Enhancing Deeper Learning Using Empathy and Creativity In Role-Playing Serious Games

Marda, M.

ENHANCING DEEPER LEARNING USING EMPATHY AND CREATIVITY IN ROLE-PLAYING SERIOUS GAMES

M. MARDA

PhD 2020

This thesis is dedicated to my parents Andreas and Anna Marda,

who always supported my decisions and being there for me.

Thank you.

Acknowledgements

I would like to thank my first academic supervisor, *Dr Daphne Economou*, for her consistent guidance, patience and generous support throughout the research thesis. Special thanks also to my second academic supervisor, *Dr Vassiliki Bouki*, for her inspiration in creating serious games, her support, and willingness to debate issues and challenges. Both made a valuable impact on my professional learning and development, and I am very grateful for that.

This research thesis wouldn't have been possible without the support of *Dr Alkystis Phinikaridou* and *Dr Antigoni Divoli,* who I immensely thank for their enormous help, support and encouragement when commencing and throughout the years of my PhD research. Also, many thanks to Sarah Jackson and my Bermondseyan friends for their positive mood and motivation.

Special thanks to the *University of Westminster* which supported my work financially and provided me with all the means necessary for conducting my research, study, and writing up my thesis.

I would like to express my appreciation to the *Cyprus Ministry of Education and Culture*, the director of Secondary Education *Dr Louis Kyprianou*, and the director of Secondary Technical and Vocational Education *Dr Elias Markatzis* who supported my decision for undertaking this PhD study.

I am also thankful to the *A.G. Leventis Foundation* for their funding to support my living expenses in London.

Many thanks to *CTVC*, *Dr Arinola Araba*, and *Kumiko Broadhurst* for inspiring me on the issue of Domestic Violence and Abuse as well as the *Serious Games at Westminster* (SG@W) who supported my research thesis.

Finally, I would like to thank my friends back home and my family for their tolerance, love and unlimited support and encouragement.

Declaration

I declare that all the material contained in this thesis is my own work. The work in this thesis is based on research carried out at the University of Westminster, College of Design, Creative and Digital Industries, School of Computer Science and Engineering. No part of this thesis has been submitted elsewhere for any other degree or qualification.

Signed:  (Maria Marda)

Date: 31/1/2020

Abstract

Although educational technology has been widely used in education and remarkably supported instruction and assessment in face-to-face instruction, remote teaching and e-learning, teaching approaches have little deviated from the conventional approaches. Since the last decade, there is a shift in education to redesign teaching strategies. Education set priorities in promoting and supporting deeper learning to empower learners in thinking critically and creatively and gain skills and expertise in transferring their knowledge and applying it in other contexts to solve new problems. Concurrently, there is a remarkable interest by educators in harnessing the power of digital games and transferring it in education by designing Serious games. Serious Games are digital games designed to support learning, training, skill acquisition, and social and behavioural change. Serious Games integrate game design elements and gamification elements such as story, characters, score, visual objects, and rewards to create a positive mood while learning, increasing excitement, interest, motivation and engagement. Bridging the necessity for guiding learners in reaching deeper learning with Serious Games, this research thesis proposes the DeLEC pedagogical framework. DeLEC provides a pedagogic model which includes an iterative learning process of instruction, assessment and feedback integrating the elements of empathy and creativity. Aiming to investigate whether the proposed DeLEC framework is valid and indeed supports learners in reaching deeper learning, a Serious Game is designed to apply the phases of the DeLEC framework. The Serious Game is called Stronger and has the form of role-playing designed with a story and characters on a fictitious scenario around domestic violence and abuse (DVA). Stronger was tested with participants in a comparative study with an e-learning course on the same learning material. The results emerged from the data analysis demonstrated higher results in learning and deeper learning compared to the e-learning course leading to conclusions that confirm that the proposed DeLEC framework indeed assists learners in reaching Deeper Learning with Serious Games.

Table of Contents

List of Figures and Tables

Abbreviations

DC=Digital Course

DeLEC = Deep Learning Empathy Creativity Framework

DVA= Domestic Violence and Abuse

DRPGs=Digital Role-Playing Games

DRPSG=Digital Role-Playing Serious Game

GBL= Game-Based Learning

HC=High Creativity

HEC=High Empathetic Characters

HES=High Emotions Score

IPO=Input Process Output

LbT=Learning by Teaching

LC=Low Creativity

LEC=Low Empathetic Characters

LFM = Learning for Mastery (Mastery Learning)

LMLE=Low/Moderate Level of Empathy

LMES= Low/Moderate Emotions Score

NPC=Non-Player Character

RPG=Role-playing Game

RPSG=Role-playing Serious Game

SGs=Serious Games

STRONGER=Digital Role-playing game developed according to DeLEC framework

VLE=Virtual Learning Environment

Chapter 1. Introduction

This chapter describes the scope and aims, the problem statement, the literature review, the methodology, the research instruments, the study and the data analysis, the discussion around the results, the contribution to knowledge, the conclusions and the future work. This chapter outlines the structure of the thesis, presenting how the field of Serious Games has contributed to education and discusses the process of deeper learning as part of the educational goals. Both serious games and deeper learning are significant elements in this thesis. The aim is to design serious games that support learners to reach deeper learning. Also, this chapter sets the research questions, describes the methodology designed to set up the research instruments and describes the study to collect and analyse data that would give answers to the research questions and contribute to knowledge.

1.1. Serious games and pedagogy

Since the 90s, the emergence of technological advances have been applied extensively in the field of education, improving the delivery approaches with digital media such as images, sound, videos, animations that captivate the attention of learners and animate their eagerness for learning inside the classroom and remotely (Zhonggen, 2019). Since the millennium, the advent of digital or video games included all the forms of digital media plus high interactivity, managed to increase efficacy in learning by dragging learners into the magic circle of gameplay and learning.

The idea of designing serious games to be used for educational purposes originates from video games and their unique captivating and motivational power. Educators noticed that video games comprise an ideal environment for learning that inspire learners into becoming more focused, interested, motivated and excited for their learning (Freitas, 2018; Vos, Van Der Meijden and Denessen, 2011; Prensky, 2003). Educational scientists attempted to transfer video games in education, switching the purpose from playing for enjoyment to playing for learning. Attempting to design games that maintain the balance of learning and play the new genre of educational games is called *Serious Games*, where *Serious* refers to serving the purpose of learning and *Games* refers to the enjoyment and attractiveness to learners (Lameras et al., 2016). The effectiveness of SGs depends on their capacity to provide a balance between gaming and the educational experience (Brisson et al., 2012).

They are called "Serious" Games because in one hand they serve a serious purpose of learning and on the other hand they are games that provide enjoyment and fun to learners (Arnab, Lim, Carvalho, Bellotti, De Freitas, et al., 2015). Abt in 1970 coined the term SGs to define games used for learning purposes around the business context. In their digital form, SGs firstly used by David Rejeski and Ben Saywer in Serious Games Initiative (US) in 2002 (Gloria et al., 2014).

SGs are educational applications designed to interact with learners and captivate their attention, increase their motivation and engagement when teachers find it hard to engage their students with the conventional teaching process. SGs provide the environment for active learning, changing the role of learners from passive listeners to active participants who interact and become responsible for their learning (Jeffrey, 2006; Kampylis et. al., 2009; Navarrete, 2013; Mullet et al., 2016).

Learning with serious games can create a positive strong experience that might retain longer in memory (Bellotti, Kapralos, Lee, Moreno-Ger, et al., 2013). SGs foster the development of knowledge and skills through interactive stories, playful activities and immersive experiences (Almeida & Simoes, 2019).

SGs use elements to increase interactivity, competition, fun and motivate, engage and focus learners in achieving their learning goals (Alsawaier, 2018). Some examples of such elements are the following:

a. Gamification elements such as score, rewards, badges, leaderboards, trophies, visual objects;
b. Game Elements (game mechanics and game dynamics) such as story, characters, rules, levels, mission, mystery, curiosity;
c. Pedagogic Elements such as quizzes for evaluating learning and assessment, feedback, repetitions to encourage learning with trial and error, scenes and dialogues, tasks and activities.

Within the genre of SGs, the Digital Role-playing games (DRPGs) are popular. The role-playing technique is known in the Social Sciences as a teaching practice in the classroom to instigate students' attention and active participation. Students learn by taking roles putting themselves in the shoes of another person and contributing in resolving an issue like a conflict situation. Accordingly, DRPGs use role-playing techniques within a digital environment where learners take a role of a game character and expose themselves to confront a problem and experience the consequences of their decisions and learn from them (Devlin-Scherer & Sardone, 2010). DRPGs open social orientations, promoting behavioural change, aiming in learning and altering beliefs and prejudice on social and cultural taboos (this is covered in detail in chapter 2).

Considering SGs as interactive and motivating applications that target learning, this research thesis examines the design of SGs and their efficacy as educational digital media designed to transfer and apply teaching strategies and pedagogic processes in meaningful contexts in assisting learners to obtain deeper learning. The effective design of SGs may result in effective learning. SGs is another approach in teaching and learning and they act as an additional educational media of learning. Their development does not exclude or undermine the importance and the value of the instructor inside or outside the classroom.

1.2. Towards Deeper Learning

Recently, a shift in education turns the focus of teaching and learning to deeper learning (Fullan & Langworthy, 2013a) as a response for providing learners robust and transferable knowledge and skills. Shifting educational strategies into promoting deeper learning has become a priority among educators who find literacy, numeracy, and IT skills to be the fundamental knowledge, yet not enough to prepare learners with advanced skills needed to secure a job in the competitive markets (Dede, 2014). Promoting and supporting deeper learning strategies empower learners to think critically, make critical decisions, and become capable of solving new problems (Grover et al., 2015).

Deeper learning is a process through which learners become capable of taking the knowledge they've developed on a particular domain and transfer it and apply it to a new situation to find solutions (Pellegrino & Hilton, 2012). Deeper learning is considered an increasing need in education for developing broad background knowledge and a set of diverse skills that are meaningful and useful in the real-world (Dede 2014, Araya and Peters, 2010),

Therefore, there is a necessity for redesigning teaching approaches to deeper learning. Rethinking the new design of teaching approaches, it took into consideration learners' personal needs and interests in supporting and achieving their learning goals. To achieve these learning goals, educational technologies such as SGs become the new interactive environments that encourage teaching and deeper learning through active participation, collaboration and cooperation, interaction and experimentation with the learning content as educational solutions that deviate from the conventional learning approaches (Gloria et al., 2014).

Deviating from conventional teaching and learning approaches, the current research thesis investigates the design and efficacy of serious games as learning environments in terms of achieving deeper learning. The thesis proposes DeLEC as the new pedagogic framework for Serious Games that enhances a learning process of instruction and assessment adapting it for SGs by using gamification elements, game design elements and pedagogic elements (see Section 1.1) as well as the components empathy and creativity. Empathy is about understanding and sharing another person's situation and consequently involving the learner in understanding the learning content. The learning experience can be improved by the gaming experience and the invoke of emotions of empathy. Moreover, creativity becomes

another powerful approach in learning as the transfer of the acquired learning gained from the SGs and applying it in new contexts by creating artefacts within SGs.

Besides the pedagogic framework, the research thesis proposes the design of a new interactive serious game which aims to include the gamification, the game design and pedagogic elements and the components of empathy and creativity. The serious game developed is a role-playing game that involves instruction and assessment using a story with mystery, dialogues, mission, score, and visual objects. It also encourages the invoking of empathy of the learner using characters that portray emotions with their facial expressions, conversations, and the progress of the story. The serious game comprises a method of non-conventional approach to learning and it is completed with tasks of creativity, inviting the learner to apply their knowledge acquired from the game into creative activities.

The current research thesis claims its originality by putting forward a pedagogic framework that enhances the instructional process based on a known learning theory of Bloom's Learning for Mastery (see Section 3.3) and besides the integration of the game design elements, it proposes the incorporation of empathy and creativity as components designed and adapted in SGs. Furthermore, the designed methodology is developed to evaluate the attainment of deeper learning following the suggestions of Pellegrino & Hilton, (2012) in designing *transfer tests* and *retention tests* (see Section 2.6.4) for the assessment of deeper learning.

Due to the lack of a pedagogic framework that assists learners in achieving deeper learning with SGs, the next section describes this problem statement and suggests the solution.

1.3. The Problem Statement

There is a concern around the lack of integrating pedagogic principles when designing serious games. Pedagogical aspects and educational principles are often not taken into consideration when designing serious games (Catalano et al., 2014; De Freitas, 2006). In many cases educational content is "poured" into the game in a retrospective manner, hoping that player/learner would be motivated just because "the content is housed inside a game" (Gunter et al., 2006). The literature documents positive outcomes when it comes to motivation, intensity and longevity of engagement, but there are less solid systematic outcomes around the design of

serious games for achieving knowledge and skills (Bellotti et al., 2014; Gunter et al., 2006).

Additionally, there is no pedagogical framework designed to guide learners in reaching deeper learning with serious games. Deeper learning is a process that supports learners to acquire and transfer their learning, skills and expertise to solve problems in new relative contexts, however, deeper learning has not been designed and tested using serious games.

Hence, the research thesis proposes the design of a new pedagogic framework designed for serious games to guide learners in reaching deeper learning. The pedagogic framework is designed based on educational theory and pedagogic principles. The Deeper Learning Empathy and Creativity Framework (*DeLEC)* (see chapter 3) proposes an integrated instructional process to support learners achieve deeper learning. The DeLEC framework proposes the design of an instructional process based on the educational theory of Bloom's Learning for Mastery (LFM) and integrates the components of empathy and creativity.

The DeLEC framework comprises of three elements illustrated in Figure 1.1.

1. The educational theory of Learning for Mastery (LFM) suggested by Benjamin S. Bloom, (1968), which comprises the foundation of the proposed DeLEC framework. LFM (see Section 3.3) demonstrated positive results in assisting students to reach mastery in learning. It has never been applied using serious games.

2. Empathy is a feeling that has been used in serious games to trigger players emotionally. Games designed to foster empathy are known as Empathy Games and target in eliciting feelings of empathy to victimised groups or for social education to encourage tolerance and behavioural change (Belman & Flanagan, 2009). Triggering empathy increases motivation and engagement and assists learning and behavioural change (see Section 2.8).

3. Creativity is a component used as part of the DeLEC framework to involve learners in transferring and applying their knowledge in creative activities, transforming their learning into deeper learning (Pellegrino and Hilton, 2012).

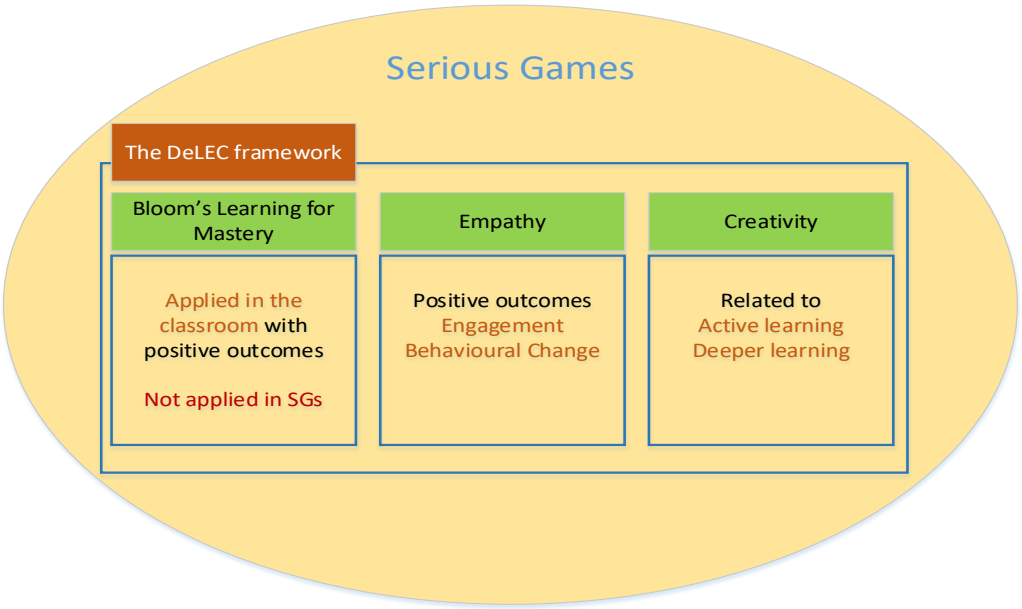


Figure 1. 1. The elements comprising the DeLEC framework for serious games

1.4. Research Aims

The research aims of the thesis are to investigate and evaluate whether learners can achieve deeper learning with Serious Games. Analytically, the research aims are the following:

1. The design of the pedagogic framework DeLEC as an integrated solution for achieving deeper learning with serious games.
2. The design and development of a serious game that applies the DeLEC framework in high fidelity.
3. The testing and evaluation of the learning effectiveness of the serious game by conducting a comparative study to conclude whether the Serious Game designed according to DeLEC framework produces a significant increment in learning and deeper learning. The study compared the results in learning and deeper of two digital media designed on the same learning material (see more in Chapter 5):
   a. The serious game designed according to DeLEC and
   b. The e-learning lesson.

The research questions addressed by this research thesis are the following:

1. Have learners who played the serious game designed according to DeLEC framework achieved higher learning compared to the learners who followed the e-learning lesson?

2. Have learners who played the serious game designed according to DeLEC framework achieved higher deeper learning compared to the learners who followed the e-learning lesson?

The aims of this research thesis are set to answer the above research questions following a rigorous methodology to plan, investigate, and analyse collected data, and emerging in results described in the following chapters.

1.5. Research Objectives

The research objectives below outline the steps taken to design and evaluate the proposed pedagogic framework and answer the research questions.

- **Research Objective 1:** Identifies the gap in research (see Section 1.3) around Serious Games and learning and focuses its investigation to the formation of a methodology that designs and explores the possibility of assisting learners in achieving deeper learning with SGs.
- **Research Objective 2:** Designs the DeLEC pedagogic framework (see chapter 3) to become the guidance to game designers to design SGs that assist learners in reaching deeper leaning with serious games. DeLEC is an original framework designed, tested and evaluated as for its validity for achieving deeper learning.
- **Research Objective 3:** Designs the research methodology which contains the study plan, the literature review, and the design of the research instruments and the methods to assist the collection of data.
- **Research Objective 4:** Designs and develops the serious game according to the DeLEC framework to empirically evaluate the efficacy of the game and validate the DeLEC framework.
- **Research Objective 5:** Conducts the comparative study with participants using the serious game and the questionnaires to collect data and then statistically analyses data to emerge conclusions that evaluate the DeLEC framework and answer the research questions.

1.6. Explaining the research thesis

The research thesis proposes a solution for achieving deeper learning with serious games by developing a pedagogic framework, the DeLEC framework that directs the design of educational serious games to assist learners in developing deeper learning, using empathy and creativity.

The research thesis aims to investigate and develop a solution combining the next components:

a. **The design of the DeLEC framework based on Bloom's LFM educational theory.**
   Bloom's LFM educational theory (Benjamin S. Bloom, 1968) is a well-known educational model which was tested in the classroom and demonstrated positive results regarding gaining mastery in learning (Guskey, 2007). However, it has not yet been tested with serious games. That means that there is no evidence in the scientific literature about how effective is the LFM model if implemented with serious games.

b. **The design of the DeLEC framework and its evaluation by designing and testing a serious game which applies the DeLEC in high fidelity.**
   To be able to evaluate whether the DeLEC framework can indeed assist learners in achieving deeper learning with serious games, it has to transfer from the theory to practice by designing a digital media tool, the serious game, which follows exactly the phases of DeLEC and then tested to analyse and evaluate the results.

c. The design and integration of empathy
   Empathy is an element that has been tested in serious games, also known as Empathy Games (Belman & Flanagan, 2009). The results showed that instigating empathy in serious games can result in positive behaviour change (Grohn et al., 2014) and belief formation (Batson et al., 1997). Nevertheless, it is suggested that empathy in learners is the prerequisite for achieving learning (Jarvis, 2012) through emotional connection, motivation and engagement and therefore it is transferred in serious games.

d. The design and integration of creative activities
   Creativity has become part of the key national educational policy and many initiatives are made across the UK to promote creativity in education (SEED, 2006). Creativity is found to benefit learning because by creating a positive mood for learning by increasing enthusiasm and enjoyment. In this PhD thesis, creativity has the form of creative activities and becomes an integral part of the DeLEC framework to assist learners with transforming their knowledge into

deeper knowledge.

e. The evaluation of deeper learning

Reaching deeper learning means learners acquired knowledge at the level that they have understood and retained knowledge in memory and they can recall it and apply it in new contexts finding solutions to new problems and they and apply. If information is understood and processed effectively, it is transformed into a deeper knowledge and is retained in the long-term memory. If the information has not been understood or learned incorrectly, or it was the result of rote memorisation, then it doesn't transform into knowledge and soon it fades out from memory.

The approach followed in this research thesis for assessing the reach of deeper learning is by:

- applying the gained knowledge using creative activities; and
- evaluating whether the gained knowledge has been retained in memory four weeks later.

Figure 1.2 illustrates the components of the DeLEC framework consisting of Bloom's LFM educational theory, empathy and creativity to reach deeper learning.

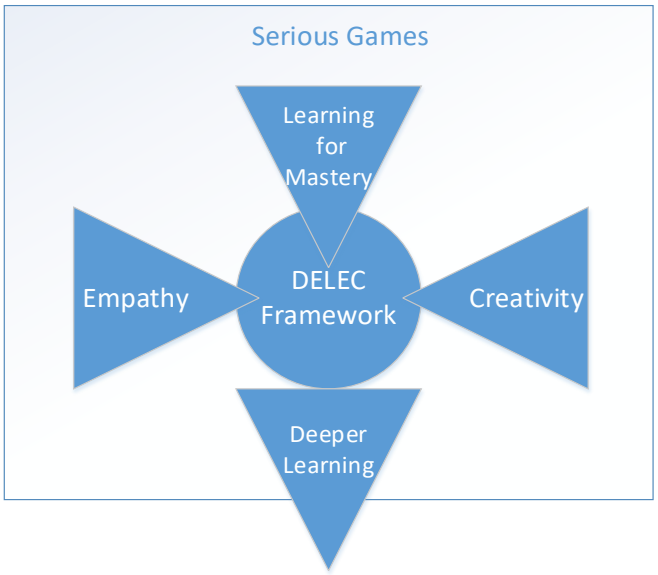


Figure 1. 2. The components of the DeLEC framework

1.7. Structure of the thesis

Chapter 1 “Introduction” outlines the research thesis presenting the background area, the problem statement, the research aims and objectives, and describes briefly the components of the DeLEC framework, which are discussed extensively in the following chapters.

Chapter 2 “Literature Review” describes the background area of serious games and pedagogy presenting the recent literature around all the relevant parts of the thesis including serious games, serious games design frameworks, role-playing serious games, empathy, creativity and deeper learning.

Chapter 3 “The DeLEC framework” describes the design of the proposed DeLEC framework setting its foundation on Bloom’s LFM educational model which is extended and adapted to apply in serious games by incorporating empathy and creativity.

Chapter 4 “Research Methodology” discusses the research methodology and describes the steps and the plan designed including the design of the DeLEC framework, the design of the corresponding serious game, the design of research instruments and variables, and research methods selected to collect the desired data to address the research questions and evaluate the proposed framework.

Chapter 5 “Design and Development of the research instruments” describes the research instruments designed to collect the desired data during the study to help emerge the correct results. Research instruments include the role-playing game called “Stronger”, the comparative e-learning resource, referred to as the Digital Course, and the questionnaires designed to collect users’ demographics data and other information.

Chapter 6 “Study and Data Analysis” describes the comparative study conducted and presents the statistical data analysis using the SPSS package for analysis and plotting. The chapter demonstrates the statistical output and the results emerged from the data analysis of the comparative study.

Chapter 7 “Discussion and conclusions” elaborates the discussion around the statistical output and the results focusing on the learning and deeper learning achievements of the experimental group in comparison to the control group and

providing clear arguments in answering the research questions. The chapter continues discussing the main conclusions of the research thesis.

Chapter 8 “Contribution to Knowledge and Direction for Future Work” presents the contribution to knowledge and proposes future work to extend the work of the current research thesis. The chapter and the research thesis complete with a summary of the main findings and conclusions and final remarks.

1.8. Summary

This chapter introduces the issues and the components that this thesis aims to investigate, and it outlines the structure of the research thesis. The chapter starts by discussing how the Serious Games can become the foundation for learning in education and their environment in accommodating teaching strategies that can lead to Deeper Learning. The chapter presents the problem statement which discusses the lack of a pedagogic framework in underpinning deeper learning in Serious Games. Following the problem statement, the chapter explains the research aims that incorporate the research questions and then presents the research objectives as the plan and the steps to address the research questions. Next, the chapter explains the steps of the research thesis. Finally, the chapter outlines the structure describing briefly the content each of the 8 chapters of this PhD research thesis.

Chapter 2. Literature Review

This chapter presents the state-of-the-art in the field of serious games based on recent literature review. It is mainly focused on serious games designed to improve educational purposes through pedagogy, motivation, and engagement and with the use of game design elements. The literature concentrates on the role-playing serious games as this form of serious games is examined in this research. Also, three pedagogic frameworks for designing educational serious games are presented to constitute the guideline for developing the proposed framework for this research. Furthermore, the main elements, empathy and creativity, as the main components of the proposed framework are discussed. Finally, deeper learning forms the frame within it can be evaluated and become the achieved goal in serious games.

2.1. The approach to literature review

Figure 2.1 illustrates the holistic view of the thesis demonstrating the elements linking and forming the pathway in which the literature review is presented. Starting from discussing the role of SGs in learning, including motivation and engagement, moving to the design of SGs and presenting three important SGs frameworks, then presenting Instruction, Assessment, Feedback, Empathy, Creativity and Deeper Learning. Figure 2.1 demonstrates how these elements link together to support the design of the proposed DeLEC framework (discussed in Chapter 3) that claims to assist the design of educational SGs that support learners to achieve effective learning.

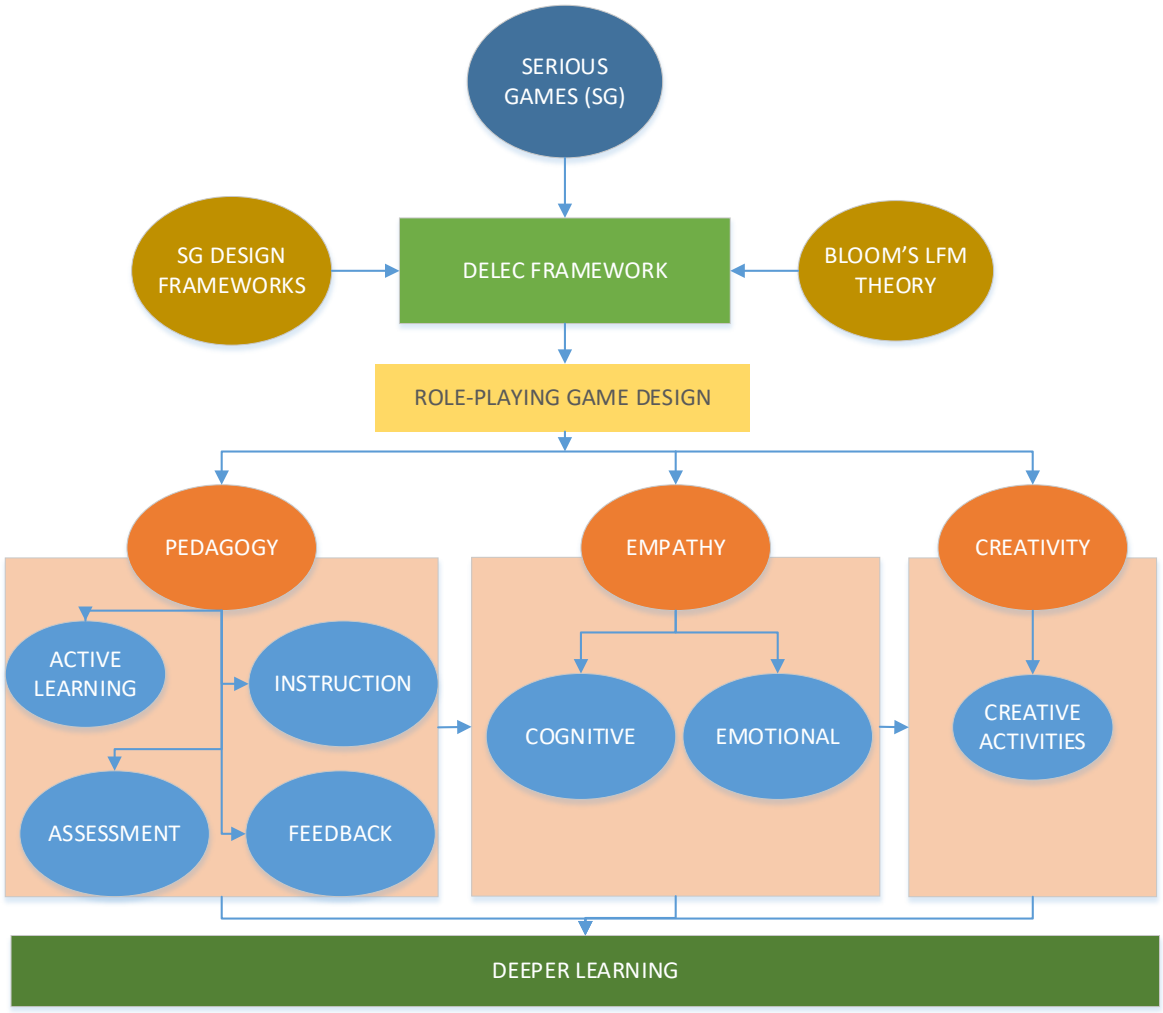


Figure 2. 1. Linking the literature review with the research thesis

The research thesis investigates the role of SGs and how their design can lead to better learning. The following section (see Section 2.2) presents the state-of-the-art

SGs according to the literature and discusses the importance of SGs and contribution to education.

2.2. Serious Games and Learning

Serious Games (SGs) is a relatively new discipline that combines learning, game mechanics and logic to provide game activities to transform users' learning experience (Lameras et al., 2016). The term SGs was first coined by the author Clarke Abt in 1970 (Djaouti et al., 2011), but in their digital form, SGs firstly used in Serious Games Initiative (US) in 2002 (Gloria et al., 2014). The terms Educational Games, Digital Game-Based Learning, Instructional Games, and Serious Games are often used interchangeably (Tsekleves et al., 2016). Through the thesis, the term SGs prevails.

As multimedia tools, SGs are designed to teach, train or contribute to behavioural change (Bellotti et. al., 2013). They are applied in different educational domains to support players in achieving their learning goals (Serrano-Laguna et al., 2018). SGs inherit game design elements from video games such as story, characters, competition, goals, rules, challenge, and mystery that increase the attractiveness for playing and create a positive mood for learning (Arnab, Lim, Carvalho, Bellotti, De Freitas, et al., 2015).

With the game features, SGs include also instructional features that initiate the active participation of the learner and allow learning-by-doing with challenges, tasks and activities to increase attention, motivation and ultimately the effectiveness in learning (Meij et al., 2020). SGs' players participate in new environments, observe, interact, learn new information through the game and use it in overcoming the obstacles and achieve the game mission (Connolly et al., 2012; Felicia & Egenfeldt-Nielsen, 2011). In this sense, the game mission correlates to the learning objectives.

Using SGs is proved to motivate and engage learners in achieving effective learning (Almeida & Simoes, 2019). Their setting offers a fertile environment for learning by allowing trial and error without any consequences outside of the game, and assists players to learn from their mistakes, experimentation and discovery of new solutions (Whitton, 2014). Those activities support learners to develop cognitive skills, such as decision-making, problem-solving and critical thinking (McGonigal, 2011). In well-designed games, learning is "hidden" behind the game missions and

activities, where players learn by being immersed in the gameplay and may become unaware of the learning that occurs (Ang et al., 2008).

Figure 2.2 illustrates the purpose and the main features of serious games to video games. Video games are played for fun and their power grips players' attention and increase their readiness to continue playing losing themselves in the world of the game (Zhonggen, 2019). The features of video games (story, art, software) can be used for the design of SGs which the main purpose is learning. SGs are designed to incorporate also learning features such as educational theories and pedagogical processes such as instruction, assessment, and feedback to achieve a set of expected learning outcomes (Garneli et al., 2017; Zyda, 2005).

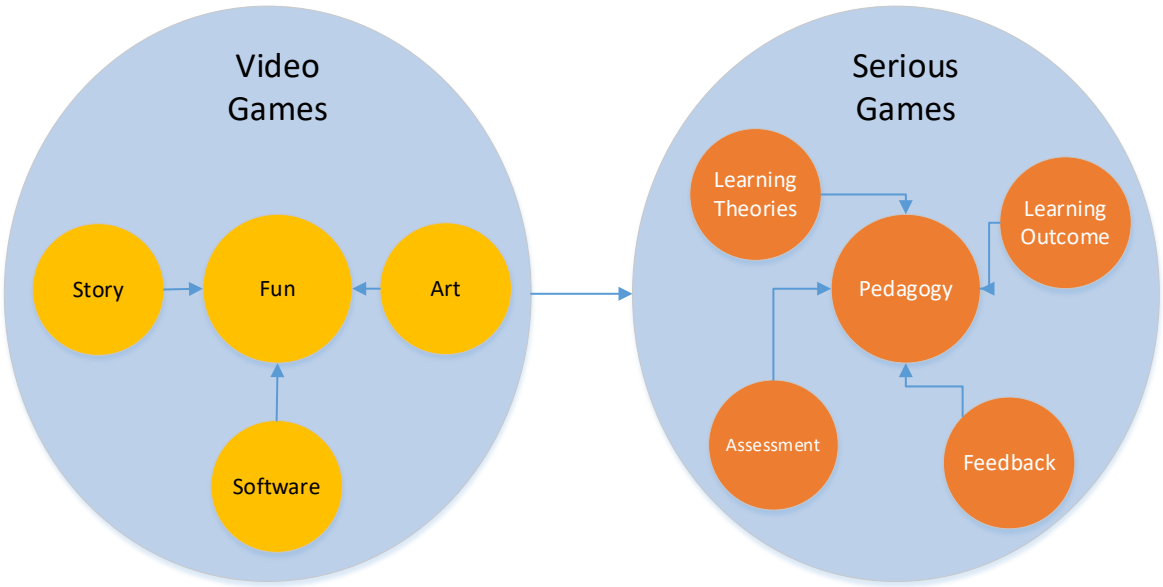


Figure 2. 2. SG design and video game. Adaptation from Zyda (2005), p.25.

The next section discusses how people conceive and understand information making meaningful links in their brain, and store it in their memory, and how the trigger of motivation leads to learning.

2.2.1. How people learn with SGs

Many theories exist on human brain information-processing that study cognitive development. Developmental psychologists who adopt the information-processing perspective contend that the theory of mental development is based on the idea that humans process the information they receive than merely responding to stimuli (Tangen & Borders, 2017). Based on information-processing theories, Mayer, (2014a) proposes the *Cognitive Theory of Multimedia Learning* and this theory is used in this thesis to explain how people learn with SGs. The theory links the human

information-processing system with multimedia learning and describes the way learning occurs in the human brain during the gameplay.

The human brain's cognitive architecture is the system that represents, process, stores, recalls and accesses the information flowed in the brain, organising the new knowledge in the memory. Figure 2.3 depicts the information flow and human functions to receive, store and organise information.

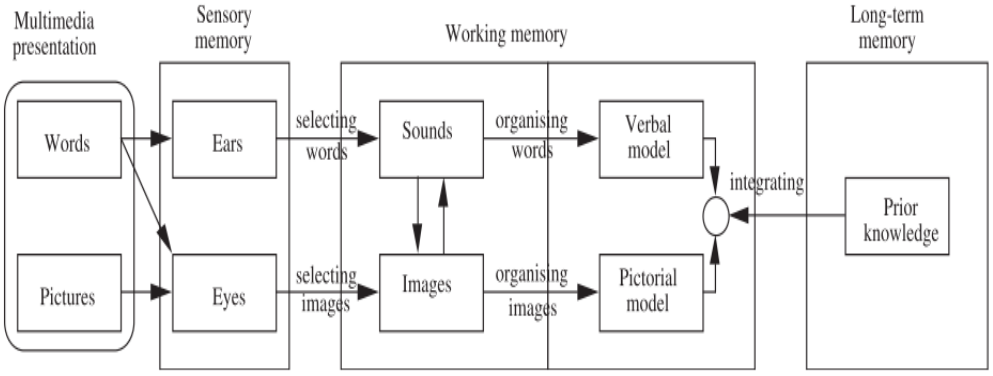


Figure 2. 3. Cognitive Theory of Multimedia Learning. Source: (Mayer, 2014), p.66.

The Cognitive Theory of Multimedia Learning receives information using dual channels. The upper row shows the auditory/verbal channel, which receives information from the ears, while the bottom row shows the visual/pictorial channel that receives information from the eyes (see Figure 2.3).

Several different brain-memory systems exist which under normal conditions are engaged to some degree in most learning situations. Memory experiences are categorised into explicit and implicit. Explicit memory experiences involve the hippocampus-medial temporal lobe system and implicit involves the cerebellum, amygdala, and other systems (Thompson & Kim, 1996). Mayer, (2014c), explaining the conception and process of information depicts three types of memory:

a. **sensory memory**

   Sensory memory holds a large amount of information input from human ears and eyes and stored for a short time (e.g. less than a quarter of a second).

b. **working memory**

   Information is transferred from the sensory memory and transformed into verbal and visual representations that can be mentally manipulated. However, only a few items of verbal and visual information can be processed

at once. The information decomposes if thirty seconds passed without being actively processed.

c. **long-term memory**

It refers to effective and permanent storage of knowledge and skills which is meaningfully organised and can be accessed unlimited times. The function is to provide long-term storage of relevant material from working memory.

Humans receive a vast amount of information each moment. Having a limited memory capacity, they can occupy only a small volume of information in each channel at a given time. Working Memory is the bottleneck in which each time only a small amount of information can be processed.

Meaningful learning happens when humans use the appropriate cognitive processing during learning, to pay attention to the relevant learning material, mentally organising it into a coherent representation and mentally integrating it after linking it to prior knowledge. The arrows in Figure 2.3 represent the cognitive process of selecting, organising and integrating information.

Mayer, (2014a) explains that the information-processing system for multimedia learning has crucial implications when learning with games because players' working memory can easily get overloaded, reducing the opportunity for making sense of the material. Therefore, the knowledge which is stored in the long-term memory is meaningful and understood and it can be recalled and transferred to solve new problems.

In the next section, the role of motivation in achieving learning is discussed and links serious games to Flow theory.

2.2.2. Motivation in SGs

Motivation refers to an individual's willingness to engage in a task putting personal effort, devotion and persistence in that activity (Pintrich, 2003). Motivation is an important feature and plays a crucial role in learner's performance. Psychological and cognitive states such as motivation, engagement, dissatisfaction or boredom influence learners' will in acquiring new knowledge and skills (Derbali & Frasson, 2012). These states should be taken into consideration when designing a learning process for SGs. Motivated learners are what educators wish for: enthusiastic; focused; interested; engaged; exhibiting high performance and outcomes (Prensky,

2003). It is easy to recognise a motivated learner, although it is difficult to find or create one (Da Rocha Seixas et al., 2016). Hence, there is a particular relevance of how motivation advances learner's performance in learning (Derbali & Frasson, 2012).

Motivation can be either intrinsic or extrinsic (Malone, 1980):

a. *intrinsic* motivation

Intrinsic motivation derives from a personal, internal willingness, enjoyment, self-determination, hard efforts and self-satisfaction of doing a task or engaging in learning (Braad et al., 2016)

b. *extrinsic* motivation

Extrinsic is the motivation which derives from the desire for external rewards, such as money, praise, promotion, recognition from others.

In game-based learning environments, the critical approach is to enhance intrinsic motivation using elements that are considered highly engaging, such as curiosity and challenge (Malone, 1980). SGs trigger motivation by using multimedia content (audio and visual features such as pictures, sounds, and video) and gamification elements such as challenges, curiosity, badges, trophies, points, timers, etc.

The *DragonBox Elements* (https://dragonbox.com/) is a math game designed to teach children maths, such as Algebra and Geometry created by a Norwegian studio and released in 2012. DragonBox introduces the player in understanding geometrical shapes, angles and theorems in Geometry. The game uses an imaginary world with cartoon characters and music. This innovative method advocates that SGs increase students' motivation and facilitate active learning. The game won the award for "Best Learning Game" in 2016. Figure 2.4 depicts and a snapshot of DragonBox.

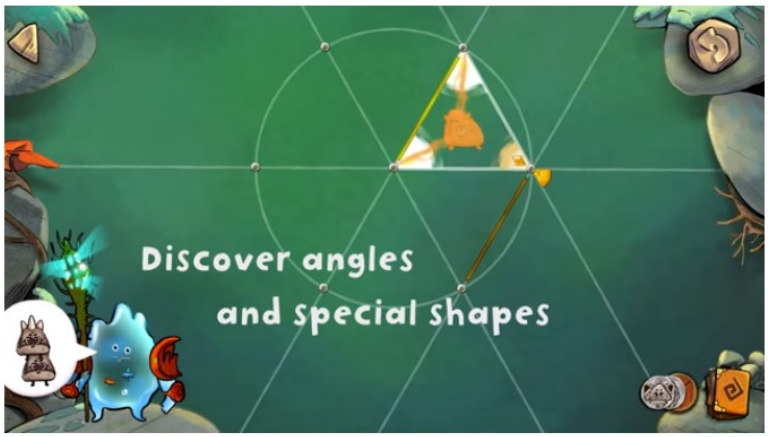


Figure 2. 4. Dragon Box Elements SG

The Flow Theory

Many researchers used the *Flow Theory* introduced by (Csikzentmihaly, 1991) to explain how motivation and engagement are achieved with games (Sharek & Wiebe, 2014). The Flow Theory refers to the positive experience of a person to *stay in the flow* when engaged in an activity. The state of flow exists when while gameplay, a player maintains a balance between the level of their skills and the level of difficulty of the game.

Figure 2.5 illustrates the state of Flow. The horizontal axis shows the level of skills of the player and the vertical axis shows the level of challenge/difficulty of the game. If the game is easy compared to a player's skills then, they might become bored while playing and soon quit the game. On the other hand, if the game is very difficult compared to a player's skills then, after several tries, they might lose interest, feel frustrated and eventually quit playing the game. The channel of flow is positioned between the blue lines and shows the state of Flow, the state where the player's skills are balanced with the game challenges. In the Flow state, the player feels motivated, focused, interested and desires to continue playing out of satisfaction and pleasure. The state of flow is necessary to keep the player in a continuous effort to accomplish a task or learning. When they accomplish the task, they get a reward for their effort, experiencing satisfaction and enjoyment (Lameras et al., 2016).

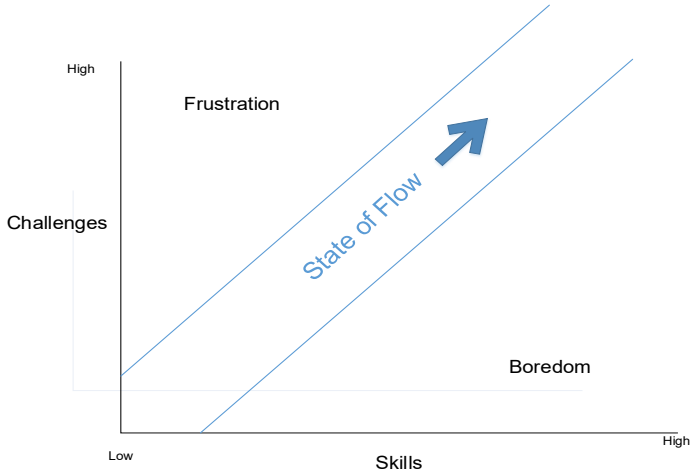


Figure 2. 5. The state of Flow (Csikzentmihaly, 1991)

The Flow Theory applies in any task and any field of activity. Educational researchers try to apply the Flow Theory to assist students in optimising their learning (Sharek & Wiebe, 2014).

Motivational methods can scaffold learners' efforts by transforming the learning process into an enjoyable and effective experience. (Derbali & Frasson, 2012). Maintaining learners' motivation is essential in achieving better learning.

In the next section, SGs instructional design is discussed which is an important part of the thesis. SGs instructional design discusses the design of instructional elements in SGs such as the instruction, assessment and feedback.

2.3. SGs Instructional Design principles

As mentioned in previous sections the learning effectiveness of SGs is attributed to the design and integration of pedagogic principles and instructional features. The research of this thesis is interested in investigating the instructional design of SGs as for their learning effectiveness to be able to design the proposed SG that targets the achievement of deeper learning.

According to (Chorianopoulos & Giannakos, 2014), there is a need for designing applications that provide meaningful and playful learning. These applications integrate design principles that assist in the development of several cognitive skills. The authors claim that the *story* is a game design element that encourages motivation for playing the serious game. Therefore, one of the game elements that is used for the development of the proposed serious game is the *unfolding of a story* in the format of narration and dialogues.

Another game design principle is the use of characters in the game and their expressivity. According to Paiva et al. (2005), when the characters are believable enough to express appropriate and expected behaviours then their emotional state can be reflected in the players. The use of characters is another game element that is used for the development of the proposed game because it can maintain the player engaged in the game and increase their emotional connection towards the game characters.

The third game design principle relies on players' competence to learn by going through meaningful experiences by designing activities, challenges and quizzes as part of the assessment and receive a score and immediate feedback (see Section 2.3.1 and 2.3.2).

The fourth game design principle is the design of levels that reach to the game mission. Levels correlate with the learning objectives. The completion of a level signifies the completion of learning objectives set to be covered. The game mission set in the beginning exists throughout the game and keeps the player motivated to reach it. The fourth game design principle is designed in the proposed game with the scenes which represent the levels and integrate the learning objects as well as the game mission of gaining the keys as a visual reward that open the next level.

Setting learning as the principal purpose in SGs creates the need to explore how to evaluate learning outcomes in SGs that comply with their pedagogical goals.

The evaluation of SGs outcomes should include (Bellotti et al., 2013):

- assessment of learning performance;
- feedback provided to the player.

The following sections discuss the assessment and particularly the formative assessment and feedback integrated in SGs.

2.3.1. Assessment in SGs

Assessment is necessary to evaluate and report the progress of learning by establishing the assessment measures and criteria (Bellotti et al., 2013). Assessment of learning should constructively align with the learning objectives and the learning activities according to Bigg's Constructive Alignment theory (Trigwell and Prosser,

2014). A learning objective intends to change learner's knowledge through learning activities.

Assessing learning through SGs should include measurable quizzes and activities which indicate the level of learning progress and outcomes to both the learner and the teacher. The results should report that the necessary learning has been occurred by playing a serious game (Zhonggen, 2019).

An assessment conducted after the game-sessions is usually done with summative tests, interviews and questionnaires that cover learner's overall knowledge and this is counts as a summative assessment. Additionally, assessment can be done within the game using variables that store score, levels, feedback and adaptation of the gameplay. The in-game activities and measures count in formative assessment (Westera, 2016).

Adams and Mayer (2014) propose three types of assessment:

a. **pre-assessment**

   It is conducted before the gameplay to assess a player's prior knowledge. It can be used to adjust the game level accordingly.

b. **formative assessment**

   Formative assessment has the form of frequent testing during instruction, which checks whether the acquisition of knowledge is achieved. Formative assessment aims to determine areas for improvement (Bellotti et al., 2013). In SGs, formative assessment (Grover et al., 2015) is conducted during the gameplay, it becomes part of the experience, it assesses the learning progress of the player and gives appropriate user feedback (Shute et al., 2009).

c. **summative assessment**

   The summative assessment has the form of the final exam and still dominates in education as it usually covers a major part of the learning content and assesses the overall learning activity (De Freitas, 2018).

Assessment can positively support students' learning, especially when it takes a more formative than summative form. Given emphasis mainly on summative assessment, students focus merely on succeeding the maximum possible grades in the exam, ending up in adopting surface approaches to study such as memorisation

to pass the exam and then forget their learning (Lynch et al., 2012). In contrast to summative assessment, frequent formative assessments encourage students in adopting deeper approaches to study than memorisation. Many studies determine the magnitude of learning outcome by comparing the pre-assessment and summative assessment (i.e. pre-test to post-test scores).

Questions to players/learners related to whether they liked the game, or how they found the game, are considered as an invalid assessment as they are not associated with the desired learning outcome. Another common mistake of integrating assessment in games is including questions asking the players to rate how much they have learned during playing the game. Such questions do not correspond to the learning outcome, because learners are unaware of their learning (Mayer, 2014b).

2.3.2. Feedback in SGs

Meaningful feedback is key for helping learners achieve their learning goals and reflect on errors in SGs (Lameras et al., 2016). The feedback that gives specific information about the errors and how to remediate them than giving a generic message of errors is found to be associated with deeper learning (Ambrose et al., 2010).

There are several types of feedback in SGs (Lameras et al., 2016).

- formative feedback projected by the system, focus on correcting knowledge misconceptions and inaccuracies (Mayer, 2014).
- Affective feedback is related to attitudes and moods, feelings and emotions (Lameras et al., 2016). Rewards in games may include characters, game gifts and objects that can lead to increased learners' confidence, maintain tolerance to failures and decrease anxiety (Lameras et al., 2016).
- Motivational feedback in games aims in creating situations that trigger students' curiosity to start playing the game and then keep them motivated to learn, by extending curiosity and balancing fun (game mechanics) with learning (learning elements) to succeed engagement (Arnab et al., 2012).
- Progress feedback in games measures and informs the player about their current progress done in the learning performance using the game encouraging to continue playing (Bellotti et al., 2014; Popescu et al., 2014).

2.3.3. Pre-tests and post-tests

Pre-tests and *post-tests* as a common approach in educational research for assessing learning outcomes. Assessment with pre-test and post-tests is one of the most widely used experimental designs that aim to measure changes in learning outcomes after modifications to the learning process (Riemer & Schrader, 2015), e.g. testing the effect of a new teaching method or testing the effect of a learning media such as a game.

With this method, participants are allocated randomly to either the treatment group (playing and testing a new feature in the SG) or the control group (playing without the new feature in the SG). The pre-test is completed by the participants before the game/experiment, while the post-test is completed after the end of the experiment. Then the pre-tests and post-tests are compared. The significant differences in the learning outcome are credited to the treatment group (Papastergiou, 2009).

According to Mayer (2014), a learning outcome is a change in knowledge that emerges as the result of delivering teaching either in the classroom or using learning technologies. In terms of SGs, the learning outcome is the knowledge learners gain while playing SGs.

