DESIGN AND ESTABLISHMENT OF A PRE-DEVELOPMENT SERIOUS GAMES VALIDATION FRAMEWORK

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SULTAN IDRIS EDUCATION UNIVERSITY

2021

DESIGN AND ESTABLISHMENT OF A PRE-DEVELOPMENT SERIOUS GAMES VALIDATION FRAMEWORK

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THESIS SUBMITTED IN FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF DOCTOR OF PHILOSOPHY
(GAME BASED LEARNING)

FACULTY OF ART, COMPUTING AND CREATIVE INDUSTRY
SULTAN IDRIS EDUCATION UNIVERSITY

2021

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ACKNOWLEDGEMENT

Firstly, I would like to express my sincere gratitude to my supervisor, Associate Professor Ts. Dr. Tan Wee Hoe for his continuous support throughout my PhD studies. His patience, motivation, immense knowledge and guidance helped me through my research and writing of this thesis. I cannot imagine having a better mentor for my PhD studies. I would also like to extend my gratitude to my friends and staff in the Faculty of Art, Computing and Creative Industry and the Institute of Graduate Studies at Sultan Idris Education University for supporting me while I conducted this research. Also, my utmost appreciation to my current and former Deputy Vice-Chancellors, Prof Dr. Hon Wei Min and Dr Tan Hui Leng who both encouraged and helped me along on this journey. To my colleagues in UOW Malaysia KDU, thank you for your encouragement and advice especially Dr Wong Yoke Seng. I am also grateful to my family members and friends who have supported me along the way. Specifically, to my darling wife Jean Liew, who remained steadfast by my side and motivated me up when the going got tough. To my two lovely daughters, Faith and Hope, who bring me such joy and always inspire me to do better. To my sister, who has always been my inspiration. And finally, last but by no means least, to both of my life-coaches, my parents - I owe it all to you. You have provided me with priceless moral and emotional support my whole life. I dedicate my PhD to the both of you.

ABSTRACT

The primary goal of this thesis is to design and establish a pre-development validation framework in the knowledge domain of serious games (SG). SG are specially designed video game systems with a primary purpose other than entertainment. Existing SG frameworks have neglected to account for a detailed method and relationship between the game design elements and its process. Hence, the SG Community is currently still lacking comprehensive best practices for SG design in the pre-development stage. To achieve the research objectives, a mixed methods research design was implemented, consisting of exploratory, confirmatory, and explanatory phases. The exploratory and explanatory phases utilized a series of semi-structured interviews with six prominent game design practitioners using a SG design theoretical framework. The SG Design theoretical framework is intended to test the areas of game design and its contribution to an immersive and engaging SG. 30 hypothetical propositions were generated based on the exploratory phase findings and were used to develop a quantitative research instrument. 145 game designers participated in the confirmatory stage to affirm or refute the results of the exploratory stage. The explanatory phase was conducted to seek an in-depth understanding of the results in the explanatory and confirmatory phases. The findings indicated ten core game design elements consisting of user experience, energy, tension, focus, creativity, core mechanics, game goals, outcomes, feedback and game rules arranged in a procedural manner. In conclusion, video games and serious games share a similar game design process and the ten core elements indicated in the findings formed three distinct layers signifying that process flow resulting in the Rules of Immersion and Player Emotion Game Design Model for SG. The implication of this research suggests that this model can serve as a guiding principle framework for game designers to use in the preliminary stages of SG development.

REKA BENTUK DAN PENGUKUHAN KERANGKA PENGESAHAN PRA-PEMBANGUNAN PERMAINAN SERIUS

ABSTRAK

Matlamat utama kajian ini adalah untuk mereka bentuk dan menubuhkan kerangka pengesahan pra-pembangunan dalam domain pengetahuan permainan serius. Permainan serius adalah sistem permainan video yang direka khas dengan tujuan utamanya adalah sebagai selain hiburan. Kerangka permainan serius sedia ada telah mengabaikan untuk mengambil kira kaedah terperinci dan hubungan antara elemen reka bentuk permainan dengan prosesnya. Oleh itu, komuniti permainan serius pada masa ini masih kekurangan amalan komprehensif terbaik untuk reka bentuk permainan serius pada peringkat pra-pembangunan. Bagi mencapai objektif kajian ini, kaedah kajian secara campuran telah digunakan, yang terdiri daripada fasa penerokaan, pengesahan dan penjelasan. Fasa penerokaan dan penjelasan telah menggunakan satu siri temu bual separa berstruktur dengan enam orang pengamal reka bentuk permainan terkemuka menggunakan rangka teori reka bentuk permainan serius. Rangka teori reka bentuk permainan serius adalah bertujuan untuk menguji bidang reka bentuk permainan dan bagaimana ianya dapat menyumbang kepada permainan serius yang menarik. Sebanyak 30 cadangan hipotesis telah dirangka berdasarkan dapatan dalam fasa penerokaan dan telah digunakan untuk membangunkan instrumen kajian kuantitatif. Seramai 145 pengamal reka bentuk permainan menjadi responden pada fasa pengesahan bagi menerima atau menolak hasil dapatan dalam fasa penerokaan. Fasa penjelasan telah dilaksanakan bagi mendapatkan kefahaman mendalam terhadap hasil fasa penerokaan dan fasa pengesahan. Hasil dapatan menunjukkan sebanyak sepuluh elemen asas reka bentuk permainan yang terdiri daripada pengalaman pengguna, tenaga, ketegangan, fokus, kreativiti, mekanik asas, matlamat permainan, hasil, maklumbalas dan peraturan permainan disusun dalam bentuk prosedur. Kesimpulannya, permainan video dan permainan serius berkongsi proses reka bentuk permainan yang sama dan sepuluh elemen asas dalam dapatan membentuk tiga peringkat yang membuktikan aliran proses adalah berdasarkan Peraturan Penglibatan dan Model Reka Bentuk Permainan Emosi Pemain untuk permainan serius. Implikasi daripada kajian ini mencadangkan model ini berfungsi sebagai rangka panduan prinsip untuk pereka permainan yang digunakan dalam peringkat awal pembangunan permainan serius.

