gameplay would be closely related to one another and happen simultaneously. It was also important that the design ideas and logical underpinnings of the serious game would therefore accommodate the pedagogical theories underpinning the learning content of the game.

The original design plan for the serious game proposed a sole game studio environment, with subsequent modifications aimed at enhancing a varied gameplay experience for the player through the incorporation of game and level design techniques and typologies. The key factor in the game design was to accommodate the concept of an endogenous educational game where the game play is informed by the learning content and pedagogical theory. Students will be assessed in various 3D environments with the primary outcomes of obtaining information and thereby solidifying their knowledge about job roles and career pathways in the games industry. An additional output of the serious game is to guide and support game development undergraduate students in their career pathway choices and to help them gain a greater understanding of how job roles interrelate in the games industry. From a game design perspective, it was crucial to design and develop a game that would resonate with the students, gaining inspiration from focusing on genre-specific mechanics that game development students could relate to. The serious game integrated a well-

established level design typology known as “hub-and-spoke”. This typology features a central hub serving as a safe place for the player, with multiple branching locations to various areas (The Level Design Book, n.d.). The central hub symbolises the initial game studio environment from original design plans for the game. Each level or branch is dedicated to a specific job role within the games industry, such as design, programming, art, animation, and quality assurance (see Figure 4). To create diverse experiences for the player, each level focusses on an individual job role and game genre thereby adding an element of fun and engagement for the player. Whilst embedding an element of fun into the game, the levels facilitate a sense of exploration for the player with a degree of linearity for the content. The levels including art and animation were merged, due to the similar nature their job roles thereby allowing for more extensive game play in terms of player navigation and exploration (see figure 2). It is important to note that [1] and [5] are currently in development at the time of writing this paper. Figure 3 details original simplified design plans of the [2], [3], and [4] from Figure 2.

Level	Game Genre	Typology
1	Game Studio	Sandbox
2	Design	Platformer
3	Programming	Puzzle
4	Art & Animation	Role-Playing Game (RPG)
5	Quality Assurance (QA)	First-Person Shooter (FPS)

Figure 2: Serious game level design genre typologies.

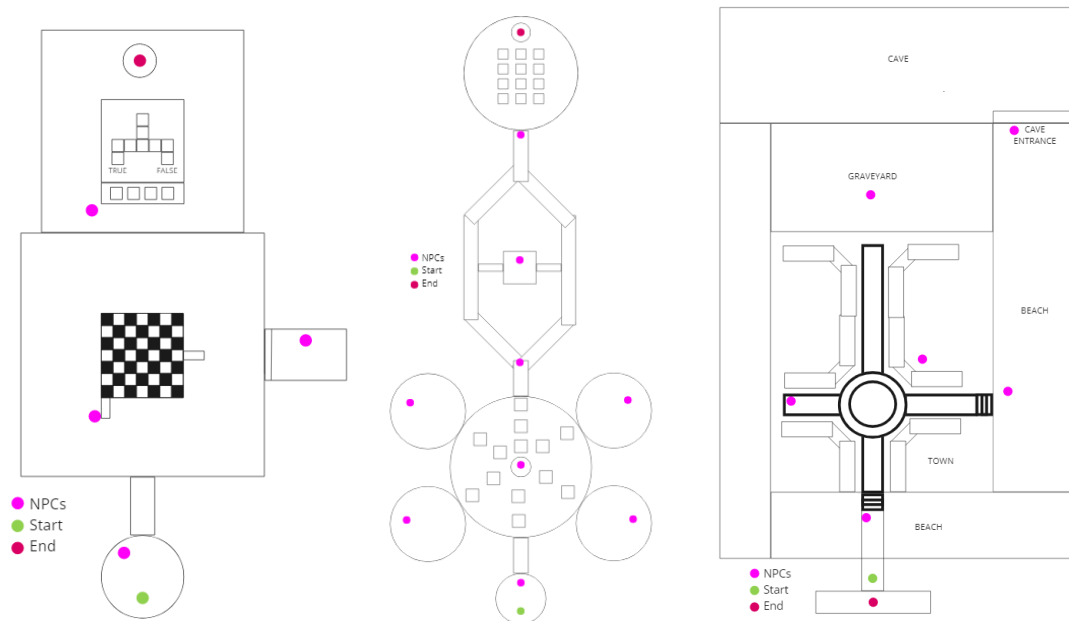


Figure 3: Design, Programming and Art and Animation initial level top-down layouts.