The proposed SG for this thesis includes the game design principles discussed in section 2.3 which includes the story, the characters, assessment/feedback, and levels. Therefore, the proposed SG is designed in the form of role-playing to include the above game design principles. Hence, the next section presents the literature around digital Role-playing games.

2.4. Digital Role-Playing Games

Digital Role-Playing Games (DRPGs) simulate real-life situations for training purposes and acquisition of skills around conflict resolution or behavioural and prosocial change. DRPG creates a self-sustaining, highly motivating learning environment emphasising the significant role of language and narrative while playing (Cornillie et al., 2012).

Role-playing was first used to train medical staff to increase empathetic understanding, critical thinking and retain knowledge (Pettenger et al., 2014). Students in sociology and political science are often involved in role-playing. In law

schools, role-playing is a routine part of mock trials, used as a pedagogy approach for understanding the legal code, but also the human dynamics.

DRPGs are used as an alternative instructional approach. Based on narrative, episodes, characters and dialogues, they are used by teachers who want to create interactive instructions to capture the attention of all students, even the less interested (Cornillie et al., 2012).

Learners participate in DRPGs by taking the role of a character in virtual systems and experience learning by interacting with other virtual characters or by making decisions and understanding the consequences of their choices (Devlin-Scherer & Sardone, 2010). Role-playing is a technique which distinguishes from other active learning techniques because it puts learners in the position of another, convincing them to examine an alternative viewpoint and understand it in their way (Niemeyer et al., 2014). Role-playing is more effective than other techniques when it is used for:

- problem-solving;
- applying negotiation and other soft skills;
- changing beliefs, behaviour or reconsidering personal values (Niemeyer et al., 2014).

Figure 2.6 depicts the instructional strengths and values of a DRPG.

Figure 2. 6. Role-play strengths (Johnston-Hollitt, 2008)

Role-playing aims are developed to help learners understand the interplay of personalities and situations (Oblinger, 2004) and they are designed to raise awareness on social issues and support behavioural change. The next section describes examples of games developed to help young people understand bullying behaviours and learn about relationships in sex education.

2.4.1. 'Take it to the top: Stand up to Bullying'

An example of DRPG is the *"Take it to the Top: Stand up to Bullying"* BBC Games production (Take it to the Top: Stand up to Bullying, viewed July 2017, https://www.bbc.co.uk/cbbc/games/the-next-step-take-it-to-the-top) that deals with bullying behaviours among teenagers. The player helps a friend who is bullied by making choices about replying to bullying texts messages and involving other friends in the issue. Figure 2.7 depicts a snapshot of the game which is related to the anti-bullying week that campaigns every year to raise awareness about bullying, cyber-bullying and encourage reports against it.

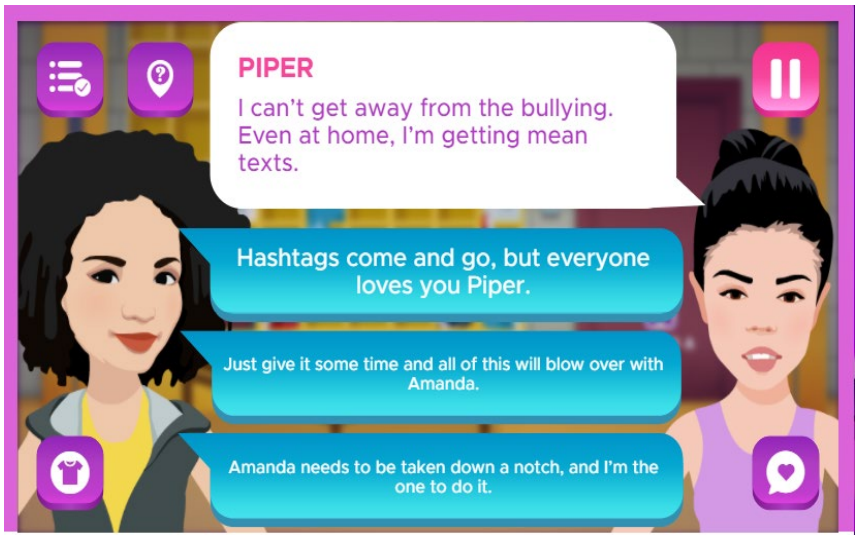


Figure 2. 7. Stand up for Bullying.

2.4.2. The 'PR:EPARe game

The 3D role-playing game PR:EPARe (Arnab et al., 2013) is designed by a cross-disciplinary team of UK researchers, the Adolescent Sexual Health (SASH) research group and the SGs Institute (SGI) at Coventry University. The game is related to Relationships Sex Education (RSE) which according to the Legislation passed in the Children and Social Work Act 2017, from September 2019 secondary and primary schools are encouraged by the Department of Education to provide sex education

and relationships education. The game was tested with 505 school students aged 13-14 years old. The results of the study suggest that students who played the game increased confidence to recognise coercion and act to stop it compared to the control group. A snapshot of the game is illustrated in figure 2.8.

Figure 2. 8. Snapshot from the game PR:EPARe (Arnab et al., 2013)

2.5. SGs Design frameworks

Many game design frameworks propose the design and development of games related to the use of game mechanics, learning elements and aesthetics. Other frameworks are developed to propose pedagogic processes and seek to evaluate how well the frameworks support the understanding of correlations by combining different game components (Arnab et al., 2015). In this section, three game-design frameworks are presented and discussed:

- The IPO model
- The ADGBL
- The MDA framework

The first two frameworks are selected because they include pedagogy elements in game design and the third framework is selected because it includes game design elements that are related to the game experience of the player. Elements from the game design frameworks have been used in directing the development of the current research thesis.

2.5.1. The Input-Process-Output model

Figure 2.9 depicts the Input-Process-Outcome (IPO) as the model for designing instructional games suggested by Garris et al., (2002). Two elements need to be paired when designing instructional games for learning: The instructional content and the game characteristics that enrich the game experience. The combination of the instructional content and the game elements trigger a cyclical iteration (the Game Cycle), where player/user interacts with, to play and learn. In the game cycle the player interacts with the game and depending on the interest and enjoyment they feel they form their judgments (user judgments), which leads the user exhibiting analogous behaviour. If players are interested in the game and they receive the appropriate feedback from the system, they spend more time and effort completing tasks. The learning is achieved via a cycle of user reactions and iterations, depending on user motivation, while playing the game. To achieve the desired learning outcomes, it is essential to include debriefing and scaffolding as instructional support (Garris et al., 2002).

This IPO model has common characteristics with the DeLEC framework which is proposed in this PhD research as discussed in Chapter 3.

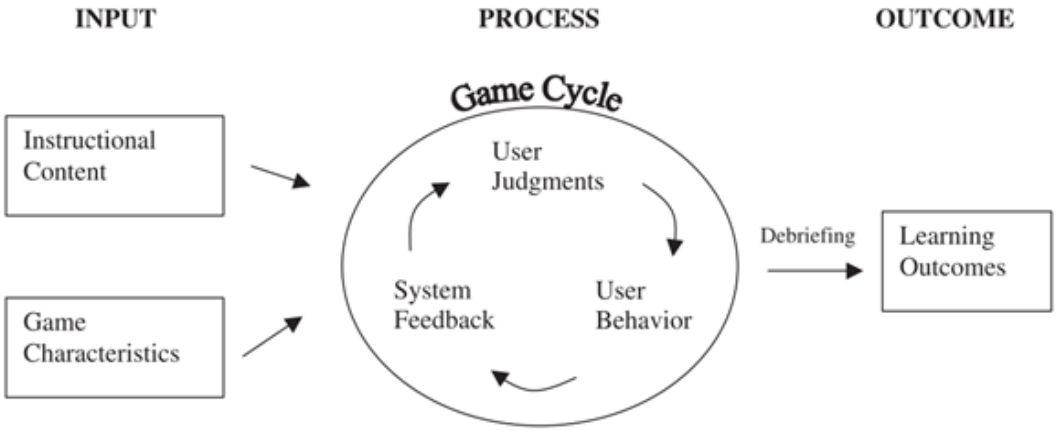


Figure 2. 9. The Input-Process-Output Model (Garris, Ahlers and Driskell, 2002, p.445)

2.5.2. Adaptive Digital Game-Based Learning Framework

The Adaptive Digital Game-Based Learning (ADGBL) framework (see Figure 2.10) introduced by Tan et al. (2007) and suggests components that leverage the pedagogical aspect and the game design aspect. The pedagogical aspect incorporates components that support the learner as follows:

a. *psychological needs*, learners act and behave according to what they think and feel, a game design that satisfies learners' psychological needs might trigger their interest to continue playing the games;

b. *cognitive development*, the design should take in mind human cognitive development such the age or culture, to correspond accordingly to the level of knowledge, age, and performance;

c. *learning behaviour*, learners' needs should be identified to determine their learning behaviour which affects the learning outcome.

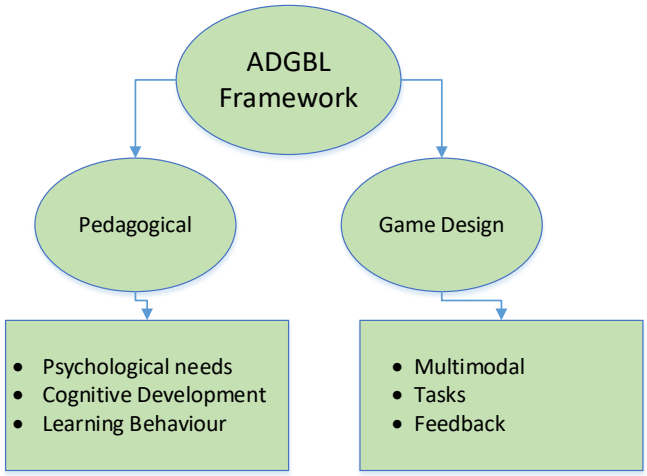


Figure 2. 10. ADGBL Framework (Tan et al., 2007)

The game design aspect includes components that support the learner with their interaction with the game as follows:

a. *multimodal*, modality controls the interaction and communication between the learner and the game. The game design could include multimedia features such as graphics, sounds, animations, user interface and storytelling;

b. *tasks* or *challenges* motivate learners in making efforts to achieve them, this is how learners assimilate the learning material. Tasks should have levels of difficulty or progression appropriate to the level of achievement of learners;

c. *feedback*, direct or indirect is essential for learners to be aware of their progress and the step they need to advance their learning.

SGs consist of a balance between learning and gaming elements (All et al., 2016) and are designed to both entertain and educate (Bellotti et al., 2013). To ensure balanced SG design both educators and game designers should collaborate. Learning remains the main goal in SGs. Tan et al. (2007) suggest that a well-designed game should

include features such as story, challenge, goals and objectives. These elements add to the method of designing the new DELEC framework.

2.5.3. The MDA framework

The *Mechanics Dynamics Aesthetics (MDA) framework* (Hunicke et al., 2004) is a formal approach to better understand game design from the perspective of the designer and the perspective of the player. It is considered the bridge between the game design and the game experience. MDA helps in understanding how to create successful games by breaking up games into 3 core categories depicted and expanded below (Figure 2.11).

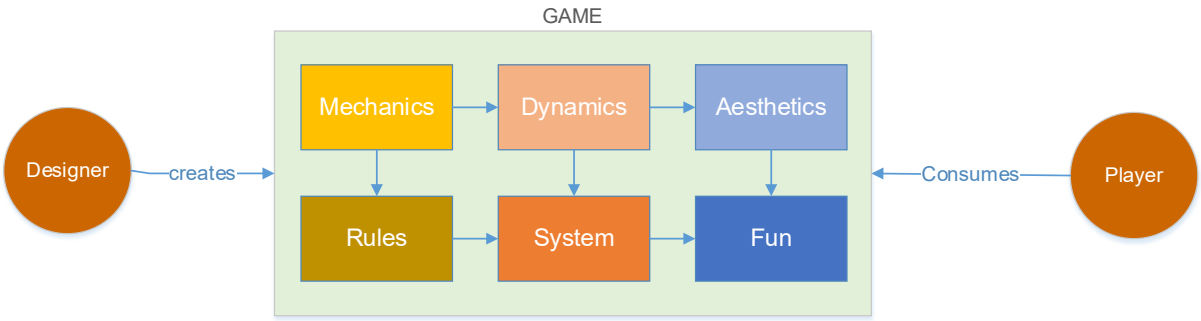


Figure 2. 11. The MDA framework

The MDA framework suggests three layers of game design:

- *Mechanics*, the actions the players can take in the game

Mechanics are the actions the players can take in the game. If the genre of the game is an action game, mechanics could be the movements designed for the sprite, such as running or jumping. Mechanics are actions defined by the rules. They can best describe what the player "gets to do". Systems utilise these mechanics, providing the necessary means for players to attain their goals.

- *Dynamics,* how the rules act in motion, responding to player input

Dynamics describe how the rules act in motion, responding to player input. These can be, e.g. the momentum to overcome challenging obstacles, competing against other players to accomplish a goal or cooperating, negotiating or trading with others, making a discovery, avoiding a trap, et cetera. Dynamics work to create aesthetic experiences. For instance, if a player must get their character from one side of a screen to another before a clock runs out, they will experience

the dynamic of time pressure. If they must do this in conjunction with another player, this will combine the dynamics of both time pressure and social pressure.

- *Aesthetics* has nothing to do with impressive graphics. Aesthetics describe the player's emotional response to the game, such as their enjoyment, frustration, discovery and challenge. Hunicke, LeBlanc and Zubeck, (2004) proposed a taxonomy of aesthetics given to the list below:
  - *sensation*, the fun, pleasure of the game;
  - *fantasy*, graphics that illustrate reality or fantasy;
  - *narrative*, unfolds a sequence of events, story themes that can evoke emotions;
  - *challenge*, obstacles, problem-solving;
  - *fellowship*, social framework, interaction with others;
  - *discovery*, exploring new things;
  - *expression*, the game as self-discovery, creativity, self-touch;
  - *submission*, achieving the goal of the game.

Designers create the mechanics of the game, and through mechanics, dynamics and aesthetics games are produced. From the other end, the player experiences the game through the aesthetics provided by the game dynamics, which emerged from the mechanics. The authors suggest that the fundamental about MDA framework is the idea that games are more like artefacts and games' content is their behaviour.

The MDA framework gives an insight about how the mechanics, dynamics and mainly the aesthetics should be designed for the DeLEC framework to create a pleasant game experience to the player.

The next section defines and discusses the Deeper Learning process that forms the principal aim of DeLEC framework to support learners to reach deeper learning with the use of SGs.

2.6. Deeper Learning

Deeper learning is the process of developing durable, transferable knowledge that can be applied in new situations (Pellegrino & Hilton, 2012). Deeper learning refers

to conscious efforts for meaningful learning and understanding that links to prior knowledge. When prior knowledge is robust, accurate and occurs at an appropriate time then it provides a strong foundation for building and retaining new knowledge (Ambrose et al., 2010). Deeper learning focuses on the development of deeper and functional understanding, enabling learners to see deeper relationships and create broader connections among concepts (Ambrose et al., 2010).

Deeper learning has a general pedagogical significance related to the development of analytical skills, cross-referencing, imaginative reconstruction, and independent thinking in discovering the underlying meaning (Warburton, 2003)(Warburton, 2003). Students who adopt deep learning approaches retain knowledge, perform better and can integrate and transfer information at higher levels (Laird et al., 2008).

On the other hand, surface learners have received learning without making meaningful connections with the learning content and consequently, they soon forget it (Ambrose et al., 2010). Examples are found to students who study superficially by memorising learning material without making sense or understand their study material targeting only to pass the module and end it there (Laird et al., 2008; Trigwell and Prosser, 2014).

If the goal of instruction is to prepare students to complete tasks or solve problems exactly like the ones addressed during instruction, then deeper learning is unnecessary (Pellegrino & Hilton, 2012).

According to Dede, (2014); Pellegrino & Hilton, (2012) Deeper learning:

a. refers to acquiring knowledge and skills on a topic that can be recalled and transferred to solve new problems in that subject field or domain of knowledge;
b. involves repetition, aligned with constructive feedback that aid learners correct errors and re-practise;
c. leads to meaningful learning that develops a deeper understanding of a topic.

Preparing students to achieve these ambitious standards, schools should change learning strategies to incorporate teaching approaches that reach deeper learning (NCR report, 2012). Therefore, there is a need to design and apply instructional strategies and learning processes to incorporating deeper learning, based on advanced educational technologies (Dede, 2014).

The following subsections discuss the significance of promoting active learning approaches and its relevance to deeper learning.

2.6.1. Active learning and deeper learning

Active learning involves learners in participating actively in obtaining their learning by discovering, processing, creating and applying their knowledge in meaningful tasks (Niemeyer et al., 2014) than merely passively listening. Active learning is perceived as a fundamental change from traditional instruction to the active involvement of students in their learning (Prince, 2004). Many examples of activities considered as active learning include collaborative projects, SGs, simulations and role-play.

Research suggests that active learning strategies can positively influence deeper learning (Cherney, 2008). For example, activities that involve learners to be the authors of their learning enhances retention of concepts in memory. Learners retain better in memory concepts introduced through active learning exercises, learning by doing, or knowledge that comes from meaningful or real-world paradigms, or relate to self-experiences (Cherney, 2008).

SGs are identified as compelling and engaging tools inviting learners into active learning through active participation and interaction with the learning environment forming deeper conceptual understanding (Navarrete, 2013).

2.6.2. Teachers approach to promote deeper learning

The importance of deeper learning is acknowledged by teachers who develop pedagogic approaches to promote it, resulting in higher quality learning outcomes for the students. Teachers' opinions and beliefs on their teaching and assessment has shown two main categories of teachers (Prosser, Trigwell and Taylor, 1994):

- teacher-focused and content-oriented teachers;
- student-focused and learning-oriented teachers.

Figure 2.12. illustrates teachers' approaches to teaching that influence students' approaches to study and hence their learning achievement.

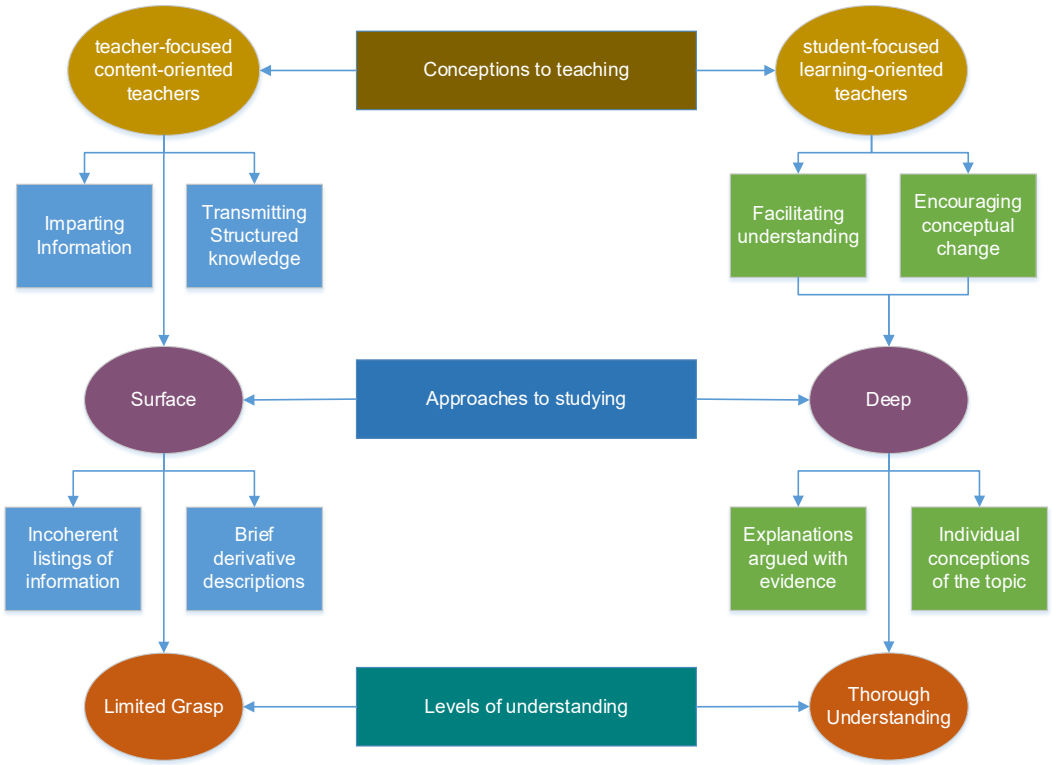


Figure 2. 12. Teachers' approaches to teaching (Entwistle, 2000, p.5)

Teachers adopting a teacher-focus and content-oriented approach to teaching, shown vertically on the left side of Figure 2.12, believe that priority in teaching is placed on covering the syllabus, hence they work on imparting information and structured knowledge. These teachers design assessments that require detailed factual knowledge of the syllabus and they consider the learning outcomes to be the total responsibility of the students, depending on their competence and motivation (Entwistle, 2000). This approach to teaching pushes students in adopting a surface approach to learning, memorising and reproducing the content, creating lists of incoherent information and brief descriptions (Trigwell et al., 1999).

Student-focused and learning-oriented teachers, shown vertically on the right side of Figure 2.12, care more about facilitating understanding, encourage self-directed learning, interact and discuss problems students encounter in learning, provoke debates and develop conversations with students to encourage conceptual change. Those teachers use a variety of assessments and are considered to have a great part of the responsibility for their students learning. They encourage students to develop deep levels of understanding and transform their conceptual thinking (Trigwell et al., 1999). Students gain skills in providing arguments and explanations with evidence and develop a personal view on the topic (Entwistle, 2000).

Therefore, teachers' approaches to teaching and assessment influence their students' approaches to studying and through those, the learning outcome (Trigwell et al., 1999).

The next section discusses the relationship between deeper learning and how information is encoding, stored and retained in memory.

2.6.3. Memory and Deeper Learning

Human memory involves the acquiring, storing and recalling information learned or experienced. Information in the memory can last seconds (sensory memory, short-term memory) or days, weeks, months and decades (long-term memory). Memory, learning and retention of information are closely connected because learning retains in human memory (Conway and Loveday, 2015). On the other hand, forgetting is a common occurrence in memory. Cognitive psychology contends there are numerous reasons why information fades from memory. Among the reasons is the failure to store and retrieve information, or the failure to encode information correctly to the memory (Moreno and Mayer, 2005).

There are many theories and studies on storing and retrieving information from memory. The Decay Theory proposed by Thorndike (1914), argues that the critical factor for forgetting information is time, particularly if the information has not been revisited or recalled. Knowledge learned can easily be forgotten if people do not actively review or rehearse what they have learned (Cherney, 2008). The time needed for the loss of information from memory is not defined because of numerous reasons and factors that influence the memory such as physical, emotional and psychological factors. Interference theory describes forgetting learned information as the interference of new knowledge with previously retained information that hampers one another causing memory loss (Moreno & Mayer, 2005)

Researchers suggest that individuals can remember longer the information processed to a "deeper" level than information processed only at a shallow level. Deeper levels of analysis last longer in memory than superficial analysis. information that resonates with learners' own experiences facilitates good memory in an elaborated and well-organised network of knowledge. Interpreting information, connecting it with previous knowledge and reflecting on it, is another aspect facilitating deeper encoding of information (Cherney, 2008).

Another method of retaining knowledge in memory is by stimulating imagination. Imagination creates visuals and connections in the brain, which can lead to significant improvement in memory and retention (Tansel, 2013). This method is associated with the creativity that this thesis examines, and it is discussed later in this chapter.

2.6.4. Assessing Deeper Learning

Measuring deeper learning cannot be explicitly defined and measured. However, setting criteria of what is expected by the learners who have reached deeper learning provides a means of measuring it. Pellegrino and Hilton (2012) suggest the transfer and retention tests for measuring deeper learning. They contend that learners who can transfer and apply their knowledge in new contexts and retain their knowledge in their memory for a long period have possibly achieved deeper learning.

The *transfer tests* (see Figure 2.13) evaluate learner's deeper learning by measuring learner's ability to use what they have learned in new situations (Pellegrino and Hilton, 2012; Mayer, 2010). Although using knowledge learned is required to accomplish retention tests, achieving transfer tests requires deeper processing that includes organising new knowledge and integrating with prior knowledge in learner's mind.

The retention tests are designed to measure the learner's memory on the learning material through recall tests and recognition tests (see Figure 2.13). If the information makes sense to the learner and has a meaning, then it is most likely to retain in the long-term memory (Sousa, 2017) and learners will remember it for a longer time. Otherwise, if learning is based on rote memorisation and learners don't make sense of their learning, they will soon forget it, for example when learners memorise their notes only to pass their exams.

In this PhD research, both transfer and retention tests are used in measuring deeper learning with SGs.

To explain better the measurement of deeper learning using transfer and retention tests we resulted in drawing the Figure 2.13, derived from the discussion of Pellegrino and Hilton, (2012), Mayer (2010) and Sousa (2017).

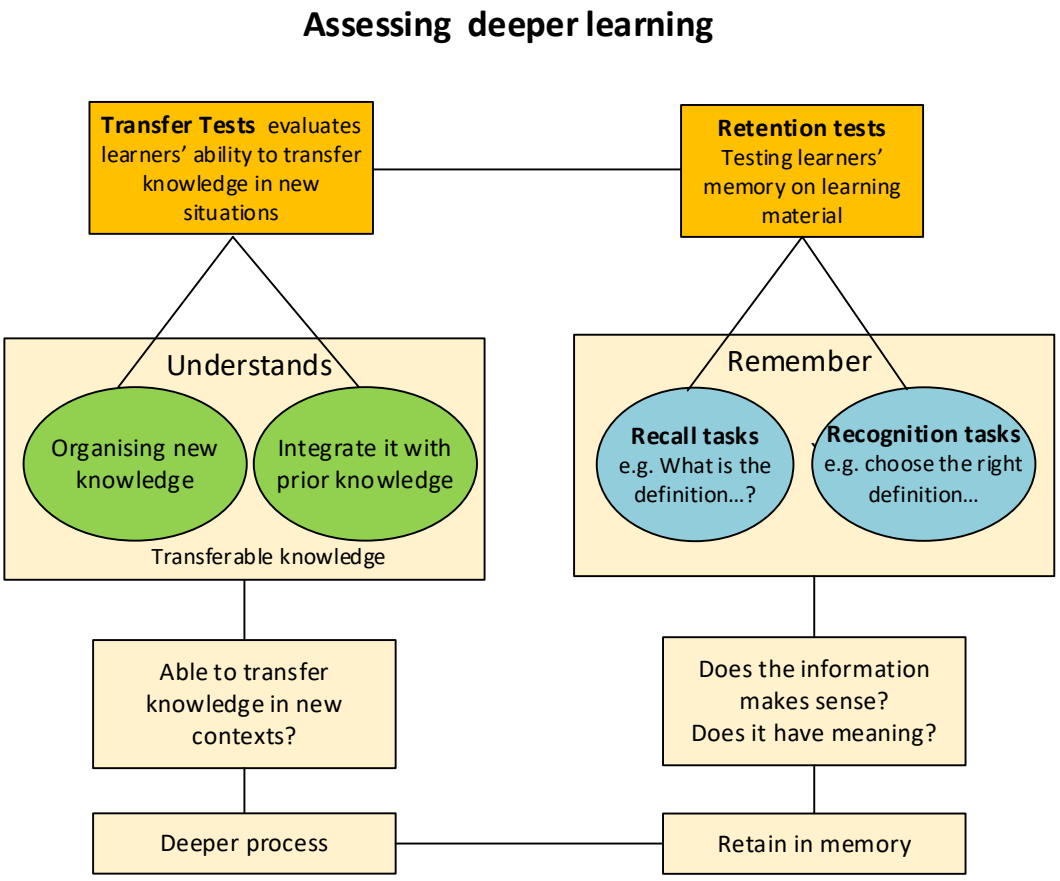


Figure 2. 13. Assessing deeper learning (adapted from Pellegrino & Hilton, 2012)

The results from transfer and retention tests are summarised in three categories of learning outcomes shown in Table 2.3 (Mayer, 2010).

Type of Outcome	Transfer Performance	Retention Performance
No learning	Poor	Poor
Rote learning	Poor	Good
Meaningful deep learning	Good	Good

Table 2. 1. The three types of learning outcome (Mayer, 2010).

If transfer and retention tests performance are poor, then there is No learning. If the transfer test is poor and the retention test is good, then there is Rote learning. If both transfer and retention test are good, then meaningful and deeper learning occurs.

Therefore, there are two distinguishing elements used in the current project:

a. the ability of the learner to transfer their knowledge in solving problems in new situations using the transfer tests.

b. the ability of a learner to remember their knowledge using the retention tests;

The current PhD study measures deeper learning with the use of transfer tests to assess transferable knowledge achieved while learners actively participate in creative tasks. Then a retention-knowledge test is used to assess the knowledge held in long-term memory.

The next two sections present how the component of empathy and creativity form two significant elements of DeLEC framework that actively engage learners and support them to achieve deeper learning.

2.7. Empathy

Empathy is defined as *"an observer reacting emotionally because he perceives that another is experiencing or about to experience an emotion" (Paiva et. al., 2005, p.237)*. Putting ourselves in the shoes of another and feel emotions about what is happening to them is empathy (Paiva et al., 2005). Empathy contributes to stimulating the attention and interest as well as in changing the behaviour of a learner (Stephan & Finlay, 1999). As argued by educators and game designers, promoting empathy is part of civic and moral education (Flanagan & Nissenbaum, 2014).

Empathy is studied through the lenses of many disciplines and becomes part of the theory and research on:

- how people experience empathy (Stocks et al., 2009);
- whether and how empathy could be taught (Shapiro et al., 2004);
- how empathy affects attitudes and behaviours (Nickerson et al., 2008).

There are many examples in teaching and training of using empathy, such as in conflict resolution; counselling psychology; nurse and doctor training; parent training; rape prevention; social work; and social education to encourage tolerance and support towards victimized groups (Belman & Flanagan, 2009).

2.7.1. Parallel and Reactive Empathy

The Dual Theory model of empathy proposes two routes of empathy (Yu & Chou, 2018). Cognitive empathy and affective or emotional empathy are explained below.

a. ***Cognitive Empathy*** refers to the intentional efforts to understand a person in respect to their cultural norms, values, beliefs and differences (Belman & Flanagan, 2009).

b. ***Affective or Emotional Empathy*** refers to the emotional responses towards another person and has two distinct types (Stephan & Finlay, 1999):

   i. ***Parallel Empathy*** occurs when a person empathises with somebody else by sharing the same feelings with them, for example, a student feels fear and embarrassment witnessing another student being bullied who feels also fear and embarrassment being in this situation;

   ii. **Reactive Empathy** occurs when a person empathises to another person feeling different than the other person, for example, a student feels anger witnessing another student being bullied who feels fear and embarrassment being in this situation.

Figure 2.14 illustrates the categories of empathy.

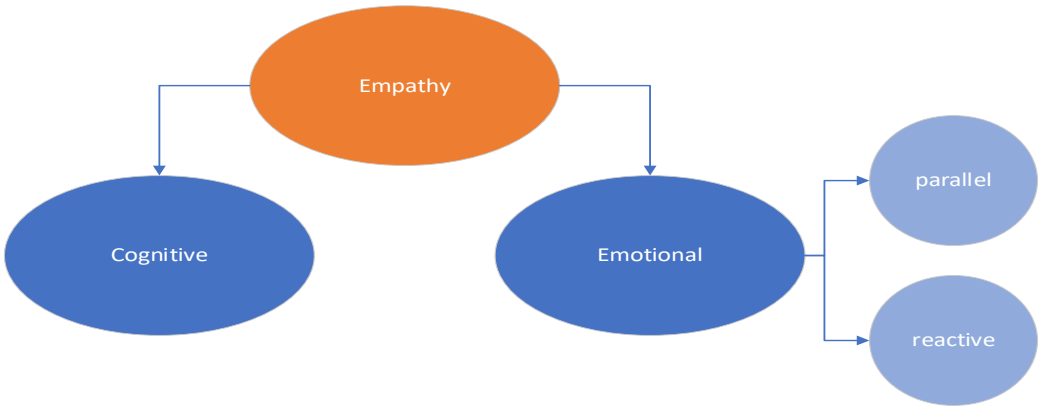


Figure 2. 14. Types of Empathy (adapted from Stephan and Finlay, 1999, p.736)

2.7.2. Empathy in SGs

SGs are particularly appropriate in supporting players to represent characters and look into the perspectives of others (Belman & Flanagan, 2009). Empathy in SGs triggers attractive potentials in motivating learners and in promoting behavioural change (Belman & Flanagan, 2009). SGs can well simulate an issue allowing players to experiment and find solutions by taking roles of others to experience, understand and empathise with people from vulnerable groups (Belman & Flanagan, 2009).

There is substantial growing interest from organisations and researchers to develop resources and to direct game designers to create "*games for good*" (Stokes et al.,

2011). Games for good focus on social issues and target in achieving behavioural change to players. Many games are designed to teach prosocial behaviour against bullying, domestic violence, drugs, alcoholism and other serious social issues (Stokes et al., 2011). The research revealed that playing prosocial games increases prosocial cognition and behaviour and decreases aggressive cognition (Greitemeyer et al., 2010). Playing prosocial games is assumed to increase empathetic concern towards others who are suffering and reduce the pleasure at someone's misfortune (Greitemeyer et al., 2010)

This PhD study follows the game designed principles proposed by Belman and Flanagan (2009) to integrate empathy in the design of educational SGs.

2.7.3. Game design principles that foster empathy in SGs

Belman and Flanagan, (2009) suggest four game design principles to integrate empathy in SGs that can be used by the game designers who want to invoke players' empathy in a game:

- Principle #1

  If players while playing a game are instructed to make intentional efforts to empathise, they are more likely to empathise, otherwise they will play without empathy.

  The empathy game should instruct players from the beginning of the game to make intentional efforts to empathise with the game characters (Belman & Flanagan, 2009). This principle defined based on the studies of (Stephan & Finlay, 1999) and (Batson et al., 1997) where participants taking part in those experiments showed no changes in attitude or behaviour when they solely watched films of stories of victimised groups. When they were asked to make a purposeful attempt to empathise with those characters, then films had a positive impact on their attitudes and inspired the altruistic attitude. Mindfulness is the mode of playing where players continuously reflect on what they have learned. However, players do not normally play in a "mindful" mode unless being prompted to do so, by teachers, or in-game messages. Belman and Flanagan, (2009) suggest "empathetic play" that instruct players to induce empathy at the beginning of the game.

- Principle #2

When players get empathised and there are issues to be solved in the game, then it is essential to provide explicit instructions to the players about how to address these issues in the game.

Urging players to empathise with a person (real or fictitious) who is suffering and providing explicit directions to help to address such issues is essential. If players have no instructions about how to help the situation, then they remain with empathetic pain and emotional trauma. Possibly players may avoid putting themselves into feeling empathy in the future to protect themselves from experiencing this unpleasant situation again (Schroeder, Penner, Dovidio & Piliavin, 1995).

- Principle #3

  Emotional empathy can occur and willingness to help one who suffers if the game situation is relevant to the personal beliefs of the players.

  If players get engaged in a game where the situation is close to their personal beliefs, then it is more likely that they would consent and agree to follow or help the situation described. In a different situation, where a game promotes values or beliefs that the players are not keen, likely, players would not compromise or help. To change players' beliefs, the game should put the player facing the same situation or getting the position of a game character in the game.

- Principle #4
  Empathy could be induced if games highlight specific similarities between player and people of groups depicted in the game

  If the players find similarities with the game characters then this could invoke empathy towards the game character (Paiva et al., 2005) and demonstrate positive attitude changes, especially when they value the same things. For example, if the game depicts a family with strong family relationships and this resonates with player's values, then is more likely that the player will find it easier to empathise.

The game design principles of Belman and Flanagan (2009) have been taken into consideration while designing the Stronger game (see Chapter 5) and they were applied to the design at the appropriate level in the game. Principle 1 and 2 were part of the design, while principles 3 and 4 were applied according to the profile of

each of the players. The design of empathy used in this serious game is described in section 5.4.6.

2.8. Creativity

Creativity is a mental process that involves the invention of new ideas, the production and associations between existing ideas and concepts. The outcomes of creative thinking are thought to include originality and appropriateness (Walia, 2019).

Creativity is an essential component of active learning (Rankin & Brown, 2016) when is facilitated in a positive learning environment (Sternberg, 2006). Creativity can be included in all areas of the school curriculum spanning from expressive arts to science.

Understanding the definitions given by several authors, (Walia, 2019) suggests four elements that characterise creativity answering four questions:

1. What is Creativity?

   Creativity is a cognitive activity that results in creating something new and original. It can be a physical object or even a mental or emotional concept.

2. What kind of activity is it?

   Creativity is a productive activity that refers to the brain's ability to generate original images combining the past experiences and knowledge.

3. Why is there a need to produce something new?

   A complete equilibrium in the world gives no motives for individuals to be creative. Humans remain in the frame of their existing conformity. Disequilibrium bears the need for production and creativity. An example of creativity is the artists in Athens who became exceptionally creative during the economic crisis since 2008. Another example of creativity is found during lockdown due to the pandemic of Covid-19.

4. What makes a new creation or change?

   Creativity is about perceiving an original problem than finding a novel solution.

2.8.1. Creative pedagogy

Creativity within pedagogy motivates individuals to apply their knowledge productively, analyse and synthesise information purposefully build confidence in their abilities, and have fun while learning. When learners get creative they become enthusiastic and engaged in their learning (Rankin & Brown, 2016).

Jeffrey and Craft, (2004) created a model with three elements of creative pedagogy which are listed below and illustrated in Figure 2.15:

1. *teaching for creativity*

   Teaching for creativity means teachers aim to identify students' creative abilities and provide opportunities to assist them in developing these creative competencies (Jeffrey & Craft, 2004).

2. *creative teaching*

   Creative teaching occurs when teaching includes creative approaches to make learning more efficient, attractive and useful (see below Table 2.1). According to Lin (2011), discussions around creative teaching and teaching for creativity neglect in many occasions the spontaneous willingness of the learner for creative learning that includes experimenting, playfulness, autonomy, spontaneity, collaboration and imagination.

3. *creative learning*

   Creative learning is a middle ground between creative teaching and teaching for creativity. Creative learning requires teachers to provide opportunities for students to develop new meaningful learning, share and receive feedback on their unique perspectives, as well as provide the ground to students to contribute to their peer and teachers learning (Beghetto, 2016).

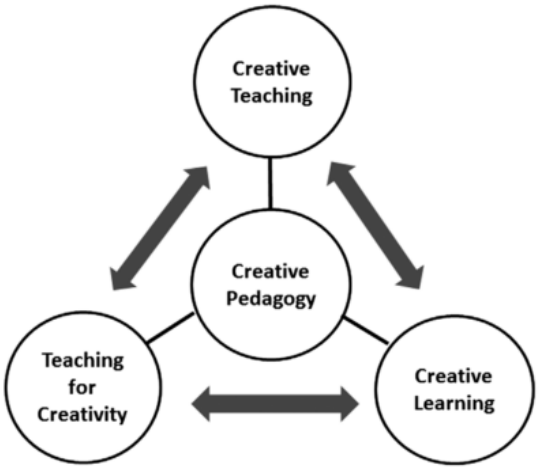


Figure 2. 15. The three elements of Creative Pedagogy (Lin, 2011, p. 152)

2.8.2. Supporting creativity in the classroom

Teaching approaches, affect the motivation and creativity of students. Creativity outcomes revealed from the study of Hennessey & Amabile, (2010) who explored the impact of two instructional approaches on a creative problem-solving: the algorithmic and the heuristic. Each instruction approach had a different impact on student's perceptions on completing the task, their behaviour during the task and the final solution they came up to solve the problem. Two cohorts of students had to create a game following the algorithmic or heuristic instruction. Students who followed the algorithmic instruction were given instructions and steps to create the game. Students demonstrated higher confidence and speed, but their solution and their final product did not deviate much from the sample structure. On the contrary, students who followed the heuristic instruction were not given additional instructions or steps on how to create the game. These students showed greater engagement and exploratory behaviour and produced a final product that was different from the sample structure. However, the freedom to use their imagination and their creative thinking to design their own original game increased their enthusiasm and enjoyment to learn more.

In a systematic review on creativity studies, Chan (2013), reviewed the results of eight studies on teaching and learning nursing programmes through creative artworks. These programmes were designed to help nurses learn creatively through forms of arts such as music, dance, sculpture, painting, drama, story, poetry and

other forms, developing the ability to create, analyse and brainstorm. Nurses were asked to express their clinical experience through storyboarding, by drawing the scenes and writing their clinical descriptions. Using storyboarding, nursing students were engaged in creative, critical and reflective thinking. Students had an active role in the teaching and learning process which stimulated their creativity and put their knowledge into practice.

Students play a crucial role in forming a creative learning environment by demonstrating willingness and confidence in sharing their unique views and ideas and similarly supporting their peers to do the same (Beghetto, 2016). Teachers play also an important role. Instead of lecturing and giving out the information, teachers challenge students to think and participate creatively. According to (Beghetto, 2016; Davies et al., 2013; Gajda et al., 2017), teachers role in supporting creative classroom includes:

- inspiring students to use their imagination;
- allowing students for discovery and choice;
- providing opportunities for more game-like or playful approach;
- challenging students with questions and ideas;
- helping students build their confidence to encourage them to express their creative ideas;
- encouraging students to take sensible risks and act independently.

Table 2.1 tabulates examples of creative activities that can be integrated into the teaching and learning process as described by Chan (2013).

Creative Activities
Role-playing
Drawing, Writing
Storyboarding, Storytelling
Music, dance, painting, drama, story, poetry, sculpture
Construction with wood, paper, fabric
Debate and negotiations

Table 2. 1. Creative activities to support learning (Chan, 2013)

Other approaches to learning through creativity refer to Project-Based Learning (PBL) that encouraged students to get involved in discussions and think more

creatively into building the solution as well as learning through Group Work. Group work encourages students to share their ideas and learn from each other, think creatively, and understand how to put together what they have learned.

2.8.3. Creativity and deeper learning

Activities that involve learners in creative processes can link to deeper learning (Caperton, 2010). Learning-by-doing is suggested by Seymour Papert (1928-2016) who founded the learning theory of Constructionism. According to the theory, students should participate in project-based activities and learn by doing things rather than by being told. Moreover, according to Van Eck (2006), Papert suggests that learning occurs more effectively when learners build their knowledge by being actively involved in creating tangible objects in the real world. The learning theory links to *experiential learning* and builds on Piaget's theory of constructivism. Papert has been a great proponent in bringing technology into the classroom and he suggested *LOGO* as the first educational computer programming language to draw visual shapes using lines, steps and angles through coding.

The research thesis suggests that learning is enhanced to deeper learning when transferred and applied to new contexts using creative activities. For example, designing and coding a game, students actively participate in a creative process acquiring learning through learning by doing and producing something meaningful (Ke, 2014).

2.9. Summary

The chapter presented the state of the art of SGs in education and discussed the main elements that are combined with serious games in this thesis to support learning. Explaining how people learn with serious games, there is a description of the Cognitive Theory of Multimedia Learning and factors that support learning with serious games, such as motivation and the flow theory, and how the formative assessment and feedback is integrated into the learning process in serious games. This thesis is focused on serious games in the form of role-playing games and two successful examples of such games found in the literature and presented. Following the examples, the chapter analyses and discusses three principal frameworks suggested in the literature for the design of SGs in education. Then there is a discussion of the main elements used in the current thesis as described in the literature. The main elements are: (a) the deeper learning, deep and surface

approaches to learning, the effect of deeper learning in memory, and the assessment and evaluation of deeper learning, (b) the use of empathy in serious games and the dual routes of empathy, and its integration to the instruction in the current thesis and (c) creativity as a mean of supporting learning and deeper learning and retaining of knowledge in memory. Deeper learning, empathy and creativity linked to instruction and assessment are used in the current thesis to form the proposed pedagogic framework for deeper learning which is described in the next chapter.

Chapter 3. The Deeper Learning Empathy Creativity framework (DeLEC)

This thesis proposes the development of a new framework to address the lack of a pedagogic framework that assists the achievement of deeper learning with serious games. This chapter discusses the integration of learning theories and in the design of serious games for learning. It describes Bloom's Learning for Mastery theory as the learning theory to become the foundation for the design of the framework proposed in this thesis. The new pedagogic framework proposed in this thesis by the author is the Deeper Learning Empathy Creativity (DeLEC) framework which is designed to put forward a solution in reaching deeper learning using serious games. DeLEC framework integrates the learning process that contains the elements of empathy and creativity. The learning effectiveness of the DeLEC framework is examined through the design of a serious game which is tested and evaluated with participants emerging results about its efficacy as a serious game and as a valid and value-added framework.

3.1. The lack of pedagogy in SGs

The literature reports positive results of SGs designed for improving knowledge and skills in several domains such as using SGs for learning foreign languages (Moura, 2015), improving mathematics skills (Chorianopoulos & Giannakos, 2014), learning history (Lercari et al., 2014), building environmental consciousness (Boomsma et al., 2018), contributing to improving social and behavioural change (Dunwell et al., 2013).

However, according to Gunter et al. (2008), SGs design is not based on well-established learning and instructional theories, taking the risk of failing to meet their intended educational goals. The authors argue that the positive learning outcomes that can occur with SGs are mostly attributed to the game setting and game elements that can increase motivation and achieve skill-building and behavioural change. Hence, their learning effectiveness attained in motivating learners to play SGs and in social interactions than to their effectiveness as a knowledge acquisition standalone mechanism. They concluded that an educational game which its learning content is poured in the game in an afterthought manner hoping to motivate learners just because its learning content is housed into the game then the game is not an effective learning tool.

Similarly, Bartolomé et al. (2018) claim SGs that are designed to provide personalised and adaptive learning lack pedagogical perspectives. To explore the pedagogic nature of personalisation from the perspective of educational technology, the authors suggest it is necessary to understand the form of didactic implementation of personalisation technologies.

The literature suggests the necessity of designing SG underpinned by educational theories and pedagogic principles. Therefore, the new pedagogic framework DeLEC proposed in the thesis is designed taking into consideration the following gaps as emerged from the literature:

1. Lack of pedagogic principles to underpin the design of SGs that target learning and deeper learning;
2. Lack of a pedagogic framework to guide the design of SGs that target learning and deeper learning;
3. The appropriateness of Bloom's LFM to become the foundation on which the DeLEC framework is developed.

4. Lack of any SG designed in providing the solution for reaching deeper learning.

Reporting these gaps in the literature and extending LFM educational theory, and adapting it in SG, integrating Empathy and Creativity, this thesis proposes the new pedagogic DeLEC framework to reinforce its design on the foundation of Bloom's Learning for Mastery (LFM) which is described in section 3.3.

3.2. The suitability of the Learning for Mastery model

This section attempts to explain why the educational theory of Bloom's LFM is the appropriate educational theory and chosen to underpin the design of the proposed DeLEC framework.

Learning for Mastery (LFM) (also known as Mastery Learning) is an educational approach based on the idea that learners develop mastery in their learning by repeating instruction, revising, and reassessing their knowledge at the level they have proved to have bridged their learning gaps and covered their learning objectives before moving to the next learning section (Guskey, 2007). The LFM educational theory entails formative assessment which is related to deeper learning.

Deeper learning is a process through which learners are capable of taking what they have learned in one context and transfer it in another context to gain expertise and become capable of solving new problems (Pellegrino & Hilton, 2012). An example is when learners apply fractions in practical/meaningful way such as measuring portions of ingredients for cooking a recipe.

Deeper learning involves formative assessment which frequently evaluates the level of acquired learning to suggest corrective actions. Formative assessment is related to teachers' approaches to teaching that affect students' approaches to learning. When teaching entails a summative assessment that usually occurs only once when completing all the learning material, then learners adopt surfaces approaches to learning and rote memorisation. On the contrary, when teaching involves frequent formative assessment then learners stay in touch with their learning material, study and assessed more frequently and hence adopt deeper approaches to studying and learning (see Section 2.6.2).

Thus, deeper knowledge retains longer in memory (see Section 2.6.3) contrary to

learners who study only to pass exams and use rote memorisation without doing the effort to make any links in their brain, risking in easily forgetting their learning after they passed the exam.

Both Learning for Mastery and Deeper Learning are related in making cognitive relations and encoding information in long-term memory, therefore, retaining information longer in memory.

3.3. Bloom's Learning for Mastery

LFM is an educational model, proposed by Benjamin Bloom (Benjamin S. Bloom, 1968), an American educational psychologist who is also known for his Taxonomy of Learning Objectives (B S Bloom et al., 1956). LFM gained considerable importance in the educational community as an effective method for gaining Mastery in learning and improve learning achievement (Guskey, 2007).

Bloom observed that teachers use the same approaches for teaching all students with different skills and abilities and allocate the same time to learn. Bloom observed that such approaches created considerable variation in students' performance. Students who find this teaching approach appropriate perform higher than students who find this teaching approach less appropriate for them. Bloom suggested LFM as an educational approach that supports a learning process where students can succeed better results and reduce variations of performance among them. This can be achieved by teachers adopting a different type of instruction (Guskey, 2007), providing different time and means of learning to meet students' individual learning needs and help them achieve mastery.

LFM suggests a learning process which is divided into instructional units. Each student has to master the learning unit before proceeding to the next one (Arlin & Webster, 1983). The LFM consists of the following elements (Livingston & Gentile, 1996):

a. defined learning objectives;
b. the passing score that defines mastery;
c. feedback and corrective activities.

Figure 3.1 depicts Bloom's LFM educational model, where the LFM instructional procedure is divided into instructional units. It starts with instruction for unit 1 to

cover the defined objectives. Each student has to master the instructional unit before proceeding to the next one (Arlin & Webster, 1983). To master each unit, students follow the instruction and then complete the formative assessment A to assess their learning. The formative assessment A sets a passing level (score) which defines whether learners reached mastery. Students who pass the formative assessment A, are considered successful and they continue their learning with enrichment activities.

Learners who fail to pass the Formative assessment A have not achieved mastery, and they are not progressing to the next unit because they still have learning gaps. In this case, teachers provide correctives to support learners in bridging their learning gaps.