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LIST OF ABBREVIATIONS

PGD	Persuasive Game Design
DPE	Design, Play, and Experience Framework
LM-GM	Learning Mechanics and Game Mechanics Model
HEP	Heuristics for Playability
KLCEL	Kolb and Lewinian Cycle of Experiential Learning
MDA	Mechanics, Dynamics, Aesthetics Framework
GOM	Game Object Model
SDLC	Software Development Life Cycles
GDLC	Game Development Lifecycle
SGDTF	Serious Game Design Theoretical Framework
RIPE	Rules of Immersion and Player Emotion Game Design Model for Serious Games
IGDA	International Game Developers' Association
MDEC	Malaysia Digital Economy Corporation
PX	Player Experience
SG	Serious Games
UX	User Experience

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CHAPTER 1

INTRODUCTION

1.1 Overview

Technology has progressed enormously in the last few decades, and society is witnessing the progression of technology in every field imaginable. The serious games sector is no exception to this, as technology is now shaping how educators approach the concept of teaching and learning and their understanding of serious games tools. Much of it is a result of the current generation termed as the gen-z and the gen-alphas growing up exposed to possibly a very pervasive digital technology condition, and its ubiquitous and invasive nature. Prensky (2001), writes that this digitally connected generation's minds have plainly been 'rewired' predominantly in how they view and adapt to learning. This new generation of learners, according to Prensky, are termed as the "digital native'. Digital natives are now the fluent speakers in the new language of

the digital world which includes computers, digital entertainment, smartphones, and its applications, and generally everything related to the internet of things. These digital natives are extremely fast paced, visually stimulated and learn best by doing, and this had led to the need to find new structures for learning and engaging them. The study in video games has now emerged as a new concept on the application of digital platforms that designed to motivate and engage these technologically inclined generation of learners. Thus, the implementation of serious games is fast becoming more prevalent thanks to video games, arguably one of the most significant contributors of technology in modern digital entertainment. In short, video games possess an innate ability to engage consumers or players in a highly immersive entertainment bubble. It is this engagement that has sparked an interest in serious games research as many scholars believe that video games may be able to afford a deliberate method to channel and utilize the ideology of play and entertainment into systemic education.

While much research has suggested that well-designed games are effective for learning, the biggest question is how to design effective serious games. According to Braad, Žavcer, and Sandovar (2016), the argument is that while games might prove to be an effective learning tool, not all types of video games can be used effectively for this purpose. Therefore, the development of any serious game should involve elements of existing commercial game design practices. Combined with the understanding of content development and learning assessment methods, the development for a successful serious game would be achievable. Many researchers acknowledge that studies into the understanding of game design for educational intent is still largely in the stages of infancy (Gaydos, 2015). This is considered a crucial aspect any commercial game development process as the complete understanding of elements of

game design is critical to a game's success. Becker (2007) argues that video games embody many worthwhile learning theories, as the reason for why these games are so engaging because games have the potential to intrinsically teach players in a method which suits them best. According to Gee (2005), all video games have an intrinsic element of learning embedded in its entertainment aspect. Players learn the game to improve or reach a certain milestone. He raises this question, "How do game designers manage to get new players to learn their long, complex, and difficult games?" He states that effective video games are intended to explicitly trigger learning which is the reason that makes games so engaging. Regardless of whether the intrinsic learning is intentional or not, game designers must constantly figure out the best methods to keep their players interested (Becker, 2007; Gee, 2005), mostly through the application of game design elements.

Developers of serious games should learn from the commercial video games industry because serious games design should synergise game design practices and learning. According to Gaydos (2015), there is a need to develop more established and comprehensive guidelines in the serious games field as well as an understanding between serious games and commercial video games. As Becker (2009) states, the number of designers and studios from the commercial game development industry who are interested to design serious games are limited, thus there is a need to fill the gap by either training more dedicated serious game designers or providing a guiding principle for these designers to follow.

Thus, this research aims to identify elements of game design that make video games so motivating and engaging; and create a model on how to apply these elements in serious games. The aim is then to use the model as a set of guiding principles within a validation framework for serious games. Understanding the process of game design is an initial step in any game development which deals with the conceptual aspects of the entire game production process. Game design processes generally differ from genre to genre; and from studio to studio but there are certain key characteristics that these processes have in common, mechanics, core concepts, aesthetics, characters, levels, and narratives. These are all considered as the essential elements within the game design process.