Figure 4: HUB guiding player to the Art and Animation level (work in progress).

Development Environment and Content Creation

The popular cross-platform game engine Unity by Unity Technologies (n.d.) was used for the core development of the serious game and was assisted by the Unity Asset Store for time-intensive resources. Some game resources were created additionally using Maya (Autodesk, n.d.), ZBrush (Pixologic, n.d.), Substance 3D Painter (Adobe, n.d.), and Photoshop (Adobe, n.d.). Unity was the core engine used by the developers to create the serious game. Justifications for using Unity were its versatility in supporting the development of both 2D and 3D games. It was also considered that in relation to future developments of the game, Unity has the ability to support gameplay across game devices and platforms (e.g., iOS, Android, PC) and supports mobile game development.

Content Integration Through Game Mechanics

The primary goal in the game design process was to establish a universal game mechanic that integrated content within the serious game. To achieve this aim, a dialogue system was implemented as a core mechanic across all levels of the game, enabling players to engage with non-playable characters (NPCs). The design of this dialogue system was inspired by the RPG game genre. The dialogue system incorporation provides players with opportunities to perform varied actions by selecting their dialogue options thereby locating and digesting the information they will retain from the career path they have chosen to obtain knowledge about. The intrinsic content integration adopts a linear and cyclical approach, (Aldrich, 2004, 2005), embedding paths and activities that may or may not impact the gameplay for the player depending on the player's actions. The pedagogical focus of the game is conveyed through dialogue interaction, for example, with NPCs at the beginning of a level or subsequent engagement with NPCs as the player progresses throughout the level. The player is able to retain knowledge formatively whilst navigating the level whilst solidifying their knowledge when their learning is evaluated summatively post completion of the level.



Figure 5: Dialogue System in the Art and Animation Level.

The dialogue system is a primary mechanic that adheres to content integration in the serious game and is used to convey game industry job roles associating details on job roles and skill set requirements for that job position such as hard and soft skills. The importance of the inclusion of the graduate attributes in the game was relevant to make students aware and knowledgeable about the soft skills they will develop through their university experience. In addition to highlighting these generic attributes, it was fundamental to address and illustrate the ones that are specific to various job roles in the games industry. From a game designer perspective, it was important to have a game mechanic that would make these attributes accessible to the player via the gameplay while offering a challenge to increase player engagement. Player collectibles are a common mechanic used widely in AAA games developed within the industry to increase engagement and the time a player spends on a game (Schell, 2020, pp. 231-234). Each of the game's levels, excluding the game studio environment, includes 27 collectibles in relation to generic graduate attributes in addition to ones required to learn about specific game industry job roles. The game mechanic of introducing collectibles to the player had to provide an incentive for the player. To accomplish this via the game mechanics, acquiring these collectibles initiated a levelling up system (e.g., acquiring a certain amount of points via the scoring system). Each of the graduate attributes collected have been assigned a level from 1-4 depending on how many the player collects across all of the four levels. See Figure 6 for the original design plans for the game.