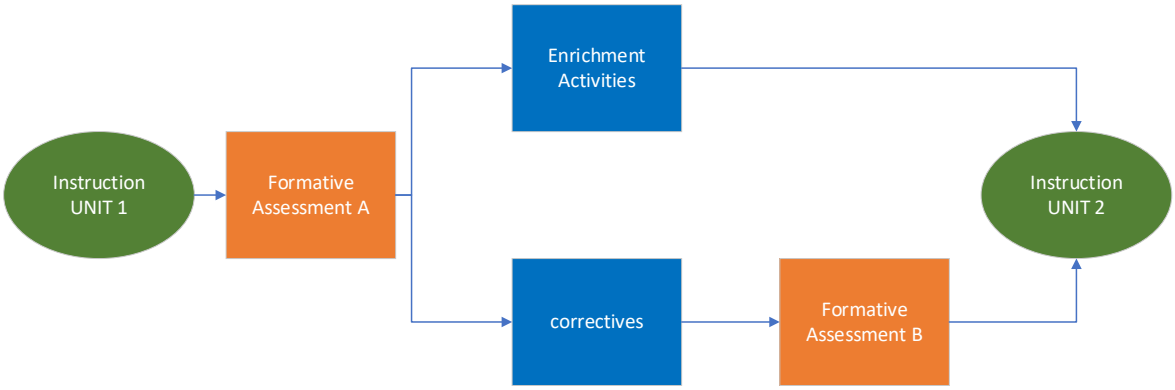


Figure 3. 1. Bloom's LFM (Pelkola, Antti and Christofer, 2017), p.4

Correctives include one-to-one tutoring, individualised instruction within a group-based classroom setting, providing alternative learning resources (Guskey, 2007). Learners who have gone through correctives have another opportunity to pass the formative assessment B to evaluate their improved learning before they move to the next unit.

The second formative assessment satisfies two reasons:

a. it ensures that correctives helped students in overcoming their learning difficulties and achieve learning;
b. it offers learners a second opportunity to become successful, and therefore, it increases their motivation (Livingston & Gentile, 1996).

Learners who passed the formative assessment A are considered the "fast" learners. Bloom suggests that teachers should provide fast learners with enriching activities while the "slow" learners are doing the correctives so that later all students move to

the next unit. Enriching activities can include advanced exercises or advanced problem-solving tasks, research and production of reports.

Figures 3.2 and 3.3 below depict the learning performance of students marked A, B, C, D and F. Figure 3.2 depicts the performance of students in a traditional classroom. The normal distribution suggests that the majority of students perform around C grade. Fewer students perform A and B grade.

Figure 3.3 depicts the performance of students following the LFM educational model. The curve is shifted to the right, showing that most students, perform better with more A and B grades and fewer C and lower grades.

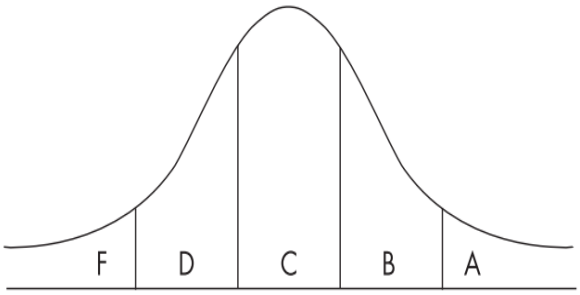


Figure 3. 2. Students' performance in a traditional class

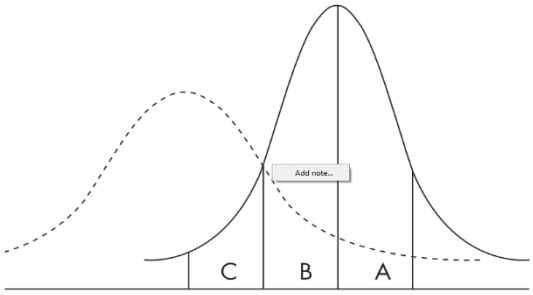


Figure 3. 3. Students' performance with LFM

3.3.1. Proponents and opponents of LFM

Proponents of Learning for Mastery (LFM), in their research findings, support that this theory produces successful learning experiences, high level of retention and satisfaction emphasising the role of the teacher in persisting into supporting students to reach mastery in learning (Whiting et al., 1994).

Bloom made two statements associated with LMF:

a. when learners are given feedback, correctives and individualised support, under ideal conditions of mastery learning, they become gradually competent until the difference between fast and slow learners cannot precisely be measured in time.

b. when the quality of instruction and the amount of time becomes available to learners considering their characteristics, their aptitude, and their needs in

learning, most of the students are expected to achieve mastery on their subject (Livingston & Gentile, 1996).

However, there is a debate on LFM among criticisms who support that within limited schooling time, individual differences in students are reflected through differences in their learning performance (Arlin & Webster, 1983). Teachers believed that the constraint of limited class time would restrain their efforts to implement mastery learning and therefore they won't be able to cover the amount of the material defined by the school or the curricula (Horton, 1976).

Other criticisms argue that Bloom's Mastery Learning (Gage and Berliner, 1988; Mueller, 1976):

a. removes the responsibility for learning away from the students who learn to have support to fill their gaps;
b. the time for applying the strategy is not enough during the class time;
c. fast learners should wait for slower learners to catch up;
d. a large amount of time is committed for the correctives;
e. supports that all learners need to learn equally.

The DeLEC framework discussed in the next sections addresses these criticisms.

3.3.2. Bloom's LFM applied in SGs

After examining many educational models, Bloom's LFM was adopted and adapted for designing SGs aiming to support learners in achieving deeper learning. The main reasons for selecting Bloom's LFM are the following:

a. LFM is an integrated learning model providing instruction, formative assessment and feedback and can facilitate the design of such learning procedure for SGs aiming in achieving deeper learning;
b. LFM includes iterations to help learners achieve learning which is a procedure that can be designed and applied in SGs;
c. LFM refers to learning mastery which, as a learning achievement, is considered compatible with deeper learning.

The LFM learning process applied to SGs aims to overcome:

- the criticism discussed earlier (see Section 3.3.1.) related to lesson time constraints;

- the criticism about the waiting time of successful learners for other learners to reach the same level as them.

SGs, designed to integrate LFM, can deliver learning independently of time constraints because the serious game, can be played individually, according to the time and pace of the learners. Moreover, the use of instruction and formative assessment in SGs can be played repeatedly as many times required to achieve learning.

3.3.3. Bloom's applied in DeLEC framework

Bloom's LFM provides the foundation of DeLEC framework. The LFM components of instruction, formative assessment, feedback, repetitions, and correctives provide a potential solution for designing SGs for achieving deeper learning.

DeLEC framework suggests the development of a new learning process that adapts Bloom's LFM for SGs. The DeLEC framework includes:

a. instruction;
b. formative assessment and feedback;
c. repetition;

integrating two more components:

a. empathy;
b. creativity.

Empathy is the component integrated into the instruction phase and serves the purposes of motivating and engaging learners facilitating learning more effectively (see Figure 3.4).

Creativity is the component proposed for LFM's enrichment activities. Creative activities allow the transfer of knowledge gained during the instruction phase into new contexts transforming the new knowledge into deeper knowledge (see Figure 3.4). This is translated into transforming the surface knowledge to deeper knowledge.

3.4. The proposed Deeper Learning Empathy and Creativity (DeLEC) framework

This section proposes the DeLEC framework which is a new original pedagogic framework, conceived and developed by the author in this research thesis to become

the backbone and the guidance in designing SGs as the educational technology solution targeting deeper learning and forms one of the main contributions of this work. The DeLEC framework is designed according to the guidelines and remarks emerged from the literature review concerning the lack of pedagogy in SGs design and the necessity of learning theory to support the SGs design (see Section 3.1). The DeLEC framework defines a learning/teaching process that extends Bloom's LFM using Empathy and Creativity and adapts this learning process for SGs to assist learners in achieving deeper learning using SGs.

Taking into consideration the components described in section 3.3.3, the proposed DeLEC framework is described below and illustrated in figure 3.4.

The DeLEC framework as a learning process contains two phases:

- *the instruction phase* which includes activities that support learners to meet the expected learning objectives referred to this level of learning as surface learning and,
- *the creative phase* which involves learners in activities that support them to transfer and apply their learning in a new situation demonstrating the transformation of knowledge into deeper knowledge.

The learning process states that learners are exposed to the instruction phase first and then they deepen their learning by completing the creative phase. Figure 3.4 illustrates the phases and the components of DeLEC framework.

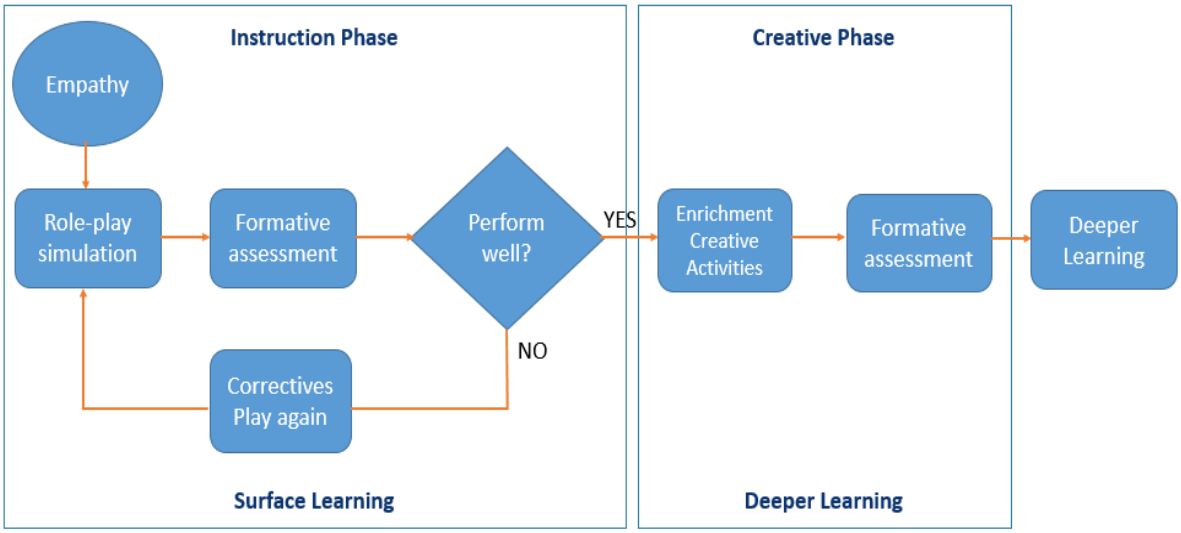


Figure 3. 4. DeLEC Framework - Deep Learning, Empathy and Creativity Framework

(1) DeLEC: The instruction phase

The instruction phase illustrated in figure 3.4, contains learning units that include learning objectives. At the end of the instruction of each learning unit, learners evaluate their acquired knowledge through formative assessment. The feedback indicates whether learners have performed well or not by assessing their level of achievement with the passing score.

If learners perform well, it means they have achieved the passing level and they progress to the creative phase. If learners perform lower than the passing level, then they are prompted to do the correctives. Correctives in DeLEC mean that learners are transferred back to revisit the learning unit and go through the instruction again to fill their learning gaps and then have another formative assessment. When learners complete the instruction phase, they progress to the creative phase.

(2) DeLEC: The Creative phase

In DeLEC framework, the creative phase comprises of creative activities and formative assessment. DeLEC framework suggests that creative activities contain any form of activities that enable the invention, composition, combination, creation and production of a new, innovative and original concepts and digital products derived from ideas connected to existing knowledge. The creative phase allows the environment to transfer and apply attained knowledge in a new situation demonstrating its transformation into deeper learning.

(3) The use of empathy

The instruction phase in DeLEC framework integrates empathy in the learning procedure as a motivational game design element shown in figure 3.4. The learning process evokes the learner to make intentional efforts to empathise with the game characters. Invoking empathy is proven an engaging and motivating element for learning (Jarvis, 2012).

(4) From surface to deeper learning

The instructional phase launches learners to surface learning. Learners acquire knowledge which is yet shallow; they have not reached deeper learning. DeLEC framework suggests learners should transform their surface learning into deeper learning. Deeper learning is built gradually through the phases of DeLEC

starting from instruction and continue to the creative phase. Creative activities allow learners to associate the acquired knowledge with their prior knowledge. The DeLEC framework suggests the creative phase to include synthetic and creative tasks to support the transferring, extending and connecting the acquired knowledge to devising and formulating new ideas, that support learners in reaching deeper learning (Fullan & Langworthy, 2013b).

(5) The formative assessment

Aiming in developing approaches for teaching and assessment that promote deeper learning, there is a necessity in establishing learning processes that integrate formative assessment, meaning providing continuous assessment and instant feedback (Lynch et al., 2012). DeLEC allows formative assessment in the form of frequent evaluation of the learning acquired by learners after the completion of each instructional unit. Formative assessment is designed to measure the learning achievement with the mastery score. If learners fail to achieve mastery, they are transferred to repeat the instruction.

The suggestion for applying the LFM model using SGs can overcome the claims of criticisms (see 3.3.1) that considered LFM is unachievable in the classroom due to time constraints; and the waiting time of faster students for the slower students to reach the same level of learning. The DeLEC framework as an adaptation and extension of the LFM model to address the needs of designing SGs aims to overcome those limitations as it is independent of time restrictions: individual learners can implement their learning, playing the serious game, on their own pace and replay it as many times as they wish to gain knowledge and deeper learning (Marda, Economou, Bouki, 2018).

3.5. Summary

The chapter presented the proposed DeLEC framework as the pedagogic solution and the guideline for designing SGs to assist learners in achieving deeper learning. The DeLEC framework addresses the needs of adopting an educational process to lead the design of SGs in achieving deeper learning. First, the chapter presented the LFM learning process. Extending and adapting the LFM for SGs, the proposed DeLEC framework addresses criticisms' arguments around LFM related to the limited and waiting time and hence puts forward a solution for achieving deeper learning overcoming classroom constraints. Then it presented the DeLEC framework which consists of the phases of instruction and creative activities. DeLEC integrates formative assessment, feedback, repetitions, empathy and creativity and suggests an iterative process that allows an iterative process of instruction and assessment as many times required for learners to reach deeper learning.

Chapter 4. Research Methodology

This chapter describes the research methodology designed to organise the data collection and analysis of this PhD research to address the research questions. The research methodology describes the design of experimental research which applies a quantitative method of data collection. Part of the experimental research is the development of a serious game designed according to the DeLEC framework described in chapter 3, aiming to evaluate DeLEC framework by recording players'/learners' learning performance. Also, the research methodology describes the design of a comparative study aiming to compare learning achieved by the experimental group using the serious game and learning achieved by the control group using another learning media following the conventional approach of learning. The research methodology describes the entire process followed justifying the use of the specific research method, the design of research instruments, the study plan, the recruitment of participants, the limitations as well as the ethical considerations of the research thesis.

4.1. Conducting scientific research for SGs

The research methodology is the process designed to address the research questions. The research methodology ensures that the research instruments are designed, and tested appropriately to administer valid, accurate and meaningful findings (Mayer, 2014).

According to Mayer (2011b), there are three types of experiments in SGs:

a. Value-added experiments

The purpose of the valued-added experiments is to determine whether the addition of the feature to the game causes a useful change in the learner's knowledge. The characteristics of the control and the treatment groups of value-added research design are the following:

i. control group: participants play a base version of the game
ii. experimental group: participants play the same game with one feature added.

b. Cognitive Consequences Experiments

This type of research is used to investigate if a specific game, when played for a specific time, can improve cognitive skills related to learning. If for example, an action game played for a couple of weeks could improve attention skills.

i. Control group: participants are engaged in an unrelated computer-based activity for a specific period;
ii. Experimental group: participants play an off-the-shelf game for the same period.

c. Media Comparison Experiments

This type of experiment aims to compare media and determine whether people learn better from games or conventional media. For example, if students learn fractions better if they are engaged in a math game for ten days compared to students that for the same content and the same period are completing spreadsheets.

i. Control group: participants learn academic material using conventional media;

ii. Experimental group: participants learn academic material by playing a game.

The current research methodology applied the *Media Comparison Experiments* in SGs as it develops a serious game to investigate and draw results about the learning achievement of playing a serious game compared to another conventional media of learning.

4.1.1. Violations in experimenting with SGs:

When conducting experiments with SGs, the following violations should be taken into consideration:

a. No random assignment

Random assignment is an essential feature for experimental comparisons (Mayer, 2014). People who participate in an experiment should be assigned in groups randomly. If, for example, the study requires participants to be grouped to game players and non-game players and participants assign themselves to any of the two groups selecting without following objective criteria, then there is a violation of the requirement if no investigation or assessment determined who of the participants are indeed game-players or not.

b. Non-appropriate measures of learning outcome

In empirical studies of SGs, researchers are investigating the use of games as a learning tool to enhance positive educational changes. Hence, when measuring the learning outcome, it is essential to use metrics that can support results about what is learned. Valid metrics of learning outcome include the analysis of means, standard deviation and sample size of variables. Asking participants to rate *how much they learned* while playing a game is not a valid evaluation (Mayer, 2014).

In the PhD study, participants are assigned randomly to the experimental and the control group without imposing any criteria about their experience in playing games or using e-learning applications.

Measures are planned to assess the learning outcome of the learners in both groups, and their performance in pre-tests and post-tests explained later in this chapter.

4.2. The Experimental Quantitative Research Design

The design of methodology guides the researcher in designing and implementing the research study obtaining the intended data and emerging results to give answers to the research questions. This study used experimental quantitative design to quantify, analyse and describe factors that constitute the proposed DeLEC framework described in chapter 3).

The research methodology suggests the development of a serious game, in the form of a Digital Role-Playing Serious Game (DRPSG) designed according to DeLEC framework (this is detailed in section 5.4). The design of the DRPSG targets the collection of data related to players' learning achievement which will help to verify the validity of DeLEC framework. Furthermore, it targets to compare the learning achievement obtained from the DRPSG and compare it with another digital e-learning tool, the Digital Course (DC), which is developed using a conventional method of learning (this is detailed in section 5.5).

DC is designed to represent a conventional digital approach to learning. It is selected to become the comparative digital tool in the research study because learning in the form of digital course using presentation slides is a common way used for designing e-learning courses.

The study is conducted as a comparative study with two groups of participants:

- the experimental group which tests the DRPSG; and
- the control group which tests the digital course.

To reach valid conclusions we need to examine whether:

- first, the proposed DeLEC framework is an efficacious learning process in achieving deeper learning;
- second, the proposed DeLEC framework is more effective than other digital conventional approaches to learning for achieving deeper learning.

Two research questions need to be answered:

1. **Does the proposed DeLEC framework increase participants' learning?**

i. Does the experimental group achieve higher learning compared to their learning before the testing?

ii. Does the experimental group achieve higher learning compared to the control group?

2. **Does the proposed DeLEC framework assist participants in achieving deeper learning?**

   i. Does the experimental group achieve deeper learning?

   ii. Does the experimental group achieve higher deeper learning compared to the control group?

Aiming at collecting data around the learning achievement using the DeLEC framework, the research methodology suggests the following process (see Figure 4.1).

The comparative study is planned to run in two parts in two different time points. The first part is the main study and the second part takes place at least four weeks later. In the first part of the study, both groups complete the same pre-knowledge test. Then the experimental group plays the DRPSG, while the control group completes the DC. Then both groups complete the same post-knowledge test and complete questionnaires assessing their knowledge. Four weeks later, the same participants are invited again to complete the retention-knowledge test. The data from the game and the digital course are stored and collected for analysis.

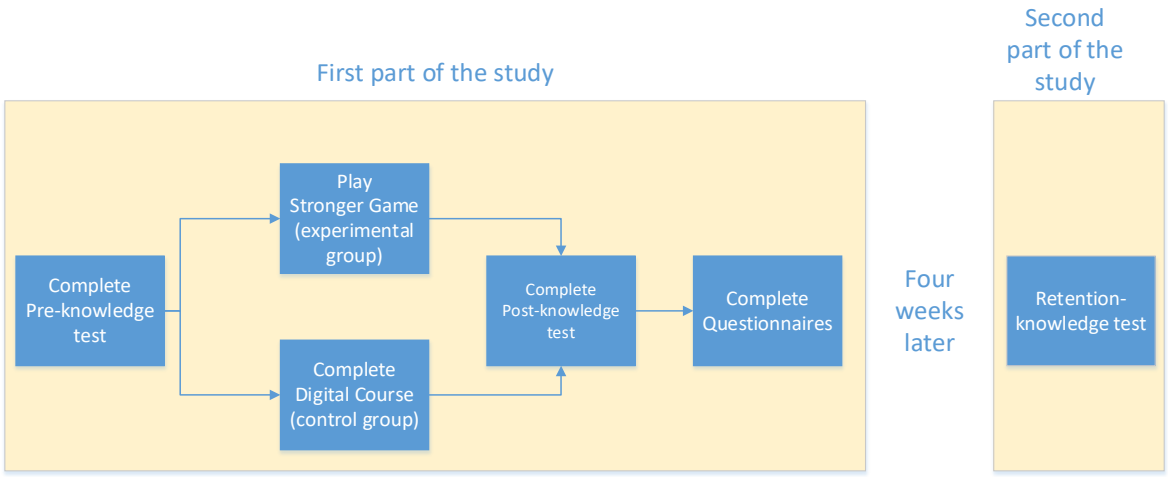


Figure 4. 1. The research study

4.3. Collecting Data from the Research tools

The research tools were designed to assist the collection of the appropriate data that answer the research questions. Before referring to each of the research tools

separately, the next table provides a summary of the data collected by each of the research tools (also see Sections 4.3.7, 4.3.8, 4.3.9, 5.4.1, 5.4.2, 5.4.3, 5.4.4, 5.4.5, 5.4.6).

Research Tool	Variables	Justification
Pre-test questionnaire (Done prior the DRPSG and DC)	Pre-knowledge score (16 questions of 10 points each max score=160) Measures the pre-existing knowledge on the topic	1. To identify that the sample has basic knowledge on the topic and allows enough room to develop further the knowledge. 2. To ensure that scores are normally distributed. 3. Allows comparisons between the two groups for the knowledge before and after the intervention.
Post-test questionnaire (done after the DRPSG and DC)	Post-knowledge score (16 questions of 10 points each max score=160) Measures the knowledge acquired using DRPSG and DC.	1. To compare pre-knowledge to post-knowledge and measure the knowledge acquired after using DRPSG and DC. 2. To compare the post-knowledge of each group and make conclusions about the learning effectiveness of each media tool.
Retention-test questionnaire (done 4 weeks after the DRPSG and DC)	Retention-knowledge score (16 questions of 10 points each max score=160) Measures the retention of knowledge 4 weeks later.	1. To compare the retention of knowledge of both groups 4 weeks later and make conclusions. 2. To compare it with pre-knowledge as for the amount of knowledge retained in memory and maybe assimilated with previous knowledge. 3. To compare it with post-knowledge and lead to conclusions.
Empathy questionnaire	Level of Empathy Likert scale 1 – 5.	1. To examine the level of empathy as rated from the experimental group. 2. Empathy level is a prerequisite for undergoing all stages of DeLEC framework and measure learning.
Creativity	Creativity Score	To emerge results as for the extent to which participants transfer their knowledge in new contexts.
Demographics questionnaire	demographics	To ensure that both groups have participants with similar demographics profile.

Table 4. 1. Justification for designing the research tools

The following sections describe in detail the data collected by each of the research tools to assist the statistical analysis and the emerge of conclusions that lead to answering the research questions.

4.3.1. The design of the Digital Role-Playing Serious Game

The DRPSG is designed and developed around the learning content of domestic abuse and includes instruction, formative assessment, feedback and repetitions. The designed variables set to measure the learning as follows:

- measuring participants' prior knowledge before starting the game;
  - **variable:** *pre-knowledge score*
- measuring the learning acquired during the instruction;
  - **variable:** *learning score*
- measuring the knowledge when completing the game;
  - **variable:** *post-knowledge score*
- measuring the retention of knowledge in memory after the passing of 4 weeks;
  - **variable:** *retention-knowledge score*.

4.3.2. Defining the categories of Low/Moderate and High Empathy

Measuring Empathy of users while playing the game is difficult and questionable in terms of objectivity. Objective methods to capture empathy required the recording of biometric data like eye movement, heart ratings, face expressions, etc. However, such a process falls beyond the need for this study. The record of the level of empathy of the participants has been measured by asking participants to use a self-report and a self-rating mechanism. Therefore, the values gathered for empathy are subjective and rely on the answers that participants submitted. An empathy self-report was designed using a Likert scale questionnaire with a scale of 1 to 5 that shows the low intense and the high intense of emotions and empathy. The necessity of distinguishing participants into low and high category resulted from the fact that none of the participants reported zero empathy. So, all participants have declared empathy even those who declared 1 (one) as empathy. In this case, there is no way to apply a comparison between the participants if assuming that all participants have empathy. Therefore, it was essential to distinguish participants into two categories to check whether participants who reported high empathy had indeed

achieved higher results than those who reported low empathy. As for which level of empathy is considered high and which is considered low and what is it between the two, the literature demonstrated similar examples.

Research around empathy showed that several psychological tests measure empathy. One of them is the Empathy Quotient (EQ), a psychological self-report that measure empathy. EQ is developed by Baron-Cohen and Wheelwright and measures cognitive and affective empathy. Empathy is the ability to understand another's emotion (cognitive empathy) and feel an appropriate emotion in response to another's emotion (affective/emotional empathy). Initially, the EQ was developed to test Cohen's empathizing-systemizing (E-S) theory of autism. The Empathy Quotient is intended to measure how easily a person picks up on other people's feelings and how strongly a person is affected by other people's feelings. The self-report is a 60-item questionnaire designed to measure adults' autism. Autism is believed to be an empathy disorder (Lawrence et. al, 2004). Hence, the EQ questionnaire takes the score of a respondent and categorise them in the next four categories:

Score	Meaning of scores
0-32:	A respondent has **a lower** than average ability for understanding how other people feel and responding appropriately.
33-52:	A respondent has **an average** ability for understanding how other people feel and responding appropriately. They know how to treat people with care and sensitivity.
53-63:	A respondent has **an above-average** ability for understanding how other people feel and responding appropriately. They know how to treat people with care and sensitivity.
64-80:	A respondent has **a high ability** for understanding how other people feel and responding appropriately. They know how to treat people with care and sensitivity.

Table 4. 1. EQ categories of Empathy according to score

Interpreting the above scale of scores, three categories are found:

i. 0-32: Category 1: Low ability;
ii. 33-63: Category 2: Average and above-average ability;
iii. 64-80: Category 3: High ability;

The optimum cut-off point

Taking into consideration the EQ categories and before defining the categories, the cut-off point is defined using the Histograms and the ROC Curve in SPSS. The process and the results of calculating the cut-off point are shown in Section 6.4.4. The optimum cut-off point is 3.50. This means that within the psychometric scale of 0 to 5 all values above 3.50 show that the participants have high empathy while all the values of 3.50 and below show a low or moderate level of empathy. Since the ratings are integer numbers, number 3 is the cut-off point (see Section 6.4.4.). According to the rating of the participants, the level of empathy they reported falls into the next categories:

i. 0: No Empathy;
ii. 1-3: Low/Moderate Empathy (LMLE);
iii. 4-5: High Empathy (HLE).

Chapter 6 demonstrates the numbers of participants with low/moderate empathy and a high level of empathy. To maintain the consistency, the variables empathetic score, creativity and empathetic characters, followed the same approach using Low and High categories.

4.3.2.1. The design of variables for measuring empathy;

As empathy is one important part of the DeLEC Framework and the DRPSG, empathy is measured using three metrics and it is categorised into Low/Moderate and High categories as explained in section 4.3.2.

- **Emotions Score**
  - This measurement indicates the intensity of players' feelings towards the game character, e.g. neutral, worried, afraid, angry, other. Participants rated their emotions in a 1 to 5 scale, where 1 is weak feeling and 5 is a strong feeling indicated for the victim game character. Respectively, participants are divided into the categories of High Emotions Score and Low/Moderate Emotions Score (see Section 6.6.1.2.1);
    - **variable:** *High Emotions Score – HES;*
    - **variable:** *Low/Moderate Emotions score – LMES;*

- **Level of empathy**
  - Participants are asked to rate their empathy towards the victim game character in the scale 0 to 5, where 0 indicates no empathy, 1 - low empathy, and 5 - high empathy. According to the rating, participants are divided into the categories High Level of Empathy and Low/Moderate Level of Empathy (see Section 6.6.1.2.2);
    - **variable:** *High Level of Empathy – HLE;*
    - **variable:** *Low/Moderate Level of Empathy – LMLE;*

- **Empathetic characters and the level of empathy in the game**
  - Participants are asked to classify themselves as empathetic personalities. The participants answered a set of questions taken from *The Basic Empathy Scale Questionnaire in Adults* (Carré, 2013). According to their answers, participants have been divided into the categories of High Empathic Characters and Low Empathetic Characters (see Section 6.6.1.2.3);
    - **variable:** *High Empathetic Characters – HEC;*
    - **variable:** *Low Empathetic Characters – LEC;*

4.3.3. The design of variables for measuring creativity

The phase that follows the instruction and empathy is the creative activities related to the experimental group only. The participants complete three creative activities as follows:

- Creative Activity 1: Enables participants to use their critical thinking selecting whether an action is abusive or not and create a list of abusive or non-abusive incidents.
  - **variable:** *CreScore1*

- Creative Activity 2: Gives participants the space to apply their knowledge and create an infographic by selecting the correct statements out of a list of statements and position colours and relative images on the infographic.
  - **variable:** *CreScore2*

- Creative Activity 3: Gives participants the space to create a motivational poster against domestic violence and abuse.
  - **variable:** *CreScore3*

The creative activities, sum up together, constitute the *TotalCreativeScore* which is used in the data analysis (see Section 6.6.1.3).

4.3.4. The design and development of the pre-tests and the post-test

When investigating learning achievement, there is a common technique of measuring the knowledge by using *pretests and posttest* (Riemer & Schrader, 2015) which assess the knowledge of the participants before starting and after completing the research testing. Figure 3.2. illustrates the comparative research study.

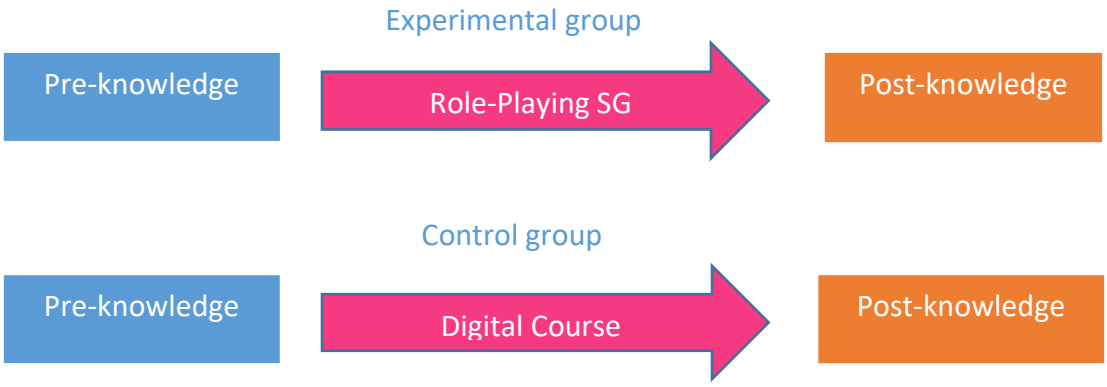


Figure 4. 2. Pre-knowledge and post-knowledge tests (Flanagan & Nissenbaum, 2014)

Participants in both the experimental and control group are required to answer the same pre-knowledge test checking their previous knowledge related to the learning content. Pre-knowledge test and post-knowledge test scores are compared to determine in which extent the DRPSG changed in participants' learning compared to the DC.

Scores are expected to be lower in the pre-knowledge test score and higher in the post-test score at the end of the game. At the end of the DRPSG and the DC, participants in both groups are requested to answer the same post-knowledge test.

The experimental group uses the DRPSG for achieving learning which includes the parts of instruction, assessment, feedback, repetitions, empathy and creativity. The control group uses the DC comprises of a text-based presentation enriched with images. The presentation has no story, no game characters, no empathy and no creativity. The instruction is given using text and images with basic interactivity, simulating the traditional approach of learning.

Variables:

- **Experimental group:**

- **Variable:** *pre-knowledge score*
- **Variable:** *post-knowledge score*
- **Variable:** *retention-knowledge score*

- **Control group:**
  - **Variable:** *pre-knowledge score*
  - **Variable:** *post-knowledge score*
  - **Variable:** *retention-knowledge score*

4.3.5. The retention-knowledge questionnaire

The research methodology includes two parts (see Figure 4.1). The second part of the study takes place four weeks after the first part. The second part includes only the retention-knowledge test which is the same as the post-knowledge test and includes 16 questions in a random sequence where participants complete digitally. The scoring results, of both experimental and control group, are compared to assess whether the knowledge for the participants of the experimental group retained better in memory when using the DRPSG compared to control group that used the DC to conclude in results about obtaining deeper learning. This part of the study collects data about assessing participants' deeper learning.

Variables:

- **Experimental group:**
  - **Variable:** *retention-knowledge score*
- **Control group:**
  - **Variable:** *retention-knowledge score*

4.3.6. The design and development of a digital course;

The digital course (DC) includes the same learning content as the serious game, but it follows a conventional style of sequential learning without any components of the DeLEC framework. It is designed using text-based slide presentation enriched with relevant images. The DC serves the purpose of the comparative study to help in drawing useful results for the value of DeLEC framework in comparison to other learning processes.

Variables:

- **Control group:**
    - **Variable:** *pre-knowledge score*
    - **Variable:** *post-knowledge score*
    - **Variable:** *retention-knowledge score*

Control group variables are analysed and compared to the experimental group for emerging results.

4.3.7. The demographics questionnaire

The profile of the participants that take part in the study is essential information to verify that both groups are similar as for their participants. Sensitive data, such as questions about gender, age, and ethnicity, included another option of *"Prefer not to say"*. The demographic questionnaires are designed to collect data digitally using Google forms which could be easily exported to spreadsheets.

The demographic information collected was the following:

Variables:

- gender;
- age;
- ethnic background;
- educational level;
- the frequency of using e-learning applications;
- the frequency of playing video games;
- whether participants previously participated in courses related to domestic violence and abuse.

The demographics data depicted the profile of the participants and namely ensured that participants in both groups have similar demographic characteristics and are assigned randomly so that the comparison between the two groups is valid and fair. None of the demographics data has been separately processed and analysed in association with learning as this was out of the scope of the study. The study examined and compared the performance in learning of both groups, the experimental and control group without distinguishing gender, age, education level, etc.

4.3.8. Empathetic Characters Questionnaire

The design of the Likert Scale Empathetic Characters Questionnaire was also designed using Google forms. This questionnaire was completed only by the experimental group and questions were related to the empathetic character of the participants.

The questions are part of the Basic Empathy Scale in Adults (Carré et al., 2013) questionnaire. The questionnaire has the form of Likert Scale questions with options from 1 to 5 where:

1. Strongly Disagree,
2. Disagree,
3. Neither Agree or Disagree,
4. Agree,
5. Strongly Agree.

The questions included in the Empathetic Character Questionnaire are the following:

a. I am a person who finds it easy to put myself in somebody else's shoes.
b. I tend to get emotionally involved with a friend's problems.
c. It upsets me to see an animal in pain.
d. I can make decisions without being influenced by people's feelings (Reversed).
e. I usually stay emotionally detached when watching a film (Reversed).

According to their rating participants were divided as follows

- Low empathetic characters
  - If their rating to the questions was 1, 2 or 3.
- High empathetic characters
  - If their rating to the questions was 4 or 5.

4.3.9. Summary of data collection for the experimental and the control group

Table 4.1 below shows the collected data for the experimental and the control groups to support the analysis and the emerging of conclusions addressing the research

questions. The first column indicates what is measured, the second column shows the research instruments used to collect the data, and the third column shows the collected data.

Measuring	Research Instrument	Data Collected
Experimental group		
Prior knowledge	Pre-knowledge test	*Pre-knowledge score*
Learning during the instruction (surface learning)	Formative assessment quizzes	*Learning_score*
Emotions Score in the scale of 1 to 5	List of emotions to indicate	*Emotions_Score*
Level of Empathy in the scale of 1 to 5	Participants indicate empathy from 0 to 5	*Level_Empathy*
Whether participants are empathetic characters	Empathy Likert Scale Questionnaire	*Empathetic_Character_score*
Creativity	Creative activities	*Creative_score*
Knowledge gained after completing the game	Post-knowledge test	*Post-knowledge score*
The amount of knowledge remained in memory after four weeks	Retention-knowledge test	*Retention-knowledge score*
The profile of the participants	Demographics questionnaire	*Gender, age, ethnicity, education, etc.*
Control group		
Prior knowledge	Pre-knowledge test	*Pre-knowledge score*
Knowledge gained after playing the game	Post-knowledge test	*Post-knowledge score*
The amount of knowledge remained in memory after four weeks	Retention-knowledge test	*Retention-knowledge score*
The profile of the participants	Demographics questionnaire	*Demographics of the participants*

Table 4. 2. Summary of data collected by the experimental and the control groups

4.4. Ethical considerations

The research study complied with the University ethics guide (the University of Westminster Code Of Practice Governing the Ethical Conduct of Research 2017/18 | The British Educational Research Association document Ethical Guidelines for Educational Research 2011) to proceed with study testing involving real users. University ethics approval acquired for this study and a consent form was prepared and signed by all the participants along with a participant's information sheet giving

them information about the purpose of the study. Therefore, to conduct the research study, the following ethical issues were addressed:

- informed consent is granted from participants and that these are treated with dignity and without prejudice;
- there should not be coercion in recruiting participants;
- confidentiality and anonymity of participants personal data following the Data Protection Act (1998);
- the researcher has a responsibility to design an inclusive study, fit the purpose, produces meaningful data and covers themes that positively contribute and extend knowledge of pedagogy.

For the current research thesis all related documents were submitted for approval to the Westminster Research Ethics Committee:

- the design of the *Demographics questionnaire;*
- the design of the *Empathy questionnaire;*
- the *Part A form* which describes the pedagogic nature of the research thesis;
- the *Information Sheet* informs the participants about the aims and the scopes of the research study;
- the design of participants' *consent form* that gives the researcher the consent to collect, analyse and publish data about participants anonymously, meaning without revealing their identity.

4.5. Summary

This chapter described and presented the research methodology. The research methodology uses experimental design and quantitative research methods. The research methodology suggests the development of a DRPSG designed according to DeLEC framework to collect data associated with the learning achievement of the participants. DRPSG integrates variables that store participants' previous knowledge, their learning performance while playing the game, their gained knowledge when completing the game, as well as their retention of knowledge four weeks later. Furthermore, aiming to gather comparative data related to the learning effectiveness of DRPSG, the research methodology suggests the development of DC for testing with the control group. The next chapter describes in detail the development used in PhD research.

Chapter 5. The Design of the Research Tools

This chapter describes the research tools that have been designed and developed to assist the author to conduct the study with participants, and through which data are gathered and analysed to progress the thesis investigation. The research tools consist of the serious game called *Stronger,* which is a digital role-playing serious game (DRPSG) designed according to the DeLEC framework, the Digital Course (DC), which is a non-gaming application which follows the conventional approach of learning. The DC is developed to become the comparative investigation and comparison with the Stronger game. Finally, another research tool is the demographics questionnaire designed with questions that draw the profile of the participants, as well as the design of empathy questionnaire.

5.1. Introducing the digital role-playing game Stronger

The Stronger game is a 2D digital role-playing game and it is the principal research tool designed and developed by the author. The purpose of the Stronger game is to apply the phases of DeLEC framework to evaluate whether the DeLEC framework is a valid pedagogic approach designed for achieving deeper learning using serious games. The case study is developed around the topic of domestic violence and abuse (DVA).

Stronger uses a story and characters who interact with each other using written dialogues. Stronger consists of scenes designed to follow the phases of the DeLEC framework described in chapter 3. The instruction is delivered through the scenes. In each scene, the story unfolds through conversations between the characters. At the end of each scene and before moving to the next one, there is a formative assessment in the form of a quiz to evaluate the learning acquired.

The player is taking place in the game as a character who actively participates as the trusted friend of the victim character. While playing the game, the player is requested to empathise with their friend, who turns out to be a victim of domestic abuse, follow the story and the conversations, and make decisions related to helping the character. The DeLEC framework as a learning process can become the basis for designing SGs on other topics as well.

5.2. The pre-designed phase of the Stronger game

Before the design of Stronger, other games developed on DVA have been studied and are presented below:

5.2.1. Research on DVA resources

Designing an educational game on the issue of DVA demands research and study on the subject (see Appendix E). DVA resources have been gathered and studied and include:

- online resources;
- online courses on DVA;
- short films and documentaries;
- the Office for National Statistics;

- interview from a member of a DVA organisation about the help they provide to DVA victims.

Before designing the Stronger game, we investigated other educational games around the issue of DVA, aiming to form ideas about how DVA can become gamified. Three games on DVA are described below:

5.2.1.1. Ending the Cycle - Board Game

"Ending the Cycle" is an educational board game developed by Peter Wonica with the collaboration of *Galerstein Women's Center* at the University of Texas following extensive research and interviews from survivors of relationship abuse http://endingthecycle.info/. The game is played by cards aiming to engage players in emulating real-life events as they, and their character, try to leave an abusive relationship. The game aims to spark discussions among players and raise awareness about domestic violence and unhealthy relationships. Ending the Cycle includes different ways of modifying the gameplay experience. Players have the power to develop their cards and scenarios for the game.

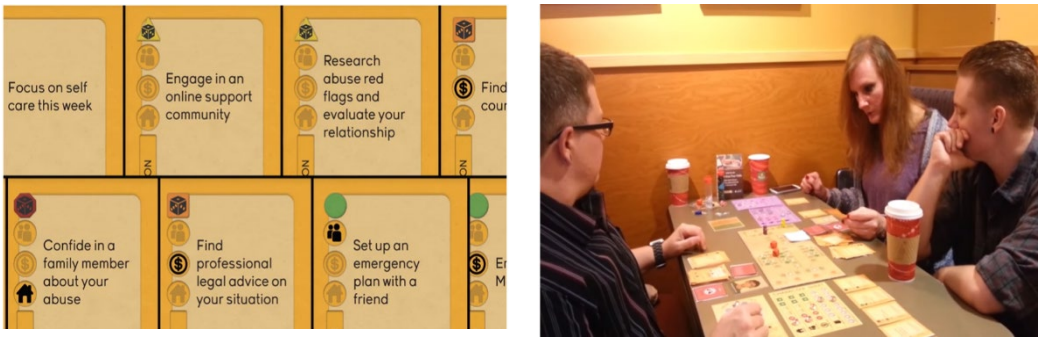


Figure 5. 1. Board Game on Domestic Violence and Abuse

The game is inclusive of gender, race and sex-orientation, communicating the message that violence can happen to everyone. It raises awareness about the ways of escaping abuse. Figure 5.1 shows snapshots from the game. A facilitator's guide is required to run the game so that integration into a workshop is as easy as possible. Snapshots of the game are shown in Figure 5.1.

5.2.1.2. P.S. Be Brave

The *P.S. Be Brave* game is a digital game made by Bravo Team has developed to increase awareness about Teen Dating Violence and won the prize of Life.Love in 2015 http://www.dariogimenez.com/tdv/. The game communicates the message that people should speak up when witnessing incidents of domestic abuse and report

abuse. The game provides information about abusive relationships and controlling behaviours. Snapshots of the game are shown in Figure 5.2.

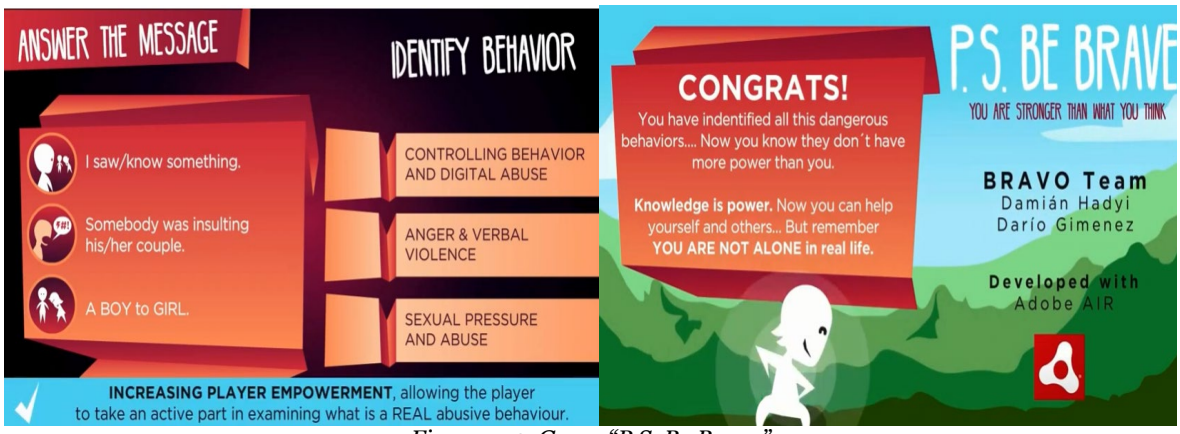


Figure 5. 2. Game "P.S. Be Brave"

The game is educational especially towards the young people who start their relationships. The information delivered via P.S. Be Brave formed the basis for designing the quizzes for Stronger. P.S. Be Brave delivers learning via selecting an option from a list of many options that are not part of the design of Stronger.

5.2.1.3. Jesse

A 3D educational game called *Jesse* designed by David Smith (Smith, 2017; Boduszek, D., Debowska, A., Jones, A., Ma, M., Smith, D., Willmott, D., Kirkman, G. (2019).), University of Huddersfield (2017). Jesse is a ten-year-old boy who lives with his pregnant mom and her abusive boyfriend. Jesse supports his mother to escape abuse. Figure 5.3 shows a snapshot from a scene at home. The 3D game design is an attractive way to engage students. The game was tested in schools in Barbados and Grenada. Students were playing one level each day and then discussed it in the classroom. One of the findings showed that the most effective learning came from the game's dialogue. They also showed that players become more familiar with an emotional self-reporting interface over time and that children are more adept at identifying threatening behaviour and body language than other emotions. The dialogues and characters of Stronger were influenced by *Jesse*.

Figure 5. 3. Jesse game about Domestic Violence.

However, for these sensitive issues like domestic abuse, teachers should be prepared that such experience might be traumatic for some students if it recalls similar personal experiences. When designing Stronger a consideration was taken about avoiding scenes of violence that may recreate unpleasant experiences.

The next section describes the design of the phases of the Stronger game making references to DeLEC framework which replicates.

5.3. Designing the flow of *Stronger*

The role-playing game Stronger has emerged to be the child of the DeLEC framework in the sense that it is designed to apply the phases of DeLEC framework. The purpose of the Stronger game is to provide the practicality to test and evaluate the DeLEC learning process with SGs. It is, therefore, designed to provide the learning environment that provides the instruction and learning part through the interaction of the player with the story, the characters and the dialogues, followed by the creative activities that transfer the knowledge to new contexts.

The design of the Stronger game consists of two main phases: the instruction phase and the creative phase, as these, are illustrated in Figure 5.4 and correspond to the DeLEC framework illustrated in Figure 5.5.

1. The Instruction Phase

The instruction phase is the biggest part of the game and covers the learning objectives through the learning content around the issue of DVA. The learning content is divided into six scenes, that appear with blue rectangles in figure 5.4. Each scene progresses the learning through the story and dialogues between the

characters. Correspondingly, instruction is illustrated in DeLEC framework as the box of Role-Playing Game in figure 5.5. While going through instruction, players are prompt to indicate their empathy towards the game character. The integration of empathy in the game scenes is depicted in Figure 5.4 with the yellow boxes in scenes 2 and 5.

As it is instructed by the DeLEC framework, at the end of each scene, players are requested to complete the formative assessment which evaluates their learning and understanding. Formative assessment has the form of a multiple-choice quiz. If players answer correctly and pass the quiz, they gain the key to unlocking the next scene, otherwise, they are taken back to repeat the scene, gain better knowledge and retry the quiz. Players may pass the quiz from the first try or repeat the scene and the quiz many times until they pass. The iteration of the scene allows them to revisit the learning content and learn better. Players should repeat both the scene and the quiz until they pass the quiz. The game provides help to the player after the second unsuccessful attempt to pass the scene. Help allows the viewing of the correct answers of the quiz before they trying the scene and the quiz again. The instruction is completed when all six scenes and the quizzes are passed successfully.

The quizzes, in Figure 5.4, appear in orange rhombus. Correlatively, formative assessment is illustrated in the DeLEC framework in figure 5.5.

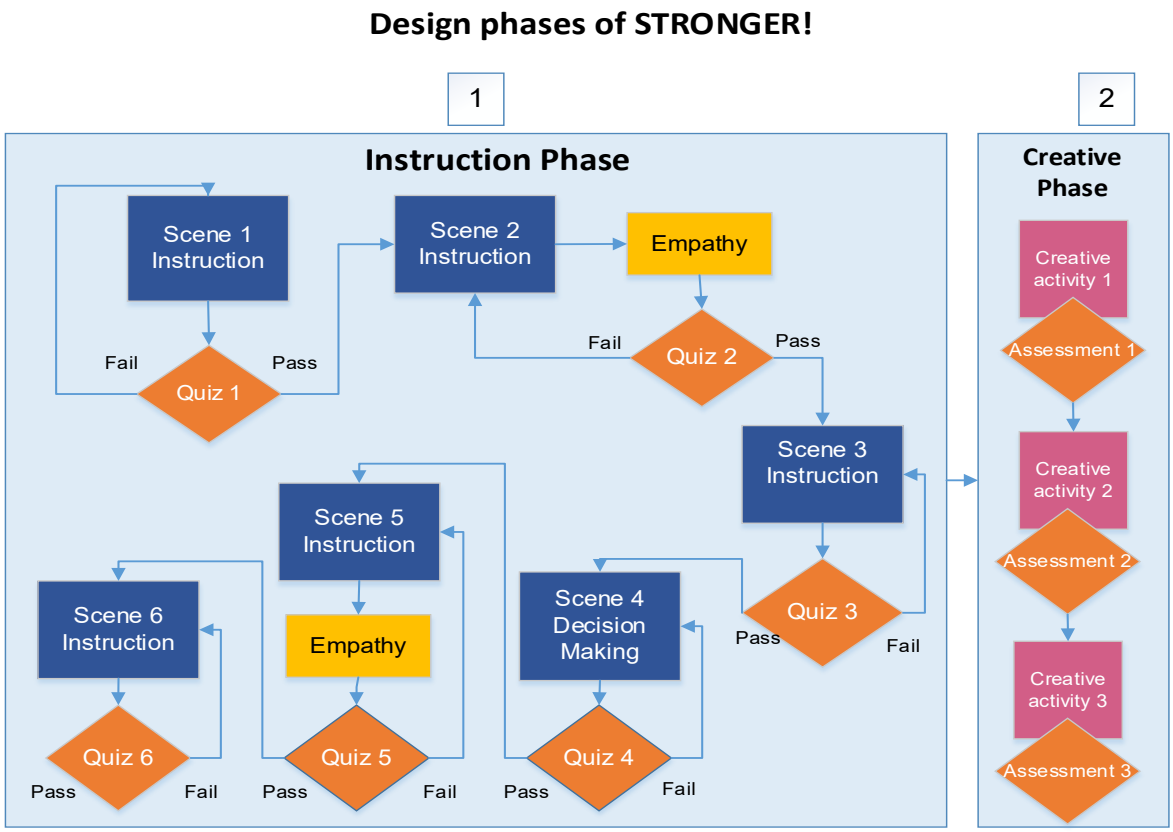


Figure 5. 4. The main phases of Stronger Role-Playing Serious Game.