1.2 Research Background

The contrast between leisure and learning has been the focal point of heightened debate in the background of learning technology. While interest in serious games has been gaining attention in the last few years, there is still currently a lack of instruments to actually verify that readily available serious games are genuinely a more effective educational tool as compared with traditional classroom teaching. Aside from that, there is a scarcity of practical and appropriate frameworks for the evaluation of effective serious games (Abdellatif, McCollum, & McMullan, 2018). There is also an indication of the absence of guiding principles for the design of serious games in the field of learning (Linehan, Kirman, Lawson, & Chan, 2011; Mestadi, Nafil, Touahni, & Messoussi, 2018; Shi & Shih, 2015). Furthermore, according to Vlachopoulos and Makri (2017), there is also no formal guidelines or policy frameworks that has been

recommended by most, if not all governments on serious games implementation in their countries. The responsibility of the application of such methods are the prerogative of the individual learning institutions. Linehan et al. (2011) states that while there is a general agreement that serious games could have a substantial importance as an educational learning tool, the irony is that there are surprisingly, lack of concrete and scientifically validated approaches on how to develop such effective serious games. To build an effective and successful serious game, the first step is understanding the required the process in the design and development of a conventional video game. According to Shi and Shih (2015), many serious games have failed their intended purpose attributable to the incompatibility of the educational content and elements of game design application.

While there are certain forms of validation conducted in the wider spectrum of serious games - based on several papers and meta-analyses done on empirical evidence on serious games effectiveness, it would indicate or suggest that most evaluation or validation were administered at a post-development stage (Clark, Tanner-Smith, & Killingsworth, 2016; Connolly, Boyle, MacArthur, Hainey, & Boyle, 2012; Wouters, Van Nimwegen, Van Oostendorp, & Van Der Spek, 2013). The utilization of various quasi-experimental studies especially randomized control trials which are approaches appropriate for assessing a causal relationship between product and its effect is evident of this. There is still lacking at the time of this research, a validation framework for serious games that not only serves as a guideline in the process to design successful serious games but also the potential to function as a tool to evaluate its effectiveness. Thus, a validation framework that is aimed at the pre-development game design phase would provide some degree of control that would help the serious game developers

recognise and utilize the right game design mechanisms. The aim of this research is to study the immersive and engaging factors in the development of serious games with the intent to produce a validation framework that would serve both as a guiding principle as well as to eventually gauge the effectiveness of a serious game.

1.3 Problem Statement

According to Rai and Boo (2020), at each stage of serious game (SG) design and development, there must be a process of validation before the serious game can be made available. Serious game developers who intend to market their serious games to the various consumers must be able to articulate convincing evidence of the game's ability to achieve the intended outcomes, which in this case is training or learning (Rai & Boo, 2020). In the absence of a regulatory framework, developers should use a variation of framework or approaches to develop their serious games (Verschueren, Buffel, & Vander Stichele, 2019). This would not only significantly increase the SG probability of success but would also provide the necessary evidence required by stakeholders and enhance the credibility of SG developers (Verschueren et al., 2019). According to Verschueren et al (2019), if this is not thoroughly conducted, the resulting games are bound to be ineffective. In an article, Lee (2017) states that engagement is a core element in a successful serious game. Serious games have a clear and achievable objective that provide internal motivation to the players and if that is inherently missing, the educational game or serious game will fail to achieve its objectives.

Based on the Mindbytes Evidence-based Serious Games Validation Model, there are six stages in serious game development (Verschueren et al., 2019). Each stage has a specific focus and requires a form of validation to ensure that the process is sound. Several iterations of development may occur within a given stage, to refine the serious game. One of the stages is the design foundation which covers the area of game design including game mechanics, UX, gameplay and player experience. This allows for the successful transference of the content into relevant, implementable game design elements. Hence, a framework that focuses on this aspect of serious games is highly needed (Verschueren et al., 2019).

According to Tan and Zary (2019), there is a gap in research in regard to a consistent and definitive standard game design framework to serve as a guideline and basis of serious games evaluation. The apparent lack of tools is detrimental to serious game design pathways that are looking to enhance learner engagement and quality of learning through serious games. These tools once implemented would enable the serious game community to adopt a set of guiding principles and a benchmark for good practices in the design of serious games. Ávila-Pesántez, Rivera and Alban (2017) and Slimani, Yedri, Elouaai, and Bouhorma (2016) also stated that despite the abundance of research on game design, there is very little studies on the methods of designing effective serious games. Even within the game development industry, there has not been a standard game development method, guideline, or a set of best practices for pre-production stages of commercial games (Colby & Colby, 2019; Ghulamani, Shah, & Khowaja, 2020; Lamminmäki, 2017; Marklund, Engström, Hellkvist, & Backlund, 2019; Mestadi et al., 2018). This highlights three major problems: (i) a lack of understanding of how to utilize the principles of game design to create engaging serious

game content, (ii) a lack of a pre-development validation serious game framework that can offer guiding principles for local serious game designers to refer to, (iii) an absence of required information in the process essential to align serious games design with game design for a positive play experience.

1.4 Purpose of the Study

According to a 2017 market intelligence report (Newzoo, 2017), Malaysia is ranked 21st in the top 100 countries by game revenue and recorded an export revenue of RM1.17 billion from the outsourcing of video game and animation development (MATRADE, 2017) up from RM836.77 million in 2014. While Malaysia is fast becoming a strong contender within the South East Asian Game Development hub for the outsourcing and in-sourcing of digital content predominantly for entertainment-based video games, there is a growing movement to venture in other areas of video games; namely in serious games (SG).

According to market research, the worldwide market in serious games is estimated to achieve USD9.1 billion by 2023, growing at a rate of 19.2% within the next five years (Allied Market Research, 2017). In his 2016 New Year's speech, the Malaysian Minister of Higher Education (MOE), (Jusoh, 2016) advised all parties involved to pay close attention to this as it could be a lucrative form of revenue for this nation. The minister also added that an initiative should be formed to build up this growing industry for teaching and learning amongst Malaysian students. Malaysia Game Development Initiative or MYGAMEDEV is the 14th entry point project

(EPP14) under the National Key Economic Area (NKEA) for Education that was tasked with creating awareness and developing talents for the Malaysian game development ecosystem. This cluster, a strategic collaboration between institutes of higher learning that offers game development programmes, the game development industry and the various government agencies tasked with a similar mandate; reports to MOE and has included the growth and establishment of the Malaysian serious games ecosystem as part of its responsibilities, in line with the education ministry's aspirations and advice.