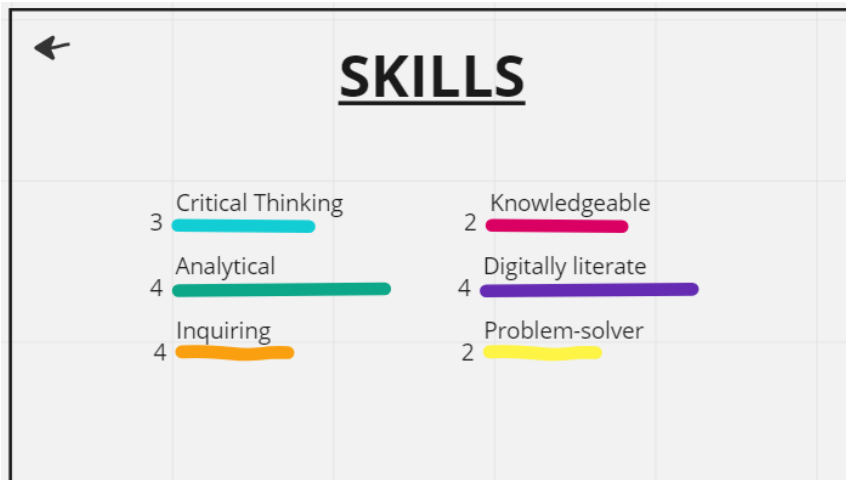


Figure 6: Example of some Graduate Attributes Collectibles (Mock-Up Design).

Assessment Integration

The knowledge retention of the students playing the game had to be concurrently evident during and towards the completion of the various levels. It was important to ensure that there was a clear indication to the player in terms of feedback indicating they have successfully retained the knowledge they have learnt. The game accommodates assessment-based exercises designed to

evaluate whether the player has successfully retained the knowledge acquired from the learning content in the game.

Each level formatively assesses the player predominantly through NPC interaction and quizzes. The aim is to assess the player on the retention of knowledge in the job role that they are learning about associated with the games industry. This occurs at the end of each level thereby catering for summative assessment. These summative assessments will be predominately in the form of a quiz allowing the player to remain immersed in that specific game genre whilst being tested in relation to questions associated with a specific games industry job role.

Figure 7 provides an overview on the quiz methods for each level and Figure 8 highlights an example of assessment integration.

Level	Quiz Method
1 Design	<u>Pads</u> Correct answer – progress to next question. Incorrect answer – fall in pit and start at checkpoint of questions again.
2 Programming	<u>XYZ Axis</u> Move block from starting position to the correct answer using the XYZ axis and frames to help guide.
3 Art & Animation	<u>RPG Boss Fight</u> RPG boss fight (player vs pirate ships) with large enemy health bar and player health bar. Correct answer – enemy health depletes. Incorrect answer – player health depletes.
4 Quality Assurance (QA)	<u>Enemies Shoot</u> (subject to development) Fast-paced enemies with answers to shoot. Correct answer – progress to next question. Incorrect answer – player health depletes/ run out of ammo.

Figure 7: Quiz methods introduced as assessment integration.



Figure 8: Programming, Design and Art and Animation (Work in Progress) Quiz Method Assessment Integration.

Achieving learning outcomes of the game

When undertaking the design and development of the serious game it was relevant to accommodate and incorporate design aspects of fun, engagement, and immersion. The primary aim was to establish core game design theories and techniques with a pedagogical focus of educational theory whilst supporting an aesthetically pleasing, yet familiar environment for the player. The pedagogical theories underpinning the game include problem-based learning, reflection, and intrinsic motivation. The retention of knowledge via the gameplay, mechanics, narrative, and challenge aids to support this pedagogy.

Each initial learning outcome for the serious game are as follows:

- i. Educate and familiarise the player with the basis environment of a AAA games studio.
- ii. Inform the player about the concept of career pathways in the games industry illustrated through the different roles in a games development team.
- iii. Reflect upon the skill sets required to work in the games industry in addition to what skills to improve upon.
- iv. Reinforce learning through content integration in the game in the form of puzzles, quizzes, interactive dialogue, and feedback.

The identified learning outcomes aid towards accommodating the player in the elements of fun, engagement, and immersion. The serious game design methodology approach proposed by Silva (2019), was adopted as a useful development framework for the serious game (see Figure 8). This framework assisted in identifying the salient components of the serious game such as the levels their associated genres, the game's learning aims and objectives and how the learning outcomes would be met. This would allow informative gameplay approaches to be made and players of the game to reflect on the skill sets required to work within job roles of the game industry. Players' knowledge retention is assessed through the unique quiz designs through summative assessments per level of the game.