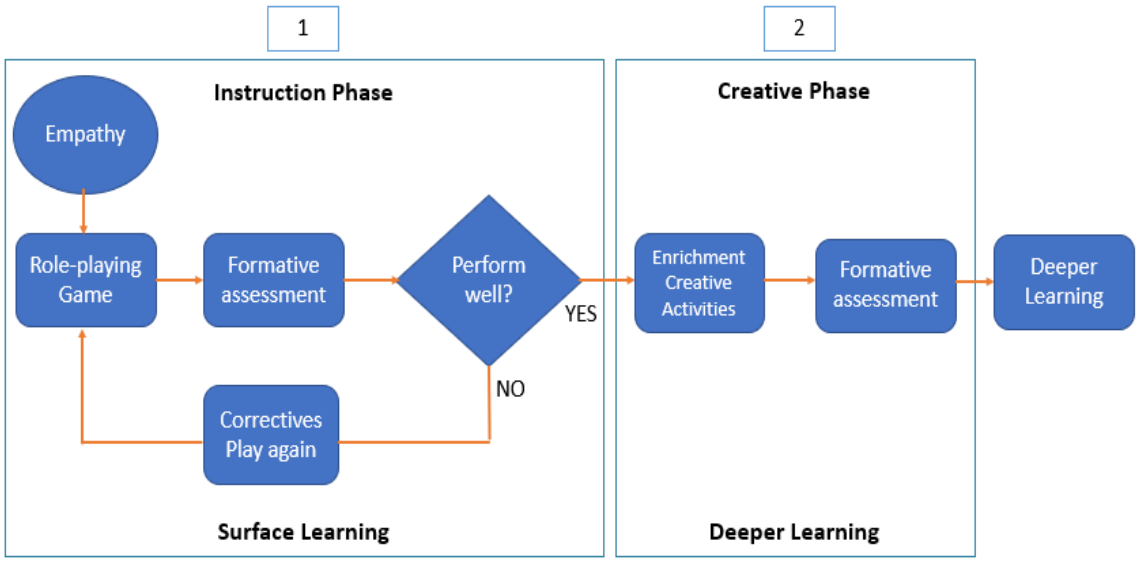


Figure 5. 5. The DeLEC framework phases

The phases of Stronger in Figure 5.4 mirror the phases of DeLEC framework illustrated in Figure 5.5.

2. Creative phase

After completing the instruction phase, players are transferred to the creative phase. In this phase, players transfer and apply their gained knowledge in a new context engaging them in creative activities requiring them to create an infographic and to make a poster related to DVA. Each activity includes a formative assessment and gets a score called creative score. The creative phase is illustrated in Figure 5.4 and correspondingly in figure 5.5.

5.3.1. The extended flow of Stronger

Aiming to evaluate the effectiveness of the proposed DeLEC framework and assess the learning and deeper learning, Stronger extends the design to include another two phases: the pre-knowledge phase and the post-knowledge phase. Their existence is essential for the evaluation of DeLEC framework and the learning achievement with Stronger. The assessment phases collect data about the learning before and after the Stronger game as shown in figure 5.6:

- the pre-knowledge phase; and
- the post-knowledge phase.

1. Pre-knowledge Phase

In the beginning, players complete the pre-knowledge test/quiz, which records players' previous knowledge on the subject. The quiz comprises of 16 questions around the issue of domestic abuse. In Figure 5.6, the pre-knowledge phase is illustrated with number 0.

2. Post-knowledge phase

Following the completion of both the instruction and creative phase of Stronger, the players answer another quiz, the post-knowledge quiz, to demonstrate their knowledge gained after completing the game. The post-knowledge phase is illustrated in Figure 5.6 with number 3.

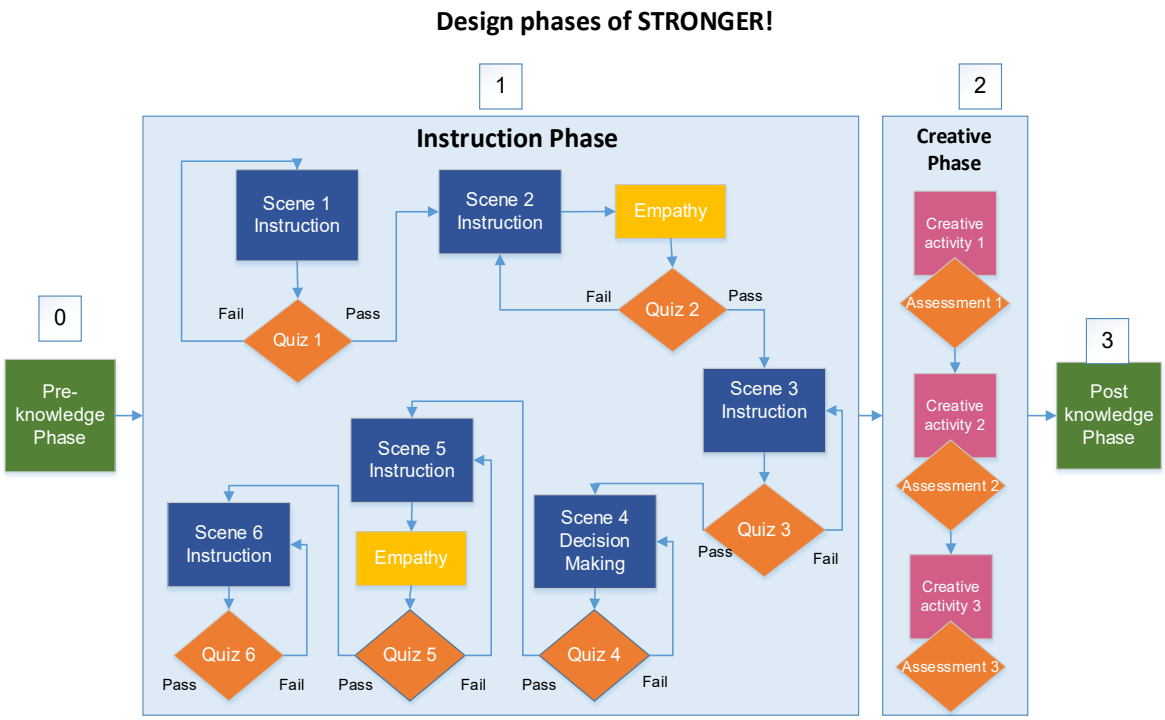


Figure 5. 6. The Stronger game including the pre, post knowledge phases.

5.4. Designing the screens of *Stronger*

This section describes the design of Stronger which applies the DeLEC framework in a role-playing serious game. It consists of the scenes, the characters, pre-knowledge and post-knowledge, and the formative assessment. The numbers in Figure 5.6 show the sequence of each phase in the game.

The following sections explain in detail the design and development of Stronger:

- the content and functionality of each scene;
- how each part of the game addressed the DeLEC framework;
- how each part of the game collects data related to user performance which will be used for the data analysis to support the addressing of the research questions.

Stronger is developed using the licenced version of the *Articulate Storyline 360* which is an authoring tool that can be used for the development of interactive courses and games. The software incorporates a rich toolbox to design objects and then make them interactive using code, such as buttons, shapes, text boxes, sliders. It also includes a huge collection of assets such as illustrated and photographic characters with different poses and facial expressions that can change during

playing using variables and conditional statements, and a licenced stock of images, videos, animations and illustrations.

5.4.1. The initial screen

Figure 5.7 displays the initial screen of Stronger, which illustrates the characters of the game. The initial screen requests from users to type the participant number provided when taking part in the study to secure the participant's anonymity. The characters are described in detail in section 5.4.3.1.

Figure 5. 7. The initial screen of the game "Stronger"

5.4.2. The Pre-knowledge phase

The pre-knowledge phase corresponds to the pre-assessment of knowledge before starting the game as this is depicted in figure 5.6. It contains the pre-knowledge quiz, which consists of 16 multiple-choice questions (see Appendix D – Pre-Knowledge quiz). For each correct answer, the player gets 10 points with the maximum score is 160. Once the player submits the answers, their score is stored in the variable *pre-knowledge score*. Figure 5.8 shows a sample of the questions of the pre-knowledge test.

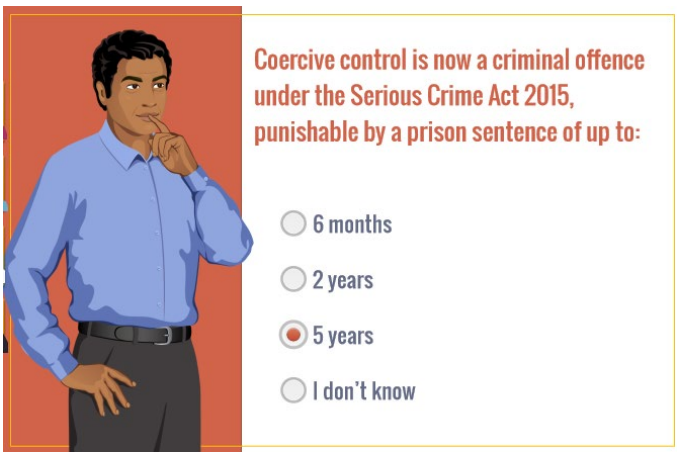


Figure 5. 8. A question in the Pre-knowledge test

Each multiple-choice question has four possible answers. The last option is "*I don't know*" allowing the learner to select this option if they don't know the answer instead of picking randomly one of the answers that could lead to the right answer by chance. The questions are designed to appear in a random sequence, so two players who play the game the same time they don't have the same sequence of questions.

Completing the quiz of the pre-knowledge test, the player does not receive any feedback about their score. They are informed about their pre-knowledge score at the final stage of the game. Regardless of their pre-knowledge score, the players receive the first key to unlock the first scene of the instruction phase discussed next.

5.4.3. The instruction phase

The instruction as this is depicted in figure 5.4, consists of the learning content on the case of DVA, divided into six scenes. The story unfolds in each scene where the learner immerses in the life of the DVA victim following the dialogues between the game-characters. Based on the dialogues, players improve their knowledge around the learning content.

Figure 5.9 shows the main menu of the instruction phase. When the pre-knowledge phase is completed, the player starts the game having a key (key1) gained from the pre-knowledge phase, to unlock scene1. When scene 1 is completed, meaning that players passed the quiz successfully, they gain the second key (key2) to unlock scene 2 and this applies to all scenes.

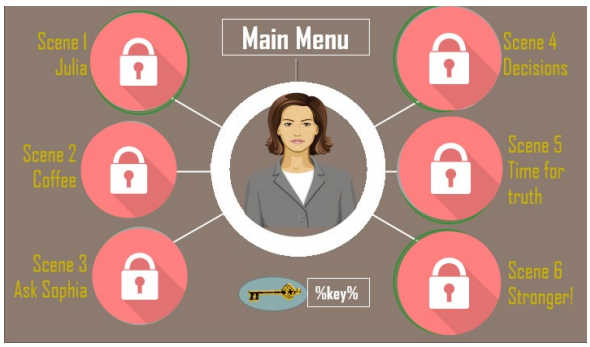


Figure 5. 9. The main menu of the game showing all six scenes locked

The following sections expand the instruction phase of Stronger describing the characters and the scenes.

5.4.3.1. Meeting the game characters

Characters can embody different roles in each game depending on the learning subject aiming in triggering interactions with the learners (Paiva et al., 2005). Virtual Learning Environments (VLE) can become a safe setting for exploration and simulation and practising of social problems and consequences avoiding dangers arise from practising social problems in the real world.

Stronger uses game-characters who interact with each other through conversations. The illustrated characters exhibit their feelings through facial expressions and body postures aiming to engage and trigger the empathy of the players. Figure 5.10 illustrates the game-characters used in Stronger.

Figure 5. 10. The game characters of Stronger

The game-characters taking part in Stronger are the following:

a. **Julia,** second on the left

   Julia is a young female going through domestic abuse. Out of fear and shame, she hides the abusive situation she is going through.

b. **Emma**, first on the left

   Emma is the close friend of Julia. Emma noticed a significant change in Julia's behaviour since Julia has been with her partner. Through the conversations, Emma realises that Julia could be a victim of DVA and tries to help her.

c. **Sophia**, second on the right

   Sophia is a counsellor expert on issues of DVA. Her role in the game is to provide more information about the learning content.

d. **Mark**, first on the right

   Mark is Julia's partner. He is not explicitly shown in the game but there are many references about him in the dialogues between Julia and Emma. Mark is implied in the story via the text messages he sends to Julia.

e. The **male and female characters** in the middle

   These game characters represent the players who choose either the male or the female character to represent themselves and they give them a name at the beginning of the game. These characters are called *avatars* and they are the trusted friends of Julia. Their role is to guide the player through the game in decision making, quiz answering and feedback, and to get emotionally engaged with the story and the victim.

5.4.3.2. The learning aspect of the instruction phase

Figure 5. 11. The six scenes

Scene 1: Julia

Scene 1 sets the scene of the two women's friendship, Emma and Julia, and provides information about Julia. The learning aspect in Scene 1 is related to the warning signs of two types of abuse: financial control and isolation. Scene 1 shows Julia becomes financially depended on their partner, as he convinced her to quit her job. She also becomes isolated from her family and friends by moving to the countryside. Scene 1 shows that the victim tries to hide their unhealthy relationship and present

outside that she lives a happy relationship with her partner, which is typical behaviour of DVA victims. Figure 5.12 displays a screenshot of the conversation between the game characters.

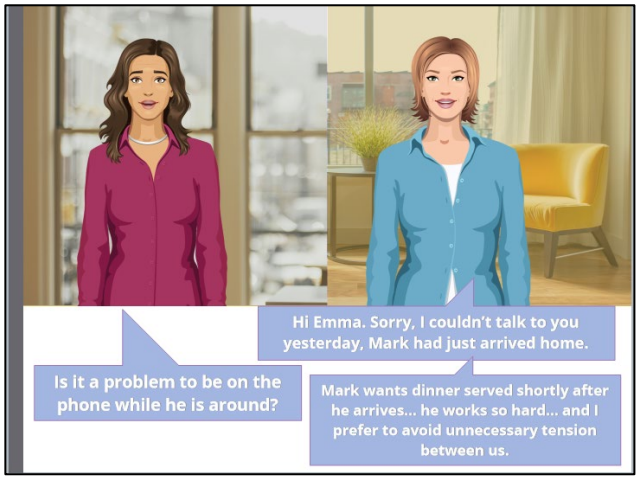


Figure 5. 12. A snapshot from scene1

Scene 2: Coffee with Julia

In Scene 2, players learn about three additional types of abuse, emotional, digital and verbal abuse. Scene 2 shows that Julia's partner "gained" consent to have access to her emails and social media and control her in this way. The escalation of the scene shows the victim receiving threatening messages from their partner for leaving the house without informing him, demonstrating an example of verbal and emotional abuse. Figure 5.13 shows a snapshot of scene 2.

Figure 5. 13. A snapshot from scene 2 revealing emotional and digital abuse.

Scene 3: Asking Sophia.

Scene 3 shows Emma visiting a DVA specialist to gain more information about how she, as a friend, could help Julia (see Figure 5.14). This scene serves the purpose of learning more details about the warning signs exhibited by a person who receives abuse and ways that the supporting environment (friends and family) should act.

Figure 5. 14. A snapshot from scene 3

Scene 4: Decision making

Scene 4 puts the player in making decisions. The player/learner is requested to make three different decisions by choosing the best option for the victim to progress the story. The game reveals the correct decisions and explains the consequences of incorrect decisions. Figure 5.15 shows a snapshot from scene 4.

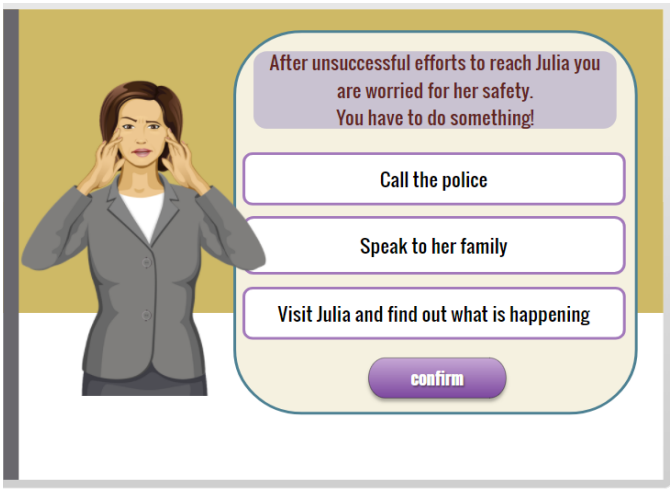


Figure 5. 15. Decision-making

Scene 5: Time for truth

Scene 5 reveals the truth about the abuse that Julia admits she is going through. The players learn that victims, out of fear and shame, hide from their friends and family, their suffering of emotional and physical abuse they receive from their abusive partner. Screenshot from Scene 5 in Figure 5.16 shows signs that Julia is a victim of physical abuse.

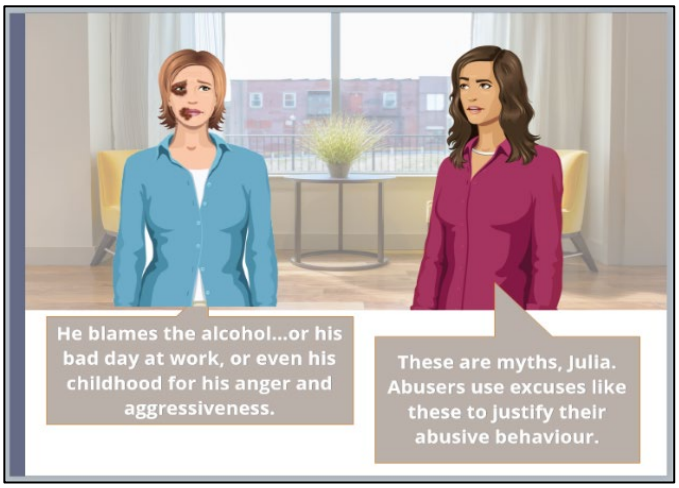


Figure 5. 16. The reveal that Julia is a victim of physical abuse

Scene 6: Stronger!

Scene 6 is called "Stronger" because Julia recognises the abusive signs and behaviour and realises that what she is going through is domestic abuse (as depicted in Figure 5.17). The recognition from a victim that they go through domestic abuse is the first step before asking for help and this makes the victim Stronger. Julia's friend, Emma, supports her in reaching professional help and legal advice. The player is also stronger at this stage provided that the expected learning objectives of the instruction phase of the game have been covered and the player learned to recognise the warning signs and patterns of DVA.

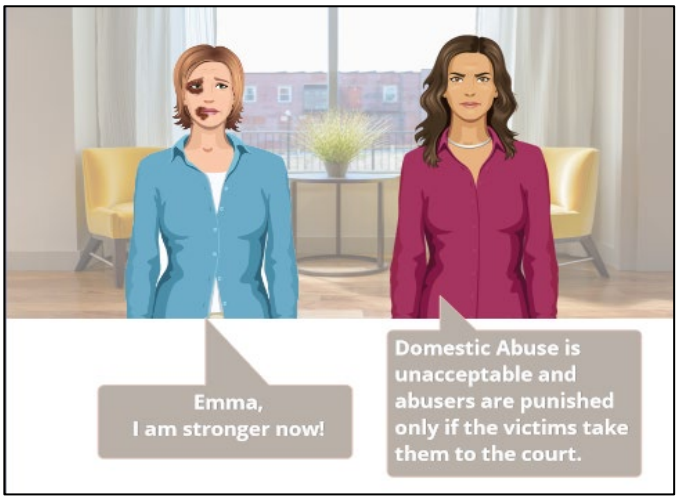


Figure 5. 17. A snapshot from Scene 6

As discussed in the DeLEC framework, formative assessment follows each scene of instruction in the form of quizzes. Formative assessment is discussed next.

5.4.3.3. The formative assessment

The formative assessment evaluates the learning performance of the Stronger players gained from the instruction phase and it is a significant part of the DeLEC framework as shown in Figure 5.4 and 5.5. The formative assessment is designed in the form of a quiz at the end of each scene.

Each quiz contains multiple-choice questions related to the learning content of the scene. The questions in each quiz and the multiple options in each question appear randomly (see Figure 5.19). The randomness of the questions prevents learners from achieving the next try of the quiz by memorising the sequence of the questions and the correct answers. For every correct answer, the learner gets a score of 10 points and has to achieve the passing level given in the instructions at the beginning of each quiz (see Figure 5.18).

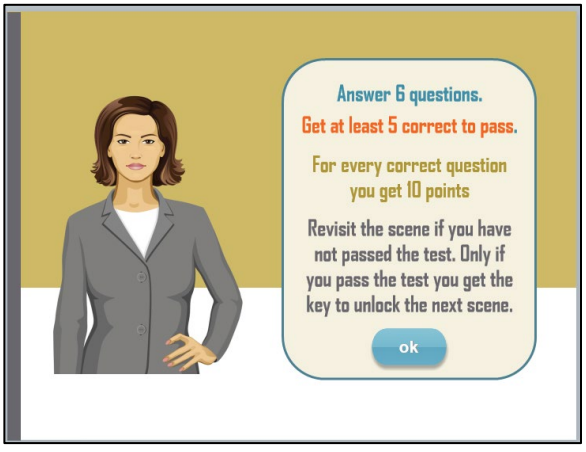


Figure 5. 18. Instructions are given at the beginning of a quiz

If learners complete the quiz successfully, they gain the key and move to the next scene. If learners fail to pass the quiz, according to DeLEC framework, (see Figure 5.4) it means they need more opportunities to learn the material by repeating the scene and the quiz to successfully pass the quiz. In every repetition, the score for the quiz resets to zero and the players can repeat the scene and do the quiz as many times necessary. After the second repetition, they can get help given with the revision of the correct answers and with dialogues that reveal the correct answers.

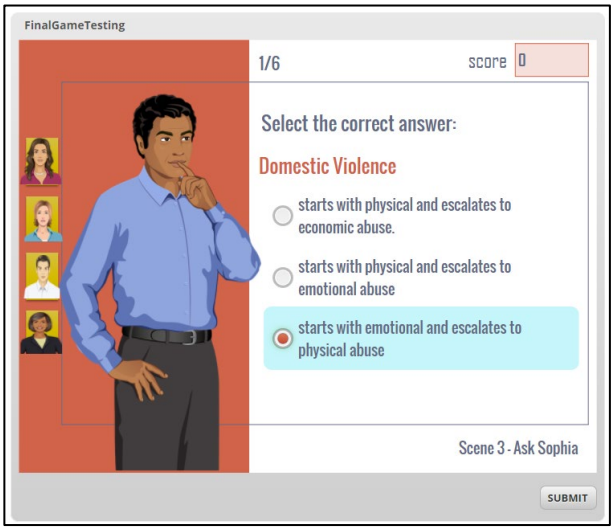


Figure 5. 19. Questions and answers appear randomly

5.4.3.4. Feedback

The feedback informs learners if they passed the quiz and progress to the next scene. Figure 5.20 displays the feedback given when learners pass the quiz. Players who complete the quiz successfully as the reward for their achievement, they get the next key to unlock the next scene.

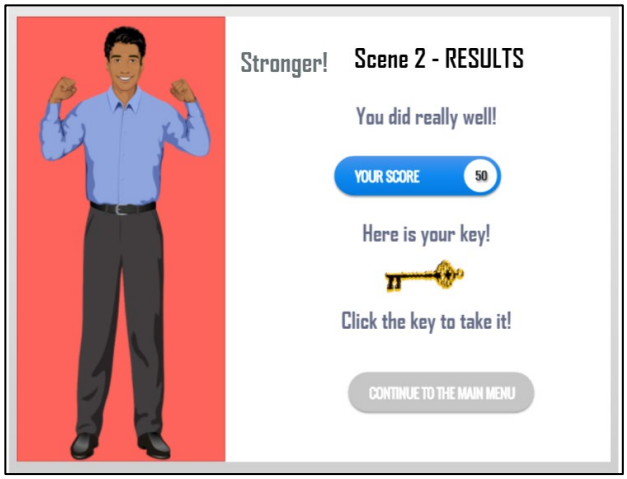


Figure 5. 20. Feedback for success in passing the quiz.

Figure 5.21 displays the feedback given when learners fail the quiz. The feedback shows learners' score and the passing score. The key is not provided and players cannot progress to the next scene. Instead, they are transferred back to repeat the scene they failed and try the quiz again to obtain the next key.

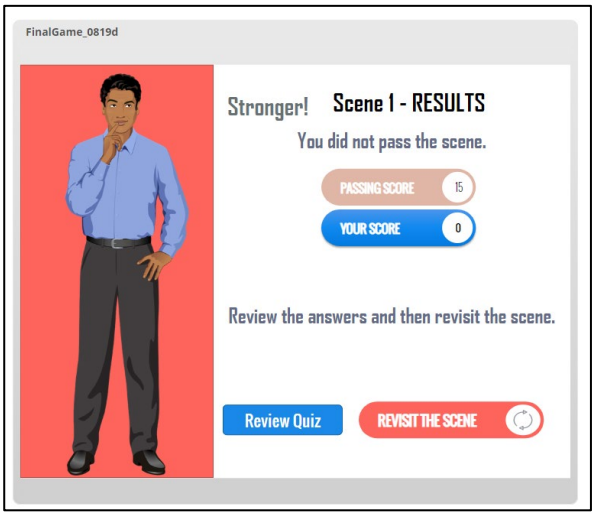


Figure 5. 21. Feedback fail to pass the quiz

Because of the repeating nature of the learning procedure, the feedback does not disclose the correct answers to the player when they repeat a scene. However, in case a player is unable to pass the quiz after the second attempt, a button appears *Review Quiz* (see Figure 5.21) where players can take help and review all the questions and view the correct answers before they revisit the scene.

5.4.4. The creative phase

According to DeLEC framework (see Chapter 3, and figures 5.4, 5.5), after completing the instruction phase and having gained the surface learning, players transfer and apply their knowledge in a new context by taking part in creative activities. In Stronger, players complete three creative activities that offer the opportunity to transform their learning into deeper learning. For each creative activity, they gain a creative score. The creative activities are described in the next paragraphs.

5.4.4.1. Creative Activity 1 - Is it abusive?

In creative activity 1 (see Figure 5.22), learners become critical thinkers and use what they have learned into defining which statement or human reaction might be abusive, non-abusive or depends on the situation. Completing this activity they

transfer their knowledge in a new context. For every correct matching, players gain 10 points. Full score for this activity is 90 points.

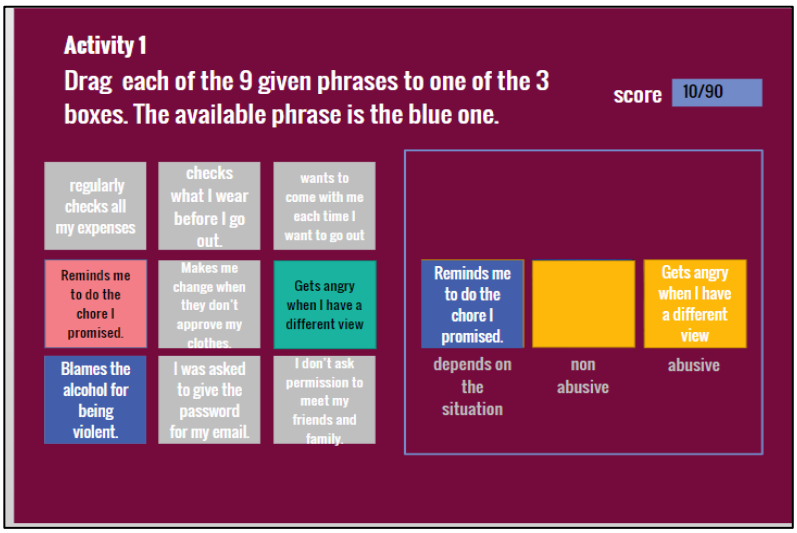


Figure 5. 22. Creative activity 1

5.4.4.2. Creative Activity 2 - Create an infographic

Creative activity 2 supports learners to transform their knowledge gained in the instruction phase by combining the correct phrases and choosing images to create an infographic showing how the DVA victims can protect themselves when facing domestic abuse. Ten statements are provided, of which only five are correct. Players have to choose the correct statements (see Figure 5.23) and position them on a given canvas choosing also relevant images from a list of images (see Figure 5.24). For every correct statement, they get 10 points.

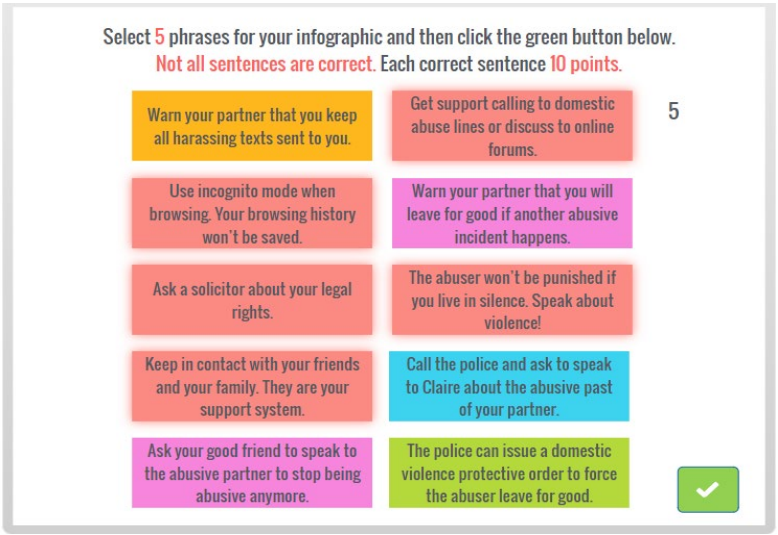


Figure 5. 23. Selecting the five correct statements.

Figure 5. 24. Creative Activity 2 - Infographic.

5.4.3.3. Creative Activity 3 – Create a poster

In creative activity 3, players are asked to create a poster using messages out of a list of encouraging messages for victims of domestic abuse, see Figure 5.25. The background image and the supportive messages are selected and positioned according to the learner's preference. This creative activity encourages players to pass a supportive message to victims of domestic abuse. Full score for this activity is 40 points.

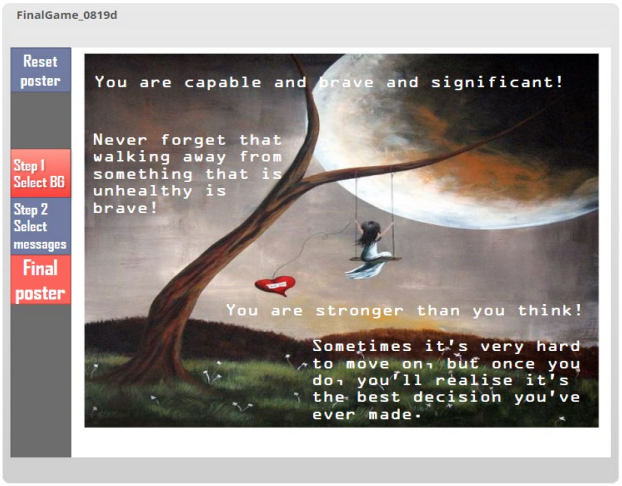


Figure 5. 25. Creative Activity 3 - Poster

Adding the score of the three creative activities comprises the *Creative Score*. Following the completion of the creative phase, players complete the Stronger game and progress to the assessment of their overall learning gained from the Stronger game, the post-knowledge phase.

5.4.5. Post-knowledge phase

The post-knowledge phase is the assessment done at the end of the game after the instruction and the creative phase, as this is depicted in figure 5.6. The post-knowledge phase contains the post-knowledge quiz which consists of 16 questions based on the learning content delivered through the game. These questions are the same as at the pre-knowledge quiz and appear in random order. The post-knowledge score shows the progress of the learner compared to their pre-knowledge score. Figure 5.26 shows a sample of a post-knowledge question.

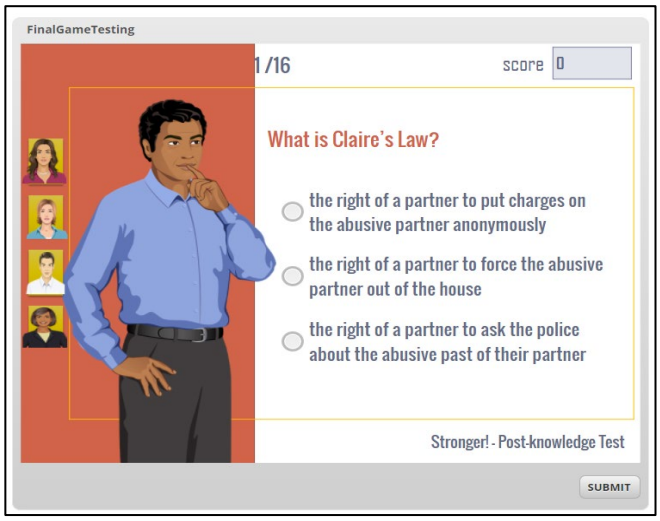


Figure 5. 26. The post-knowledge Test

5.4.4.1. Post-knowledge Feedback

In this stage, following the submission of their answer, learners receive feedback for each of the 16 questions. Figure 5.27 and Figure 5.28 below shows feedback for the correct and the incorrect answer, respectively.

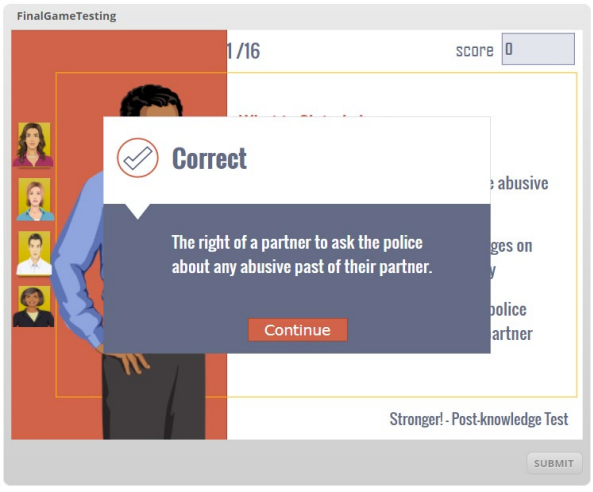


Figure 5. 27. Feedback for Correct Answer Post-Knowledge Test phase

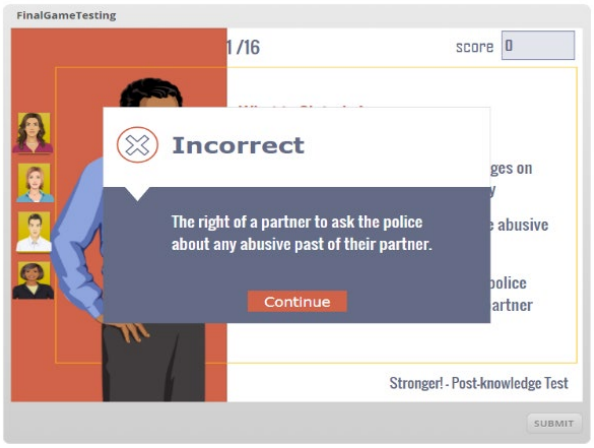


Figure 5. 28. Feedback for Incorrect Answer Post-Knowledge Test phase

The assessment of retaining knowledge and the achievement of deeper learning is part of the design of the research instruments, presented in the following section.

5.4.6. Measuring Empathy in Stronger

Empathy in Stronger is designed according to DeLEC framework (see Figure 5.4, 5.5) to evoke empathy feelings of the learners through the following game design elements:

a. the story;
b. the dialogues;
c. the game characters and their facial expressions;
d. the game character that represents the player.

Learners can develop empathy towards the game characters when the game characters look realistic and act in a believable way (Paiva et al., 2005). The Stronger game supports characters with many different emotional states expressed through their facial expressions and their body postures, such as happiness, sadness, frustration, worry, stress, fear and anger, as shown in Figure 5.29, attempting to make players understand these feelings and trigger empathy.

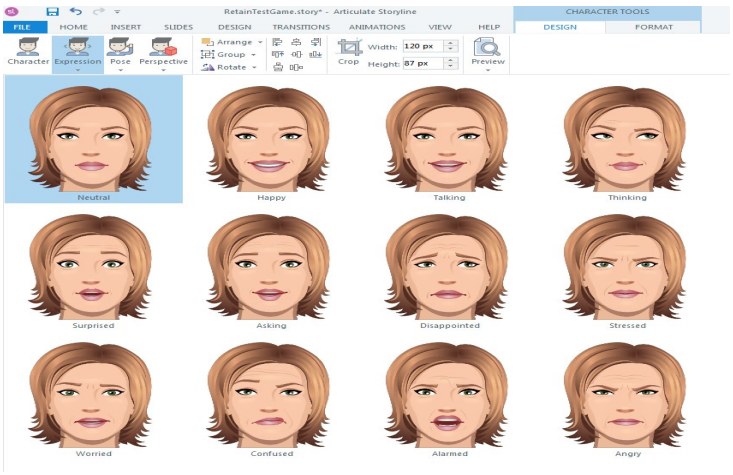


Figure 5. 29. Facial Expressions

The game is designed to capture empathy in three ways:

a. Cognitive Empathy - Players recognise the feelings of the victim

Players are prompt to indicate the feelings of the victim after being abused by their partner choosing as many feelings of the five options: (i) happy, (ii) worried, (iii) afraid, (iv) angry, and (v) other, by adding feelings in the given textbox as shown in Figure 5.30.

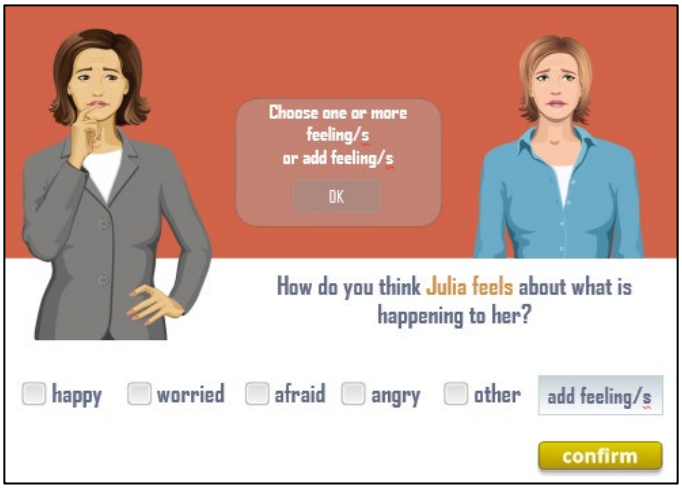


Figure 5. 30. Recognising the feelings of the victim

b. Emotional Empathy - Players state their feelings towards the victim

Players are requested to imagine the victim as their closest friend and indicate their feelings by choosing one or more of the given options: (i) neutral, (ii) worried, (iii) afraid, (iv) angry or (v) other, adding other feelings in the given textbox (See Figure 5.31). For the options worried, afraid, and angry, players rate the intensity of their feelings in a scale of 1 to 5 (1: week feeling, 5: high feeling). This measurement is used later in assessing the level of empathy of the players.

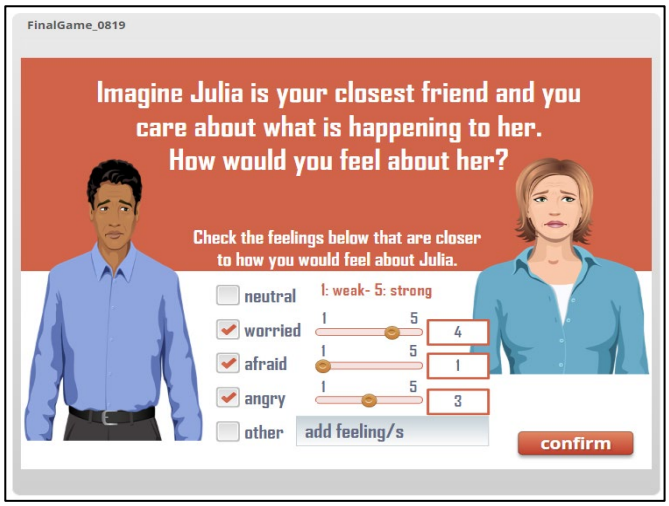


Figure 5. 31. Emotions towards the victim

As discussed above, players are requested to recognise and indicate the feelings of the game character and then indicate their feelings towards the game player. According to these indications, empathy could be either:

i. Parallel empathy:

If the player indicates the same feelings as for how the game character feels and how they feel towards the game character, then there is parallel empathy. For example, when the player indicates that the game character feels worried, and they also indicate they feel worried for the game character, this is parallel empathy.

ii. Reactive empathy:

If the player indicates different feelings as for how the game character feels and how they feel towards the game character, then there is a reactive empathy. For example, when the player indicates that the game character feels worried while they indicate they feel angry about the situation, this is reactive empathy.

Parallel and reactive empathy are discussed in detail in Section 2.6.1.

c. Players state the **level of empathy** towards the victim game character

Players are requested to rate the level of empathy they feel about the game character by moving a slider (see Figure 5.32) and indicate a value between 0 and 5. Where empathy is 0, there is no empathy. Choosing the values 1, 2 and 3, the learner states low/moderate level of empathy (LMLE) while choosing the values 4 and 5 the learner reports a high level of empathy (HLE).

Figure 5. 32. State the level of empathy

5.4.7. Game Design Elements in Stronger

Game elements are used to increase the game experience and drive motivation and engagement for learning (Lamprinou & Paraskeva, 2015; Plass et al., 2015). The game elements used in Stronger are the following:

1. The story

The story keeps players in suspense and in anticipation of what is going to happen next. The plot has a beginning, an escalation and an ending providing information about the forms of domestic abuse and gradually revealing the warning signs and abusive patterns.

2. The dialogues

Dialogues happen mainly between the two friends and help the progress of the story. Dialogues provide the learning content by letting the player reach their conclusions about when the relationship is healthy or abusive and which are the boundaries. Dialogues between characters drift away from the teacher-student learning model. Instead, the game characters, through their own story, try to captivate the interest of the learners and deliver contextual knowledge. Figure 5.33 shows an example of transferring knowledge through the game characters.

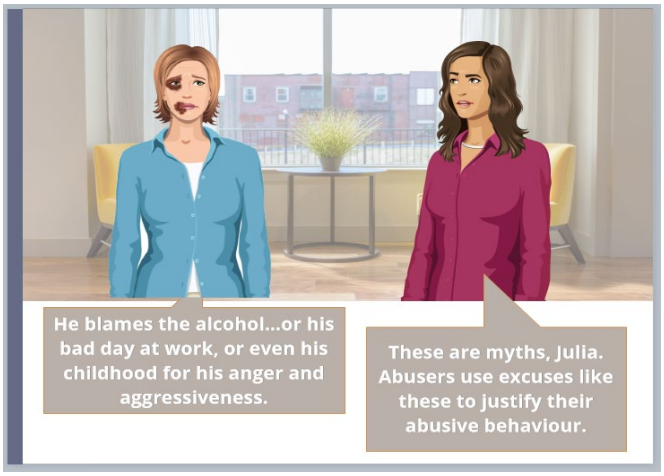


Figure 5. 33. The use of dialogues in transferring learning.

3. Score

A significant game design element when designing digital games is the score (Gee, 2003; Prensky, 2003). The score becomes a reason for players to play a game many times. The score energises players to chase the goals of the game and drives them to do their best to achieve the highest possible performance. A high score makes players feel satisfaction and engagement with a game. Competition is another reason that drives players in achieving a high score, especially if the score is compared to other players. Stronger generates many different scores throughout all the phases of the game, which are useful in indicating the learning achievement of the players.

At the end of the game, there are four final scores:

a. the score achieved when completing the instruction (Part A);
b. the creative score when completing the creative phase (Part B);
c. The pre-knowledge score;
d. The post-knowledge score;

Figure 5.34 shows a snapshot of scores at the end of the Stronger game.

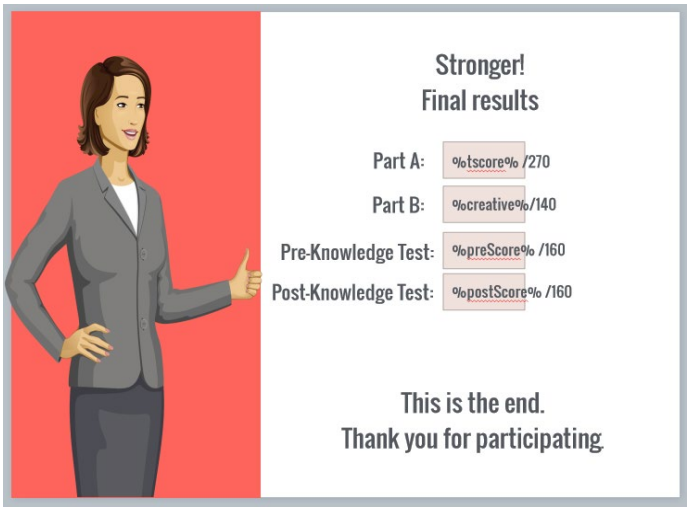


Figure 5. 34. Final Scores are shown at the end of the game

Figure 5.35 demonstrates the score variables that are generated in chronological sequence while players complete the game phases. The P*re-Knowledge* Score is gained before the game to acknowledge the level of pre-knowledge, the Learning *Score* represents the total score gained from all the scenes during the instruction, the *Creative Score* is acquired during the creative phase and the completion of the creative activities and, finally, the P*ost-Knowledge Score* is the score taken from the quiz which is done just after the game. Four weeks later players are answering another quiz getting the *Retention-Knowledge Score* to evaluate what they still remember out their learning four weeks later.

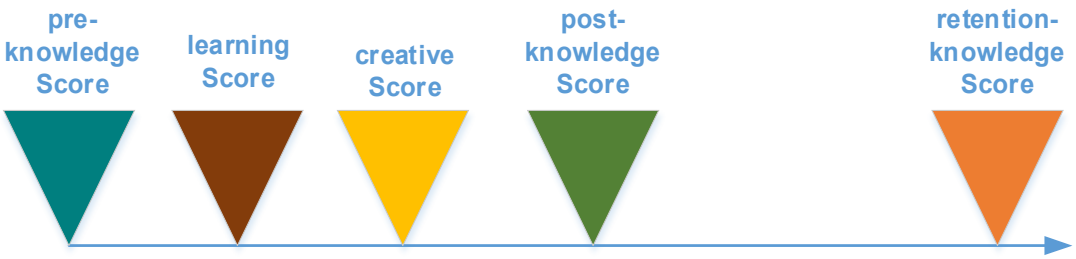


Figure 5. 35. Score variables in a chronological sequence

4. Keys

The keys comprise a game mission in Stronger. Six keys unlock the six scenes. The key as a game design element has a motivational drive. It becomes the reward for players' performance passing each quiz and acts positively encouraging the player to continue playing the game to collect the remaining keys. Figure 5.36 gives a snapshot of gaining the key after the successful completion of the scene.

Figure 5. 36. The key as the prize for completing the scene successfully

5.4.8. Coding interactivity in Stronger

The Stronger game supports interactivity that allows the change of a state of an object (e.g. change the facial expression) based on players actions, for example when players click a button, or choose the correct decision, or fail a quiz, "take" the key etc. Coding the interactivity on an object requests the writing of instructions.

Figure 5.37 depicts an example of how a screen appears according to the score that the player achieved. In this example, four variables change the appearance of the screen as follows:

a. the display of score: Variable: *scene4Score*

b. the posture of the character to be "happy with thumps up" if the score is higher than the passing level. Equivalently, the body posture and the facial expressions of the character changes if the score is less than the passing level.

c. the key object appears if the player passes the quiz. Respectively, it does not appear if the player fails the quiz. The key is clickable and disappears once it is clicked.

d. The button "Continue to Main Menu" (visible in design mode, invisible in run mode) becomes visible only when the key is clicked, to allow the player to go to the main menu and continue. Similarly, if the player fails the scene, the button "Revisit the scene" appears instead.

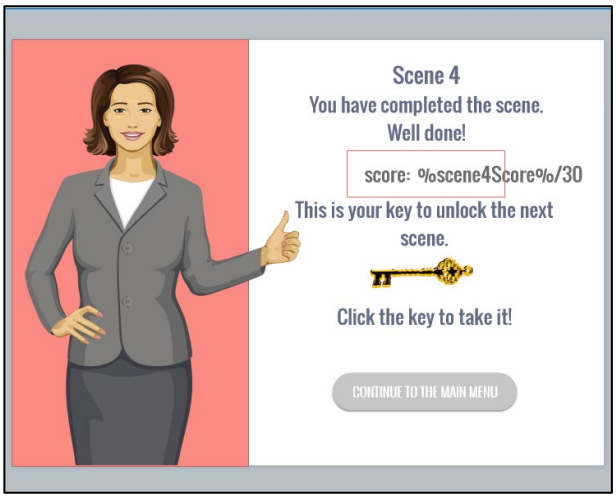


Figure 5. 37. Stronger Game, coding an event.

Figure 5.38 explains the coding instructions (also called triggers) which include the changes discussed above.