MYGAMEDEV is now collaborating with Universiti Pendidikan Sultan Idris (UPSI) and the Serious Games Association Asia to conceptualize a virtual marketplace concept for the aggregation of serious games content. UPSI is the ideal collaboration partner for MYGAMEDEV, as they are synonymous with education, educational content and teacher training; and are at the forefront of teaching and learning practices including serious games. This is highly crucial as this proposed marketplace concept must act as a one-stop self-contained ecosystem – which would include a network of content curators or validation experts, education experts, content experts and game developers. This virtual marketplace ecosystem would bring together relevant experts within their fields that would be responsible for the entire pipeline process of producing serious games in Malaysia from conceptualization to commercialization and would hopefully be endorsed by the respective governmental agencies or bodies.

One of the areas contained within this ecosystem is a curation framework that encompasses both the validation and evaluation of content at various stages – from conceptualization (design), right up to the marketplace (deployment). This study aims to conceptualize a pre-development validation framework that would conform in a

larger picture of the Malaysian serious games curation framework and offer an eventual set of guiding principles that could be referred to by game designers, a necessary but currently missing element as stated by Mestadi et al (2018) and Westera (2019). Hence, this research is aimed at creating an understanding of the factors for successful and engaging commercial video games and how those factors may be applied into serious games. The research is also aimed at understanding the required processes to create an overall positive play experience in serious games. This is process is required to produce a pre-development validation framework acting as a guiding principle for local serious game designers to establish that the serious games developed are effectively designed to motivate and engage its users. It is with this holistic serious games marketplace concept and a pre-development framework put into place, that the Malaysian serious games community can move towards achieving the education ministry's goal to have Malaysia not only at the forefront of educational technology and progressive learning practices but be the leader in South East Asia for serious games – all these possible through a set of guiding practices and related instruments to guide our Malaysian serious game developers.

1.5 Research Objectives

The aim of this research is to study the immersive and engaging factors in the development of serious games with the intent to produce a validation framework that would serve both as a guiding principle as well as to eventually gauge the effectiveness of a serious game. To achieve this goal, it was essential to understand elements of game design and the application of the engaging and immersive factors from commercial

video games to serious games. This in turn would require a comprehensive literature review to connect the dots between learning and game design practices as outlined by Westera (2019) and Gaydos (2015). The literature review and subsequent studies was to further understand and resolve if there exist variations of practice between the commercial video game pre-development processes and the serious game pre-development processes. However, the study focused primarily on the game design elements of the proposed pre-development validation framework. This thesis has achieved the following objectives:

i. To identify game design elements for a pre-development serious game validation framework.

ii. To compare the variations of game design process between commercial video games and serious games development that affects the design of a pre-development validation framework.

iii. To develop a pre-development validation framework that offers a set of guiding principles for game designers to design engaging and motivating serious games.

To achieve the above-mentioned objectives, several research designs were considered, and the mixed methods design was chosen eventually to suit the context and constraints of this research (see Chapter 3, Section 3.2, p. 110).

1.6 Research Questions

There is a need for a better understanding of existing practices and approach in the design and development of a serious game validation framework especially in the game design aspect of serious games (Silva, 2020). The following are the research questions that needs to be focused on:

i. What are the typical game design elements for a serious game that can be validated at a pre-development stage?

ii. What are the differences in the entire game design process between commercial video games and serious games that can affect the design of a validation tool for serious games at a pre-development stage?

iii. How will the entire process flow of a pre-development game design stage for serious games resemble?

1.7 Hypothetical Propositions

Hypothetical propositions (HP), either argumentative or analytical by nature, are the thesis statements held in this research. In this research, the hypothetical propositions were characterized as statements that expresses opinions constructed through the findings in the exploratory studies. As a result, each item of the response category in the questionnaire design was in fact a finding from the exploratory phase. The list of the 30 pairs of HPs were developed based on findings revealed in an exploratory study

of this PhD research, consisting of interviews with prominent game designers (see Chapter 4, section 4.2.10, p.184). 20 of the hypothetical propositions served to answer the following research questions – (RQ1) what are the typical game design elements for a serious game that can be validated at a pre-development stage? While another 10 was used to answer the third research question (RQ3) - How will the entire process flow of a pre-development game design stage for serious games resemble?. The answers to these two research questions would then assist in the solution to the following problem statements - a lack of understanding of how to utilize the principles of game design to create engaging serious game content; and an absence of required information in the process essential to align serious games design with game design for a positive play experience.

The purpose of these HPs in this research is also to affirm or refute the findings of the exploratory study. The findings were sub-divided into four categories: the attributes of the essential factors in the process of game design as perceived by game practitioners which generated five HPs; the attributes of common practices in the game design process as perceived by game practitioners which generated eleven HPs; general statements linked to the core layer of the theoretical framework – serious game model as perceived by game practitioners which generated five HPs and the attributes to achieve good game balance in gameplay as perceived by game practitioners which generated eight HPs. All thirty pairs of the propositions were converted into thirty responses in three categories with which statistical findings in the confirmatory stages are expected to reveal if the related game design respondents confirm of refute the findings. The hypothetical propositions of this research are listed as such:

HP1: The selection of a game's target markets (feasibility studies) is regarded as an essential factor in the preliminary stage of game design.