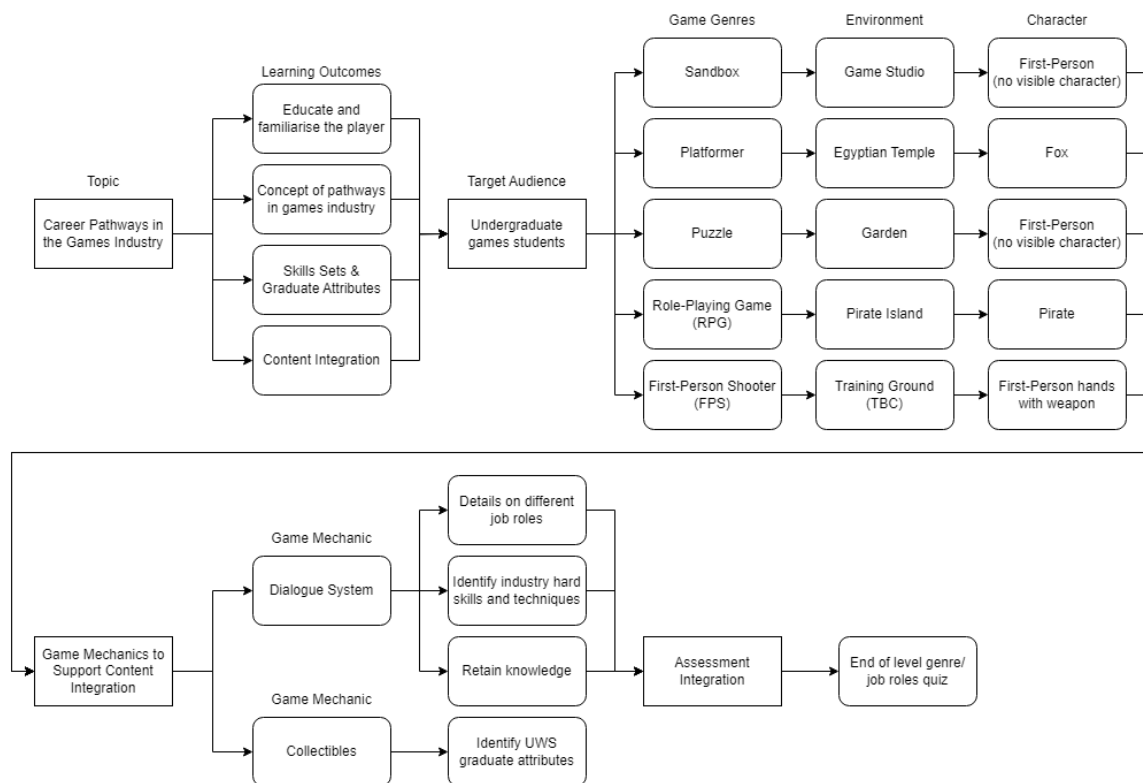


Figure 8: Main steps in defining the aims, gameplay, mechanics and learning activities of the serious game. Adapted from Silva (2019).

6. Conclusion and future developments for the game

This paper has presented the design and development of a serious game to educate and inform computer game development students about the career pathways in the games industry. The game accommodates and embeds elements of fun, engagement, and immersion, while establishing key game design and pedagogical elements to aid student learning. The serious game is designed to propose a solution to educate and inform students in the games industry about what job role they might want to engage in post their degree and thereby reduce the dilemma some students may face when choosing such a career path. Future directions for this game could be adapted to other disciplines outside of the games industry as an adaptive serious game platform to assist in potential career pathways in other career disciplines such as nursing and midwifery. At the time of writing this paper, the development of the serious game is still ongoing, with the central HUB (Game Studio) and the Quality Assurance (FPS) level yet to be completed.

The serious game will be further evaluated and given to potential games development students during forthcoming academic terms to assess whether the gameplay and mechanics contribute towards guiding and informing game development students in reflecting upon and choosing a career pathway in the industry. This will be evaluated upon first to final year undergraduate students studying computer games development through a series of live gameplay sessions with feedback to the game digested and interpreted through a mixed methods questionnaire. Initial evaluation has however been performed for earlier levels of the serious game by game development students from year one and two, using mixed methods post questionnaires. The evaluation and ongoing results are currently being analysed, with comments for feedback being taken into consideration for the continued enhanced development of the game.

The current serious game is not available due to ongoing development though in the future, will be made available to other game development programmes run at other academic institutions for continued evaluation prior to final release.

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