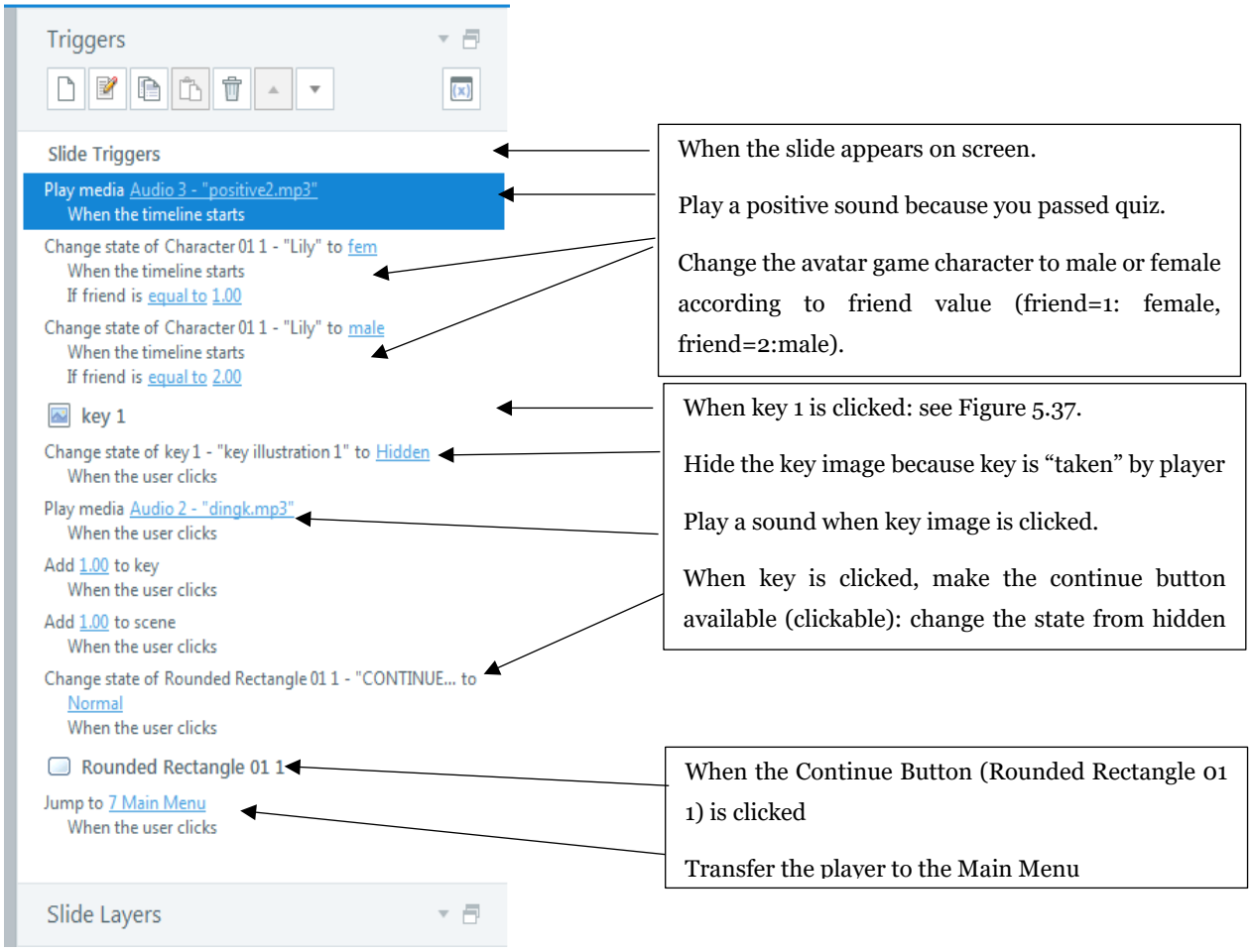


Figure 5. 38. Coding a slide

The triggers have to be designed in a logical sequence to work correctly. For example, players have to take the key first, and then the "Continue to the main menu" button becomes visible, avoiding mistakes such as returning to the main menu without having taken the key.

5.4.9. Exporting and collecting the data

A Javascript code is developed to export all the game variables from Articulate Storyline 360 to a spreadsheet file which is updated whenever a player completes the game, the pre-knowledge and post-knowledge quizzes, allowing the researcher to collect the data values.

5.5. The comparative study

Aiming to compare the learning effectiveness of the Stronger game and to evaluate the DeLEC framework, another learning tool is designed and developed to deliver learning. This is a digital course (DC) titled "*Warning Signs of Abuse*", a text-based digital slide presentation on DVA and contains the same learning content as the game Stronger following the conventional approach of teaching. The DC is also developed with *Articulate Storyline 360*.

Although there are other games designed on DVA (see Section 5.2.1) that could be used for the comparative study, it was necessary to design a new digital media tool since the objective of the study is to examine the learning effectiveness of both media on the same learning content. Therefore, the DC is designed as the alternative educational resource to deliver the same learning aiming to compare the learning effectiveness and draw conclusions about the learning tool that is more effective in supporting learners to perform better learning.

Unlike the Stronger game, DC has no characters or story. There is no reference to empathy, and there are no creative tasks. The instruction of the learning content is designed to be delivered in four sections:

a. What is domestic abuse;
b. Forms of domestic abuse;
c. Warning Signs of domestic abuse;
d. How to help.

To evaluate the learning acquired from the DC, the design is extended to include the pre-knowledge assessment, which evaluates the prior knowledge of players on the subject and at the end of the learning delivery, another assessment, the post-knowledge test evaluates the learning gained from the DC. The instruction does not include formative assessment or repetitions.

Similarly to Stronger, DC is designed to collect data about players' achievement in learning and deeper learning. The DC stores values in the type of learning scores using the following variables:

a. The pre-knowledge score;
b. The post-knowledge score;

Once learners complete the DC, all scores are exported to a spreadsheet file to be used later in the data analysis in comparison to the results of the Stronger game.

Hence, the DC has the following structure as shown in figure 5.39:

a. the pre-knowledge test;
b. the instruction;
c. the post-knowledge test;

Figure 5. 39. The structure of the DC

In the next section, the structure above is described.

5.5.1. Description of the DC

The Digital Course (DC) is developed in the form of a conventional e-learning media tool and consists of the comparative digital media tool. It is designed to include the same learning content to help learners achieve the same learning outcomes as the Stronger game to provide a valid means of comparing the learning effectiveness of the two resources. The Stronger game could not be compared to other games described in section 5.2.1 because those games do not cover the same learning material and therefore they could not be used to compare whether the same level of learning has been achieved.

The initial screen of DC is shown in Figure 5.40. Participants are given a participant number to gain access to the application to maintain anonymity.

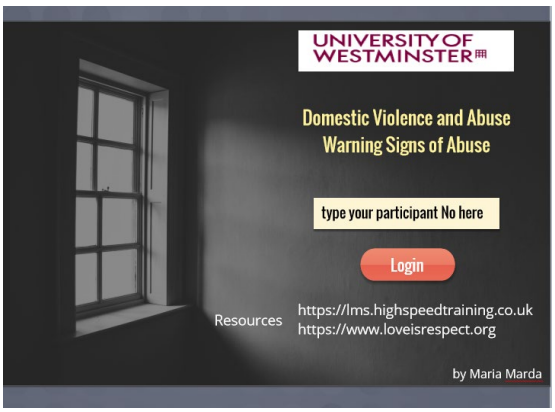


Figure 5. 40. The DC

Before starting the DC, players complete the pre-knowledge test. Respectively, after completing the DC, they complete a post-knowledge test. Both tests are described below.

a. The pre-knowledge phase

Like Stronger, DC starts with the pre-knowledge test, which includes 16 questions on DVA. The pre-knowledge test contains the same questions as the pre-knowledge test in Stronger game to facilitate the comparison of the results that emerged from both learning media. The questions appear in a random sequence and each correct answer gets 10 points.

b. The instruction phase

The instruction in DC includes the main menu with four distinctive units that comprise the learning content of the course (see Figure 5.41). The instruction is delivered using conventional approaches such as text in bullet points and images.

Figure 5. 41. DC - Main Menu

The learner clicks on each of the buttons in Figure 5.41 and they are transferred in the specific section following the sequence of the slide presentation. Once they finish the section they are transferred back to the main menu to click the next button. Figure 5.42 shows screenshots from the instruction phase of DC.

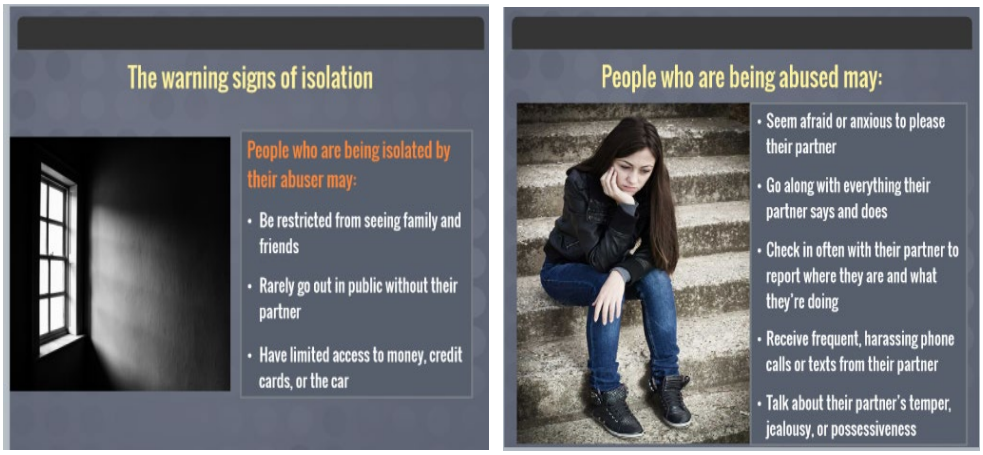


Figure 5. 42. Screenshots from DC on domestic abuse.

There is no formative assessment in between the learning sections. Once the learner completes a section, they progress the next section. Once completed all sections, learners are transferred to the post-knowledge phase.

The Post-knowledge phase

The post-knowledge phase contains the post-knowledge test, which is the same as the post-knowledge of the Stronger game. It stores the score for the correct answers and gives the feedback directly after submitting each question, informing the learner about the correct and incorrect answers (see Figure 5.43).

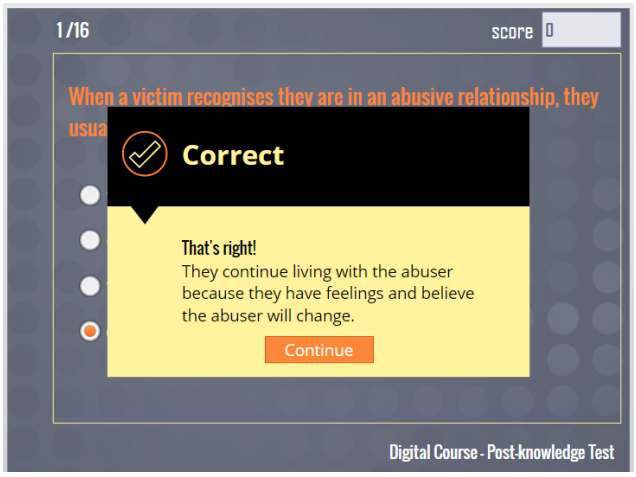


Figure 5. 43. DC - Post-Knowledge Test- Feedback

After the post-knowledge test and the feedback, the DC ends showing the pre-knowledge and post-knowledge scores as the final results (see Figure 5.44).

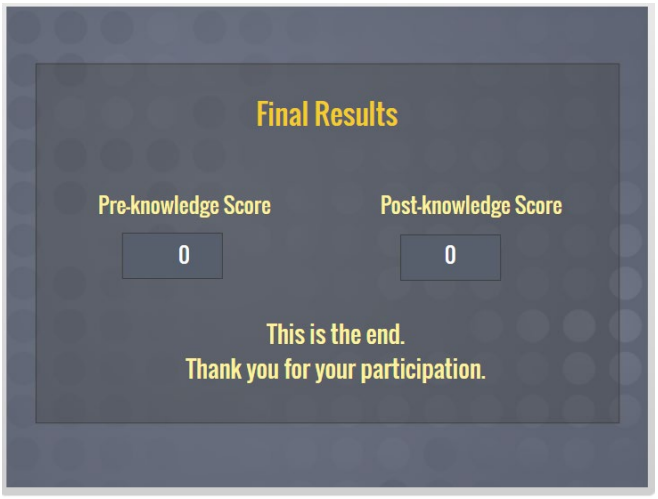


Figure 5. 44. DC - Final Results

With the display of the final results, the description of DC is completed.

Table 5.1 summarises the features of the two learning tools, the Stronger game and DC.

Stronger DRPSG	Digital Course (DC)
follows the DELEC learning process	follows a conventional learning process
Has a formative assessment	Has no formative assessment
Has repetitions of instruction	Has no repetitions of instruction
Empathy is designed and measured	No designed empathy
generates score	generates score
includes the collection of visual elements (keys) as the game mission	Has no visual elements to collect. The mission is to complete the learning material.
Learning is integrated into the dialogues	Includes no dialogues. Learning is given in a text-based form.
Includes illustrated characters supported by facial expressions and body postures revealing emotions	does not support any characters
role-playing game	text-based presentation

Table 5. 1. List of features of the Stronger game and the DC.

Alongside with Stronger and the DC, the questionnaires are designed to collect the demographic information of participants and assess their empathetic personality.

5.6 The questionnaires

There are two questionnaires designed to support the study (see Appendix F):

- the demographic questionnaire;
- the self-assessment for evaluating players' empathetic personality.

5.6.1. Demographics questionnaire

The demographics questionnaire is designed to collect information related to the profile of participants who took part in the study. It contains questions about participants' gender, age, ethnicity, education, frequency of using e-learning applications, frequency of using video games for entertainment and attendance to any DVA course. Demographics questions are the same for both the groups of participants who played the game or followed the DC.

The purpose of demographics questionnaire is to ensure that participants have been allocated evenly to the two cohorts and none of the groups overtakes the other group in terms of the gender, age, educational level, game experience so that the comparative study is equal for both groups and the data analysis is valid. An analytic table of demographics of the two groups is given in section 6.5.8, table 6.7.

5.6.2. The Empathetic personality Questionnaire

The empathy questionnaire contains Likert Scale questions related to the empathetic personality of the participants, and it is addressed only to the participants who played the Stronger game. Questions of this questionnaire are taken from the *Basic Empathy Scale Questionnaire in Adults* (Jolliffe & Farrington, 2006) to investigate whether participants are empathetic persons or not. For the Empathy Questionnaire see Appendix F.

Besides the questionnaires, the participants who took part in the study were invited four weeks later to complete the second part of the study, the retention-knowledge test.

5.6.3. The retention-knowledge test

The retention-knowledge test seeks to investigate whether learners maintained their knowledge learned from the game and the DC four weeks later. The retention-knowledge test is the second of the two tests that measure deeper learning. As explained in 2.6.4, to measure deeper learning, transfer tests and retention tests are

used. Transfer tests are conducted in the creative phase, with creative activities. The retention test is conducted four weeks after for both the play of Stronger and the completion of DC and measures the extent which learners maintained in memory the acquired knowledge gained either from playing the game or from completing the DC.

The retention-knowledge test has 16 multiple-choice questions around the learning content of DVA, appearing in a random sequence, similar to the post-knowledge. At the end of the retention-knowledge quiz, the learner has the opportunity to review the correct answers (see Figure 5.45).

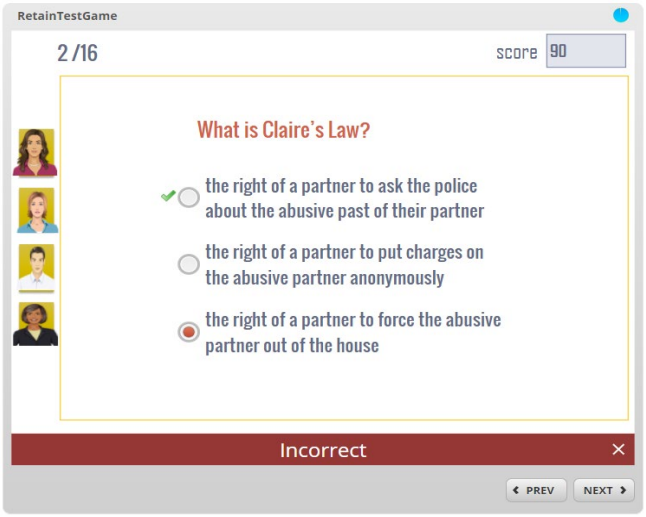


Figure 5. 45. Reviewing the Quiz

5.7. Summary

The chapter described the design and development of the research instruments of this research thesis, which are the Stronger game, the DC, and a set of questionnaires that collect data to support the data analysis. The chapter describes the design and the development of the phases of the role-playing game Stronger, the game design elements, the variables and values they collect. Accordingly, it describes the design and development of the DC, the variables and the data that it collects. The chapter also describes the questionnaires designed to support the study. The demographics questionnaire collects data about the profile of the participants at the study, and the empathy questionnaire collects data about the empathetic personality of participants. Finally, the retention-knowledge test evaluates the level of knowledge retained in memory four weeks after playing the game Stronger or completing the DC.

Chapter 6 – Study and Data Analysis

This chapter describes the empirical study of the research thesis and presents the outcomes of the data analysis. The study is conducted to evaluate the DeLEC framework, its learning effectiveness, and how it supports learners in achieving deeper learning. First, it discusses the pilot study, and then it presents the study process following the data analysis. The data analysis conducted in two ways: "within-subjects" where data analysis describes the results of the experimental group (the group that plays the Stronger game with the DeLEC framework), and; "between-subjects" where data analysis describes the results of the comparative study between the experimental group and the control group which uses the digital course.

6.1. The pilot testing

The pilot testing is a necessary stage of the development (Ternauciuc & Vasiu, 2015) to ensure that the research instruments are efficient and suitable for study. Pilot testing is essential to ensure that the final product released to the participants do not influence the study outcomes or prevent/reduce users' experience. According to Julious (2005), twelve participants for each group is a reliable number for conducting pilot testing. The pilot testing for both the role-playing game and the digital course conducted with twelve participants each, who tested the application and gave suggestions and recommendations for changes and improvements. Most of the suggestions were implemented to the final version of the applications and improved the functionality, usability and reliability of both learning products.

The questionnaire used for the pilot study and the suggestions for improvements are provided in Appendix F. After completing the pilot study and granted the approval from the Ethics Committee, we proceeded to the recruitment of the participants.

6.2. The recruitment of participants

After gaining approval from the Research Ethics Committee, the recruitment of participants started. Participants were invited to participate in the study by:

a. emails were sent to university students and staff inviting them to participate in the study;
b. posters were posted on announcement boards at the university;
c. face-to-face invitations.

The sample of participants that took part in the study consisted of 88 participants, males and females between the ages of 18 – 55 with different ethnic background and educational level. Participants were undergraduate students who volunteered to participate, academic staff, administrative staff, as well as other participants outside the university.

The participants were assigned randomly into two groups:

a. the experimental group, which consisted of 48 participants, tested the Stronger game, and,
b. the control group, which consisted of 40 participants, tested the digital course.

The inclusion criteria allowed participants of all genders, ethnic background and education level to participate in the study with a minimum age of 18 years old. The reason for requesting adults is related to the request of parental consent that is necessary to be granted before involving teenagers in a study. Another reason is related to the learning content which revolves around the issue of domestic abuse and would request extra arrangements while the study especially if it recalled unfortunate memories or traumas that would lead to unforeseen conditions during the study.

6.3. The research study process

The study conducted at the University of Westminster, the Cavendish Campus. The participants gathered in the computer room and randomly assigned to play the game or do the digital course.

The researcher welcomed the participants and explained the study process. The participants received the participation sheet explaining the aims of the research thesis and signed the consent to let their data to be used anonymously for the study purposes. They were also informed they could interrupt the study and leave the room at any point if they wished. Nobody left the study. Throughout the process, the researcher remained in the room, facilitating the participants in case of technical issues or questions about the study. No issues occurred during the study.

Additionally, the researcher had the chance to do informal observations, taking brief notes of the participants' reactions and comments while playing the game and completing the digital course. The qualitative data is presented in section 6.8.

During the study the participants of both groups had to do the following (see Figure 6.1):

1. Complete the information sheet and sign the consent;
2. Complete the pre-knowledge test;
3. Play Stronger (experimental group A) or the digital course (control group B);
4. Complete the post-knowledge test;
5. Complete the demographic questionnaire;
6. Complete the empathy questionnaire (only for experimental group A)
7. Complete the retention-knowledge test, four weeks later.

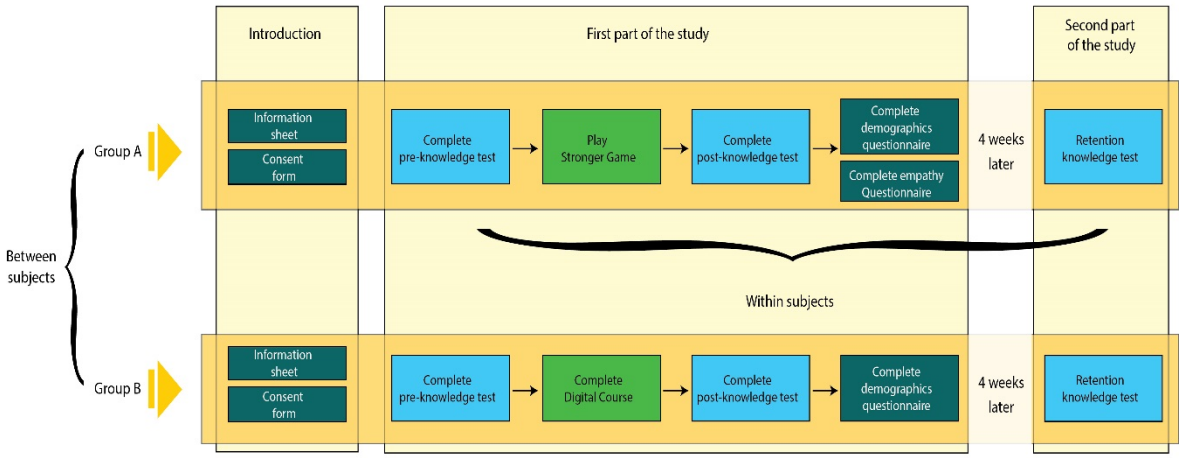


Figure 6. 1. The research study process

The study planned to run in two parts:

a. The first part included the main study as described above, where participants completed the pre-knowledge test, played the game or completed the digital course and then completed the post-knowledge test and the questionnaires.
   The first part of the study lasted as follows:
   - Stronger game: It takes around 40 minutes to complete it and another 15 minutes to complete the questionnaires;
   - Digital course: It takes around 25 minutes to complete it and another 10 minutes to complete the questionnaires.

b. The second part of the study conducted with the same participants four weeks after playing the game/digital course. In the second part, participants completed the retention-knowledge quiz which lasted around 15 minutes.

6.4. The Quantitative Data Analysis Process

The data analysis is implemented using the licenced SPSS® version 25 provided by the University of Westminster. The raw data are documented in Appendix H.

The data analysis is conducted as follows:

a. Demographics data analysis

The data analysis of the demographic information of the participants (see section 6.5)

b. Data analysis within-subjects (within the experimental group)

The data analysis refers to the sample of participants who played the role-playing game Stronger also called the experimental group (Group A) (see section 6.6.).

c. ***Data analysis between-subjects (between the groups)***

Between subjects is the comparative study between the experimental group (Group A) and the control group (Group B) (see Section 6.7).

6.4.1. The Data Analysis in steps

Each research question is statistically analysed following the next three steps:

a. **Step 1: Form the hypotheses.**

In this quantitative study, there are two groups and three main learning variables that are examined. Aiming to answer the research questions each test is set under two hypotheses, the null (H_0) and the alternative (H_1). The null hypothesis states that experimental group has achieved equal or less than the control group and therefore no difference is claimed while the alternative hypothesis states that the experimental group has achieved greater than the control group and therefore a significant difference/result is claimed for the Stronger game which adds value to the new proposed DeLEC framework.

b. **Step 2: Test of Normality**

It is essential to test whether the data of a variable are normally distributed and decide about the test to be used for the data analysis. When the data of a variable are normally distributed then the comparison of means is done with parametric tests. Likewise, when data are not normally distributed the comparison of the means is done with non-parametric tests. This is explained because during the testing in the next sections different tests are chosen depending on the normality test.

Hence, the tests for comparing the means of the two groups are chosen as follows:

i. Within the same group (within-subjects) data analysis:
   - If the data of a variable are normally distributed -- Paired t-test
   - If the data of a variable are not normally distributed -- Wilcoxon Signed-Ranks Test.

ii. For the comparison of two independent groups (between subjects) data analysis:
    - If the data of a variable are normally distributed -- Independent Samples t-test.
    - If the data of a variable are not normally distributed -- Mann-Whitney U Test.

c. Step 3: Running the test

Applying the appropriate test for comparing the means, the test output suggests whether retaining or rejecting the null hypothesis, set in step 1. The test outputs the p-value (Sig) suggests rejecting the null hypothesis when the p-value is smaller than 0.05 or 0.001. Rejecting the null hypothesis means that the alternative hypothesis is accepted.

6.4.2. The learning variables

The three main learning variables examined through the research study are:

a. The pre-knowledge score

The pre-knowledge score measures the existing knowledge of a participant about the learning subject before playing the game or the digital course (see Figure 6.1). The pre-knowledge test comprises of 16 questions of 10 points, so the maximum score is 160. The pre-knowledge quiz is the same for both groups A and B.

b. The post-knowledge score

The post-knowledge score measures the knowledge of participants about the learning subject acquired from the game, or the digital course (see Figure 6.1). The participants complete the post-knowledge quiz after playing the game or the digital course. The post-knowledge quiz comprises of 16 questions of 10 points, so the maximum score is 160. The post-knowledge quiz is the same for both groups A and B.

c. The retention-knowledge score

The retention-knowledge score measures how much of the acquired knowledge retained in memory four weeks after playing the game/digital course (see Figure 6.1). The quiz is similar to pre-knowledge and post-knowledge quiz. It consists of 16 questions of 10 points each with a maximum score of 160. The quiz is the same for both the experimental and the control group.

d. The creative score

The creative score is obtained as the total score from the three creative activities with a max score of 180 points. Particularly, the first creative activity counts 90 points, the second 50 points and the third 40 points.

6.4.3. The dependent and independent variables

The data for the statistical analysis is provided by the dependent variables. Hence, the dependent variables are the mean scores of the learning variables, including the mean of the pre-knowledge score, the mean of the post-knowledge score, the mean of the retention-knowledge score, and the mean of the creative score, as well as the empathy score and level of empathy.

The independent variables constitute the values or scores of each participant collected through the game and the DC. These values are the scores of pre-knowledge, post-knowledge, retention-knowledge, level of empathy of each participant, and the creative score.

6.5. The Demographics Data Analysis

The experimental group consists of 48 participants, while the control group consists of 40 participants. The demographic profiles of the participants of both groups are described in section 6.5. The raw data are documented in Appendix G.

The purpose of the demographic questions is to draw the profile of the sample of participants that took part in the study. The role of the demographics is to support the idea that a random sample of participants has been used for the Stronger game and the digital course. Demographics are not part of the main statistical analysis and therefore, they have only been described.

6.5.1. Gender

Table 6.1 presents the distribution of participants by gender, allocated in the two groups, the experimental group (A) and the control group (B). The experimental group consists of 48 participants (55%), of which 32 are females and 16 males. The control group consists of 40 participants (45%), of which 28 females and 12 males. In total, we have 60 females and 28 males who took part in this study.

Groups * Gender

		Gender		
		Female	Male	Total
Groups	A	32	16	48
	B	28	12	40
Total		60	28	88

Table 6. 1. Gender of participants per group A and B

6.5.2. Age

Participants aged 18 and above. All participants, according to their age, are allocated in five age categories as follows (see Table 6.2):

a. 18-24
b. 25-34
c. 35-44
d. 45-55
e. >55.

The majority of the participants (35 out of 88) aged between 18-21 and the second biggest group (27 out of 88) age between 35 and 44. Table 6.2 shows the allocation of participants according to their age group for the experimental group (A) and the control group (B).

Groups * Age
Count

		Age					
		18-24	25-34	35-44	45-55	>55	Total
Groups	A	21	8	14	4	1	48
	B	14	9	13	2	2	40
Total		35	17	27	6	3	88

Table 6. 2. Participants' age in each group.

6.5.3. The ethnicity of the participants

The participants are asked to indicate their ethnicity. Most participants are White in both study groups, followed by Asians. Smaller ethnic groups of participants are Black, Chinese and Mixed. Table 6.3 shows the allocation of participants in ethnic groups.

In group A, out of 48 participants, 30 are White, 9 Asians, 3 Black, 2 Chinese, 2 Mixed and 2 participants declared as other. In group B, out of 40 participants, 23 are White, 9 Asians, 3 Black, 3 Chinese, and 2 Mixed.

Groups * Ethnicity
Count

		Ethnicity						
		Black	White	Chinese	Asian (excluding Chinese)	Mixed	Other	Total
Groups	A	3	30	2	9	2	2	48
	B	3	23	3	9	2	0	40
Total		6	53	5	18	4	2	88

Table 6. 3. Participants: Gender and Ethnicity

6.5.4. The level of education of participants

The demographics recorded the education level of the participants. Table 6.4 presents the education of the participants per group. Most participants for both study groups are undergraduates (47), 20 postgraduates, 19 on the doctoral level and 2 reported other education.

Groups * Education Level Crosstabulation
Count

		Education Level				
		undergraduate	post-graduate	doctoral	other	Total
Groups	A	26	12	10	0	48
	B	21	8	9	2	40
Total		47	20	19	2	88

Table 6. 4. Education Level of the participants

6.5.5. The frequency of using e-learning applications

E-learning applications are digital learning media used as an alternative media for learning. The purpose of this question is to investigate the familiarity of the participants are with e-learning applications.

Table 6.5 displays the frequency of using e-learning applications. Most participants (60 out of 88), reported they used e-learning applications a few times. 18 participants out of 88 reported they have never used e-learning applications for their learning and 10 participants use e-learning most of the times. Therefore, most participants are familiar with e-learning applications because they have used it either few or many times.

How frequently do you use e-learning applications?
Count

		How frequently do you use e-learning applications?			
		no, never	Yes, a few times	Yes, most of the times	Total
Groups	A	14	28	6	48
	B	4	32	4	40
Total		18	60	10	88

Table 6. 5. Participants: Familiar with e-learning applications

6.5.6. Frequency of playing video games

Table 6.6 displays the frequency of playing video games in both study groups. In group A, 13 participants play games every day while only 5 participants play games in group B. The majority of participants in group A (17) play digital games very often contrary to group B of 9 participants. Rarely playing games reported 11 participants in group A and 16 in group B. A smaller number of 7 participants in group A, reported they do not play video games. The corresponding number of participants who stated they do not play video games for group B is 10.

How frequently do you play video games for entertainment?
Count

		How frequently do you play video games for entertainment?				
		Every day	Very often	Rarely	I don't really play digital games	Total
Groups	A	13	17	11	7	48
	B	5	9	16	10	40
Total		18	26	27	17	88

Table 6. 6. Participants: Frequency of playing video games

6.5.7. Domestic abuse course

Participants were also asked to indicate whether they had attended a course on domestic violence. The majority of participants, 96% responded they had never attended any course on domestic violence and abuse.

6.5.8. Summary of demographics between the two groups

The demographics of the two groups are summarised in Table 6.7. Eighty-eight participants took part in the study and are assigned in two groups: the experimental group (48) and the control group (40). Observing table 6.7 for the first four demographic characteristics it can be found that the two groups maintain similar demographic as for the gender, age, ethnicity and the educational level. There are some differences in the percentages of participants and their experience with

playing video games and e-learning courses, but this is not included in the demographic characteristics of the participants. Nevertheless, none of the participants expressed any difficulty in using the game or the DC.

		Group A Participants/percent	Group B Participants/percent
gender	Male	16 (33%)	12 (30%)
	Female	32 (67%)	28 (70%)
Age	18-24	21 (44%)	14 (35%)
	25-34	8 (16%)	9 (23%)
	35-44	14 (30%)	13 (32%)
	45-55	4 (8%)	2 (5%)
	>55	1 (2%)	2 (5%)
Ethnicity	Black	3 (6%)	3 (7%)
	White	30 (63%)	23 (58%)
	Chinese	2 (4%)	3 (7%)
	Asian	9 (19%)	9 (23%)
	Mixed	2 (4%)	2 (5%)
	Other	2 (4%)	0
Education	Undergrad	26 (54%)	21 (52%)
	Postgrad	12 (25%)	8 (20%)
	Doctoral	10 (21%)	9 (22%)
	Other	0	2 (5%)
e-learning	Never	14 (30%)	4 (10%)
	Few times	28 (58%)	32 (80%)
	Most times	6 (12%)	4 (10%)
Play video games	Every day	13 (27%)	5 (12%)
	Very often	17 (35%)	9 (23%)
	Rarely	11 (23%)	16 (40%)
	Don't play	7 (15%)	10 (25%)

Table 6. 7. Summary of demographics

Therefore, the comparison between the two cohorts shows that participants have been assigned to the two groups randomly and equally.

6.6. Within-Subjects Investigation

Within-Subjects investigation refers exclusively to the experimental group. To investigate the learning and the deeper learning achieved by the experimental group with Stronger it is necessary to examine first the components of the DeLEC framework showing that participants have gone through the DeLEC learning process and they have completed the instruction, empathy and creativity stages. Satisfying that participants have followed the DeLEC learning process we can then examine their learning achievement. For the experimental group, the number of subjects (N) is 48. The row data are documented in Appendix G.

The DeLEC framework proposed an integrated learning process consisted of:

1. Instruction, formative assessment, and repetitions;
2. Empathy;
3. Creativity;

In this stage, the investigation presents the results of participants at the instruction phase, their empathy during playing the game and their creativity.

6.6.1. Instruction, formative assessment and repetitions

All participants completed the instruction part including the formative assessment. The instruction in Stronger progresses in each scene through the dialogues between the characters. At the end of each scene, the formative assessment measures the learning gained with a quiz. Participants could pass the quiz from the first attempt, or otherwise, they go through the instruction again and retry the quiz. The game is designed in a way that the instruction cannot be skipped and only if the instruction is completed, and the assessment successful the participant can move to the next level.

Unlike other learning methods that would assess learning once, in Stronger, learners should repeat instruction until the formative assessment score reaches the desired learning level/score.

Question 1. Have the participants in experimental group (group A) gained better learning by following the DeLEC process in the instruction phase?

The instruction and formative assessment in the DeLEC framework are designed in sections (scenes). If participants fail the formative assessment, the DeLEC approach requires the repetition of the scene as many times necessary until they successfully pass the scene.

To answer this question, it is necessary to compare learning recorded in the game if a participant had only one chance to play the scene (initial score) to the learning they have achieved with the DeLEC framework after the repetitions (final scene score). Hence, we recorded the participants' score at the first try of the formative assessment for all scenes (Tot_Ini_Scores) and compare it to the learning score they achieved after repetitions (Tot_Sc_Scores). Next, the hypothesis is set.

Step 1: Form the hypotheses:

$Q1H_0$: *The mean Total Scene Score (Tot_Sc_Score) is less than or equal to Total Initial Score (Tot_Ini_Scores).*

$$\mu_{tot\_Sc\_score\ A} <= \mu_{tot\_ini\_scores\ A}$$

$Q1H_1$: *The mean Total Scene Score (Tot_Sc_Score) is greater than the Total Initial Score (Tot_Ini_Scores).*

$$\mu_{tot\_Sc\_score\ A} > \mu_{tot\_ini\_scores\ A}$$

To claim that participants achieved higher learning following the DeLEC framework with repetitions than going through learning only once, the test should accept the alternative hypothesis (*$Q1H_1$).*

Step 2: Test of Normality

Table 6.8 shows that the Shapiro-Wilk test of normality indicates that Tot_Ini_Score and Tot_Sc_Score are not normally distributed because the p-value for the two variables is less than the (0.05), hence, according to 6.4.1., when variables are not normally distributed the Wilcoxon Signed-Ranks Test is chosen.

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Tot_Ini_Score	.165	48	.002	.915	48	.002
Tot_Sc_Score	.197	48	.000	.903	48	.001

Table 6. 8. Normality test

Step 3: Wilcoxon Signed-Ranks Test

The Wilcoxon Signed-Ranks test in table 6.9 rejects the null hypothesis because the p-value is less than 0.001 and accepts the alternative hypothesis set in step 1, The alternative hypothesis suggests that the mean Tot_Sc_Score is greater than the mean Tot_Ini_Score.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The median of differences between Tot_Ini_Score and Tot_Sc_Score equals 0.	Related-Samples Wilcoxon Signed Rank Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Table 6. 9. Comparison of the means

Table 6.10 shows the values of the means. The mean of the Tot_Sc_Score is M=222.08, (SD=12.36), which is increased around 20 points compared to the Tot_Ini_Score which mean is M=201.66, (SD=27.39).

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Tot_Ini_Score	48	120.00	240.00	201.6667	27.39260
Tot_Sc_Score	48	200.00	240.00	222.0833	12.36989
Valid N (listwise)	48				

Table 6. 10. Initial Scores and Final Scores in the instruction

Hence, it is concluded that the repeated instruction and formative assessment designed for the DeLEC framework improved learning compared to instruction and formative assessment that enable learners to assess their learning only once.

6.6.2. Empathy

Question 2. Have participants invoked empathy following the DeLEC process?

Empathy is one of the components of the DeLEC framework designed into the instruction phase. The role of empathy is to trigger participants' empathy to develop

connection and engagement with the game character. This can be translated as a motivation for playing the game.

Empathy in game was measured by asking participants to rate their emotions and level of empathy while playing the game in a likert scale from 0 to 5, where 0 is no empathy, no emotion, 1 is a weak level of empahty and 5 is high level of empathy.

In this section, we aim to evaluate whether participants empathised with the game character. Empathy is measured based on the ratings of participants about their emotions and empathy towards the game character while playing the game.

Empathy is investigated with three measurements:

- The Emotions Score,
- The Level of Empathy, and
- Empathetic characters and the Level of Empathy in the game.

6.6.2.1. Defining the Optimum Cut off point to define the categories of Low/Moderate and High Level of empathy

The cut-off point is identified on a psychometric scale where it clearly demarcates those participants that have a specific condition and those that don't have a specific condition. In this case participants are checked whether they belong in the high level of empathy category or the low level of empathy category. To investigate this condition, two variables are used: **Empathy1** (level of empathy in the incident 1) and **Empathy2** (level of empathy in the incident 2).

The next histograms (see Figures 6.2 and 6.3) illustrate the number of participants who reported ratings 0, 1, 2, 3, 4, and 5 for the level of empathy in two instances, Empathy 1 and Empathy 2. The histogram in Figure 6.2 shows the rating of participants for the level of empathy they felt for the victim game character for the first time after scene 2 where the victim receives threaten text messages show a prevailed value of 4.

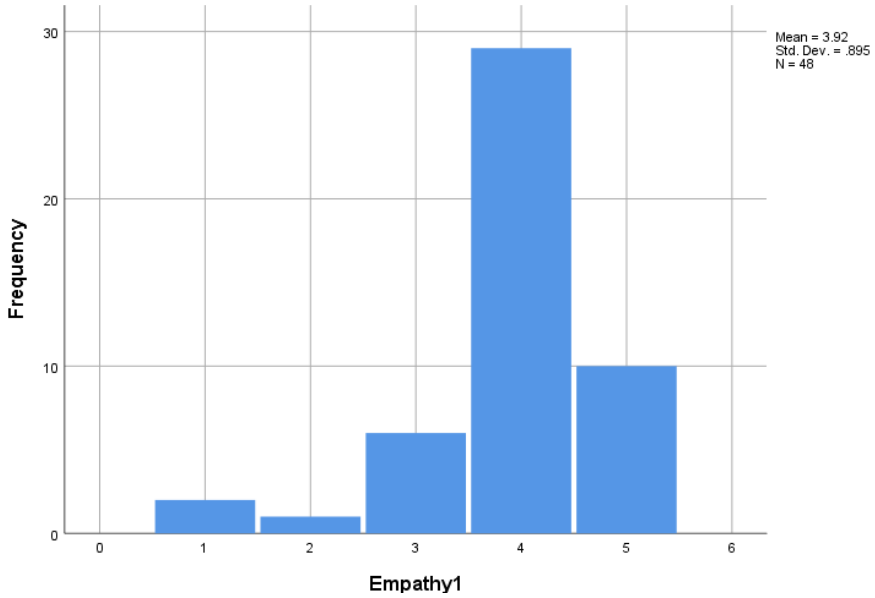


Figure 6. 2. Histogram shows participants' rating of the Level of Empathy 1

The histogram in Figure 6.3. shows the rating of participants in the second incident (scene 5). It is observed an increase in the number of participants who rated 5 (the highest level of empathy) towards the victim. So, the prevailed number is 5.

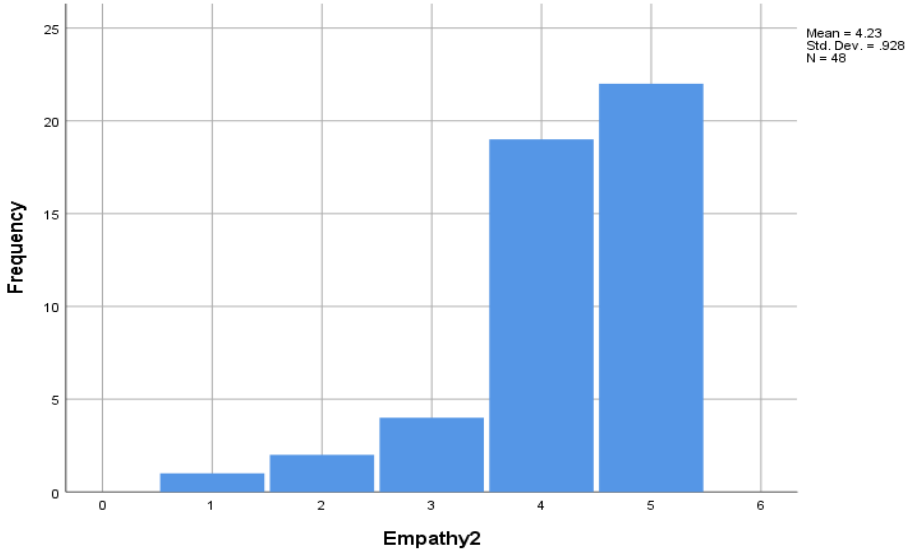


Figure 6. 3. Histogram shows participants' rating of the Level of Empathy 2

To determine the cut-off point it is essential to run the ROC Curve with both Empathy 1 and Empathy 2 which shows the Sensitivity and the 1-Specificity. The point of the curve which is closer to the Sensitivity 1.0 (shown with the red circle) has coordinates shown in the next Figure 6.4.

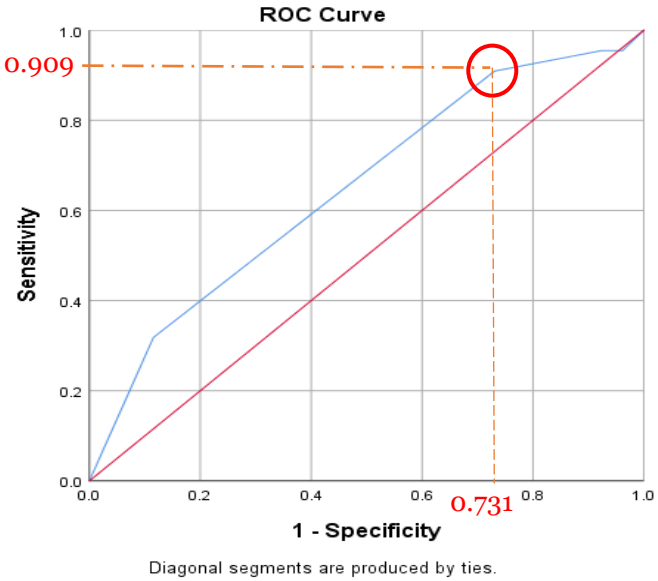


Figure 6. 4. The ROC Curve

Coordinates of the Curve

Test Result Variable(s): Empathy1

Positive if Greater Than or Equal To[a]	Sensitivity	1 - Specificity
.00	1.000	1.000
1.50	.955	.962
2.50	.955	.923
3.50	.909	.731
4.50	.318	.115
6.00	.000	.000

Table 6. 11. The cut-off point

Matching the coordinates of the ROC Curve shown in Figure 6.4, table 6.11., shows the cut-off point at 3.50. This means that within the rating scale of 1-5 any values above 3.50 show that participants belong to the category High Level of Empathy, while all values equal or below 3.50 belong to the category Low/Moderate Level of Empathy. The cut-off point justifies why number 3 became the border for category low/moderate level of empathy and why 4-5 is set to show High level of empathy.

6.6.2.2. The emotions score

Participants are asked to rate their emotions in two incidents during the game. The emotions are: neutral, worried, afraid and angry, other. Participants rated their emotions to the scale 1 to 5, where 1 is weak feeling, and 5 is a strong feeling

indicated for the victim game character. The scale does not apply for neutral and the option other. In figure 6.5 the screen of emotions ratings used in the game.

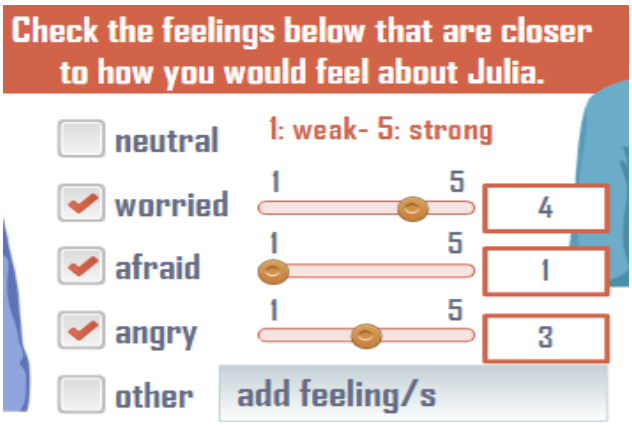


Figure 6. 5. Rate of emotions while playing the game.

As shown in figure 6.5, a participant who rates their emotions 5 in each of the three emotions can take a maximum score of 15. Because there are two different incidents to rate emotions, the maximum score is 30. Participants depending on their rating in Emotions Score are divided into the categories:

- Participants who rated their emotions 4 and above, consist the category HES (High Emotions Score).
- Participants who rated their emotions less than 4, consist the category LMES (Low/Moderate Emotions Score).

Out of 48 participants (see Table 6.12), 37 showed Low/Moderate Emotion Score (LMES) and 11 showed High Emotion Score (HES). This is the first indication that participants demonstrated emotions towards the game character. Around 23% of the participants rated strong emotions towards the situation of the game victim and 77% showed low/moderate emotions.

Categories Emotion Score

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	LMES	37	77.1	77.1	77.1
	HES	11	22.9	22.9	100.0
	Total	48	100.0	100.0	

Table 6. 12. Empathy score per category

The analysis given in table 6.12 presents the number of participants who rated 1,2,3 (LMES) in both incidents as well as the number of participants who in both incidents rated 4 or 5 (HES).

Detailed data of the two incidents are presented to the Table 6.13.

Summary table of the Emotion Score ratings

Table 6.13 presents the number of participants rated themselves in scale 1-5 for the emotions: Neutral, Worried, Afraid, Angry, and Other for the two incidents. A participant could choose more than one emotion. The numbers 0 to 5 show the intensity of emotions with 1 to be a weak emotion and 5 strong emotion.

For example, none of the participants rated Neutral during playing the game while 35 participants rated 5 for Worried in incident 1 and 38 participants rated 5 for Worried in incident 2. The prevailed emotion of participants according to their rating is the feeling of Worried about the game character during playing the game and their worry is at the highest level. At the second violent incident, 38 out of 48 rated themselves worried about the game character, while 20 said they are afraid about the game character and 17 are angry about the situation concerning the game character.

		Number of Participants				
	Emotions rating	Neutral	Worried	Afraid	Angry	Other
Violent Incident 1	0	0	2	18	22	5
	1		2	2	6	
	2		1	3	4	
	3		1	4	3	
	4		7	11	4	
	5		35	10	9	
Violent Incident 2	0	0	4	17	23	4
	1		4	4	3	
	2		1	4	1	
	3		1	3	2	
	4		0	1	2	
	5		38	20	17	

Table 6. 13. Emotions Score Ratings

6.6.2.3. The Level of Empathy

The Level of Empathy is another measurement rated by the participants. Participants are asked to rate their empathy towards the victim game character in

the scale 0 to 5, where 0 is no empathy, 1 is low empathy, and 5 is high empathy (see Section 5.4.6). Because participants are asked twice during the game to indicate their level of empathy, the maximum score for the Level of Empathy is 10 (see Figure 6.6.).

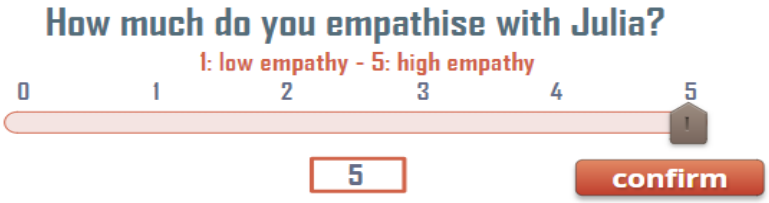


Figure 6. 6. The level of empathy

None of the participants indicated zero empathy. According to their score in the Level of Empathy, participants are divided into 2 categories:

- The participants who in each instance rated the level of empathy 4 or 5, comprise the category High Level of Empathy (HLE).
- The participants who in each instance rated the level of empathy less than 4, comprise the category Lower/Moderate Level of Empathy (LMLE).

Table 6.14 shows the two categories of the level of empathy LMLE and HLE. Most of the participants reported a high level of empathy. Particularly, out of 48 participants, 36 (75%) reported a High Level of Empathy (HLE) and 12 (25%) reported Low/Moderate Level of Empathy (LMLE). The results give a good indication that participants have demonstrated empathy towards the game character.

Cat_Empathy

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	LMLE	12	25.0	25.0	25.0
	HLE	36	75.0	75.0	100.0
	Total	48	100.0	100.0	

Table 6. 14. Total of participants in each category.

The analysis given in table 6.14 presents the number of participants who rated 1,2,3 (LMLE) in both incidents as well as the number of participants who in both incidents rated empathy 4 or 5.

Detailed data of the two incidents are presented to the Table 6.15.

Summary table of the Level of Empathy ratings

	Level of Empathy	Number of Participants
Violent Incident 1	0	0
	1	2
	2	1
	3	6
	4	29
	5	10
Violent Incident 2	0	0
	1	1
	2	2
	3	4
	4	19
	5	22

Table 6. 15. The level of empathy and the number of participants

Table 6.15 describes the number of participants that corresponds to their rating of the level of their empathy towards the game character. For incident 1, most participants (29) rated level of empathy 4 and another 10 rated 5. So, in total 39 participants out of 48 showed high level empathy at the point of incident 1. For incident 2 most of participants, 22 rated 5 and another 19 participants rated 4. So, in total 41 participants showed high empathy at the point of incident 2. It's worth noticing that the numbers of participants are shown significantly increased for the level of empathy 4 and 5 which is set as the high level of empathy compared to ratings 1,2, and 3.