HP2: The identification of a game's business model is regarded as an essential factor in the preliminary stage of game design.

HP3: The identification of a clear storyline is regarded as an essential factor in the preliminary stage of game design.

HP4: The identification of the overall game theme is regarded as an essential factor in the preliminary stage of game design.

HP5: The identification of the game genre is regarded as an essential factor in the preliminary stage of game design.

HP6: The identification of the game's user experience flow is regarded as an essential factor in the preliminary stage of game design.

HP7: The identification of the game's objective is regarded as an essential factor in the preliminary stage of game design.

HP8: The game's requirement settings are regarded as an essential factor in the preliminary stage of game design.

HP9: The conceptual model of the game is regarded as an essential factor in the preliminary stage of game design.

HP10: The creation of a concept art book for visualization purposes is regarded as an essential factor in the preliminary stage of game design.

HP11: Clearly defined game rules are required to achieve good game balance in gameplay.

HP12: Clearly defined player goals are required to achieve good game balance in gameplay.

HP13: Clear game objectives are required to achieve good game balance in gameplay.

HP14: A feedback mechanism is required to achieve good game balance in gameplay.

HP15: Consideration on potential user interface is required to achieve good game balance in gameplay.

HP16: Game Interaction is required to achieve good game balance in gameplay.

HP17: Conflict, competition, challenge, and opposition is required to achieve good game balance in gameplay.

HP18: Core game mechanics are required to achieve good game balance in gameplay.

HP19: Player representation is required to achieve good game balance in gameplay.

HP20: Clear player outcomes are required to achieve good game balance in gameplay.

HP21: The storyline of the game is considered an important element to engage players in digital games.

HP22: The originality of the game is considered an important element to engage players in digital games.

HP23: The build-up of the game is considered an important element to engage players in digital games.

HP24: The movement, momentum and pacing of the game is considered an important element to engage players in digital games.

HP25: The depth and richness (character) of the game of the game is considered an important element to engage players in digital games.

HP26: The balance of the game is considered an important element to engage players in digital games.

HP27: A good use of core game mechanics is considered an important element to engage players in digital games.

HP28: Clear elements that provides a player with something to strive towards is considered an important element to engage players in digital games.

HP29: Game flow is considered an important element to engage players in digital games.

HP30: A vibrant visual element is an important element to engage players in digital games.

1.8 Theoretical Framework

In the literature review (Chapter 2, p.33), this research identified three core references that establishes the theoretical framework for this research (Chapter 2, section 2.3, p. 41). In terms of theories that forms the backbone of this theoretical framework, these are mostly theories grounded on the experience of industry practice. Theories developed through academic empirical studies can be considered as abstracted practice, while the theories based on industry practice and experience is applied theory (Haddad, 2019). These two concepts form a juxtaposition in that a theory is meant to eventually become practice, while a practice can eventually become a theory. The theory of fun as presented by Raph Koster, a 26-year game design legend (Sinclair, 2019) who worked on Everquest and Ultima Online is one such practice-based theory. Koster's book became a major reference point for game designers while universities with game design programmes adopted his theories as part of their curriculum (Rigney, 2013). The core concept of the theory of fun is that– that learning, and fun can be synonymous. According to Koster (2013), games present us with models of real things which are highly abstract. He went on to add that if games are essentially a model of reality, then the things that games teaches must reflect on reality. It is this reality which is considered a learning experience. According to Koster (2013), "[Games]… primarily teach us things that we can absorb into the unconscious, as opposed to things designed to be tackled by the conscious, logical mind.". Another theory presented in the research is based off the book by Rouse III (2004), game design: theory and practice, which focuses on the elements of gameplay. In the book, it states that game designers develop games that that either facilitates the interaction between other players or between a single person and the system. How the player interacts is dependent on the elements of

gameplay. Again, the author is a practicing game design industry veteran. Based on these two theories, the research was then grounded on the persuasive game design (PGD) approach which describes the principles of how video games influence behavioural changes on players (Visch, Vegt, Anderiesen, & Van der Kooij, 2013). PGD proposes the use of elements of gameplay such as motivation, engagement, outcome, immersion, feedback, and challenges (Rouse III, 2004) to create a digital environment for players that could assist in real-world behavioural changes (Siriaraya, Visch, van Dooren, & Spijkerman, 2018; van Dooren, Visch, & Spijkerman, 2019). The second core reference – the Enhanced Design, Play, and Experience (DPE) framework reflects the entire gameplay experience and how the player can be immersed into a serious game (Ghulamani et al, 2020; Winn, 2008). The three prominent layers in the enhanced DPE framework are storyline, gameplay, and user experience. Lastly, the Learning Mechanics and Game Mechanics (LM-GM) model showed that game mechanics can be aligned to learning mechanics (Slimani, Yedri, Elouaai, & Bouhorma, 2016). This supports the PGD theory in how the virtual world can affect real world behaviours (Koster, 2013). As Chance (1979) puts it, “learning is a change in behaviour that is due to experience”. Figure 1.1 shows the alignment between all three framework and models to the establishment of this research’s theoretical framework. When all these three are put together, they share a common goal of motivation, engagement, and immersion in serious games.