6.6.2.4. Correlation of the Level of Empathy and Learning

Although empathy is part of the DeLEC framework and it is not considered to work alone but in association with all the elements of DeLEC such as the instruction, assessment and creativity, it is checked whether empathy alone can impact learning.

The analysis investigated whether the level of empathy alone correlates with the level of learning. If it correlates, it means that when there is a high level of empathy rating then it implies a higher level of learning (post-knowledge scores) or when

there is a low level of empathy ratings there is a low level of learning. The output shows a weak correlation across the level of empathy and post-knowledge score because the pattern does not systematically repeat across the learning scores and level of empathy ratings. However, the next tables (see Table 6.16 and Table 6.17) present the results of the ratings of the level of empathy in Incident 1 (Empathy 1) and in Incident 2 (Empathy 2) in relation to post-knowledge score.

Empathy1 * Post-Knowledge Score Crosstabulation

Count

		Post-Knowledge Score						
		100	120	130	140	150	160	Total
Empathy1	1	0	1	0	1	0	0	2
	2	0	0	0	0	1	0	1
	3	0	1	2	0	2	1	6
	4	1	3	2	9	8	6	29
	5	0	2	1	1	2	4	10
Total		1	7	5	11	13	11	48

Table 6. 16. Level of Empathy1 (Incident 1) and Learning

Empathy2 * Post-Knowledge Score Crosstabulation

Count

		Post-Knowledge Score						
		100	120	130	140	150	160	Total
Empathy2	1	0	0	0	0	0	1	1
	2	0	0	1	0	0	1	2
	3	1	2	0	1	0	0	4
	4	0	2	1	4	8	4	19
	5	0	3	3	6	5	5	22
Total		1	7	5	11	13	11	48

Table 6. 17. Level of Empathy2 (Incident 2) and Learning

Both tables show the empathy rating and the corresponding post-knowledge score. Observing the post-knowledge scores and the empathy ratings it is obvious that low empathy rating doesn't mean low post-knowledge score. However, the highest post-knowledge scores (140, 150, 160) are observed to occur by participants who rated themselves with a high level of empathy. The red boxes demonstrate an area where most participants who scored 140, 150, and 160 have also rated empathy 4 and 5. Of course, there are exceptions of participants who scored the highest score having low empathy rating, but this number is still very small.

Therefore, it seems that in the game, the level of empathy contributed to the high post-knowledge score. This might be attributed to the fact that users created empathy and connection towards the game character as well as acknowledged their role as the close friend in the game and increased their interest and motivation for the game, the story and the game characters and this engaged them and persist them for learning.

6.6.2.5. *Empathetic characters and the Level of Empathy in the game*

In this section, we examine the participants who rated themselves as empathetic characters using Likert Scale Questions the Basic Empathy Scale in Adults Questionnaire (Carré et al., 2013). Their rating as empathetic characters is compared to their rating about the level of empathy they demonstrated in the game. Thus, to distinguish the empathetic participants, we divided participants into two categories according to their rating. Participants who rated the Empathy Likert Scale questions with 4 (Agree) or 5 (Strongly Agree) are considered High Empathetic characters while participants who rated the questions 1, 2, or 3 are considered low empathetic characters (see Empathy Likert Scale Questions in section 4.3.8).
Below are the two categories of empathy created according to participants' answers:

- The Low Empathetic Characters (LEC) and
- The High Empathetic Characters (HEC).

Table 6.18 presents 31 participants who rated themselves High Empathetic Characters and 17 participants who rated themselves Low/Moderate empathetic characters.

EmpChar_Cat

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	LEC	17	35.4	35.4	35.4
	HEC	31	64.6	64.6	100.0
	Total	48	100.0	100.0	

Table 6. 18. Empathetic characters

Question 2.1. Have participants who are considered as high empathetic characters exhibited high level of

To examine this question, we compared the 48 participants and their answers in rating themselves as empathetic characters and compared it with their rating for the

Level of Empathy. The categories of empathy are Low/Moderate Level of Empathy (LMLE) and High Level of Empathy (HLE). The results are the following:

Participants who rated:	No of participants	Percent
HEC rated LMLE	5	10.42%
HEC rated HLE or	26	54.16%
LEC rated LMLE	7	14.58%
LEC rated HLE	10	20.83%
	48	100%

Table 6. 19. Empathetic Characters and Level of Empathy.

Table 6.19 displays that only 5 of the participants who rated themselves as High Empathetic Characters (HEC), rated LMLE which shows that their empathetic character does not comply with the empathy they've shown in the game. Furthermore, 33 participants who rated themselves either HEC or LEC, have shown consistency with the rating in the Level of empathy. Particularly, 26 were HEC and rated HLE and 7 reported LEC and rated LMLE. Another group of 10 participants rated themselves as LEC and as a matter of fact, they have demonstrated HLE in the game Stronger.

The answer to question 2.1 suggests that with an exception of 5 participants, 26 (54.16%) participants show High Level of Empathy and another 10 (20.83%) participants who are considered LEC report also High Level of Empathy.

6.6.3. Creativity

In this section, we examine creativity as another significant component of the DeLEC framework. Creativity, as explained in section 5.3, is conducted after the instruction where participants are asked to apply their knowledge gained from the Stronger game into creative tasks. According to 2.6.4, creativity is the approach of transferring the gained knowledge to new contexts and contributes to achieving deeper learning.

There are three creative activities in the game (creative activity 1, 2 and 3) where participants are asked to complete (see Section 5.4.4). The three creative activities have scores of 90, 50 and 40 respectively. The maximum total creative score is 180. The passing level is set to 100 (and not to 90), to ensure that participants complete

more than the first activity. The mean score of all creative activities (Total Creative Score) is 119.17 out of 180 according to table 6.20.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Total Creative Score	48	70	160	119.17	23.140
Valid N (listwise)	48				

Table 6. 20. The mean of Creative Score

Examining further the scores of creative activities participants are divided into two categories depending on their score with a maximum score of 180.

- Participants who scored more than 100 comprise the category of High Creativity (HC)
- Participants who scored less than or equal or 100 comprise the category of Low Creativity (LC)

As shown in Table 6.21, the majority of participants (38) (79%) scored high creativity (HC) (M=128.42 SD=14.98) and another 10 (21%) participants scored low creativity (LC) (M=84, SD=11.73). There is a mean difference of 44.42 between the scores of HC and LC.

Report

Total Creative Score

Creativity Categories	Mean	N	Std. Deviation
LC	84.00	10	11.738
HC	128.42	38	14.982
Total	119.17	48	23.140

Table 6. 21. Creativity Categories

In more detail (see Table 6.22), 34 participants of the HC category have achieved scores between 110 and 140 and another 4 participants achieved score 150 and 160. Therefore, 38 participants doing the creative activities, they have transferred their knowledge to new contexts, which according to section 2.6.4, leads to deeper processing and deeper learning.

Creative Score	Number of participants
<=100	10
110 - 140	34
150 - 160	4

Table 6. 22. Creativity scores and number of participants

6.6.3.1. *Creativity and Learning*

Creativity is another element of the DeLEC framework that is set to contribute to learning in combination with the other pedagogic elements and particularly after the completion of instruction and assessment, and empathy. Creativity is the phase where learners can apply their knowledge into new creative activities that help them remember better what they have learned and retaining it in memory.

Total Creative Score * Post-Knowledge Score Crosstabulation

Count

		Post-Knowledge Score						
		100	120	130	140	150	160	Total
Total Creative Score	70	0	1	0	1	1	0	3
	80	0	0	0	1	1	0	2
	90	0	0	2	0	1	0	3
	100	0	0	1	0	0	1	2
	110	0	3	1	1	1	2	8
	120	1	0	1	2	4	3	11
	130	0	1	0	2	1	1	5
	140	0	1	0	4	3	2	10
	150	0	0	0	0	1	0	1
	160	0	1	0	0	0	2	3
Total		1	7	5	11	13	11	48

Table 6. 23. Summary table of the creative score and post-knowledge score

Examining learners' Creative score (see Table 6.23) related to their learning performance (post-knowledge score) we can see scattered values. However, most participants that performed a medium creative score of 120, 130, 140, had a high post-knowledge score 140, 150, 160. Out of 48, 2 participants scored highest (160) both in creative activities and post-knowledge showed in a separate red box.

The design of creative activities within a digital space and within the time of the study was challenging and limited. The possibilities of the tool in providing functionalities that allow participants to be truly creative were also limited. However, out of the three creative activities, the first two creative activities enabled more the application of knowledge learned rather than the free expression of creation. On the other hand, the third creative activity enabled more creative thinking.

It cannot be argued from the results of this thesis that creative score alone supported the achievement of deeper learning. It is the combination of factors together with creativity that assisted learners in achieving high scores in learning and in retaining

learning. Creativity in serious games resembles the approach of *"learning by doing"* (Meij et al., 2020) as a way to express how they conceived and demonstrate the acquired knowledge. Considered an enjoyable way of expressing and demonstrating learning, creativity might cause remembering and retaining knowledge in memory which is part of deeper learning.

The methodology was designed to investigate whether the DeLEC framework as a completed learning process contributes to learning. Participants had to go through all the steps of both phases instruction and creativity to reach deeper learning. To better examine the weighting and validity of creative activities as part of the future work, a different methodology could define a separate group of participants who play the game without having to do the creativity phase, and then compare this group with the group that goes through all the DeLEC process comparing their post-knowledge and their retention-knowledge as the results of the learning effectiveness with and without creativity and reach to conclusions whether creative phase has indeed contributed to learning, retain of knowledge and deeper learning.

6.6.4. The satisfaction of the prerequisite of DeLEC

Investigating the three factors of DeLEC, the instruction/formative assessment, the empathy, and the creativity, we conclude that participants have followed the DeLEC learning process as it is defined by the DeLEC framework. Therefore, we can now proceed in investigating the learning achievement within-subjects which is the experimental group. The data analysis measures the pre-knowledge score, the post-knowledge score, and the retention-knowledge score within the experimental group.

6.6.5. Within Subjects Data analysis

The within-subjects data analysis examines the results of the experimental group (Group A) comparing the values of the same participant in two different time points (paired values).

6.6.5.1. Question 3

> ***Has the experimental group increased their learning by using the role-playing game "Stronger" compared to their knowledge before playing the game?***

Question 3 compares the means of the pre-knowledge score to the post-knowledge score within the experimental group. The comparison of the two means measures the learning occurred with Stronger. If the post-knowledge score is increased compared to the pre-knowledge score, then Stronger has contributed to learning. On the other hand, if the pre-knowledge score and post-knowledge score are not significantly different, it shows that participants did not change their knowledge by playing the game and therefore the game has not contributed to learning.

Step 1: Form the hypotheses:

$Q3H_0$: The post-knowledge score is less or equal to the pre-knowledge score;

$\mu_{\text{post-knowledge score A}} <= \mu_{\text{pre-knowledge score A}}$

$Q3H_1$: The post-knowledge score is greater than the pre-knowledge score;

$\mu_{\text{post-knowledge score A}} > \mu_{\text{pre-knowledge score A}}$

Step 2: Test of Normality

The Shapiro-Wilk test, (see Table 6.24), indicates the pre-knowledge score is normally distributed with p-value 0.825>0.05, while the post-knowledge score with p-value 0.000<0.001 is not normally distributed. Because the post-knowledge score is not normally distributed, the non-parametric test for paired values Wilcoxon Signed-Ranks Test is chosen (see 6.4.1.).

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Groups	Statistic	df	Sig.	Statistic	df	Sig.
Pre-Knowledge Score	A	.084	48	.200*	.986	48	.825
Post-Knowledge Score	A	.194	48	.000	.895	48	.000

Table 6. 24. Normality Test pre-knowledge score – post-knowledge score

Step 3: Wilcoxon Signed-Ranks Test

The test rejects the null hypothesis as the p-value 0.000 is less than 0.001 and hence accepts the alternative hypothesis set in step 1, which suggests that the mean of the

post-knowledge score is greater than the mean of the pre-knowledge score (see Table 6.25).

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The median of differences between Pre-Knowledge Score and Post-Knowledge Score equals 0.	Related-Samples Wilcoxon Signed Rank Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Table 6. 25. Wilcoxon Signed-Ranks Test for paired values

In Table 6.26, the mean pre-knowledge score (M=78.96, SD=29.33) is significantly higher than the mean of the post-knowledge score (M=142.50, SD=14.80). The mean of the post-knowledge score is almost double of the mean of the pre-knowledge score, while the standard deviation decreased to the half (14.80). (see Figure 6.7).

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Pre-Knowledge Score	48	0	150	78.96	29.336
Post-Knowledge Score	48	100	160	142.50	14.804
Valid N	48				

Table 6. 26. The means of pre-knowledge scores and post-knowledge scores

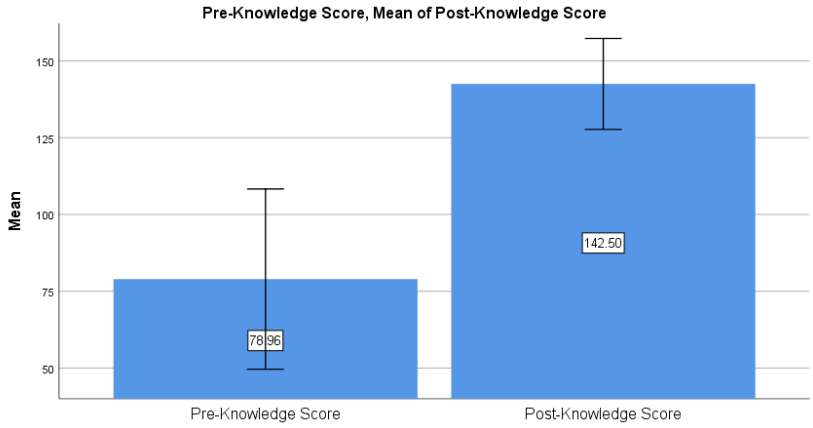


Figure 6. 7. Pre-knowledge score and Post-knowledge score within subjects.

Hence, the answer to question 3 is that yes, the experimental group increased and almost doubled their pre-knowledge by playing the Stronger game.

6.6.5.2. Question 4

> ***Has the experimental group retained their knowledge four weeks after playing the role-playing game "Stronger" compared to their knowledge before playing the game?***

Question 4 examines the retention-knowledge score compared to the pre-knowledge score. If the retention-knowledge score is increased compared to the pre-knowledge score, then it is concluded that the experimental group has achieved deeper learning.

Step 1: Form the hypotheses:

$Q4H_0$: *The retention-knowledge score is less or equal to the mean of the pre-knowledge score;*

μ *retention-knowledge score A* $<= \mu$ *pre-knowledge score A ;*

$Q4H_1$: *The retention-knowledge score is greater than the mean of the pre-knowledge score;*

μ *retention-knowledge score A* $> \mu$ *pre-knowledge score A ;*

Step 2: Test of Normality

The Shapiro-Wilk test (see Table 6.27), shows the pre-knowledge score with p-value 0.825 >0.05, and retention-knowledge score with p-value 0.111> 0.05 are normally distributed. Therefore, we choose the Paired t-test to compare the means (see Section 6.4.1).

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Groups	Statistic	df	Sig.	Statistic	df	Sig.
Pre-Knowledge Score	A	.084	48	.200*	.986	48	.825
Retain Score	A	.156	48	.005	.961	48	.111

Table 6. 27. The Normality Test Pre-Knowledge score – Retention-knowledge score

Step 3: Paired t-test

The paired t-test presented in table 6.28 shows that the p-value 0.000 < 0.001 and suggests we should accept the alternative hypothesis (set in step 1).

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Pre-Knowledge Score - Retain Score	-45.208	34.456	4.973	-55.213	-35.203	-9.090	47	.000

Table 6. 28. Paired t-test

To answer question 4 it is essential to check the means. In table 6.29, the retention-knowledge score (Retain Score) 124.17 is increased by 45.21 points compared to the pre-knowledge score 78.96. The participants have increased and retained their knowledge more of their pre-knowledge on the topic.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre-Knowledge Score	78.96	48	29.336	4.234
	Retain Score	124.17	48	20.088	2.900

Table 6. 29. Means of Pre-knowledge and Retention-knowledge score

Figure 6.8 illustrates the means of pre-knowledge and retention-knowledge scores of the experimental group showing the retention-knowledge score significantly higher.

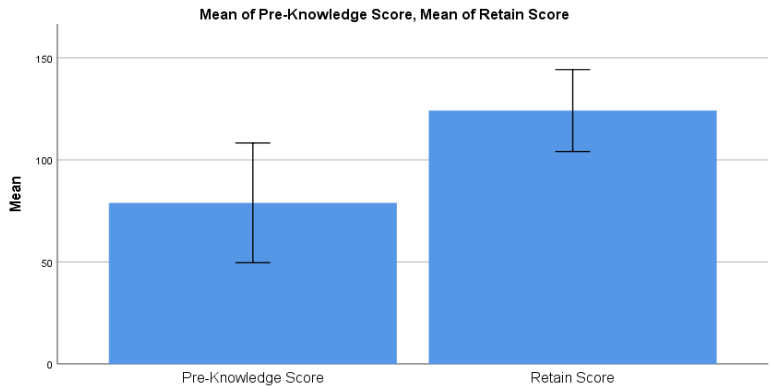


Figure 6. 8. The means of the pre-knowledge score and retention-knowledge score

In conclusion, the experimental group added to their initial knowledge on the topic and maintained this knowledge four weeks later and it seems they have assimilated new knowledge with their existing knowledge.

6.6.5.3. Question 5

Has the experimental group retained their knowledge four weeks later compared to their post-knowledge?

Question 5 compares the post-knowledge score to the retention-knowledge score. This investigation gives information about the amount of knowledge which is probably lost from memory four weeks later.

Step 1: Form the hypotheses:

Q5H₀: *The post-knowledge score is less or equal to the mean of the retention-knowledge score;*

μ *post-knowledge score A* $<=\mu$ *retention-knowledge score A;*

Q5H₁: *The post-knowledge score is greater than the mean of the retention-knowledge score;*

μ *post-knowledge score A* $> \mu$ *retention-knowledge score A;*

Step 2: Test of Normality

The Shapiro-Wilk test, (see Table 6.30), indicates the post-knowledge score is not normally distributed with p-value < 0.05, while the retention-knowledge score is normally distributed with p-value >0.05. So, the Wilcoxon Signed-Ranks Test is selected.

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Post-Knowledge Score	.194	48	.000	.895	48	.000
Retain Score	.156	48	.005	.961	48	.111

Table 6. 30. The Normality Test Pre-Knowledge score – Retention-knowledge score

Step 3: Wilcoxon Signed-Ranks Test

The results of the Wilcoxon Signed-Ranks Test (see Table 6.31) suggests the rejection of the null hypothesis and suggests that the mean of the post-knowledge score is higher than the mean of the retention-knowledge score.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The median of differences between Post-Knowledge Score and Retain Score equals 0.	Related-Samples Wilcoxon Signed Rank Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Table 6. 31. The Wilcoxon Signed-Ranks Test, post-knowledge score, retain-score

The mean of the retention-knowledge score (see Table 6.32) shows a decline of approximately 18 points four weeks later compared to the post-knowledge score. This is attributed to the fact that a part of learning is forgotten four weeks later. Although retention-knowledge score (M=124.17, SD= 20.08) is reduced by 18 points it didn't fall to the level of the pre-knowledge (M=76.98, SD= 29.33) it maintains far above which indicates retention of knowledge in memory and therefore, deeper learning.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Post-Knowledge Score	48	100	160	142.50	14.804
Retain Score	48	70	160	124.17	20.088
Valid N (listwise)	48				

Table 6. 32. The means of the post-knowledge score and retention-knowledge score.

Figure 6.9 illustrates the means of post-knowledge and retention-knowledge scores of the experimental group. The retention-knowledge score (Retain Score) appears to be decreased compared to the post-knowledge score.

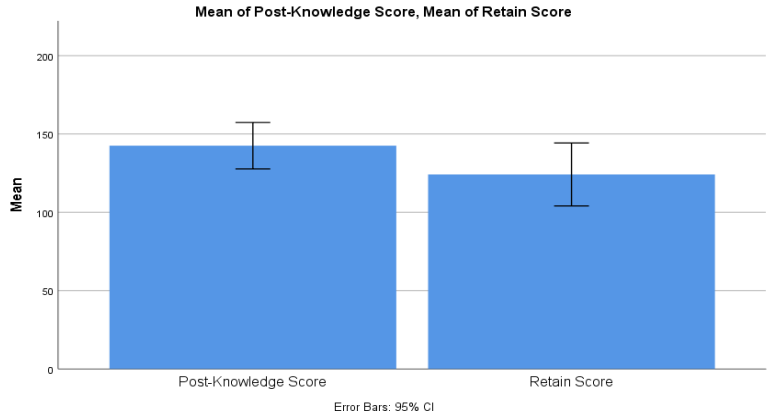


Figure 6. 9. The means post-knowledge score, retention-knowledge score.

In conclusion, learning is increased with the Stronger game, as the post-knowledge showed compared to pre-knowledge. Furthermore, the participants demonstrated higher retention of knowledge compared to their prior knowledge. A decline in retention-knowledge is observed in comparison to the post-knowledge score and this is expected as the memory fades out information as time passes. However, participants have retained their knowledge 46 points higher compared to their knowledge before playing the game.

6.7. Between subjects: The comparative study

In this section, the attention is focused on comparing the experimental group (group A) to the control group (group B). Details on the profiles of the participants are found in section 6.5 and documented in Appendix G.

The experimental and control group are compared as for their score with the following dependent variables:

- the pre-knowledge score;
- the post-knowledge score;
- the retention-knowledge score.

6.7.1. ANOVA Analysis

Aiming to analyse all three dependent variables by the two groups and get a picture of their trend over time, the multivariance analysis (MANOVA) and ANOVA are conducted. The grouping variable is Groups, the experimental and control group.

Table 6.33 shows the between-subject factors which are the two groups: Group A, the experimental group (number of participants: 48) and Group B, the control group (number of participants 40), and the total number of participants 88.

Between-Subjects Factors

		Value Label	N
Groups	Group A	A	48
	Group B	B	40

Table 6. 33. Between-Subjects Factors

The next table presents the descriptive statistics of the three dependent variables between the two groups which describes the mean values and the standard deviation for the pre-knowledge score, the post-knowledge score and the retain-knowledge score across the two groups (see Table 6.34).

Descriptive Statistics

	Groups	Mean	Std. Deviation	N
Pre-Knowledge Score	A	78.96	29.336	48
	B	72.50	23.288	40
	Total	76.02	26.805	88
Post-Knowledge Score	A	142.50	14.804	48
	B	112.75	24.494	40
	Total	128.98	24.684	88
Retain Score	A	124.17	20.088	48
	B	104.25	24.899	40
	Total	115.11	24.401	88

Table 6. 34. Descriptive statistics of the dependent variables.

Visually inspecting Table 6.34, the pre-knowledge score and standard deviation are similar for both groups. Hence, this is the first indication that participants in groups

are assigned randomly and their initial knowledge on the topic is similar, based on their personal experiences and social knowledge.

The post-knowledge score depicts that Group A (142.50) scored around 30 points higher than Group B (112.75) of which is considered a great difference between the two groups. In the same results, the standard deviation of Group A (14.80) is observed significantly decreased contrary to Group B which remains the same as in pre-knowledge score. Reduced standard deviation means that post-knowledge scores got closer to the mean post-knowledge score which indicates homogeneity of the participants of group A, meaning that participants have a similar level of knowledge on the given topic.

The retain-knowledge score conducted 4 weeks later continues to show Group A (124.17) to have scored around 20 points higher than Group B (104.25) which indicates that Group A not only learned more but also retained more of their acquired knowledge in memory one month later which, according Section 2.6.4, it indicates the acquisition of deeper learning.

The next table 6.35 depicts the Multivariate Test. The results for Groups are identical across the four tests. The Wilk's Lambda test shows that the p-value is less than 0.05 and therefore the experimental and control group are significantly different for the three dependent variables. The MANOVA Multivariate Tests looked at the dependent variables together, simultaneously.

Multivariate Tests

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Intercept	Pillai's Trace	.978	1266.061[b]	3.000	84.000	.000	.978	3798.184	1.000
	Wilks' Lambda	.022	1266.061[b]	3.000	84.000	.000	.978	3798.184	1.000
	Hotelling's Trace	45.216	1266.061[b]	3.000	84.000	.000	.978	3798.184	1.000
	Roy's Largest Root	45.216	1266.061[b]	3.000	84.000	.000	.978	3798.184	1.000
Groups	Pillai's Trace	.370	16.470[b]	3.000	84.000	.000	.370	49.411	1.000
	Wilks' Lambda	.630	16.470[b]	3.000	84.000	.000	.370	49.411	1.000
	Hotelling's Trace	.588	16.470[b]	3.000	84.000	.000	.370	49.411	1.000
	Roy's Largest Root	.588	16.470[b]	3.000	84.000	.000	.370	49.411	1.000

a. Design: Intercept + Groups
b. Exact statistic
c. Computed using alpha = .05

Table 6. 35. Multivariate Tests

The next tests look at the univariate, the dependent variables separately, that is why there are three p-values, one for each of the three variables.

Table 6.36 Tests of Between-Subjects Effects, depicts the results of the ANOVA. It contains many effects (see column Source). Focusing on Groups there are three separate ANOVA tests each for the dependent variables. The Alpha 0.025 is used for checking each test.

The first result, the pre-knowledge score, has a p-value of 0.263 which is greater than 0.025 and therefore the result is not significant. This indicates that the two groups do not differ as for their score in pre-knowledge.

The post-knowledge score result has a p-value less than 0.001, which is a significant result, therefore, the post-knowledge is significantly different between the two groups. Likewise, the retention-knowledge score (retain score) also depicts a p-value less than 0.001 which is also a significant result, showing that there is a significant difference in the means of retention-knowledge score between the two groups.

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[d]
Corrected Model	Pre-Knowledge Score	910.038[a]	1	910.038	1.271	.263	.015	1.271	.200
	Post-Knowledge Score	19310.455[b]	1	19310.455	49.283	.000	.364	49.283	1.000
	Retain Score	8654.697[c]	1	8654.697	17.252	.000	.167	17.252	.984
Intercept	Pre-Knowledge Score	500500.947	1	500500.947	698.775	.000	.890	698.775	1.000
	Post-Knowledge Score	1421510.455	1	1421510.455	3627.863	.000	.977	3627.863	1.000
	Retain Score	1138345.606	1	1138345.606	2269.084	.000	.963	2269.084	1.000
Groups	Pre-Knowledge Score	910.038	1	910.038	1.271	.263	.015	1.271	.200
	Post-Knowledge Score	19310.455	1	19310.455	49.283	.000	.364	49.283	1.000
	Retain Score	8654.697	1	8654.697	17.252	.000	.167	17.252	.984
Error	Pre-Knowledge Score	61597.917	86	716.255					
	Post-Knowledge Score	33697.500	86	391.831					
	Retain Score	43144.167	86	501.676					
Total	Pre-Knowledge Score	571100.000	88						
	Post-Knowledge Score	1516900.000	88						
	Retain Score	1217900.000	88						
Corrected Total	Pre-Knowledge Score	62507.955	87						
	Post-Knowledge Score	53007.955	87						
	Retain Score	51798.864	87						

a. R Squared = .015 (Adjusted R Squared = .003)
b. R Squared = .364 (Adjusted R Squared = .357)
c. R Squared = .167 (Adjusted R Squared = .157)
d. Computed using alpha = .05

Table 6. 36. ANOVA tests output

Summarising the above results from tables 6.34, 6.35 and 6.36, the following (a) present the results of MANOVA while (b) presents the results of ANOVA.

a. The MANOVA Multivariate Tests (see Table 6.35), show Wilk's Lambda value=0.63, F(3, 84)= 16.47, p<0.001, and partial η^2=1. Hence the p-value shows that there is a significant difference between the two groups when considered jointly on the three dependent variables pre-knowledge score, post-knowledge score and retain score.
b. A separate ANOVA was conducted for each dependent variable with each ANOVA evaluated at an Alpha level of 0.025 (see Table 6.36).
    i. As for the pre-knowledge score, there is no significant difference between the two groups with F(1,86)=1.27, p=0.26 and partial η^2 =0.015. According to descriptive statistics (see Table 6.27), the experimental group scored M=78.96 while the control scored M=72.50, which is not considered significantly different.
    ii. As for the post-knowledge score, there is a significant difference between the two groups with F(1, 86)=49.28, p<0.001 and partial η^2 =0.364. According to descriptive statistics (see Table 6.27), the experimental group scored M=142.50 while the control scored M=112.75, which is considered significantly different where the experimental group overtakes the control group around 30 points.
    iii. As for the retention-knowledge score, there is a significant difference between the two groups with F(1, 86)=17.25, p<0.001 and partial η^2 =0.167. According to descriptive statistics (see Table 6.27), the experimental group scored M=124.17 while the control scored M=104.25, which is considered significantly different where the experimental group overtakes the control group around 20 points.

In the next sections, the results are presented analytically, taking each dependent variable separately and comparing it across the groups and answering the relevant questions.

6.7.2. Question 6

> ***Has the experimental group achieved a higher score in the pre-knowledge score compared to the control group?***

In this question, we investigate the means of the pre-knowledge score achieved by group A (the experimental group) and group B (the control group). Although the

comparison of the pre-knowledge score alone does not add to the conclusions, however, it is important later when comparing it to the other learning measurements.

Step 1: Form the hypotheses.

$Q6H_0$: There is no significant difference in the means of Pre-knowledge score of A and B;

μ *Pre-knowledge score A* $=$ μ *Pre-knowledge score B;*

$Q6H_1$: There is a significant difference in the means of Pre-knowledge score of A and B;

μ *Pre-knowledge score A* $\neq$ μ *Pre-knowledge score B*

Step 2: Test of Normality

The Shapiro-Wilk test in table 6.37 shows that the data for both groups are normally distributed with a p-value 0.825 > 0.05 and 0.198>0.05. Therefore, the Independent samples t-test is selected.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Groups	Statistic	df	Sig.	Statistic	df	Sig.
Pre-Knowledge Score	A	.084	48	.200*	.986	48	.825
	B	.154	40	.018	.962	40	.198

Table 6. 37. Test of normality of Pre-knowledge score for both groups.

Step 3: Independent samples t-test

The test (see Table 6.38) suggests retaining the null hypothesis with a p-value. 0.263>0.05 that states that the means of pre-knowledge scores between the two groups are not significantly different. This is the expected result for the pre-knowledge score as the participants were randomly allocated to the two groups and they were expected to score similarly.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Pre-Knowledge Score	Equal variances assumed	1.222	.272	1.127	86	.263	6.458	5.730	-4.932	17.848
	Equal variances not assumed			1.151	85.818	.253	6.458	5.611	-4.697	17.614

Table 6. 38. The t-test of pre-knowledge score between the groups A and B.

Table 6.39 displays the means of the pre-knowledge score for both groups. Group A scored in 78.96 (SD=29.33) and group B scored 72.50 (SD=23.28) out of 160, the maximum score.

Group Statistics

	Groups	N	Mean	Std. Deviation	Std. Error Mean
Pre-Knowledge Score	A	48	78.96	29.336	4.234
	B	40	72.50	23.288	3.682

Table 6. 39. Means of pre-knowledge score between groups A and B.

Figure 6.10 illustrates the means of the pre-knowledge score for group A and B.

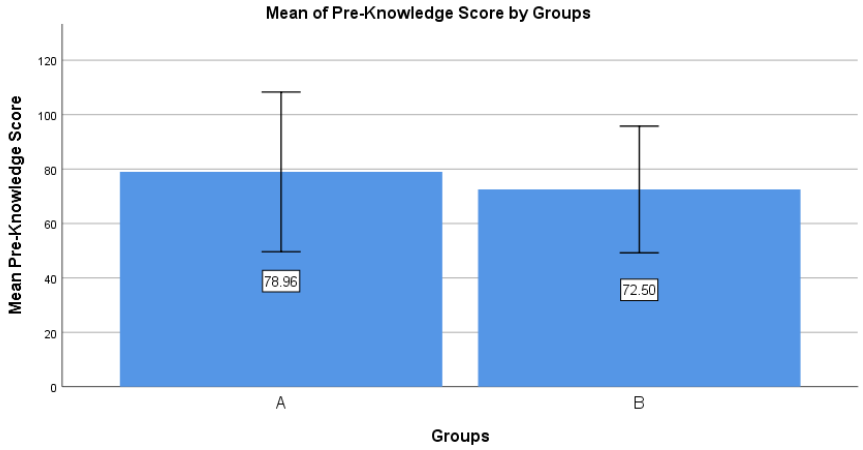


Figure 6. 10. Means of the pre-knowledge score of group A and B.

Therefore, the means of pre-knowledge scores are not different for the two groups, and they are considered to have the same knowledge level about the subject before starting the experiment.

6.7.3. Question 7

Has the experimental group achieved higher post-knowledge score than the control group?

To answer question 7, we calculate and compare the means of post-knowledge score of both groups A and B.

Step 1: Form the hypotheses

Q7H₀: *The mean Post-knowledge score of Group A is less than or equal to that of Group B;*

$H_0: \mu_{\text{Post-knowledge score A}} <= \mu_{\text{Post-knowledge score B}}$;

Q7H₁: *The mean Post-knowledge score of Group A is greater than that of Group B;*

$H_0: \mu_{\text{Post-knowledge score A}} > \mu_{\text{Post-knowledge score B}}$;

Step 2: Test of Normality

The Shapiro-Wilk test in table 6.40 shows that data in the post-knowledge score of both groups are not normally distributed with a p-value of Group A 0.000< 0.001 and a p-value of Group B 0.048<0.05. Therefore, to compare the means we select the non-parametric test of *Mann-Whitney U Test,* for independent groups.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Groups	Statistic	df	Sig.	Statistic	df	Sig.
Post-Knowledge Score	A	.194	48	.000	.895	48	.000
	B	.191	40	.001	.944	40	.048

Table 6. 40. Test of normality of Post-knowledge score for both groups.

Step 3: Mann-Whitney U Test

The Mann-Whitney U test rejects the null hypothesis (see Table 6.41) and accepts the alternative hypothesis which states that the mean of the post-knowledge score for group A is greater than the mean of the post-knowledge score for group B.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Post-Knowledge Score is the same across categories of Groups.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Table 6. 41. Non-parametric Test for Post-knowledge Score for groups A and B

Indeed, Table 6.42 displays the means of the post-knowledge score for group A (M=142.50, SD=14.80) and group B (M=112.75, SD=24.49) where group A overtakes group B in the learning performance at the end of each of the learning tools (Stronger Game and Digital Course). This is an indication that the role-playing game Stronger, designed according to DeLEC framework demonstrated higher learning results compared to the Digital Course.

Report

Post-Knowledge Score

Groups	N	Mean	Std. Deviation
A	48	142.50	14.804
B	40	112.75	24.494
Total	88	128.98	24.684

Table 6. 42. The post-knowledge score for groups A and B.

Figure 6.11 illustrates the means of post-knowledge scores of groups A and B. The experimental group A has a significantly higher post-knowledge than group B.

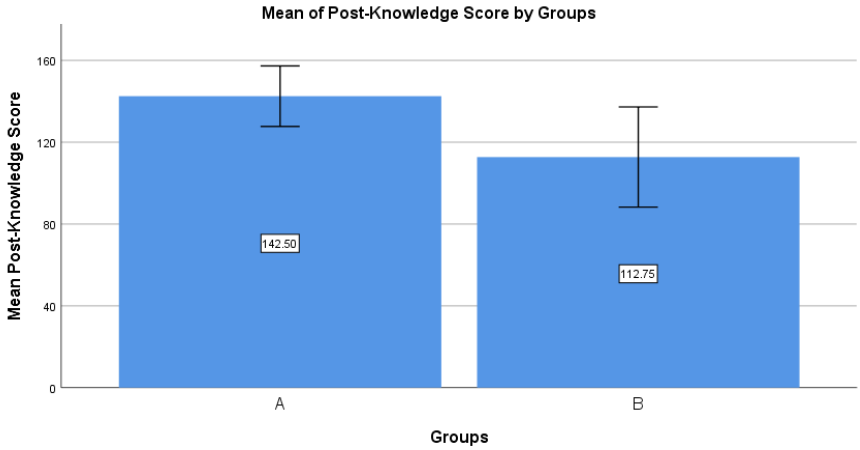


Figure 6. 11. Means of Post-knowledge score for groups A and B.

6.7.4. Question 8

Has the experimental group achieved a higher score in retention-knowledge score than the control group?

To answer Question 8, we calculate and compare the means of retention-knowledge score of both groups A and B.

Step 1: Form the hypotheses.

$Q8H_0$: The mean of Retention-knowledge score of Group A is less than or equal to that of Group B;

μ *Retention-knowledge score A* $<=\mu$ *Retention-knowledge score B;*

$Q8H_1$: The mean of Retention-knowledge score of Group A is greater than that of Group B;

μ *Retention-knowledge score A* $> \mu$ *Retention-knowledge score B;*

Step 2: Test of Normality

The Shapiro-Wilk test (see Table 6.43) shows that data for group A are normally distributed with a p-value 0.111>0.05. and not normally distributed for group B with a p-value 0.19<0.05. Since group A is the largest group, we run the Independent Samples t-test.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Groups	Statistic	df	Sig.	Statistic	df	Sig.
Retain Score	A	.156	48	.005	.961	48	.111
	B	.191	40	.001	.932	40	.019

Table 6. 43. Test of normality of post-knowledge score for both groups.

Step 3: Independent Samples Test

The Independent Samples Test (see Table 6.44) suggests we accept the alternative hypothesis Sig (0.000<0.001) that the mean retention-knowledge score of group A is greater than group B.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Retain Score	Equal variances assumed	1.008	.318	4.153	86	.000	19.917	4.795	10.384	29.449
	Equal variances not assumed			4.073	74.578	.000	19.917	4.889	10.176	29.658

Table 6. 44. Independent Samples t-test for the retention-knowledge score

This is true, as Table 6.45 shows that group A achieved an average score of 124 (M=124.17, SD=20.08) while group B achieved an average score of 104 (M=104.25, SD=24.89). Group A has retained more knowledge than group B and this is a good indication of achieving deeper learning.

Group Statistics

	Groups	N	Mean	Std. Deviation	Std. Error Mean
Retain Score	A	48	124.17	20.088	2.900
	B	40	104.25	24.899	3.937

Table 6. 45. Means of the retention-knowledge score for groups A and B.

Figure 6.12 illustrates the means of the retention-knowledge score where group A overtakes group B.

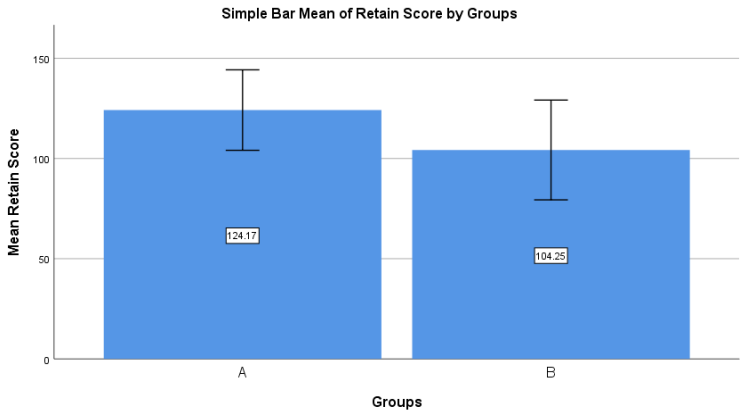


Figure 6. 12. Means of Retention-knowledge Score for groups A and B.

6.7.5. Question 9

Has the experimental group achieved a higher learning score compared to the control group?

This question aims to give an answer about which of the two groups have achieved higher learning score compared to their knowledge before playing the game / digital course. To answer question 9, a new variable *dif_Post_Pre* is set which defines the difference of deducting the pre-knowledge score from the post-knowledge score for both groups. The difference between the pre-knowledge score and the post-knowledge score is the real learning outcome achieved, that we seek to investigate.

Step 1: Form the hypotheses

Q9H₀: *The absolute difference between the mean of the pre-knowledge score and the mean of the post-knowledge score (dif_Post_Pre) of Group A is less than or equal to Group B;*

$\mu_{dif\_Post\_Pre\ A} <= \mu_{dif\_Post\_Pre\ B;}$

Q9H₁: *The absolute difference between the mean of the pre-knowledge score and the mean of the post-knowledge score (dif_Post_Pre) of Group A is greater than Group B;*

$\mu_{dif\_Post\_Pre\ A} > \mu_{dif\_Post\_Pre\ B;}$

Step 2: Test of Normality

The Shapiro-Wilk test in table 6.46 shows that the data are normally distributed as the p-value for Group A is 0.171 > 0.05 and the p-value of Group B is 0.412>0.05. Therefore, we apply the Independent Samples t-test to compare the means.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Groups	Statistic	df	Sig.	Statistic	df	Sig.
Dif_Post_Pre	A	.137	48	.025	.966	48	.171
	B	.134	40	.067	.972	40	.412

Table 6. 46. Normality Test

Step 3: Independent Samples t-test

The test suggests (table 6.46) we accept the alternative hypothesis set in step 1, with a p-value <0.001, meaning that the difference in the means of dif_Post_Pre of Group A is greater than this of Group B as shown also in Table 6.48.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Dif_Post_Pre	Equal variances assumed	.582	.447	3.910	86	.000	23.29167	5.95749	11.44856	35.13477
	Equal variances not assumed			3.904	82.702	.000	23.29167	5.96574	11.42541	35.15792

Table 6. 47. T-Test for variable dif_Post_Pre for groups A and B.

According to table 6.48, with a very similar standard deviation, group A (M=63.54 SD=27.63) overtakes group B (M=40.25, SD=28.05) by approximately 23 points.

Report

dif_PostPre

Groups	Mean	N	Std. Deviation
A	63.5417	48	27.63667
B	40.2500	40	28.05558
Total	52.9545	88	30.02524

Table 6. 48. Mean for dif_PostPre for groups A and B.

Therefore, it is concluded that the experimental group has achieved higher learning outcome than group B because group A has made a higher change in learning from scores of the pre-knowledge to the scores of post-knowledge (see Figure 6.13) compared to group B.

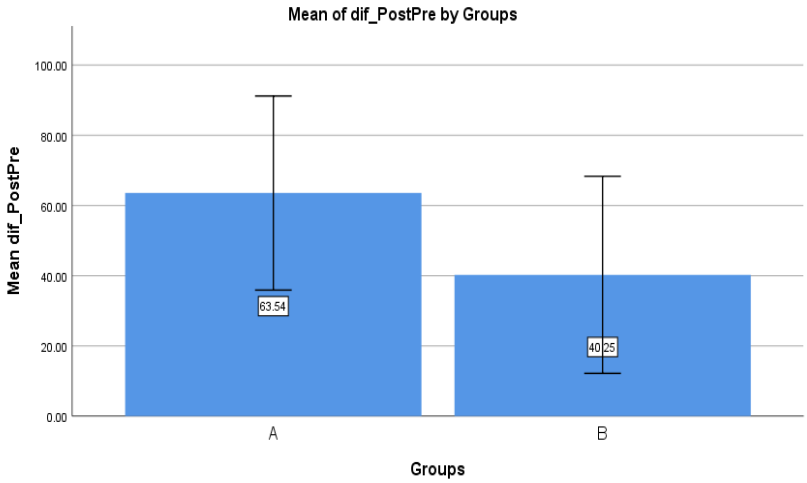


Figure 6. 13. Mean of dif_PostPre for groups A and B.

6.7.6. Question 10

> ***Has the experimental group retained their knowledge more than the control group compared to their pre-knowledge score?***

In question 10 we seek to compare the knowledge of participants before playing the game/digital course (pre-knowledge score), and the knowledge they retained in memory four weeks later (retention-knowledge score). Hence, we define a new variable *dif_Ret_Pre,* which calculates the difference for each group deducting the pre-knowledge score from the retention-knowledge score. The difference between the pre-knowledge score and the retention-knowledge score is the real deep learning achieved.

Step 1: Form the hypotheses.

Q10H₀: *The absolute difference between the mean of the pre-knowledge score and the mean of the retention-knowledge score (dif_Ret_Pre) of Group A is less than or equal to Group B;*

μ *dif_Ret_Pre A* $<=$ μ *dif_Ret_Pre B;*

QH₁: *The absolute difference between the mean of the pre-knowledge score and the mean of the retention-knowledge score (dif_Ret_Pre) of Group A is greater than Group B;*

μ *dif_Ret_Pre A* $>$ μ *dif_Ret_Pre B;*

Step 2: Test of Normality

The Shapiro-Wilk test in table 6.49 suggests data are normally distributed with a p-value 0.133 > 0.05 for Group A and 0.308 > 0.05) for group B. Hence, we choose the Independent Samples t-test (see Section 6.4.1).

Tests of Normality

	Groups	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Dif_Ret_Pre	A	.174	48	.001	.963	48	.133
	B	.102	40	.200*	.968	40	.308

Table 6. 49. Normality Test of dif_Ret_Pre

Step 3: Independent Samples t-test

The Independent Sample t-test (see Table 6.50) outputs a p-value 0.045 < 0.050 which accepts the alternative hypothesis set in Step 1 that Group A achieved a greater difference of retention-knowledge and pre-knowledge than Group B.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Dif_Ret_Pre	Equal variances assumed	1.838	.179	2.039	86	.045	13.45833	6.60166	.33468	26.58199
	Equal variances not assumed			2.092	85.103	.039	13.45833	6.43315	.66774	26.24893

Table 6. 50. Independent samples t-test for dif_Ret_Pre for groups A and B.

Translating the results (see Table 6.51) we conclude that Group A indeed increased their knowledge by 45.20 (SD=34.45), which is higher than group B that achieved an increase to their knowledge by 31.75 (SD=25.80).

Group Statistics

	Groups	N	Mean	Std. Deviation	Std. Error Mean
Dif_Ret_Pre	A	48	45.2083	34.45562	4.97324
	B	40	31.7500	25.80871	4.08072

Table 6. 51. Means for dif_Ret_Pre for groups A and B.

Figure 6.14 illustrates the differences in the learning of the two groups. Group A achieved and retain more knowledge in memory than group B.

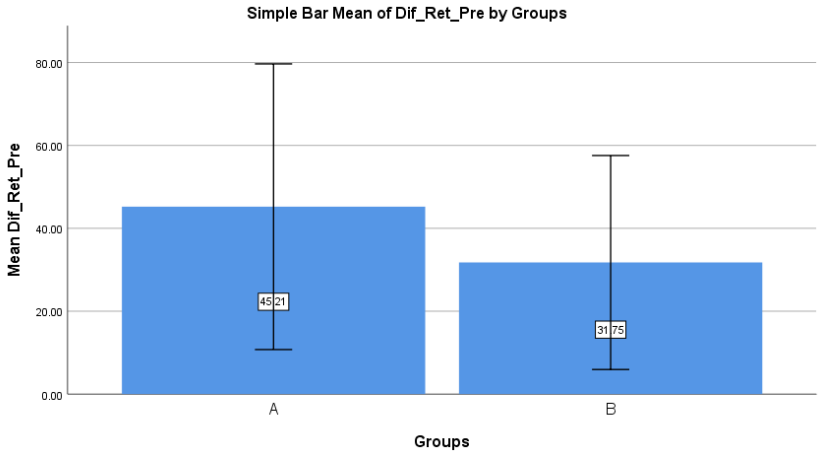


Figure 6. 14. Mean of dif_Ret_Pre for groups A and B.

6.7.7. Question 11

> ***Has the experimental group retained their knowledge more than the control group compared to their post-knowledge score?***

To answer question 11, we investigate the differences between the post-knowledge score minus the retention-knowledge score. So, we define a new variable *dif_Post_Ret* with which we check the changes in the learning outcome as for how much of the knowledge learned is lost from memory four weeks later.

Step 1: Form the hypotheses.

Q11H$_0$: *The absolute difference between the mean of the post-knowledge score and the mean of the retention-knowledge score (dif_Post_Ret) of Group A is less than or equal to Group B;*

$\mu_{dif\_Post\_Ret\ A} = \mu_{dif\_Post\_Ret\ B;}$

Q11H$_1$: *The absolute difference between the mean of the post-knowledge score and the mean of the retention-knowledge score (dif_Post_Ret) of Group A is greater than Group B;*

$\mu_{dif\_Post\_Ret\ A} = \mu_{dif\_Post\_Ret\ B;}$

Step 2: Test of Normality

The Shapiro-Wilk test (see Table 6.52) shows that data are normally distributed for group A with a p-value 0.077 > 0.05 and not normally distributed for group B with a p-value 0.003 < 0.05. Since group A is the largest group, we select the Independent Samples t-test (see Section 6.4.1).

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Groups	Statistic	df	Sig.	Statistic	df	Sig.
Dif_Post_Ret	A	.175	48	.001	.957	48	.077
	B	.220	40	.000	.904	40	.003

Table 6. 52. Test of Normality Dif_Post_Ret for groups A and B

Step 3: Independent Samples t-test

The Independent Samples t-test, in Table 6.53, outputs a p-value 0.018 < 0.05 and so it accepts the alternative hypothesis set in Step 1 which states that the difference is greater for Group A than for Group B.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Dif_Post_Ret_Scores	Equal variances assumed	.222	.638	2.412	86	.018	9.83333	4.07621	1.73010	17.93657
	Equal variances not assumed			2.396	80.585	.019	9.83333	4.10453	1.66596	18.00071

Table 6. 53. Independent Samples t-test Dif_Post_Ret

The means of Dif_Post_Ret_Scores of the two groups are shown in Table 6.54 Group A has a bigger decline (M=18.33, SD=18.37) than group B (M=8.50, SD=19.81).

Group Statistics

	Groups	N	Mean	Std. Deviation	Std. Error Mean
Dif_Post_Ret_Scores	A	48	18.3333	18.37359	2.65200
	B	40	8.5000	19.81323	3.13275

Table 6. 54. Means of differences

However, if we observe in detail the scores of the post-knowledge and retention knowledge as shown in table 6.55 we see that group A has achieved much higher mean post-knowledge score than group B and therefore group A learned more. Consequently, group A which has learned more than group B also lost more than the group B but in reality, group, A has retained 20 points more than group B (see Table 6.54).