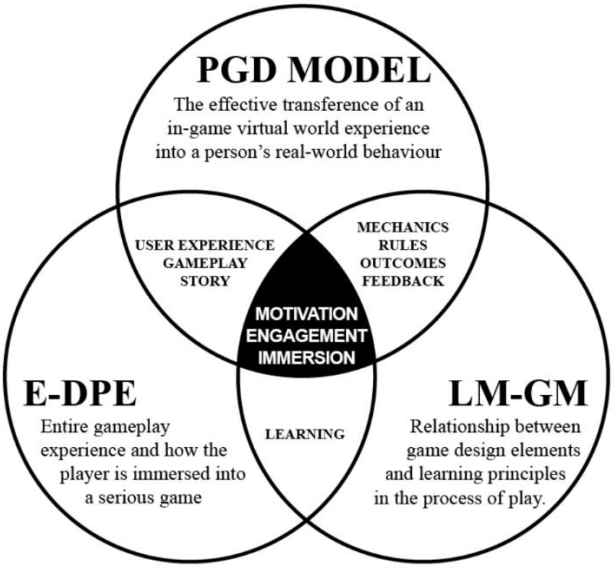

Figure 1.1. Research Alignment of existing theories, framework and model.

The theoretical framework is intended to provide an opportunity for the research to test on what areas of game design contributes to an immersive and engaging serious game. As stated in both the research objectives and research questions, this would be the primary focus and emphasis of the pre-development validation framework. Tan, Wong, Lim, and Chong (2014) wrote that the concept of video games can be broken down into three fundamental elements; (i) positive player engagement for sustained play, (ii) thematic and/or aesthetic propagation; and (iii) positive player understanding of game rules to operate and fulfil game task conditions. All three elements listed are deemed as necessary for the development of an engaging video game. In the literature review, the research stated that there are six key structural elements to games – rules, goals and objectives; the areas of conflict, competition, challenge and opposition; interaction; outcomes and feedback; and representation as conceptualized by Prensky (2001). Prensky (2001) also listed another six elements "found in every successful game throughout history" - balance, creativity, focus, character, tension, and energy. The

combination of the six key structural elements, the elements present in successful video games and the three fundamental elements formed a quintessential game design process in game development. The theoretical framework which was also published in a book chapter (Tan, 2019) are split into three layers signifying the pre-development process and aimed at promoting motivation, engagement, and immersion in serious games.

At the foundation of the theoretical framework, lies representation, which could be either in the form of an abstract or concrete statement; or direct or indirect (Prensky, 2001). Being a broad-based term, representation itself could imply a story or narrative. The term could also imply an abstract game concept with perhaps very minimal or no narrative structure at all. Representation can be considered the core concept and the main idea of the game. According to Winn (2009), representation through the element of storytelling could be used to set the stage for the game and to provide the player with purpose and engagement. It could also be used to convey the content of the game.

The middle layer consists of the core structure of the game, namely – the rules, goals, outcomes, and feedback. Prensky (2001) states that the function of rules is to impose limits. This forces the players to seek to attain their goals through a specified path or method that will ensure all players fall under a similar gameplay boundary. Apart from rules, there are goals which within a game context, creates a basis for player motivation. Goals are what players would measure themselves against (Prensky, 2001). One of the last elements are outcomes and feedback which looks at how the player can measure their progress against the game's goals. According to Prensky (2001), this creates a very strong emotional and maybe even ego-gratification implication. This is

one of the more important elements leading up to the engagement and immersion of games. Feedback, the last element in this layer is a method for the game to respond to the players' in-game actions. This would let the player know if there are any positive or negative impacts for each one of the players actions and it can manifest or be represented through visual or aural cues, in the form of a numerical score or a tactile method.

When the core elements of rules, goals and outcomes are in tandem, then what occurs is termed as game balance (Stout, 2018; Squire, 2003). Coherence would be another apt term that game designers use to describe how all the individual elements in games function in harmony or in tandem. A coherent gameplay leads to an overall positive player experience and maintaining the level of conflict, competition, challenges, and opposition with the players progress in terms of acquired skill or actual in-game progress contributes to the overall enjoyment of the game experience. This positive game experience is primary motivation for play. One of the factors in achieving a coherent gameplay is game mechanics consisting of core and secondary mechanics and the mastery of these game mechanics adds to the overall satisfaction and the enjoyment of the game as Starks (2014) and Koster (2013) mentioned. As mentioned in the literature review, Stout (2018) stated that good game mechanics will enable the player to 'repeatedly display their proficiency' of a game mechanic or a combination of game mechanics.

The outer layers of the model could be construed as the engagement factor of video games. This comprises of core elements that makes up a successful game. The core elements are what Prensky terms as fun' process of a video game (Prensky, 2001) and are broken down into five individual elements - creativity, focus, character, tension and energy. This core element makes up the very fundamental element of video games which is positive player engagement for sustained play. This is the element that is critical to the development of an engaging and effective serious game. The complete theoretical framework of all those listed layers and elements is shown in Figure 1.2. The intent of this research is to test all the elements and stages of the Serious Game Design - theoretical framework to see if the processes and the elements proposed can be used to offer a set of guiding principles in a pre-development validation framework for serious games.

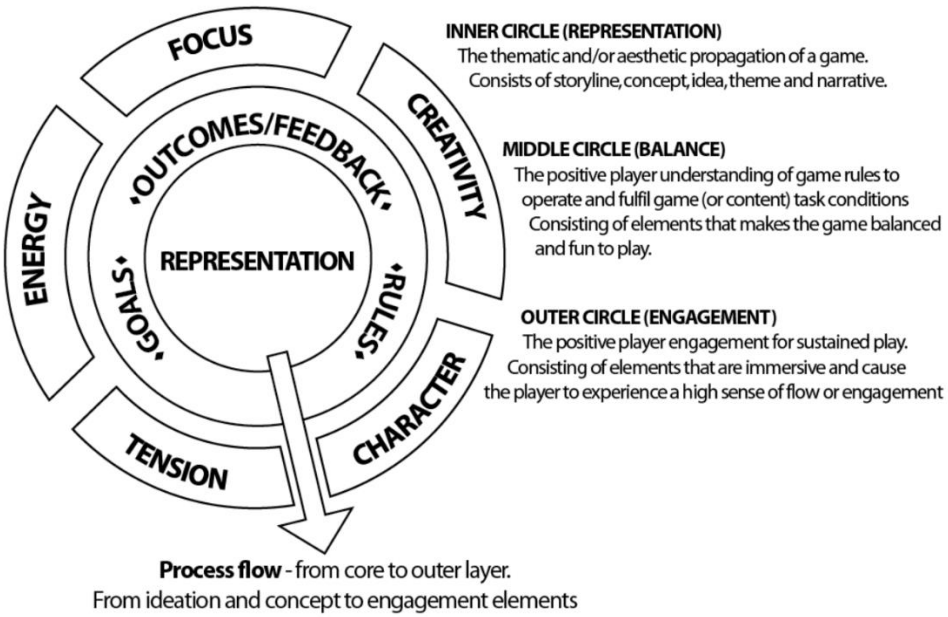

Figure 1.2. Serious Game Design - Theoretical Framework

1.9 Importance of the Research

The comprehension of the workings of learning; and how the principles of game design enhance immersion in learning application like serious games is a key area of this research. The creation of a serious game pre-development framework that identifies the practical aspects of game design and provides a guideline for serious game developers is a key objective for this research. McTigue and Uppstad (2019) implied that one of the key challenges in the preliminary development stages of serious games is the appropriate fusion of learning and fun elements. According to them, while serious games may be entertaining, the ultimate goal is not goal is not for entertainment but that the entertainment aspects enhance the learning goals. Tang and Hanneghan (2014) went on to state that there exists a need to create a holistic approach in the methodology of game design for serious games. The foremost reason that makes this study so crucial is the notion that serious game content has the positive capability to enable Malaysians students to gain valuable knowledge through serious games (Zin, Jaafar, & Yue, 2009). This fact is one of the reasons why the Malaysian education system is exploring the implementation of using serious games as progressive learning practices in the near future. However, despite the abundance of publications and books about game design, there is very little studies on the methods of designing effective serious games (Ávila-Pesántez, Rivera, & Alban, 2017; Slimani, et al., 2016). However, there are some game design guidelines and frameworks that has been proposed but these guidelines are for the application of a game solely used for entertainment-based games (Tan et al., 2007). Moreover, in regards to the game development industry, at the time of this study, there has not been a standard game development method, guideline or a set of best practices for pre-production stages of commercial games (Colby & Colby, 2019; Haltsonen,

2015; Lamminmäki, 2017; Marklund et al, 2019; Mestadi et al., 2018). According to Becker (2009), the need to understand the application of game design principles and the appraisal of the following principles in the development of serious games is one of the biggest challenges that requires solving.

The outcome of this research will address the need for a serious game pre-development process by designing a framework that will not only act as a guiding principle for serious game developers but also assists in the identification of game design elements in various successful and engaging commercial video games for the application in serious game development. This outcome of this study also investigates and analyses the current local industry practices regarding the pre-development process of commercial and serious games particularly in the area of game design; and provides a viewpoint into the core components of serious games – the elements of game design. This will afford Malaysian game designers within the local serious game spectrum with understanding of the process and steps required to develop engaging and motivating serious games for educational purposes.

1.10 Research Scope and Limitation

The identified limitations and research scope from literature reviews and the various game industry market research presented in this research shaped the foundation of this study. The following are the list of the research scope and its limitations:

i. The pre-development validation framework proposed in this research only covers the game design elements and process aspects.

ii. The confirmatory study group consists Malaysian or non-Malaysians working in local Studios or be Malaysians working in South East Asia. The following conditions also applies:

- Graduates from game design programmes who are presently in the employ of game development studios as game designers.

- Game designers who are not formally trained as game designers but have at least five years of game design experience; and are presently working in this capacity.

- Game developers who are also working in the capacity as producers or early stage/conceptual game designers.

iii. The validation framework only covers the pre-development aspects of the entire game development lifecycle.

iv. The study will only cover the literature review on learning theories in relation to understanding the cohesion between those elements and game design principles. It will not study in-depth and implement the evaluation and application of those elements in the validation framework.

This research will focus on the conception of a pre-development validation framework, acting as a set of guiding principles and benchmark for good practices in the development process of serious games with the focus on the game design aspects. While the business of integrating pedagogy knowledge to s serious game with content and technology validation is a critical component for the development of serious games; this study acknowledges that there could be challenges primarily for teachers in the integration of serious games within a normal or traditional classroom environment, and thus, the framework itself would not cover this aspect. Similarly, the research into this framework would not cover the development and post-development validation aspects but this would be an area of future studies and one that has significant importance in an overarching serious game ecosystem. The research will also discuss learning theories in Chapter 2, section 2.4 but will not involve these elements into the final framework as the aim of this research was to study the immersive and engaging factors in the development of serious games. The intent is to produce a validation framework that would serve both as a guiding principle as well as to eventually gauge the effectiveness of a serious game. Hence, the research will primarily delve into the game design aspects in the development of engaging and immersive educational games.