Group Statistics

	Groups	N	Mean	Std. Deviation	Std. Error Mean
Post-Knowledge Score	A	48	142.50	14.804	2.137
	B	40	112.75	24.494	3.873
Retain Score	A	48	124.17	20.088	2.900
	B	40	104.25	24.899	3.937

Table 6. 55. Mean Post-Knowledge score and Retention-knowledge Score

The comparative study is completed here. The comparative study has confirmed that the application of the DeLEC framework to the Stronger game has shown positive results for the learning achievement and higher retention of knowledge compared to the group B that completed the digital course.

A more in-depth discussion about the data analysis and the results is found in Chapter 7.

6.8. Qualitative Data Analysis

During the run of study, the researcher remained in the room with the participants to ensure the smooth run of the study, answer possible questions arisen by the participants and to observe possible reactions.

Observing the participants while playing the Stronger game, the majority looked focused, interested and engaged throughout the game. At the end of the study, some participants discussed what they would do to help a victim of domestic abuse or how they would react if something similar happened to them. In another occasion, a male participant was wondering whether he has been behaving in an abusive way towards his female partner. Another student expressed that they would prefer to have the option to choose the gender of the abuser as well as to choose other types of couples so that the game has been more inclusive to reflect the society.

Another observation is related to the competitive game element of the score in the game. The score made participants made an extra effort in achieving higher scores in the game. At the end of the game, some participants asked other participants about the score they achieved in the game to compare it to their own.

On the contrary, the participants of the digital course started with high focus and interest, and throughout the course, they gradually started getting tired and uninterested, and in some occasions, they skipped slides glancing at them for few seconds and then hitting “next”. At the end of the study, most of the participants rushed to leave the room without making comments.

6.9. Summary

This chapter presents the statistical results of the data analysis of the research study regarding the learning achievement of the suggested DeLEC framework. The data analysis has shown that the role-playing game Stronger has achieved higher learning scores compared to the digital course, which validates the DeLEC framework proposed learning process. The repetitive instruction and formative assessment, the trigger of empathy, the transfer of knowledge through creativity and the combination of the game elements (key, score, story, characters) contributed to higher learning achievement and led to the retention of knowledge in memory, which according to DELEC framework translates into the achievement of deeper learning.

Chapter 7 – Discussion

7.1. Summary of the research outcomes

This chapter discusses the main findings and addresses the research questions. The findings presented in chapter 6 demonstrated that the experimental group achieved a higher score in learning and deeper learning than the control group and can recall a higher amount of knowledge than the control group. The findings confirmed that the proposed DeLEC framework provided an effective learning process designed for SGs, which supports learners in achieving deeper learning.

Two types of the investigation conducted: within-subjects and between-subjects. The within-subjects investigation focused on the experimental group, the group that played the DRPSG Stronger based on the proposed DeLEC framework. The findings demonstrated that the proposed DeLEC framework made a significant change to participants' learning and assisted participants in achieving deeper learning.

Respectively, the between-subjects investigation demonstrated that the experimental group showed significantly higher results than the control group. According to the findings, the experimental group learned and retained learning more than the control group.

Figure 7.1 below illustrates the scores of the learning variables (pre-knowledge, post-knowledge, retention-knowledge scores) for the experimental and the control group. Comparing the values of the learning variables it is evident that the experimental group prevails the control group in the post-knowledge and the retention knowledge scores which means that the experimental group (142.50) learned more than the control group (112.75).

Max Score=160	Pre-Knowledge Score	Post-Knowledge Score	Retention-Knowledge Score
Experimental Group	Mean = 78.96 SD = 29.35	Mean = 142.50 SD = 14.80	Mean = 124.17 SD = 20.08
Control Group	Mean = 72.50 SD = 23.28	Mean = 112.75 SD = 24.49	Mean = 104.25 SD = 24.89

Figure 7. 1. The Learning results

Comparing the pre-knowledge score to the post-knowledge score, the experimental group increased their post-knowledge from 79 to 143 (increase 40%) while the control group increased their post-knowledge from 73 to 113 (increase 25%). It is concluded, therefore, that the Stronger game is proved to be more effective that the DC in conveying learning to learners. Comparing the pre-knowledge score to the retention-knowledge score, the experimental group increased their knowledge from 79 to 124 (increase 29%) while the control increased their knowledge from 73 to 104 (increase 20%). It is concluded, therefore, that Stronger game helped participants to retain to memory 10% more than the DC. It is worth mentioning that the retention-knowledge score of the experimental group, four weeks later, is higher than the post-knowledge score of the control group.

As for the empathy rated by the 48 participants of the experimental group (see Table 7.2), it is found that 36 participants rated in both incidents 4 or 5 as the level of empathy. This means that 75% of participants showed a high level of empathy. Hence, it is concluded that Stronger game helped participants in invoking empathy

while playing the game. Empathy is attributed to the game elements used to invoke empathy such as the scenario, the characters and their facial expressions, the dialogues, the participants' involvement to make decisions. Empathy, according to Jarvis (2012) increases motivation and engagement for learning and consists of the prerequisite for further learning and mutual understanding between the teacher and the students.

Experimental Group	Level of Empathy (Scale 0 to 5)
Out of 48 participants 36 participants	0=no empathy, 1=weak empathy 5=strong empathy rated 4 or 5 the level of empathy

Figure 7. 2. The level of empathy

As for the creativity phase, the experimental group in their majority (38 participants) scored above the passing level which was 100 out of 180. More than 60% of the participants scored above the mean score (119.17) as shown in Table 7.3.

Experimental Group	Creativity Score (Max=180)
Out of 48 participants 38 participants 30 participants	Mean = 119.17 scored > 100 scored >= Mean

Figure 7. 3. The creative score

It is concluded that participants were motivated to transfer their knowledge into creative activities. More details on the scores on creativity see Section 6.6.1.2.4.

In the next sections, we discuss the research findings aiming to address the research questions.

7.2. Addressing Research Question 1

Has the proposed DeLEC framework assisted participants to improve their learning?

Participants who followed the DeLEC framework have gone through instruction, formative assessment, empathy, creativity and repetitions of instruction and formative assessment wherever necessary. Already in section 6.6.1, we discussed the

value of instruction and repetitions in DeLEC framework and we conclude that DeLEC framework is an effective process in obtaining learning.

Discussing further the gain of learning to address research question 1, we split the question into two sub-questions:

Q1.1. Has the experimental group achieved higher learning compared to their prior knowledge?

Q1.2. Has the experimental group achieved higher learning compared to the control group?

Addressing Q1.1.

One important indication that shows the gaining in learning is the score of the post-knowledge test, which participants completed at the end of the Stronger game. The results regarding the experimental group (see Figure 7.1 and section 6.6.3.1), showed that the post-knowledge score (M=142.50, SD=14.80) is significantly higher than the pre-knowledge score (M=78.96, SD=29.33), an average increase of 63.54 points (80.47%).

Furthermore, the standard deviation of the post-knowledge score, 14.80, reveals that participants, became convergent as a group as they acquired similar learning, compared to the pre-knowledge score standard deviation of 29.35. Hence, the experimental group became a homogenous group in terms of their learning after playing the game. The homogeneity in learning has positive results for the classroom. Students who are of the same "speed" in the classroom facilitate the work of the teacher and enabling them to provide enriched teaching that can advance and deeper the level of learning. Also, students can share, exchange ideas and collaborate efficiently to progress their learning.

The positive change in learning and the transformation of the experimental group into a homogenous group suggests that the proposed DeLEC framework assisted participants in improving learning with SGs.

Addressing Q1.2.

Aiming to investigate whether the experimental group has achieved higher learning compared to the control group, we examine and discuss two measurements that split into two questions:

Q1.2.1. What is the mean post-knowledge score achieved by each group? (see Section 6.6.2) and,

Q1.2.2. What is the mean difference of the post-knowledge score deducting the pre-knowledge score (dif_Post_Pre) for each group? (see Section 6.6.4).

Addressing Q1.2.1

The results for Q1.2.1 reveal that the experimental group achieved a higher post-knowledge score (M=142.50, SD=14.80) compared to the control group (M=112.75, SD=24.49). Hence, the experimental group gained more knowledge on the subject from the Stronger game than the control group from the digital course (see Section 6.7.2).

Also, the standard deviation of the post-knowledge score in the experimental group is 10 points lower than the control group (see Tables 7.1. and 7.2), which indicates that the experimental group became a more homogenous group than the control group.

Addressing Q1.2.2

The results for Q1.2.2 (see Section 6.7.4) reveal the differences that define the real learning occurred in each group. The differences measure the knowledge gained from the Stronger game compared to the digital course. The results demonstrated that the experimental group achieved higher mean difference compared to the control group. Precisely, the experimental group achieved a mean difference (M=63.54, SD=27.63) compared to the control group that achieved (M=40.25, SD=30.02) indicating that the Stronger game is more efficient in enabling learning than the digital course.

Sum up and Answer Question 1

Therefore, the experimental group demonstrated higher post-knowledge scores compared to their pre-knowledge scores, and also showed higher post-knowledge scores compared to the control group. Also, the experimental group showed an increased difference of the post minus the pre-knowledge, compared to the control group.

The Stronger game, designed and developed according to the DeLEC framework, supported the experimental group to improve learning.

7.3. Addressing Research Question 2

Has the DeLEC framework assisted participants in reaching deeper learning?

To reach the stage of deeper learning, according to the DeLEC framework, participants gained surface learning (instruction phase), invoked empathy, then applied the gained knowledge to new meaningful contexts by creating digital artefacts related to the learning content (creativity phase). According to DeLEC framework, these phases lead them to deeper learning. To acknowledge and measure the deeper learning achieved through DeLEC, participants are required to make conscious recalls and reflect on their learning, four weeks later, in the retention-knowledge phase.

The retention-knowledge test measures the amount of knowledge maintained in memory four weeks after playing the game. If participants can recall their learning one month later, it means they integrated the gained learning to their long-term memory and therefore reached deeper learning.

The discussion around the research question 2 splits into two sub-questions related to the retention knowledge:

Q2.1. Has the experimental group achieved deeper learning?

Q2.2. Has the experimental group achieved higher deeper learning compared to the control group?

Addressing Q2.1.

Within the experimental group, the discussion around deeper learning is related to the achievement of the retention-knowledge score, and revolves around the following questions:

Q2.1.1. The retention-knowledge score of the experimental group compared to the pre-knowledge score;

Q2.1.2. The retention-knowledge score of the experimental group compared to the post-knowledge score;

Addressing Q2.1.1.

The data analysis (see Section 6.6.3.2), demonstrate a significant increase in the mean of retention-knowledge score compared to the mean of pre-knowledge score within the participants of the experimental group. In average, the participants four weeks later could recall a high percentage of the knowledge gained from the Stronger game. Particularly, the mean of retention-knowledge scores is 124.17, which is significantly increased compared to the mean of pre-knowledge score 78.96, indicating that participants not only increased their initial knowledge but also maintained in memory around 57% more of their initial knowledge about the subject.

The standard deviation of retention-knowledge scores (20.08) is improved compared to the standard deviation (29.35) of the pre-knowledge score, which means in the retention-knowledge test, participants, as a group, have maintained a relatively similar level of knowledge on the learning subject compared to their initial knowledge, at the pre-knowledge test.

Addressing Q2.1.2.

The post-knowledge score refers to the score of the new knowledge acquired completing the game and learning is still fresh in the brain. There is a decline of retention-knowledge score compared to the post-knowledge score. This decline indicates a loss of knowledge from memory.

The occurrence of forgetting, meaning the fading of information, is common for human memory (see Section 2.7.3). Cognitive psychology contends there are numerous reasons why information fades from memory. One critical factor is time. When the time passes without recalling or making references may cause the information to fade from memory. Knowledge learned can easily be forgotten if people do not actively review or rehearse what they have learned (Cherry, 2019). So, a similar phenomenon is observed in this study.

There is a decline observed in the retention-knowledge score (M=124.17) compared to the post-knowledge score (M=142.50). The decline in retention score is 18.33 (12.8%) compared to what the participants had scored to the post-knowledge test. Although the loss of knowledge four weeks later is expected (Cherry, 2019), the amount of lost knowledge of the experimental group is considered low.

The standard deviation of the retention-knowledge score increased (20.08) compared to the standard deviation of the post-knowledge score (14.80). Hence, the homogeneity of the group as observed at the post-knowledge score has slightly worsened in the retention-knowledge score, four weeks later because of forgetting. Although the homogeneity of the retention-knowledge score has been slightly lost compared to the post-knowledge score, it is still better than the one of the pre-knowledge score.

Addressing Q2.2.

Comparing now the experimental and control group and their achievement in the retention-knowledge score we elaborate the discussion with three comparisons:

Q2.2.1. By comparing the retention-knowledge scores of the experimental and the control group (see Section 6.7.3);

Q2.2.2. By comparing the mean differences found when subtracting the pre-knowledge scores from their retention-knowledge scores for each group (see Section 6.7.5);

Q2.2.3. By comparing the mean differences found when subtracting the post-knowledge scores from the retention-knowledge scores for each group (see Section 6.7.6);

Addressing Q2.2.1.

The retention-knowledge score demonstrates which of the two groups remember and recall more of what they learned about the subject. The results show an increased mean of the retention-knowledge score for the experimental group (M=124.17, SD=20.08) compared to the control group (M=104.25, SD=24.89). Taking into consideration a similar standard deviation, the experimental group demonstrates around 20 points more than the control group. This is evident that the experimental group retained and it can recall a higher amount of knowledge than group B.

Addressing Q2.2.2.

Comparing the mean differences, we aim to discover the actual amount of the knowledge gained from Stronger or the digital course and retained in memory in each group four weeks later. Hence, we deducted the pre-knowledge score from the

retention-knowledge score (dif_Ret_Pre) and compared the means difference of each group.

The results revealed that the mean dif_Ret_Pre (M=45.21) of the experimental group is higher and overtakes the control group (M=28.75). The experimental group has retained a higher amount of knowledge in memory than the control group, four weeks later. Thus, the experimental group has integrated a higher amount of new knowledge to the existing knowledge than the control group.

The conclusion is that the experimental group has achieved higher deeper learning than the control group when comparing the retention-knowledge score to pre-knowledge score.

Addressing Q2.2.3.

The means of the retention-knowledge scores for both groups are lower than the means of the respective post-knowledge scores. In section 6.7.6., we investigated the amount of knowledge that slipped the memory four weeks after playing the game/digital course, compared to the post-knowledge score that participants obtained just after the game/digital course when learning was very fresh in memory. The findings showed a decline in the retention-knowledge scores, four weeks later in both groups. This is a common occurrence of the human memory that, over time, part of the information stored in the long-memory fades out (Cherry, 2019).

The results in section 6.7.6, reveal that the experimental group has lost more knowledge, four weeks later, compared to the control group. Initially observing these figures in this data analysis, (see Table 6.43), we conclude that the control group has lost a lower amount of knowledge (M=8.50 SD=19.81) than the experimental group (M=18.33, SD=18.37).

However, studying table 6.44, we ratify that the experimental group gained a higher amount of knowledge than the control group and retained a higher amount of knowledge. The control group gained a lower amount of knowledge and forgot a lower amount of knowledge. The experimental group gained a higher amount of knowledge and forgot more than the control group. Yet, the retention-knowledge score of the experimental group is much higher than the control group (see Table 7.1, 7.2) showing that the experimental group have retained more learning in memory, at least four weeks later.

Summary and answer of Question 2

Examining the attainment of retention-knowledge score within the experimental group, we ascertain that the experimental group learned and retained their learning compared to their prior knowledge. They scored slightly lower in the retention-knowledge score, and this is considered a common occurrence due to the passing of four weeks.

Examining the attainment of deeper learning between-subjects we found that the experimental group achieved higher retention-knowledge score compared to the control group. Furthermore, the experimental group has attained a higher mean difference between the retention-knowledge score subtracting the pre-knowledge score, compared to the control group. However, the control group demonstrates a lower amount of losing knowledge than the experimental group but also gained a lower amount of knowledge compared to the experimental group.

The proposed DeLEC framework assisted participants in gaining, transforming and retaining their knowledge in memory and therefore achieve deeper learning with SGs more than the alternative learning media.

7.4. Conclusions

This section extends the discussion made on the results of the study and presents and discusses the conclusions emerged from the study involving the development and evaluation of the DeLEC framework, the evaluation of the Stronger role-playing game to learning and the evaluation and contribution of empathy and creativity to learning with serious games.

7.4.1. Conclusions on the DeLEC framework

The results derived from the data analysis demonstrated that the proposed DeLEC framework provides a solid learning solution for designing educational SGs that assist learners in achieving deeper learning. The learning effectiveness of DeLEC framework is attributed to the factors described below:

1. The DeLEC framework is based on the educational theory of Bloom's LFM, which assists learners in reaching mastery in learning. Bloom's LFM has been designed and applied in the classroom (see Section 3.3), but it hasn't been designed and tested with SGs. Applying the LFM in SGs advances Bloom's theory, as it demonstrates and evaluates its application in SGs.

2. The adaptation of the LFM theory is related to the mechanism of repetition of instruction and assessment (see Section 3.3). While the LFM proposes two repetitions of instruction and formative assessment to gain mastery, the DeLEC framework, applied for SGs, allows a limitless number of repetitions of instruction and formative assessment and thus, it gives more chances for improving learning that can lead to deeper learning.

3. Another major adaptation is the incorporation of empathy in the instruction. When instruction is related to social and psychological subjects such as domestic violence, or bullying, learning to empathise with people who are in a difficult situation is maybe the first step to learn how to help them. Thus, SGs designed for social issues should incorporate the elements that invoke empathy to help learners to understand the situation and the feelings of the people create, emotional connections and increase their engagement with the learning content (see Section 2.7.2).

4. The DeLEC framework assists learners in obtaining higher learning results. The data analysis demonstrated that the experimental group that used the Stronger game which was designed following the DeLEC framework succeeded:

    - higher results in gaining new knowledge (difference of the pre-knowledge and post-knowledge scores - see Section 6.7.4) and;
    - higher learning results (comparing the post-knowledge scores between the experimental and the control group - see Section 6.7.2);
    - higher retention results (comparing the retention-knowledge scores between the experimental and the control group – see Section 6.7.3).

5. The DeLEC framework demonstrated that it assists learners to achieve deeper learning. The experimental group produced a higher retention-knowledge score in contrast to the control group. The retention-knowledge score is evidence of retaining higher learning in memory, at least one month later, compared to the control group.

6. Furthermore, the DeLEC framework adopts a formative assessment for evaluating learning. Because of its frequency during the process of learning, formative assessment is considered an active method which assists learners adopting deeper approaches to learning contrast to summative assessment that encourages rote memorisation and surface approach to learning. Stronger adopts a deeper approach to learning with formative assessment (see Section 2.4.1.) in the form of repetitions that include retention and transfer tests to measure the attainment of deeper learning (see Section 2.6.4).

7.4.2. Conclusions on the Stronger game

Based on the study conducted as part of this research thesis, several conclusions are drawn for the use of SGs for learning, designed according to DeLEC framework outlined below:

1. The DeLEC framework, through the Stronger game, involves players in active learning. Active learning is regarded as a significant pedagogic approach for supporting learners in better understanding and retaining knowledge in memory, and it is thus associated with deeper learning (see Section 2.7.1). Representing a character in the game, players inherit the responsibility of their learning and become active participants as game characters, gaining a game experience which not only assists them to learn but also to remember what they have learned. Besides, the role-playing and the game characters encourage motivation and engagement to learning.

2. In the Stronger game, taking the role of the game characters as a close friend of the victim character, learners may identify themselves or others, which helps them resonate more with the story and become focused, interested and learning-oriented (Paiva et al., 2005).

3. The Stronger game integrates several game features described below:
   a. the game-setting;

      The game-setting of Stronger contains a story, characters, illustrated background and dialogues. The game environment sets the prerequisites for better learning raising interest, attention, and providing a game-learning experience. Drifting away from the sequential factual learning, playing a game with an interesting story creates an anticipation of what

is going to happen next, attracting learners' attention and eager for learning more.

Observing the participants while playing the Stronger game, the majority looked focused, interested and engaged throughout the game. On the contrary, the participants of the Digital Course started with high focus and interest, and throughout the course, they gradually got tired, uninterested, took deep breathes, and in some instances, they skipped slides glancing at them for few seconds and then hitting "next".

b. the competitive game elements of the Stronger game

- Score

  Setting a score counter made players competitive in acquiring the highest score possible by making an additional effort to better answering the questions. This is evident at the end of the study when a group of students discussed the score and they were curious to learn about the score of their peers in the game. The score worked as a driving force of motivation because while learners try to achieve a better score, they also achieve better learning.

- Keys

  The game mission included the collection of keys, engaging participants to continue playing until they have collected all keys. The key is another visual object of success that encouraged learners to keep playing the game.

- Decision making

  Another strategy of learning incorporated in the game was the decision making. Having to choose the best option in a critical moment, elevated the anticipation and the critical thinking of participants and allowed them to learn the consequences of their choices.

- Assessment - Quizzes

  The questions in each quiz appear in a random sequence (see Figure 5.4.3.3) as well as the multiple options in each question appear randomly. The randomness is important because it prevents players

from predicting the next question of the quiz on the second try by memorising the position of the correct answers.

The passing level of each quiz remained around 70% or higher depending on the number of questions in each quiz. So players who had more than two incorrect answers had to repeat the instruction and the formative assessment. This decision was made to ensure that learners cover their learning gaps before moving to the next section of instruction.

In each quiz, the game included the Review of the answers button. If the learner after two repetitions could not guess the right answers and did not pass the quiz, they could choose to Review button which appears on the second repetition to give them the answers. This decision was made to ensure that learners would not be caged in an indefinite circle of repetitions.

The combination of learning elements and game elements in the Stronger game reinforced learning and deeper learning. The conclusions advocate a strong suggestion that the Stronger Game designed according to DeLEC framework successfully sustains the implementation of deeper learning with SGs.

7.4.3. Conclusions on Empathy

Empathy is an integral component of the DeLEC framework and part of the instruction phase of the game. According to Jarvis (2012), empathy is a value that counts in education, not only as a learning objective but also as a prerequisite for further learning. In SGs, empathy is an essential element that increases the engagement for learning (Paiva et al., 2005). Research also suggests several game design elements that trigger empathy such as the story, the characters and the dialogues (Belman & Flanagan, 2009; Paiva et al., 2005).

In Stronger the following empathy triggers were used:

e. the story,
f. the game characters and their facial expressions
g. the game character to represent the player

h. the dialogues.

While playing the game, empathy was rated in the following ways:

1. **Emotions Score** - Participants rated their feelings towards the victim game character;
2. **Level of Empathy** - Participants rated their level of empathy towards the victim game character;
3. **Empathetic persons** - Participants rated themselves as empathetic persons by answering empathy questions taken from the *Basic Empathy Scale Questionnaire* (Carré et. al., 2013).

The above measures of empathy (1, 2, 3) required subjective ratings given by the participants according to their opinions and feelings during playing game. However, in this study, these ratings are considered as objective, and they were used as such in the data analysis.

The above three measurements were examined separately and distinguished participants who demonstrated low/moderate empathy and high empathy.

1. Emotions Score (HES)

   Examining the Emotions Score (see Sections 6.6.2.2), 11 participants (23%) reported high Emotions Score, while the rest 37 (77%) rated their Emotions Score lower. Although the number of participants demonstrated High Emotions score is small, the conclusion is that all participants exhibited emotions towards the victim and none of the participants reported unemotional or neutral.

2. High Level of Empathy (HLE)

   The picture of Emotions Score is reversed when rating the Level of Empathy. Most of the participants (36) rated high Level of Empathy towards the game character (see Section 6.6.2.3) and only 12 participants rated low/moderate level of empathy. Level of Empathy, in this case, expresses both the understanding, the compassion and concern of what is happening to the game character. Thus, the Stronger game succeeded in triggering empathy while playing the game.

   None of the participants in Stronger reported unemotional (neutral) while

playing the game. A large percentage of participants reported high empathy. The high level of empathy indicates that the Stronger game has triggered empathy to the players. The Stronger game aimed not to trigger more empathy to participants, but to invoke empathy at the same level that participants perceived and reported their empathy. That is why each participant activates a different degree of empathy. The Stronger game had no intention to change a non-empathetic person to an empathetic person.

3. Participants as empathetic persons

   Participants answered a Likert Scale questionnaire (see Section 6.6.2.5 and Section 4.3.8.) with questions taken from the Basic Empathy Scale Questionnaire (Carré et. al., 2013) to evaluate themselves as empathetic persons. Their score ranked them whether they are empathetic characters or not. This evaluation examined whether participants who reported they consider themselves empathetic characters would respectively exhibit an empathetic behaviour throughout the game.

   The data analysis indicated that 31 (64.6%) participants out of 48 rated themselves as high empathetic persons (see Section 6.6.2.5 and Table 6.18 and 6.19). Out of those 31, the 26 participants demonstrated a high level of empathy towards the game character while 5 participants demonstrated a low level of empathy. So, most of the participants who reported empathetic persons, show consistency in empathy in the game. This result was in a way expected. However, another important finding that emerged from the data analysis was that 10 participants who rated themselves as low empathetic characters, exhibited a high level of empathy while playing the game.

7.4.3.1. Level of Empathy and Learning

Although empathy is designed to be examined within the DeLEC framework and in combination with the instruction and creativity, an investigation is done around whether Empathy alone has contributed to better learning. Investigating correlations of empathy and learning, a positive correlation would show that a higher level of empathy led to a higher level of learning and a lower level of empathy led to lower learning. The analysis of data has not clearly shown a positive correlation. Nevertheless, the investigation in Section 6.6.2.4 and Tables 6.16 and 6.17 shows that most of the participants who scored high in the post-knowledge

score had also reported a high level of empathy and therefore it can be concluded that participants who showed a high inclination to empathy have energised them to be more committed to their learning and performed high scores. Hence, high scores can be attributed to the connection and understanding of the situation and the feelings of the game character and they were ready to receive and learn more about them and subsequently about the learning content.

The Stronger game, as a learning media, has attracted the attention of participants more than the Digital Course and this is might be one of the reasons for achieving higher learning score. However, the repetitive nature of the game might be monotonous. Nevertheless, the game attracted learners also because of the subject, the story, the characters, and the quizzes and that it allowed high interactivity with the learner. Empathy in combination with the instruction and the creativity assisted participants in gaining and retaining their learning. The learning process was the same for both learning media (Stronger, DC) except empathy and creativity that involved learners into deeper learning. Figure 7.4 illustrates the learning processes for both the Stronger game and the Digital Course.

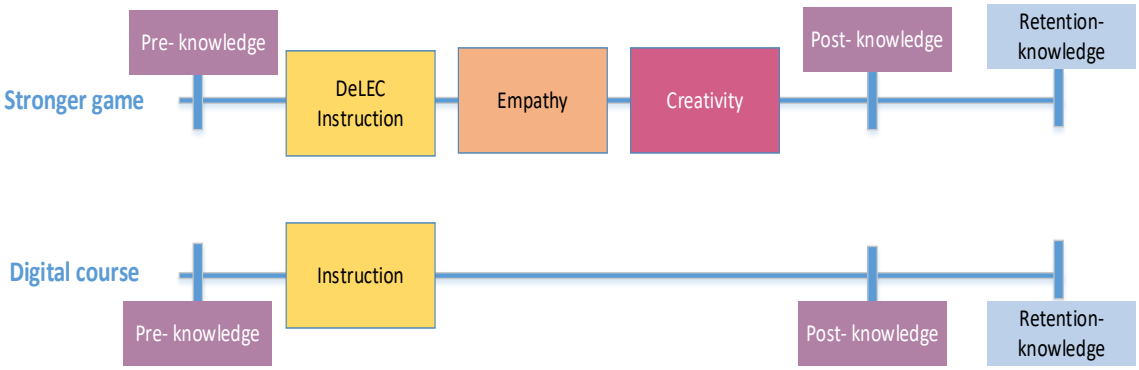


Figure 7. 4. The learning process for the two Learning Media

7.4.4. Conclusions on creativity

Creativity is the second phase of the DeLEC framework which is set to assist learners in transferring their learning in new contexts to achieving deeper learning. Initially, learners gain surface learning through the instruction phase. Then, through the creative phase, surface learning is elaborated and becomes deeper. Learners apply their knowledge into making something meaningful and creative applying their knowledge. In Stronger game learners created infographics and posters conveying messages of how to recognise abusive signs and how to help victims escape domestic abuse, resulting, according to DeLEC framework, in deepening their gained

knowledge.

According to Tansel (2013), a method to maintain learning in memory is by using the imagination and visual illustrations about the learning, which leads to better remembering. Creative activities involved the participants in a creative way of learning. Creativity, as part of the DeLEC framework, is the method used in this project for transferring knowledge into new contexts and therefore transforming the acquired surface knowledge into deeper knowledge (see Section 2.5.4).

All participants have managed a score in creative activities and none of the participants scored zero. Particularly, 38 out of the 48 participants achieved a high score in creativity (see Section 6.6.3.1, table 6.23) which led to the conclusion that most participants worked the creative activities related to the topic and therefore succeed in transferring their knowledge into new contexts.

The creative activities enabled participants to perceive learning content from another perspective that might trigger new connections with their brain and their memory. Besides, by designing the infographics and posters with encouraging messages to the victims of domestic abuse, participants not only showcased their learning but also they exhibited their empathy towards the victims of domestic abuse.

Not all participants consider themselves as creative persons, thus, requesting them to complete the creative activities, pushed some participants out of their comfort zone, and possibly made them invest more effort in applying their knowledge into drawing and creating a new digital artefact. This might be another reason that made them remember better this part and retained their knowledge.

7.4.4.1. Creativity and Learning

The creative phase has the form of active learning that enabled participants to use their gained knowledge in producing creative, original and meaningful products. Creativity, in combination with the other two components of the DeLEC framework, instruction and empathy, assisted participants in gaining and retaining their learning as shown in figure 7.4, which illustrates the two learning processes and its phases of the Stronger game and the digital course.

Examining the Creative score (see Section 6.6.3.1., Table 6.23) and the learning performance (post-knowledge score) there is no systematic pattern that proves that

high creativity meant high post-knowledge score or high retention-knowledge score. Table 6.23 tabulates a relation of the creative score of 120, 130, 140, with a high post-knowledge score 140, 150, 160, while 2 participants scored the highest score (160) in both the creative score and post-knowledge score.

The design of creative activities within a digital space and within the time of the study was challenging and limited. The possibilities of the tool in providing functionalities that allow participants to be truly creative were also limited. However, out of the three creative activities, the first two creative activities enabled more the application of knowledge learned rather than the free expression of creation. On the other hand, the third creative activity enabled more creative thinking.

It cannot be argued that creativity alone leads learners to deeper learning but in combination with other factors such as the iteration of instruction and assessment, the empathy, the score, the interaction, and the game setting it made it possible. Creativity in serious games simulates "learning by doing" where learners can reflect on what they are creating (Meij et al., 2020) as an after-instruction activity to express how they conceived and comprehend the acquired learning. Considered an enjoyable way of expressing and demonstrating learning, creativity might cause remembering and retaining knowledge in memory.

The methodology was designed to investigate whether the DeLEC framework as a completed learning process contributes to learning. Participants had to go through all the steps of both phases instruction and creativity to reach deeper learning. Probably, another approach in examining the effectiveness of the creative activities would be to define another group of participants who go through the DeLEC without the creativity phase, and then compare this group with the group that goes through the DeLEC and the creative activities aiming to compare their post-knowledge and their retention-knowledge as the results of the learning effectiveness with and without creativity and reach to conclusions whether creative phase has indeed contributed to deeper learning.

7.5. Summary

The chapter presents and discusses the results of the data analysis done in Chapter 6 elaborating an in-depth discussion and answering of the research questions set in this study. The discussion evolves around the results related to the Stronger game and evaluates the DeLEC framework in comparison to the results of the DC. The chapter addresses the research questions providing evidence from the data analysis and results of chapter 6. According to the results, the DeLEC framework via the Stronger game has achieved higher results than the alternative digital media learning approach. The results confirmed that Stronger game assisted learners in transforming their knowledge into deeper knowledge. Additionally, it presents and discusses the conclusions around the effectiveness of the DeLEC framework, the instruction and assessment, the empathy and the creativity in the game. The next chapter discusses the contribution to knowledge and future work.

Chapter 8. Contribution to Knowledge and Directions for Future Work

This last chapter compares the study results of the current thesis to other studies from the recent literature and discusses different approaches used for reaching deeper learning. It then discusses the contribution to knowledge in the field of SGs discussing three main contributions: the DeLEC framework, the Stronger game, and the study results which suggest that learners achieved deeper learning. Next, the chapter discusses directions for further work that include suggestions for extending the serious game of the current thesis and the design of new methodologies that would allow the collection and analysis of new data. Finally, the chapter completes with conclusions on the main elements of the DeLEC framework such as the learning aspect, the empathy, the creativity and their contribution to the research thesis.

8.1. The success of DeLEC in Learning

The current thesis examines the learning effectiveness of the pedagogic DeLEC framework compared to conventional learning approaches and different learning media. As found from the results of the study discussed in Chapter 7, the DeLEC framework which is applied to the Stronger role-playing game has achieved better results in learning compared to another conventional method of digital learning. The model in DeLEC involved instruction with empathy, creativity, assessment and iteration process to assist learners in better learning and applying their knowledge.

The DeLEC framework proved to be a successful pedagogic framework for achieving deeper learning with serious games because it has indeed demonstrated higher results than a conventional learning approach. Particularly, the DeLEC framework is applied to the serious game Stronger using the phases of instruction/assessment and creativity. The stronger game has demonstrated higher results in the post-knowledge test as well as in the retention-knowledge test. The results for the post-knowledge score show that learning and understanding were achieved better with the game. Also, the results for the retention-knowledge score show that the learning and knowledge retained in memory more four weeks later to the experimental group than to the control group. The Stronger game, as a learning media, through the story, the characters, the score, the visual objects, the quizzes and the high interactivity has attracted better the attention of participants than the DC and this is might be one of the reasons of achieving higher learning score.

Furthermore, it is found that empathy designed for Stronger contributed to learning. The greater percentage of participants who reported a high rating in the level of empathy, also have achieved high scores in the post-knowledge test (See Section 7.4.3.1.). It is concluded that their invoke of empathy have energised them to be more committed to their learning and performed higher scores. Hence, the high scores can be attributed to the connection of the learners to the content, the story and the game characters and their role in the game as the close friend that increased their enthusiasm and willingness to help the game character to escape abuse and kept them motivated and persisted to achieve better learning.

In creativity, there is no correlation found that proved that high creativity meant high post-knowledge score or high retention-knowledge score. Nevertheless, creative activities allowed participants to apply their learning in a new context

putting themselves into discovering their creative expression of applying their knowledge. Many participants who don't consider themselves creative managed to exercise this skill of becoming creative making them invest more time and effort in applying their knowledge into drawing and creating a new digital artefact. This might be another reason that made them remember better this part and retained their knowledge.

The design of the game to include not only game elements such as the story, characters, score, visual elements but also to include pedagogic elements such as the scenes and dialogues (the instruction) and the quizzes (assessment) and the score in combination with the empathy and creativity have successfully assisted participants in gaining and retaining their learning and achieving deeper learning.

The next section investigates other recent studies found in the literature assessing the methodology and strategies followed to assess learning with SGs and media learning applications.

8.2. Comparing the thesis with other similar studies

The systematic study carried out by Caballero-Hernández et al., (2017) emerged several methods used for assessing learning with SGs, inside or outside the game. According to the authors, SGs have specific features when it comes to assessment involving the game genre (adventure, quiz, puzzle) or the pedagogical objectives (formative or summative assessment) as well as the game content (health training, decision-making in corporate environments, etc). Inside the game, learning can be assessed during the gameplay using variables that store information about the learning performance, the level, or room visited, objects collected. Outside the game or assessment before or after the game and observations.

Likewise, Stronger included formative assessment in the pedagogic process in the form of quizzes and it used scores in quizzes to evaluate learning. It also used the game genre of role-playing and added a summative assessment at the end (post-knowledge test). The learning content allowed also decision making and empathy. Furthermore, the use of pre-tests and post-tests that measure the knowledge and skill-acquisition (Caballero-Hernández et al., 2017) also adopted in Stronger game. According to Iten and Petko, (2016), to achieve greater learning gains from playing SGs, pre-knowledge should be activated.

The empathy in the game was designed based on 4 game design principles of how empathy is integrated into SGs, proposed by Belman & Flanagan (2009) and discussed in section 2.7.3. Empathy is used as a design element that increases attention, motivation and engagement (Jarvis, 2012) and creates emotional connections between the learners and the learning content. The results on empathy demonstrated that most of the learners exhibited empathy (see Section 6.6.1.2.2) that helped them be more engaged and concentrated on their learning. Furthermore, the learning topic of DVA is a social issue that concerns the society and it elevates interest on antisocial behaviours. The creative phase of DeLEC framework provided learners with the space to apply their knowledge learned during the instruction into a new situation. The results reflected that not only have they achieved the expected learning outcomes, but they made the knowledge their own. Through creativity, learners transformed their knowledge into meaningful and deeper learning.

The thesis game and its learning results are compared to another similar role-playing game called "PR:EPARe" (Arnab et al., 2013), developed by the Serious Games Institute (SGI) of Coventry University around the topic of relationships and sex education (RSE) and particularly about in sexual coercion. The game design was based on the LM-GM framework (Arnab et al., 2015) and the study conducted among 500 high school students aged 13-14 years old. The study included blended teaching and debriefing during the game and at the end. The results of the study suggest that blending the interactive game with the traditional classroom delivery encouraged teachers and students in discussions after the gameplay and that students who played the game developed an understanding about recognising coercion and made decisions for reacting to coercion (see Section 2.4.2). Discussions on difficult issues like domestic violence can be triggered after playing an interactive game and through debriefing which activates peer learning and exchanging of views and opinions.

The design of the PR:EPARe game (Arnab et al., 2013) includes a pause button with which learners are interrupted of their immersion in the game to get back in the classroom setting to discuss the topic and then continue again which, according to my opinion, interrupts the learning flow of the user. Stronger does not interrupt the user while playing the game to allow them to remain focused on their learning until

the end of the game. Debriefing is not part of the learning approach in Stronger. Instead, learners are encouraged to continue to the learning process with the creative activities. For both games, Stronger and PR:EPARe, the study results have shown that students develop learning around the topic (Arnab, et al., 2015). However, PR:EPARe study did not apply any assessment to display evidence of developing learning around the topic. On the other hand, the study of Stronger included assessment as its main approach to demonstrate the development of learning using the game or the conventional e-learning approach.

Another study proved the acquisition of deeper learning through creating an educational game than merely playing an educational game. It claimed that knowledge is not transmitted to learners but it is constructed through creative activities. The study of Vos et al., (2011) examined two groups of students whose goal was to master several Dutch proverbs. The first group was required to build a game with proverbs while the second group was required to play a game to learn the proverbs. The two groups were compared for their motivation and deeper learning strategies. The results showed that constructing a game was more motivating and stimulates a deep learning approach more than playing a game. The creative condition provides activities with authentic meaningful tasks that engage learners in an active process of learning. Similarly, in Stronger, participants were asked to create meaningful tasks using their creative thinking and their imagination in creating an infographic and a poster. However, due to the limitations of the software, there was limited space for creativity in Stronger.

Another study claimed the achievement of deeper learning on Learning by Teaching (LbT) (Torshizi and Bahraman, 2019). Students learn by teaching their peers and could be effective instructors to each other even for complex and unfamiliar science content and peer tutors could further develop their understanding of the material through teaching. Participants in the study were 36 English literature students who involved in teaching a group of peer students and prepared assessment exercises. According to the authors, there are two features in this reaching deeper learning with this approach as this emerged from the study: (a) LbT and (b) the cognitive process inherent in this activity (i.e. deep cognitive processing due to either the expectation of teaching or actual teaching. The cognitive process which learners take in LbT is constructive in that it is formulated in a context to which explaining, interacting, questioning, responding and giving feedback promotes learners'

knowledge-building strategies. Learning through peer teaching is another interesting approach to reach deeper learning that differs from the DeLEC framework approach for deeper learning. The LbT approach is not based on Educational technologies digital teaching or SGs but it's a non-conventional teaching approach for the classroom. This idea can be extended in future work to become a designed learning process adapted for SGs.

Oyen and Bebko (1996) compared a traditional lesson with a game lesson and found that primary school children enjoyed more the game than those who had the lesson. Students enjoyed the game to the extent that they wanted to continue playing the game several times more and hence rehearsed the content more than the children in the traditional lesson and this suggests the reaching of deeper learning. A similar idea of rehearsing the content is also integrated with DeLEC framework where players rehearse the instruction until they reach the passing level and it also suggests the reaching of deeper learning.

Kebritchi et al., (2010) examined students who worked with a computer game that improved their mathematic achievement better than students who did not work with a computer game. Likewise, the use of Stronger game demonstrated higher learning results than the conventional e-learning approach.

8.3. Contribution to Knowledge

The current thesis aims to contribute to knowledge in the field of SGs designed for educational and learning purposes. Three contributions to knowledge emerged from this PhD thesis: The pedagogic DeLEC framework for Serious games, the role-playing serious game Stronger and the collected data and results from the study conducted for this research thesis investigating the learning effectiveness and the achievement of deeper learning. The contributions are discussed below:

8.3.1. The DeLEC Framework

The DeLEC framework is an original framework designed for SGs aiming in providing a learning process that supports learners in gaining learning and deeper learning. The DeLEC framework suggests a learning model that extends the LFM theory by:

- Designing the instruction phase integrated with empathy to motivate and engage learners with the educational content;
- allowing an undefined number of repetitions until learners master the learning objectives. extending Bloom's LFM model which is designed to allow a maximum of two repetitions.
- Integrating creativity to enable learners to transfer knowledge gained during the instruction to a new situation offering the ground for transforming surface learning into deeper learning.

The DeLEC framework eliminates many of the criticisms of the LFM's opponents (see Section 3.2.1).

- One criticism argued about the limited classroom time, which hinders the application of instruction and frequent assessments (Arlin and Webster, 1983).

- Another criticism refers to the vast amount of time committed by the teacher to help students apply correctives and fill their learning gaps resulting in fast learners to wait for slower learners to catch up.

Replying to these arguments, the DeLEC framework applied in SGs completes the LFM and gives a solution to the arguments of the opponents of LFM by removing the argument of limited time in the classroom and fast learners waiting for the slow learners, as the Stronger SG can be played at any time out of the classroom and also it allows each learner the time needed to repeat and complete their learning in their own pace.

However, even if the waiting time was an issue, the results of playing the Stronger game showed that the experimental group became more homogenous in terms of the level of the learning they acquired which became similar (see Section 6.6.3.2 and section 7.3) and therefore the learning gap of fast and slow students with mix-speed competences reduced.

Therefore, if, hypothetically, the lesson continues in the classroom the next time, the group of learners who played the game, acquired similar level of knowledge and therefore they can continue to the next learning material without any waiting time. The teacher can be benefited from the homogeneity by proceeding with their teaching towards all the group of learners, without wasting time and effort in

repeating the same learning content and applying correctives to a group of slow students.

Another original element of the DeLEC framework is that the components of empathy and creativity are linked together in directing the design of SGs for achieving deeper learning. Scientific literature refers to creativity as one of the six 'C' elements that can lead to deeper learning (Fullan & Langworthy, 2013b); however, the combination of empathy, creativity to achieve deeper learning has not been investigated elsewhere.

The DeLEC framework is an original contribution to the scientific literature and academic knowledge of educational computing as it enhances the LFM and offers guidance for the design of SGs for achieving deeper learning.

8.3.2. The Stronger Role-Playing Game

Stronger is an original role-playing serious game unique in many ways:

- It is designed based on the DeLEC framework providing the first learning resource aiming in supporting learners to achieve deeper learning.
- It is completed, tested and evaluated educational resource ready to be used to raise awareness on around the warning signs of domestic abuse.
- In terms of learning content, the Stronger game is designed with a unique plot and dialogues to target learning around the issue of domestic abuse. It is one of the few role-playing games around the domain of DVA that has already attracted interest from DVA organisations (Barking and Dagenham Council) to be used in campaigns to proactively educate people and limiting the incidents of domestic abuse while encouraging the reporting of abusers to the police. Using this resource adds another brick on the block to raising awareness about recognising the warning signs and help people who suffer from DVA.

  The Stronger game could be extended to cover more scenarios related to DVA, but it could as well be reused to support other role-playing scenarios. The University of Westminster is looking to adopt the Stronger game template to create similar resources to support the University's "Green Dot" programme, an active bystander training programme for staff and students aiming to provide knowledge, skills, and confidence to identify, intervene and report sexual assault

(https://www.westminster.ac.uk/current-students/support-and-services/sexual-violence-and-harassment/green-dot-active-bystander-initiative).

Furthermore, the University of Westminster is looking to adapt the Stronger game template in developing other educational resources for the Law School (similar projects have been developed by the SGs at Westminster Research Group (SG@W) (https://www.westminster.ac.uk/research/groups-and-centres/serious-games-at-westminster-research-group) as well as for training staff. The Stronger game could become a valuable resource and a template for different stakeholders who seek to design and develop similar educational resources, such as schools, the Police and other NGOs.

- the game design offers the content and the structure for computer scientists, educators and game designers to experiment with developing it using different technologies. There is currently such planning in collaboration with the SG@W and the XRLab at the University of Westminster (https://xrlab.london/) to develop the game using immersive technology.

8.3.3. The research data, the study results and conclusions

The collected data from the research study that has been conducted to address the aims of this research thesis, the findings resulted from the data analysis, and the conclusions that have been drawn based on the analysis, become an original and reliable resource of information, studies and references. The outcomes of this research study can be used by the academic community with similar research interests or by researchers who wish to extend this research thesis or reference this resource when producing new projects in the field of SGs and educational computing.

8.4. Limitations

The findings of this research thesis are seen considering some limitations. Limitations are identified in two aspects: (a) the methodology, (b) the study:

a. The methodology

- Evaluating empathy in the game.

  Designing the method of collecting data on empathy in the game was challenging. Lacking the knowledge and expertise in conducting psychometric tests for objective measurements and having no access to such equipment it

was impossible to set up such methodology. On the other hand, setting a self-report of the learners about their empathy was a safe way to avoid guessing and misleading measurements. Learners' self-report and empathy rating had the form of Likert Scale Questions in the scale of 0-5. The rating was done twice in the game and considered a reliable input from each of the participants. However, this rating was an indication that relied only on the answers of the participants and their honesty when rating their level of empathy.

- Designing and evaluating creative activities

  The decision of the creative activities that can be built given that its possibilities of the software were limited, was difficult. The authoring tool had limited space provided to the learner to express their creative thinking. Furthermore, the creative activities had to be assessed in the game to generate a creative score that was used in the statistical analysis. The evaluation of creative activities had to be done automatically by the software to emerge a score and this is another limitation because it set criteria in the creative expression of participants. It is incompatible to require the free expression of creative thinking from the participants and at the same time putting boundaries by trying to score the creative product. The expression of creativity cannot be put into limits and this limitation affected the creative score.

- The evaluation of game design elements in the game

  There was no designed assessment and evaluation of each of the game design elements separately and their contribution to the learning of participants. It is evident from the literature that game design elements have an attractive power and engagement that can help the learning effectiveness increasing the positive mood and the motivation for playing and learning. The separate assessment of the game elements was out of the scope of the study and therefore it was not measured or taken into consideration while applying the statistical analysis.

- the comparison of the game with a conventional media of learning

  Another limitation in the design of the methodology is the comparison of two different learning media that biased the results. While the question was whether empathy and creativity as additional design elements can influence the performance in learning then those elements should have been tested using

the same media learning e.g. the serious game with these two elements against the same serious games without the two elements. This is because the two different learning media themselves could have influenced the results anyway and there is no clear image whether empathy and creativity have made a difference in learning or whether the game, for example, was a more effective learning media than the e-learning course. This designed methodology can be considered as future work.

b. The study

- The first limitation involves the sample and selection. Searching for participants proved to be a hard process. So, some participants who had already tried the pilot study were also used in the final study and this proved to bias the results. Covering the learning objectives already while playing the pilot version of the game, these participants found to remember their learning while playing the final version of the game ending up achieving high scores even if they reported low empathy. Therefore, results that linked the post-knowledge score and empathy cannot be generalised as some of the participants had gone through the subject already and they achieved high scores.

- The second limitation involved the reduced participation of the participants to the second part of the study that affected the number of samples considered for the statistical analysis. Although the information sheet is given to participants during the first part of the study clearly stated that it is essential that participants participate twice to the study, some of them did not show up for the second part resulting in omitting these participants from the statistical analysis. This justifies the difference in the number of samples of the two groups which maintain their similarity in terms of participants characteristics and previous knowledge.

- Another limitation involved the statistical analysis as for the demographic profile of the participants because this was out of the scope of this research thesis. There is a lot of information that can be analysed and discussed the demographic information and the acquisition of learning between the two groups that can become future work.

8.5. Future Work

This research thesis proposed the DeLEC framework and studied empathy, creativity and deeper learning with serious games. This is the beginning of the work that can be elaborated and extended as a future work examining it from different perspectives such as:

- examining separately the impact of empathy and creativity;
- examining the impact of each game design element;
- Examining the demographic information and learning;
- extending the Stronger game as for its learning content;
- the DeLEC framework as a guideline for designing other SGs;
- Using immersive learning technologies;
- Using Artificial Intelligence.

8.5.1. Examining separately the impact of empathy and creativity

A new methodology design can examine the impact of empathy and creativity using the same game. According to Mayer, (2010), to be able to measure the impact of each design element, then only one game design element should exist so that no other factors would influence its impact.

Therefore, the Stronger game should be designed again in different versions that can be compared and emerging results.

a. Examining Empathy only

   To emerge results for the empathy generated in the game, two versions of the game can be compared. The first version of the game has instruct participants to empathise with the game characters and self-report and rate their empathy and another version of the game that doesn't instruct participants to empathise with the game characters but also asks for self-report and rate their empathy. According to the 1st game design principle of Belman and Flanagan (2009), (see Section 2.7.3), players empathise only when they are instructed to do so. The empathy level of the two groups in the same learning media might give a clear picture of whether empathy can influence the learning performance of participants who play the same game.

Also, further work could alternate the method of assessing empathy to another method that can collect data using objective measurements about participants' empathy, feelings and reactions using psychometric assessment.

b. Examining Creativity only

To be able to examine whether creativity is playing a crucial role in learning performance and deeper learning, a new methodology should be designed for the same learning media, the Stronger game. The first version of the game should include the instruction and the creativity part, while the second version of the game should not include the creative part. The two groups of participants should try the two versions of the game. Their scores in learning (post-knowledge score) and deeper learning (retention-knowledge score) would provide evidence of whether the creative activities have added to the better learning of the participants or not.