One of the research limitations are the number of specialized game design practitioners in Malaysia and South East Asia for data-gathering purposes. In this, the research would also consider general game developers who delves into some aspects of game design. The research design and data collection on elements of game design principles will focus primarily on serious game developers from the private sector and video game developers within Malaysia. Although theories and methodologies of

international developers would be covered within the literature review, the actual interviews would be focused on the local developers with certain exceptions made for local developers working overseas and highly prominent international game designers with exposure to the Malaysian game development scene. This is entirely due to limitations that some companies place on their staff with regards to non-disclosure. This may not be a major issue for the game studios in Malaysia as this study would leverage on the MYGAMEDEV and IGDA (Malaysia) connections, however – such limitations also exist. For the same reason, this framework will focus primarily on pre-development practices within Malaysia from an academic and industry perspective. The primary reasons behind this is that due to the relatively young history of the game development industry, there appears to be a lack of standard methods, guidelines or list of best practices in the game development process (Colby & Colby, 2019; Haltsonen, 2015; Lamminmäki, 2017; Marklund et al, 2019; Mestadi et al., 2018). Game Development studios all use various difference methods and these methods have been customized to fit their own studio needs including the list of terminologies and practices. As a result, each country and sometimes each studio in the respective countries draws on a different set of guidelines and practices that leads to very unique development trajectories (Rajanen & Nissinen, 2015; Toftedahl, Marklund, Engström, & Backlund, 2016). It is for this reason that this study has decided to narrow the scope down to a regional game development industry for the purpose of the data collection. As it is, the Malaysian industry is an amalgamation of different game development practices from various countries due to its early out-sourcing nature (Chung, 2013).

1.11 Operational Definition

1.11.1 Pre-development

In the context of this research, pre-development refers the planning stage of serious games development (Oppermann, Schaal, Eisenhardt,Brosda, Müller, & Bartsch, 2017). There are generally three distinct parts in the entire development process: pre-development, development, and post-development. (Czauderna & Guardiola, 2019; Paavilainen, 2020). The pre-development stage focuses on idea generation and concept development of the serious game. An important part of the pre-development stage is the creation of the game documentation which details the game concept, genre, concept art or visuals, storyboard, mood board, mechanics, gameplay, and the user experience. The pre-development phase technically ends when the planning stage is completed when the actual content starts to be developed – for example: the game art or the game engine is being produced. All these would be the guideline for the artist, designers, and programmers to begin work during the production or development phase.

1.11.2 Gameplay

Gameplay is a term used to define the specific way which players interact with the video or computer game system. Gameplay is the pattern of play experience defined through the game rules, mechanics, objectives, challenges, and the overall plot; and how the players are inherently linked to all these elements through the playing of the game (Czauderna & Guardiola, 2019; Paavilainen, 2020). Gameplay describes the connection between player and the game system. In the context of this research, gameplay refers

to all the elements and principles of game design that are required in order to make the serious game engaging and immersive.

1.11.3 User Experience (UX)

The official UX definition from ISO: ISO 9241-210 (2010) defines user experience as "a person's perceptions and responses resulting from the use and/or anticipated use of a product, system or service" (Hinderks, Schrepp, Mayo, Escalona, & Thomaschewski, 2019). In game development, UX is termed as the connection between the player and whole game experience, resulting from the emotional aspect of the player experience in the context of game design. In the context of this research, UX refers to the structural narrative aspect of the serious game in order to improve the player experience.

1.11.4 Player Experience (PX)

Player experience (PX) is the individual player perception of the gameplay interaction between the system and the player taking into consideration the cognitions, emotions, and physical activity during game play (Toft-Nielsen, 2020). It can also be described as the experience of play - by taking he players emotions into account and how well the game provides the engagement, immersion, and levels of fun that a player should experience. Player experience is the quality of the player-game interactions during and after the game. In the context of this research, player experience is what player goes through when they play the serious game involving either a positive game engagement or a negative overall experience. The combination of positive user and player experience can create a high level of immersion in the serious game.

1.11.5 Game Mechanics

Game mechanics are the player specific actions, control mechanisms and behaviours that are provided to a player within the game (Roe & Mitchell, 2019). It is the sets of interaction possibility between the virtual world governed by fixed game rules and player-controlled elements. These interactions between the player and the world translates into strategy and interaction with other elements of the game which may in turn allow for game mastery. Game mechanics are elements that exists beyond the normal gameplay rules and boundaries to allow for a richer player and game experience. In the context of this research, game mechanics refers to the allowable actions of the players in the serious game for interaction and positive gameplay experience.

1.12 Thesis Organization

This thesis contains six chapters. Chapter 1 begins with an introduction to the background of the research. It presents the context, describes the specific research objectives, research questions, research significance, defines key terms and lastly the objective of this thesis. Chapter 2 presents a review of the literature related to serious games and game design. It also seeks to identify appropriate concepts for issues concerning serious games for learning. Chapter 3 explains the research design and methodology used to investigate the research questions. It outlines the mode of research, sampling plan, data collection process and data analysis approach. Chapter 4 describes the research design and methodology used to explore the research hypotheses. It outlines the study's field survey design, sampling plan and interview questionnaires. Chapter 5 present the research findings. It synthesizes the outcomes of the exploratory

studies, presents the results of confirmatory study and indicates the findings of the explanatory study, drawn from interviews with game design practitioners. Chapter 6 concludes the thesis by discussing the research results and provides recommendations in the design of a pre-development for serious games validation framework. This final chapter also covers the contributions and limitations of this thesis and its implications for further research.

1.13 Summary

This thesis aims to understand what are the essential elements of game design that is causes player engagement and immersion. The objective of understanding that is to factor those elements into a pre-development framework for serious games validation. The results of this research may assist game designers in developing better engaging serious games for learning purposes. The final framework which is termed as the RIPE Game Design Model would help enhance the development of serious games as it would act as a guiding principle for game designers to use in the pre-development process.