8.5.2. Examining the impact of each game design element

The DeLEC framework was designed to incorporate game design elements such as the score, decision making, the collection of keys, and participants' game character could impact the excitement, interest, motivation, engagement, and eventually the learning in the game. In the current thesis, the game design elements are examined together and there is no distinction of which element has made the biggest impact on participants' learning performance.

The presence or absence of game design elements from the Stronger game could indicate a change in the learning performance of participants. Examining one game element each time (Mayer, 2010), would provide a good inside about the value of the game elements and their contribution to learning. However, we have not investigated, whether their absence would modify the learning, the motivation or satisfaction about playing the game.

The role of the player in the game is another game design element that can be examined in the game and whether its enhanced involvement would generate higher impact in learning, motivation, and satisfaction compared to the game design where the player remains uninvolved.

8.5.3. Examining the demographic information and learning

The designed methodology and the study included the comparison of the two groups as for their learning with the Stronger game and the Digital Course. The gathering of demographic information was done only to prove that the two groups are equal as for their demographic characteristics and none of the two groups was in favour against the other. However, there is a lot of information gathered that can be statistically analysed to extract useful information regarding the demographic profile of the participants and their achievement to learning e.g. their gender, age, educational level etc. So, this is a lot of future work that can be done.

8.5.4. Extending Stronger game

The Stronger game incorporates the part of the subject on domestic violence and abuse, including the forms of abuse, and the warning signs of abuse. There is an exhaustive list on other topics related to domestic abuse that can be included in the game. Moreover, the game can be designed to be addressed towards different roles of domestic abuse such as possible victims, friends and family of victims, social workers, police officers, nurses, psychologist, lawyers, or persons with abusive behaviour.

The Stronger game can also become the inspiration and the guidance for designing other games for educating individuals on other serious social issues such as behaviour change, prosocial behaviour, and bullying as well as other domains such as medical issues and mental issues.

Furthermore, the Stronger game can work well with business processes, such as customers' services, human resource management or employees and managers training.

8.5.5. The DeLEC framework as the guideline for designing other SGs

The DeLEC framework proposes an instructional solution for achieving deeper learning and it can direct the design of other SGs that guide their learners into this direction. The DeLEC framework consists of an integrated learning process that games designers can follow when designing educational games for learning. DeLEC can become the foundation based on which other SGs can be designed differently to

make sure that they include pedagogical principles when it comes to achieving learning.

8.5.6. Using Immersive Learning Technologies

The Stronger game is implemented in 2D using the Articulate Storyline 360 authoring tool (see Section 5.1.). Transferring the Stronger game in immersive technologies such as 3D or Virtual Reality could provide interesting data about the achievement of learning and deeper learning. A comparative study using the Stronger game as currently implemented and comparing it with Stronger developed in an immersive version would give valuable information on whether better learning can be achieved using different modes of games.

While Stronger is a role-playing game, it can be viewed and reviewed as for whether its enjoyment of playing becomes an additional factor of achieving deeper learning.

8.5.7. Using Artificial Intelligence

As technology evolves, Artificial Intelligence (Andrade et al., 2018) penetrates games technology. The idea is to create games with learning content that resonates the personal characteristics of the learners (Brisson et al., 2012). The stronger game can grow using artificial intelligence with the creation of several different scenarios that alternate the story, the ages of the characters, the type of couples involved in the story and other parameters corresponding to the demographics, cultural characteristics, the level of learning of the players, their learning style and their learning needs.

8.5.8. Other suggestions for future work

The Stronger game can provide more involvement to the player and active learning putting the player to the centre of their learning by designing it with branching scenarios (Antoniou et al., 2017; Smith, 2017). Altering the form of role-playing in branching scenarios the player becomes a critical thinker and makes decisions that influence and change the flow of the story. The story could have many different ending paths where the player with their choices decides the path and creates the story. The player has the responsibility for their actions and make their choices and learn from the consequences of their choices.

Another suggestion for further work is to extend the DeLEC learning process to include blended methods of teaching, like the debriefing as part of the learning

process (as shown in the IPO model, see Section 2.6.1) and also used in the game PR:EPARe (see Section 8.2). Debriefing stage can have the form of discussion with the facilitator to be the teacher and can be conducted at the end of the study encouraging the learners to discuss and share ideas supporting peer learning and understanding and achieving homogenous learning for the group of participants.

8.6. Summary

In summary, this PhD thesis attempted to study the effect of SGs in achieving deeper learning. It argued the lack of a framework for the design of SGs that include pedagogic principles and proposed the DeLEC framework to address this issue and support learners in reaching deeper learning. The proposed DeLEC learning process integrates instruction, assessment, feedback and repetition, as well as empathy and creativity.

The DeLEC framework was applied through the implementation of the Stronger game, an interactive role-playing game which revolved around the issue of domestic violence and abuse aiming in delivering the forms and the warning signs of abuse. The game includes instruction which unfolds in scenes. Each scene is linked to formative assessment and the goal of the player is to pass the formative assessment to progress to the next scene. The instruction is completed in six scenes. Upon completion of the instruction, the learner is transferred to the next level to apply their knowledge gained from the instruction in new contexts to deepen their knowledge and thus, learners complete the creative activities.

The research study had the form of a comparative study and conducted with 88 participants assigned in two groups. The experimental group consisted of 48 participants who played the Stronger game while the control group consisted of 40 participants and completed the digital course. For the requirements of the statistical analysis, the participants completed the pre-knowledge test before the game/digital course and the post-knowledge test after the game/digital course to measure the change in learning. Likewise, four weeks later the two groups completed the retention-knowledge test to measure the retention of knowledge in memory and draw conclusions on achieving deeper learning.

The data analysis demonstrated that participants of the experimental group, who followed the DeLEC framework through the Stronger game, achieved higher results

in learning and deeper learning compared to the control group. The majority of participants who played the game exhibited empathy towards the game character and this contributed to the engagement of the learners with the learning content. Likewise, creativity contributed to deepening the gained knowledge. The setting of role-playing in Stronger worked positively in attention, interest and engagement of participants with the learning content.

The results led to the conclusion that the DeLEC framework can stand as an effective learning process in achieving deeper learning. The DeLEC framework can also support other learning subjects that pursue deeper learning with SGs.

It is important to emphasise that SGs are not developed to substitute by any means the presence and the value of the teacher and the interaction with students. Games are not effective in isolation and should be used in conjunction with other instructional support (Robertson & Howells, 2008). The successful use of games in the classroom is dependent on the quality of the teaching including the teacher's skill in identifying students' abilities, and identifying the game limits in association to the learning objectives and applying the games in ways that meet these objectives (Robertson & Howells, 2008).

The contributions to knowledge derived from the present research thesis are summarised here and include first, the DeLEC framework which proposes a learning process applied to support learners in achieving deeper learning with SGs, second, the Stronger game which is based on the DeLEC framework and demonstrated successful results for learning and deeper learning. The Stronger game in the form of role-playing is a valuable educational resource about domestic abuse. Third, the research study collected valuable data from 88 participants about their learning scores, their creativity scores and the exhibit of empathy while playing the game. Fourth, the data analysis produced significant results around the achievement of learning and deeper learning compared to the control group, as well as the retention of knowledge. The experimental group demonstrated higher retention of the gained knowledge in memory compared to the control group and this is the green light that participants achieved deeper learning.

List of References

Adams, D. M., & Mayer, R. E. (2014). Chapter 6. Cognitive Consequences Approach: What Is Learned from Playing a Game? In *Computer Games for Learning. An Evidence-Based Approach*. (pp. 176–224). MIT Press books.

All, A., Castellar, E. P. N., & Looy, J. Van. (2016). Assessing the effectiveness of digital game-based learning : Best practices. *Computers & Education*, *92–93*, 90–103. https://doi.org/10.1016/j.compedu.2015.10.007

Almeida, F., & Simoes, J. (2019). The role of serious games, gamification and industry 4.0 tools in the education 4.0 paradigm. *Contemporary Educational Technology*, *10*(2), 120–136. https://doi.org/10.30935/cet.554469

Alsawaier, R. S. (2018). The effect of gamification on motivation and engagement. *International Journal of Information and Learning Technology*, *35*(1), 56–79. https://doi.org/10.1108/IJILT-02-2017-0009

Ambrose, S. A., Bridges, M. W., Dipietro, M., Lovett, M. C., & Norman, M. K. (2010). *How Learning Works: Seven Research-Based Principles for Smart Teaching*. Jossey-Bass.

Andrade, K. O., Joaquim, R. C., Caurin, G. A. P., & Crocomo, M. K. (2018). Evolutionary algorithms for a better gaming experience in rehabilitation robotics. *Computers in Entertainment*, *16*(2). https://doi.org/10.1145/3180657

Ang, C. S., Avni, E., & Zaphiris, P. (2008). Linking Pedagogical Theory of Computer Games to Their Usability. *International JI. on E-Learning*, *7*(3), 533–558.

Antoniou, P. E., Siountas, A., & Zilidou, V. I. (2017). *Perceptions and acceptance of technology-based health and wellness interventions* . https://doi.org/10.1109/CBMS.2017.115

Arlin, M., & Webster, J. (1983). Time costs of mastery learning. *Journal of Educational Psychology*, *75*(2), 187–195.

Arnab, S., Berta, R., Earp, J., de Freitas, S., Popescu, M., Romero, M., Stanescu, I., & Usart, M. (2012). Framing the adoption of serious games in formal education. *Electronic Journal of E-Learning*, *10*(2), 159–171.

Arnab, S., Brown, K., Clarke, S., Dunwell, I., Lim, T., Suttie, N., Louchart, S., Hendrix, M., & De Freitas, S. (2013). The development approach of a pedagogically-driven serious game to support Relationship and Sex Education (RSE) within a classroom setting. *Computers and Education*, *69*, 15–30. https://doi.org/10.1016/j.compedu.2013.06.013

Arnab, S., Lim, T., Carvalho, M. B., Bellotti, F., De Freitas, S., Louchart, S., Suttie, N., Berta, R., & De Gloria, A. (2015). Mapping learning and game mechanics for serious games analysis. *British Journal of Educational Technology*, *46*(2), 391–411. https://doi.org/10.1111/bjet.12113

Arnab, S., Lim, T., Carvalho, M. B., Bellotti, F., Freitas, S. De, Louchart, S., Suttie, N., & Berta, R. (2015). *Mapping learning and game mechanics for serious games analysis*. *46*(2), 391–412. https://doi.org/10.1111/bjet.12113

Bartolomé, A., Castañeda, L., & Adell, J. (2018). Personalisation in educational technology: the absence of underlying pedagogies. *International Journal of Educational Technology in Higher Education*, *15*(1). https://doi.org/10.1186/s41239-018-0095-0

Batson, C. D., Polycarpou, M. R., Harmon-jones, E., Imhoff, H. J., Mitchener, E. C., Bednar, L. L., Klein, T. R., & Highberger, L. (1997). *Empathy and Attitudes : Can Feeling for a Member of a Stigmatized Group Improve Feelings Toward the Group ? 72*(1), 105–118.

Beghetto, R. A. (2016). Creative Learning: A Fresh Look. *Journal of Cognitive Education and Psychology*, *15*(1), 6–24.

Bellotti, F., Berta, R., De Gloria, A., Ott, M., Arnab, S., Freitas, S. De, & Kiili, K. (2014). *Designing Serious Games for education : from Pedagogical Principles to Game Mechanisms*.

Bellotti, F., Kapralos, B., Lee, K., & Moreno-ger, P. (2013). *Unfinished- User Assessment in Serious Games and Technology-Enhanced Learning*. *2013*, 2–4.

Bellotti, F., Kapralos, B., Lee, K., Moreno-Ger, P., & Berta, R. (2013). Assessment in and of Serious Games: An Overview. *Advances in Human Computer Interaction*, *2013*.

Belman, J., & Flanagan, M. (2009). Designing Games to Foster Empathy. *Cognitive*

Technology, *14*(2), 5–15.

Bloom, B S, Engelhart, M. D., Furst, E. J., Hill, W. H., & Krathwohl, D. R. (1956). Taxonomy of Educational Objectives: The Classification of Educational Goals: Handbook I Cognitive Domain. *New York*, *16*, 207. https://doi.org/10.1300/J104v03n01_03

Bloom, Benjamin S. (1968). Learning For Mastery. *Center for Study Evaluation of Instructional Programs*, *1*(2).

Boomsma, C., Hafner, R., Pahl, S., Jones, R. V., & Fuertes, A. (2018). Should We Play Games Where Energy Is Concerned ? Perceptions of Serious Gaming as a Technology to Motivate Energy Behaviour Change among Social Housing Residents. *Sustainability*, *10*(1729), 1–18. https://doi.org/10.3390/su10061729

Braad, E., Gregor, Ž., & Sandovar, A. (2016). Processes and Models for Serious Game Design and Development. In *Entertainment Computing and Serious Games* (Issue October). https://doi.org/10.1007/978-3-319-46152-6

Brisson, A., Pereira, G., Prada, R., Paiva, A., Louchart, S., Suttie, N., Lim, T., Lopes, R., Bidarra, R., Bellotti, F., Kravcik, M., & Oliveira, M. (2012). Artificial intelligence and personalization opportunities for serious games. *AAAI Workshop - Technical Report*, *WS-12-17*, 51–57.

Caballero-Hernández, J. A., Palomo-Duarte, M., & Dodero, J. M. (2017). Skill assessment in learning experiences based on serious games: A Systematic Mapping Study. *Computers and Education*, *113*, 42–60. https://doi.org/10.1016/j.compedu.2017.05.008

Carré, A., Stefaniak, N., Ambrosio, F. D., Bensalah, L., & Besche-richard, C. (2013). The Basic Empathy Scale in Adults (BES-A): Factor Structure of a Revised Form. *American Phychological Association*, *25*(3), 679–691. https://doi.org/10.1037/a0032297

Catalano, C. E., Luccini, A. M., & Mortara, M. (2014). Guidelines for an effective design of serious games. *International Journal of Serious Games*, *1*(1), 1–13. http://journal.seriousgamessociety.org/index.php?journal=IJSG&page=article&op=view&path[]=8

Chan, Z. C. Y. (2013). A systematic review of creative thinking / creativity in nursing

education. *Nurse Education Today*, *33*(11), 1382–1387. https://doi.org/10.1016/j.nedt.2012.09.005

Cherney, I. (2008). The effects of active learning on students' memories for course content. *Active Learning in Higher Education*, *9*(2), 152–171. https://doi.org/10.1177/1469787408090841

Chorianopoulos, K., & Giannakos, M. N. (2014). *Design Principles for Serious Video Games in Mathematics Education : From Theory to Practice Norwegian University of Science and Technology (NTNU), Trondheim , Norway ,. 1*(3), 51–59.

Connolly, T. M., Boyle, E. A., Macarthur, E., Hainey, T., & Boyle, J. M. (2012). A systematic literature review of empirical evidence on computer games and serious games. *Computers & Education*, *59*(2), 661–686. https://doi.org/10.1016/j.compedu.2012.03.004

Conway, M. A., & Loveday, C. (2015). Remembering, imagining, false memories & personal meanings. *Consciousness and Cognition*, *33*, 574–581. https://doi.org/10.1016/j.concog.2014.12.002

Cornillie, F., Clarebout, G., & Desmet, P. (2012). *The role of feedback in foreign language learning through digital role playing games*. *34*, 49–53. https://doi.org/10.1016/j.sbspro.2012.02.011

Csikzentmihaly, M. (1991). Flow: The Psychology of Optimal Experience. *Academy of Management Review*, *16*(3), 636–640. https://doi.org/10.5465/AMR.1991.4279513

Da Rocha Seixas, L., Gomes, A. S., & De Melo Filho, I. J. (2016). Effectiveness of gamification in the engagement of students. *Computers in Human Behavior*, *58*, 48–63. https://doi.org/10.1016/j.chb.2015.11.021

Davies, D., Jindal-Snape, D., Collier, C., Digby, R., Hay, P., & Howe, A. (2013). Creative learning environments in education — A systematic literature review. *Thinking Skills and Creativity*, *8*, 80–91. https://doi.org/10.1016/j.tsc.2012.07.004

De Freitas, S. (2006). Learning in Immersive worlds: A review of game-based learning. *JISC ELearning Innovation*, *3.3*(October 14), 73. https://doi.org/10.1111/j.1467-8535.2009.01024.x

De Freitas, S. (2018). Are Games Effective Learning Tools? A Review of Educational Games. *Educational Technology and Society*, *21*(2), 74–84.

Dede, C. (2014). The Role of Digital Technologies in Deeper Learning. *Deeper Learning Research Series*, *December*. http://search.ebscohost.com/login.aspx?direct=true&db=eric&AN=ED561254&site=ehost-live

Derbali, L., & Frasson, C. (2012). Assessment of Learners' Motivation during Interactions with Serious Games: A Study of Some Motivational Strategies in Food-Force. *Advances in Human-Computer Interaction*, *2012*, 1–15. https://doi.org/10.1155/2012/624538

Devlin-Scherer, R., & Sardone, N. B. (2010). Digital Simulation Games for Social Studies Classrooms. *The Clearing House*, *83*, 138–144. https://doi.org/10.1080/00098651003774836

Djaouti, D., Alvarez, J., Jessel, J.-P., & Rampnoux, O. (2011). Origins of Serious Games. *Serious Games and Edutainment Applications*, 25–43. https://doi.org/10.1007/978-1-4471-2161-9_3

Dunwell, I., Weninger, F., & Paletta, L. (2013). *Serious Gaming for Behavior Change:* 48–55. https://doi.org/10.1109/MPRV.2013.54

Entwistle, N. (2000). *Promoting deep learning through teaching and assessment : conceptual frameworks and educational contexts* . *November*.

Felicia, P., & Egenfeldt-Nielsen, S. (2011). Game-Based Learning: A review of the State of the Art. In S. Egenfeldt-Nielsen, B. Meyer, & B. H. Sørensen (Eds.), *Serioius Games In Education: A Global Perspective* (pp. 21–44). Aarhus University Press.

Flanagan, M., & Nissenbaum, H. (2014). Introducing Values at Play. In *Values at Play in Digital Games*. MIT Press books.

Fullan, M., & Langworthy, M. (2013a). *A Rich Seam: How New Pedagies Find Deep Learning* (Issue January).

Fullan, M., & Langworthy, M. (2013b). *Towards a new end: New pedagogies for deep learning*. *June*, 31.

Gajda, A., Beghetto, R. A., & Karwowski, M. (2017). Exploring creative learning in

the classroom : A multi-method. *Thinking Skills and Creativity*, *24*, 250–267. https://doi.org/10.1016/j.tsc.2017.04.002

Garneli, V., Giannakos, M., & Chorianopoulos, K. (2017). Serious games as a malleable learning medium: The effects of narrative, gameplay, and making on students' performance and attitudes. *British Journal of Educational Technology*, *48*(3), 842–859. https://doi.org/10.1111/bjet.12455

Garris, R., Ahlers, R., & Driskell, J. E. (2002). Games, motivation, and learning: A research and practice model. *Simulation and Gaming*, *33*(4), 441–467. https://doi.org/10.1177/1046878102238607

Gee, J. P. (2003). What video games have to teach us about learning and literacy. *Computers in Entertainment*, *1*(1), 20. https://doi.org/10.1145/950566.950595

Gloria, A. De, Bellotti, F., Berta, R., & Lavagnino, E. (2014). Serious Games for education and training. *International Journal of Serious Games*, *1*(1).

Greitemeyer, T., Osswald, S., & Brauer, M. (2010). Playing Prosocial Video Games Increases Empathy and Decreases Schadenfreude. *American Phychological Association*, *10*(6), 796–802. https://doi.org/10.1037/a0020194

Grohn, J., Huck, S., & Valasek, J. M. (2014). A note on empathy in games. *Journal of Economic Behavior and Organization*, *108*, 383–388. https://doi.org/10.1016/j.jebo.2014.01.008

Grover, S., Pea, R., & Cooper, S. (2015). Designing for deeper learning in a blended computer science course for middle school students. *Computer Science Education*, *25*(2), 199–237. https://doi.org/10.1080/08993408.2015.1033142

Gunter, G. A., Kenny, R. F., & Vick, E. H. (2006). A Case for a Formal Design Paradigm for Serious Games. *The Journal of the International Digital Media and Arts Association*, *3*(1), 93–105.

Gunter, G. A., Kenny, R. F., & Vick, E. H. (2008). Taking educational games seriously : using the RETAIN model to design endogenous fantasy into standalone educational games. *Educational Technology Research and Development*, *56*(5–6), 511–537. https://doi.org/10.1007/s11423-007-9073-2

Guskey, T. R. (2007). Closing Achievement Gaps: Revising Benjamin S. Bloom's

"Learning for Mastery." *Journal of Advanced Academies*, *19*(1), 8–31.

Hennessey, B. A., & Amabile, T. M. (2010). Creativity- Annual Review Psychology. *Www.Annualreviews.Org*, *61*, 569–598. https://doi.org/10.1146/annurev.psych.093008.100416

Horton, L. (1976). Learning : Sound In Theory , But ... *Educational Leadership*, *November*, 154–157.

Hunicke, R., LeBlanc, M., & Zubeck, R. (2004). {MDA}: {A} formal approach to game design and game research. *{AAAI} {Workshop} on {Challenges} in {Game} {AI}*, *4*. https://doi.org/10.1.1.79.4561

Iten, N., & Petko, D. (2016). Learning with serious games: Is fun playing the game a predictor of learning success? *British Journal of Educational Technology*, *47*(1), 151–163. https://doi.org/10.1111/bjet.12226

Jarvis, C. (2012). Fiction , empathy and lifelong learning. *International Journal of Lifelong Eduation*, *31*(6), 743–758. https://doi.org/10.1080/02601370.2012.713036

Jeffrey, B. (2006). Creative teaching and learning : towards a common discourse and practice. *Cambridge Journal of Education*, *36*(3), 399–414. https://doi.org/10.1080/03057640600866015

Jeffrey, B., & Craft, A. (2004). Teaching creatively and teaching for creativity : distinctions and relationships. *Educational Studies*, *30*(1), 77–87. https://doi.org/10.1080/0305569032000159750

Jolliffe, D., & Farrington, D. P. (2006). Development and validation of the Basic Empathy Scale. *Journal of Adolescence*, *29*, 589–611. https://doi.org/10.1016/j.adolescence.2005.08.010

Julious, S. A. (2005). Sample size of 12 per group rule of thumb for a pilot study. *Pharmaceutical Statistics*, *4*(4), 287–291. https://doi.org/10.1002/pst.185

Kampylis, P., Berki, E., & Saariluoma, P. (2009). *In-service and prospective teachers ' conceptions of creativity*. *4*, 15–29. https://doi.org/10.1016/j.tsc.2008.10.001

Ke, F. (2014). An implementation of design-based learning through creating educational computer games: A case study on mathematics learning during

design and computing. *Computers and Education*, *73*, 26–39. https://doi.org/10.1016/j.compedu.2013.12.010

Kebritchi, M., Hirumi, A., & Bai, H. (2010). The effects of modern mathematics computer games on mathematics achievement and class motivation. *Computers and Education*, *55*(2), 427–443. https://doi.org/10.1016/j.compedu.2010.02.007

Laird, T. F. N., Shoup, R., Kuh, G. D., & Schwarz, M. J. (2008). *The Effects of Discipline on Deep Approaches to Student Learning and College Outcomes*. 469–494. https://doi.org/10.1007/s11162-008-9088-5

Lalley, J. P., & Gentile, J. R. (2009). Classroom Assessment and Grading to Assure Mastery. *Theory Into Practice*, *48*, 28–35. https://doi.org/10.1080/00405840802577577

Lameras, P., Arnab, S., Dunwell, I., Stewart, C., Clarke, S., & Petridis, P. (2016). Essential features of serious games design in higher education: Linking learning attributes to game mechanics. *British Journal of Educational Technology*, *00*(00). https://doi.org/10.1111/bjet.12467

Lamprinou, D., & Paraskeva, F. (2015). Gamification design framework based on SDT for student motivation. *Interactive Mobile Communication Technologies and Learning (IMCL), 2015 International Conference On*, *November*, 406–410. https://doi.org/10.1109/IMCTL.2015.7359631

Lercari, N., Mortara, M., & Forte, M. (2014). Unveiling California History Through Serious Games : Fort Ross Virtual Warehouse. In *Games and Learning Alliance, GALA 2013. Lecture Notes in Computer Science, Vol 8605, Springer, Cham.*

Lin, Y.-S. (2011). Fostering Creativity through Education — A Conceptual Framework of Creative Pedagogy. *Creative Education*, *2*(3), 149–155. https://doi.org/10.4236/ce.2011.23021

Livingston, J., & Gentile, R. (1996). Mastery Learning and the Decreasing Variability Hypothesis. *Journal of Educational Research*, *90*(2), 67–74.

Lynch, R., McNamara, P. M., & Seery, N. (2012). Promoting deep learning in a teacher education programme through self- and peer-assessment and feedback. *European Journal of Teacher Education*, *35*(2), 179–197.

Malone, T. W. (1980). *What Makes Things Fun to Learn? A Study of Intrinsically Motivating Computer Games*.

Mayer, R. E. (2010). Applying the science of learning to medical education. *Medical Education*, *44*, 543–549. https://doi.org/10.1111/j.1365-2923.2010.03624.x

Mayer, R. E. (2014a). Cognitive theory of multimedia learning. *The Cambridge Handbook of Multimedia Learning, Second Edition*, 43–71. https://doi.org/10.1017/CBO9781139547369.005

Mayer, R. E. (2014b). Method : Conducting Scientific Research on Games for Learning. In *Computer Games for Learning*. *An Evidence-Based Approach*. MIT Press books.

Mayer, R. E. (2014c). Theory : Applying Cognitive Science to Games for. In *Computer Games for Learning*. *An Evidence-Based Approach*.

McGonigal, J. (2011). Reality is broken: why games make us better and how they can change the world. In *The Penguin Press*. Penguin Press. http://jehaynes.files.wordpress.com/2013/02/reality_is_broken.pdf

Meij, H. Van Der, Veldkamp, S., & Leemkuil, H. (2020). Effects of scripting on dialogues, motivation and learning outcomes in serious games. *British Journal of Educational Technology*, *51*(2), 459–472. https://doi.org/10.1111/bjet.12851

Moreno, R., & Mayer, R. E. (2005). Role of Guidance , Reflection , and Interactivity in an Agent-Based Multimedia Game. *Journal of Educational Psychology*, *97*(1), 117–128. https://doi.org/10.1037/0022-0663.97.1.117

Moura, A. (2015). EAI Endorsed Transactions Using arcade games to engage students in the learning of foreign and mother languages. *EAI Endorsed Transactions on E-Learning*, *2*(5), 1–14.

Mullet, D. R., Willerson, A., Lamb, K. N., & Kettler, T. (2016). Examining teacher perceptions of creativity : A systematic review of the literature. *Thinking Skills and Creativity*, *21*, 9–30. https://doi.org/10.1016/j.tsc.2016.05.001

Navarrete, C. C. (2013). Creative thinking in digital game design and development: A case study. *Computers and Education*, *69*, 320–331. https://doi.org/10.1016/j.compedu.2013.07.025

Nickerson, A. B., Mele, D., & Princiotta, D. (2008). Attachment and empathy as

predictors of roles as defenders or outsiders in bullying interactions ☆ , ☆☆. *Journal of School Psychology*, *46*(6), 687–703. https://doi.org/10.1016/j.jsp.2008.06.002

Niemeyer, R., Johnson, A., & Monroe, A. E. (2014). Role Play for Classroom Management : Providing a Lodestar for Alternate-Route Teachers. *The Educational Forum*, *78*, 338–346. https://doi.org/10.1080/00131725.2014.912373

Oblinger, D. G. (2004). The Next Generation of Educational Engagement Abstract : Keywords : *Journal of Interactive Media in Education*, *8*, 1–18.

Paiva, A., Dias, J., Sobral, D., Aylett, R., Woods, S., & Zoll, C. (2005). Learning By Feeling: Evoking Empathy with Synthetic Characters. *Applied Artificial Intelligence*, *19*, 235–266. https://doi.org/10.1080/08839510590910165

Papastergiou, M. (2009). Digital Game-Based Learning in high school Computer Science education: Impact on educational effectiveness and student motivation. *Computers and Education*, *52*(1), 1–12. https://doi.org/10.1016/j.compedu.2008.06.004

Pellegrino, J. W., & Hilton, M. L. (2012). *Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st Century*. (National R). The National Academies Press. https://doi.org/10.17226/13398

Pettenger, M., West, D., & Young, N. (2014). Assessing the Impact of Role Play Simulations on Learning in Canadian and US Classrooms. *International Studies Perspectives*, *15*, 491–508. https://doi.org/10.1111/insp.12063

Pintrich, P. R. (2003). *A Motivational Science Perspective on the Role of Student Motivation in Learning and Teaching Contexts*. *95*(4), 667–686. https://doi.org/10.1037/0022-0663.95.4.667

Plass, J. L., Homer, B. D., & Kinzer, C. K. (2015). Foundations of game-based learning. *Educational Psychologist*, *50*(4), 258–283. https://doi.org/http://dx.doi.org/10.1080/00461520.2015.1122533

Popescu, M., Arnab, S., Berta, R., Earp, J., De, S., Popescu, M., Arnab, S., Berta, R., Earp, J., & Freitas, S. De. (2014). *Serious Games in Formal Education : Discussing Some Critical Aspects To cite this version :*

Prensky, M. (2003). Digital Game-Based Learning. *Computers in Entertainment*, *1*(1), 1–4.

Prince, M. (2004). Does Active Learning Work ? A Review of the Research. *Journal of Engineering Education*, *July*.

Rankin, J., & Brown, V. (2016). Creative teaching method as a learning strategy for student midwives : A qualitative study. *Nurse Education Today*, *38*, 93–100. https://doi.org/10.1016/j.nedt.2015.12.009

Riemer, V., & Schrader, C. (2015). Learning with quizzes, simulations, and adventures: Students' attitudes, perceptions and intentions to learn with different types of serious games. *Computers & Education*, *88*, 160–168. https://doi.org/10.1016/j.compedu.2015.05.003

Robertson, J., & Howells, C. (2008). Computer game design: Opportunities for successful learning. *Computers and Education*, *50*(2), 559–578. https://doi.org/10.1016/j.compedu.2007.09.020

SEED. (2006). Promoting Creativity in Education: Overview of Key National Policy Developments across the UK. *Scottish Executive Education Department*, *September*, 1–21.

Serrano-Laguna, Á., Manero, B., Freire, M., & Fernández-Manjón, B. (2018). A methodology for assessing the effectiveness of serious games and for inferring player learning outcomes. *Multimedia Tools and Applications*, *77*(2), 2849–2871. https://doi.org/10.1007/s11042-017-4467-6

Shapiro, J., Morrison, E. H., & Boker, J. R. (2004). *Teaching Empathy to First Year Medical Students : Evaluation of an Elective Literature and Medicine Course*. *17*(1), 73–84. https://doi.org/10.1080/13576280310001656196

Sharek, D., & Wiebe, E. (2014). Measuring Video Game Engagement Through the Cognitive and Affective Dimensions. *Simulation & Gaming*, *45*(4–5), 569–592. https://doi.org/10.1177/1046878114554176

Smith, D. (2017). *None in Three : The Design and Development of a Violence Prevention Game for the Caribbean Region*.

Stephan, W. G., & Finlay, K. (1999). *The Role of Empathy in Improving Intergroup Relations*. *55*(4), 729–743.

Sternberg, R. J. (2006). The Nature of Creativity. *Creativity Research Journal*, *18*, 87–98. https://doi.org/10.1207/s15326934crj1801

Stocks, E. L., Lishner, D. A., & Decker, S. K. (2009). Altruism or psychological escape : Why does empathy promote prosocial behavior ? y. *European Journal of Social Psychology*, *39*, 649–665. https://doi.org/10.1002/ejsp

Stokes, B., Seggerman, S., & Rejeski, D. (2011). For a Better World: Digital Games and the Social Change Sector. *Games for Change*, *1*. http://medcontent.metapress.com/index/A65RM03P4874243N.pdf%5Cnhttp://www.gamesforchange.org/whitepaper.pdf

Tan, P. H., Ling, S. W., & Ting, C. Y. (2007). Adaptive digital game-based learning framework. *ACM International Conference Proceeding Series*, *274*(1), 142–146. https://doi.org/10.1145/1306813.1306844

Tangen, J. L., & Borders, L. D. A. (2017). Applying Information Processing Theory to Supervision: An Initial Exploration. *Counselor Education and Supervision*, *56*(2), 98–111. https://doi.org/10.1002/ceas.12065

Ternauciuc, A., & Vasiu, R. (2015). Integrated Usability Testing. *TEM Journal*, *4*(4), 388–395. https://doi.org/10.1016/B978-0-12-800985-7.00007-7

Thompson, R. F., & Kim, J. J. (1996). Memory systems in the brain and localization of a memory. *Colloquium Paper*, *93*(November), 13438–13444.

Torshizi, M. D., & Bahraman, M. (2019). I explain , therefore I learn : Improving students ' assessment literacy and deep learning by teaching. *Studies in Educational Evaluation*, *61*(March), 66–73. https://doi.org/10.1016/j.stueduc.2019.03.002

Trigwell, K., & Prosser, M. (2014). Qualitative variation in constructive alignment in curriculum design. *Higher Education*, *67*(2), 141–154. https://doi.org/10.1007/s10734-013-9701-1

Trigwell, K., Prosser, M., & Waterhouse, F. (1999). Relations between teachers' approaches to teaching and students' approaches to learning. *Higher Education*, *37*, 57–70.

Tsekleves, E., Cosmas, J., & Aggoun, A. (2016). Benefits, barriers and guideline recommendations for the implementation of serious games in education for

stakeholders and policymakers. *British Journal of Educational Technology*, *47*(1), 164–183. https://doi.org/10.1111/bjet.12223

Van Eck, R. (2006). Digital Game-Based Learning : It ' s Not Just the Digital Natives Who Are Restless …. *Educause Review*, *41*(2), 1–16. https://doi.org/10.1145/950566.950596

Vos, N., Van Der Meijden, H., & Denessen, E. (2011). Effects of constructing versus playing an educational game on student motivation and deep learning strategy use. *Computers and Education*, *56*(1), 127–137. https://doi.org/10.1016/j.compedu.2010.08.013

Walia, C. (2019). A Dynamic Definition of Creativity. *Creativity Research Journal*, *31*(3), 1–11. https://doi.org/10.1080/10400419.2019.1641787

Warburton, K. (2003). Deep learning and education for sustainability. *International Journal of Sustainability in Higher Education*, *4*(1), 44–56. https://doi.org/10.1108/14676370310455332

Westera, W. (2016). Performance assessment in serious games: Compensating for the effects of randomness. *Education and Information Technologies*, *21*(3), 681–697. https://doi.org/10.1007/s10639-014-9347-3

Whiting, B., Van Burgh, J. W., & Render, G. F. (1994). Mastery Learning: Thousands of Students, Thousands of Excellent Learners. *Educational Resources Information Center (ERIC)*. http://www.eric.ed.gov/ERICWebPortal/contentdelivery/servlet/ERICServlet?accno=ED425159

Whitton, N. (2014). Overview. In *Digital Games and Learning*.

Yu, C.-L., & Chou, T.-L. (2018). A dual route model of empathy: A neurobiological prospective. *Frontiers in Psychology*, *9*(NOV), 1–5. https://doi.org/10.3389/fpsyg.2018.02212

Zhonggen, Y. (2019). A Meta-Analysis of Use of Serious Games in Education over a Decade. *International Journal of Computer Games Technology*, *2019*(3). https://doi.org/10.1155/2019/4797032

Zyda, M. (2005). From visual simulation to virtual reality to games. *Computer*, *38*(9), 25–32. https://doi.org/10.1109/MC.2005.297

Appendices

Appendix A.	**Information Sheet /Consent form**
Appendix B.	**Invitation to participants**
Appendix C.	**Pre/Post/Retention Quiz**
Appendix D.	**Game Quizzes**
Appendix E.	**Domestic Violence and Abuse Resources**
Appendix F.	**Demographics Questionnaire**
Appendix G.	**Row Data**

Appendix A – Participation Sheet / Consent form

PARTICIPATION INFORMATION SHEET – STRONGER GAME

Enhancing Deeper Learning using Empathy and Creativity in Role-Play Serious Games

Researcher(s): Maria Marda

Supervisors: Dr Daphne Economou, Dr Vassiliki Bouki

This research is undertaken as part of the researcher's studies for the doctoral program in Computer Science at the University of Westminster.

You are invited to take part in the research study which involves the use of a role-playing game related to a scenario on domestic violence and abuse. Your participation is important because your input will help the collecting of data that are useful for the statistical analysis that would lead to results related to the achievement of deeper learning with serious games.

The study will involve you in:

1) Playing a role-play serious game developed around the issue of domestic violence. The game progresses in 6 scenes. At the end of each scene, you will be asked to answer a quiz. Passing the quiz, you will get a key to unlock the next scene. If you don't pass the scene, you have to repeat the scene and try the quiz again until you pass the quiz. The duration of the game is about 30 minutes. During playing the game:
    a. You are requested to get the role of the trusted friend and follow the story, answer quizzes and make choices that to help the game character recognise warning signs of abuse. While you are playing you try to get the best score.
    b. you will be requested to give your emotions related to the level of empathy you feel towards the game character who is a victim of domestic abuse.
    c. you will be requested to complete creative activities, such as creating an infographic and a poster.
2) Completing a questionnaire that evaluates the prior knowledge on the issue of domestic violence and abuse.
3) Completing a demographics questionnaire at the end of the game.
4) Completing an empathy questionnaire.
5) Participating in a repeating study by answering a simple questionnaire 4 weeks later. This questionnaire is related to evaluate the level the user maintained the knowledge 4 weeks later. The results will be used for comparing and measuring deeper learning.

PARTICIPATION INFORMATION SHEET – DIGITAL COURSE

Enhancing Deeper Learning using Empathy and Creativity in Role-Play Serious Games

Researcher(s): Maria Marda

Supervisors: Dr Daphne Economou, Dr Vassiliki Bouki

This research is undertaken as part of the researcher's studies for the doctoral program in Computer Science at the University of Westminster.

You are invited to take part in the comparative research study which involves the use of a text-based slide presentation related to a scenario on domestic violence and abuse. Your participation is important because your input will help the collecting of data that are useful for the statistical analysis that would lead to comparisons and results related to the achievement of deeper learning with serious games.

The study will involve you in:

6) Completing a text-based slide presentation learning about the forms and the warning signs of domestic violence and abuse.
7) Completing a questionnaire that evaluates the prior knowledge on the issue of domestic violence and abuse.
8) Completing a demographics questionnaire at the end of the game.
9) Participating in a repeating study by answering a simple questionnaire 4 weeks later. This questionnaire is related to evaluate the level to which users maintained their knowledge gained from the slide presentation 4 weeks later. The results will be used for comparing and measuring deeper learning.

Please note:

- Your participation in this research is entirely voluntary.
- You have the right to withdraw at any time without giving a reason.
- Wherever practicable, withdrawal from the research will not affect any treatment and/or services that you receive.
- You have the right to ask for your data to be withdrawn as long as this is practical, and for personal information to be destroyed.
- You do not have to answer particular questions either on questionnaires or in interviews if you do not wish to do so.
- Your responses will normally be made anonymous and will be kept confidential unless you provide explicit consent to do otherwise, for example, the use of your image from photographs and/or video recordings.
- No individuals should be identifiable from any collated data, the written report of the research, or any publications arising from it.
- All computer data files will be encrypted and password protected. The researcher will keep files in a secure place and will comply with the requirements of the Data Protection Act.
- All hard copy documents, e.g. consent forms, completed questionnaires, etc. will be kept securely and in a locked cupboard, wherever possible on University premises. Documents may be scanned and stored electronically. This may be done to enable the secure transmission of data to the university's secure computer systems.
- If you wish you, can receive information on the results of the research. Please indicate on the consent form if you would like to receive this information.
- The researcher can be contacted after participation by email (m.marda@my.westminster.ac.uk).
- If you have a complaint about this research study you can contact the project supervisor, Dr Daphne Economou by e-mail (D.Economou@westminster.ac.uk) or by telephone (0207 911 5000 ext 64506).

CONSENT FORM

Title of Study: Towards Deeper Learning by enhancing learners' role in Role-Play Serious Games using Empathy and Creativity

Lead researcher: Maria Marda

I have been given the Participation Information Sheet and/or had its contents explained to me.	Yes ❒	No ❒
I have had an opportunity to ask any questions and I am satisfied with the answers given.	Yes ❒	No ❒
I understand I have a right to withdraw from the research at any time and I do not have to provide a reason.	Yes ❒	No ❒
I understand that if I withdraw from the research any data included in the results will be removed if that is practicable (I understand that once anonymised data has been collated into other datasets it may not be possible to remove that data).	Yes ❒	No ❒
I would like to receive information relating to the results of this study.	Yes ❒	No ❒
I wish to receive a copy of this Consent Form.	Yes ❒	No ❒
I confirm I am willing to be a participant in the above research study.	Yes ❒	No ❒
I confirm I am willing to participate to the repeat study in 4 weeks from now, answering only a questionnaire.	Yes ❒	No ❒

Participant's Name: _____

Signature: _____ **Date:** _____

This consent form will be stored separately from any data you provide so that your responses remain anonymous.

_____

I confirm I have provided a copy of the Participant Information Sheet approved by the Research Ethics Committee to the participant and fully explained its contents. I have given the participant an opportunity to ask questions, which have been answered.

Researcher's Name: _____

Signature: _____ **Date:** _____

Appendix B – Invitation to participants

I would appreciate your participation in my research study. Your participation is important to collect data about how students perceive learning using educational role-playing games compared to conventional methods of learning.

You will be asked to play **an educational role-playing game related to the issue of domestic violence and abuse** and then complete a questionnaire. The duration of the game is around 30-40 minutes and then you will complete a questionnaire which takes around 15 minutes.

This is scheduled for …. to Room….

If you wish to participate, please follow the link and click the checkbox next to your name.

Thank you,

Maria Marda

I would appreciate your participation in my research study. Your participation is important to collect data about how students perceive learning using educational role-playing games compared to conventional methods of learning.

You will be asked to complete a **small lesson related to the issue of domestic violence** and abuse and then complete a questionnaire. The duration of the game is around 20 minutes and then you will complete a questionnaire which takes around 10 minutes.

This is scheduled for …. to Room….

If you wish to participate, please follow the link and click the checkbox next to your name.

Thank you,

Maria Marda

Do you enjoy playing digital games?

Stronger!

UNIVERSITY OF WESTMINSTER

A role-play game on Domestic Violence and Abuse

PLAY

What do I need to know to spot signs of abuse to a friend or a family member?

What should I do to help a friend that is being abused?

What help is out there to help victims of domestic abuse?

Play and learn!

This is a research study to assess the effectiveness of empathy serious games in better learning.

Your participation is important!

Play, enjoy and learn!

Appendix C – Pre/Post/Retention Quizzes

Pre/Post/Retention Quizzes (Tests)

Questions

1 Which is the most harmful form of abuse?

- Emotional abuse
- Physical abuse
- Both emotional and physical forms of abuse are equally harmful.
- I don't know.

2 Forcing a partner to have sex without their consent, even if they had sex before, is:

- Rape
- Normal situation
- Proof of deep love
- I don't know

3 When domestic violence and abuse were first recognised as a serious issue for the society?

- 2010
- 1980
- 1920
- I don't know

4 Coercive control is now a criminal offence under the Serious Crime Act 2015, punishable by a prison sentence of up to:

- 6 months
- 2 years
- 5 years
- I don't know

5 What is coercive control?

- The repeated behaviour of a person that makes their partner feel scared by using threats, humiliation or intimidation.
- A rule that restricts an abusive person from controlling their partner.
- The physical violence used by a person to control their partner.
- I don't know

6 What is the real reason for a person being abusive to their partner?

- A person wants to have power and control over the life of their partner.
- There is economic hardship in the family
- There is a family dysfunction and inadequate communication
- I don't know

7 Select all that apply.

Domestic Violence Agencies can provide:

- A 24/7 free helpline for anyone who wants to speak in confidence about DVA.
- Safe accommodation for victims that are fleeing DVA.
- Support by coming to the victim's home and speaking to the abuser.
- I don't know

8 Select all that apply.

What would you advise a victim of DVA to do if they are not ready to report abuse to the police?

- Take photos of their bruises and keep a journal of abusive incidents.
- Visit the medical centre and report what has happened and ask the doctor to document the visit.
- Speak to a 24/7 DVA helpline seeking for advice and psychological support or speak to a trusted friend.
- I don't know

9 What can the police do when an abusive incident is reported?

- Remove the abuser and guard the house for 48 hours.
- Put charges on the abuser.
- Issue a Domestic Violence Protection Notice.
- I don't know

10 What is Claire's Law?

- the right of a person to put charges on the abusive partner anonymously
- the right of a person to force the abusive partner out of the house
- the right of a person to ask the police about the abusive past of their partner
- I don't know

11 A Domestic Violence Protection Notice (DVPN)

- forces the abusive partner to leave the house for 48 hours
- forces the abusive partner to leave the house for 28 days
- forces the abusive partner to leave the house for good
- I don't know

12 A Domestic Violence Protection Order (DVPO)

- forces the abusive partner to leave the house for 48 hours
- forces the abusive partner to leave the house for 28 days
- forces the abusive partner to leave the house for good
- I don't know

13 If you have suspicions that your friend is being abused by their partner you should discuss it with:

- your friend's abusive partner
- your abused friend
- your friend's family
- I don't know

14 Select all that apply

Which of the following are myths about why a person is abusive?

- They had experienced abuse in their childhood.
- They want to dominate and control the life of their partner.
- They can't control themselves because of consuming alcohol.
- They had a bad day at work.
- I don't know

15 Select all that apply

Why victims often stay with their abuser?

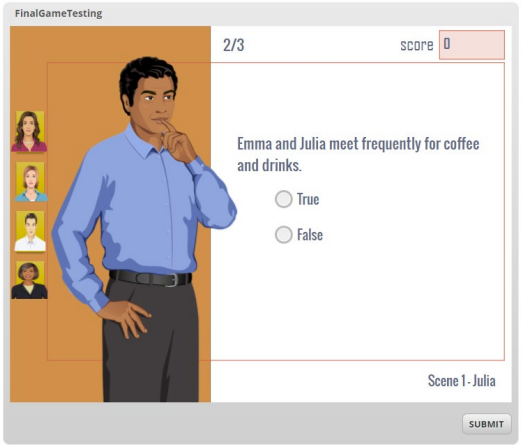
- They have no financial resources to leave.
- They fear that the abuser will become more violent if they attempt to leave.
- Victims believe the abuser will change
- They want to take revenge on their abuser.
- I don't know

16 When a victim recognises they are in an abusive relationship, they usually

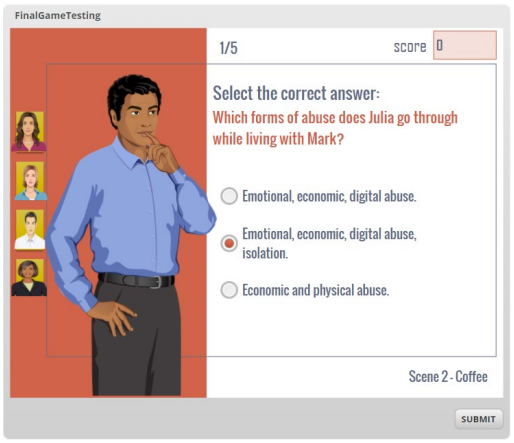
- Threaten to throw the abuser out of the house.
- Continue living with the abuser.
- Try to develop tactics against the abuser.
- Escape the abuser immediately.
- I don't know

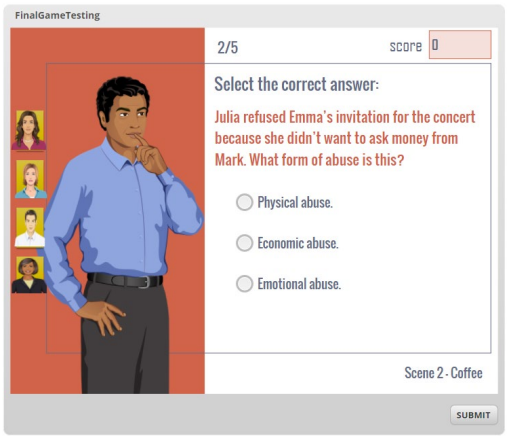
Appendix D – Game Quizzes

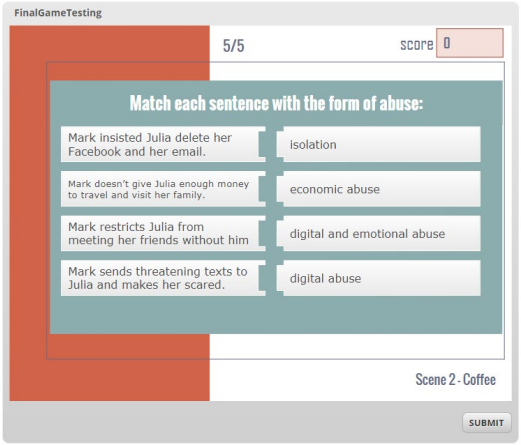
Instructional Phase – Scene 1 – Quiz 1



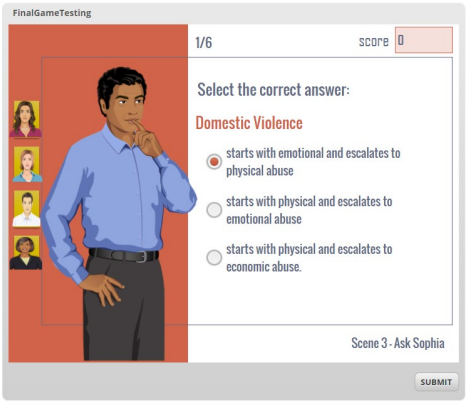
Instructional Phase – Scene 2 – Quiz 2

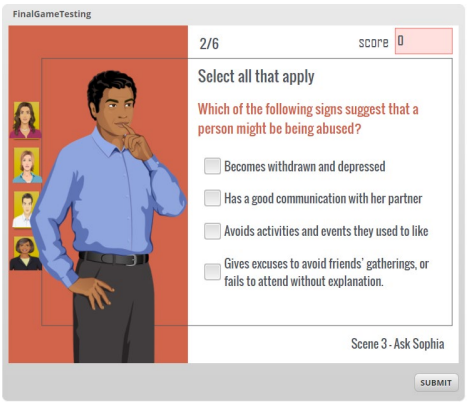


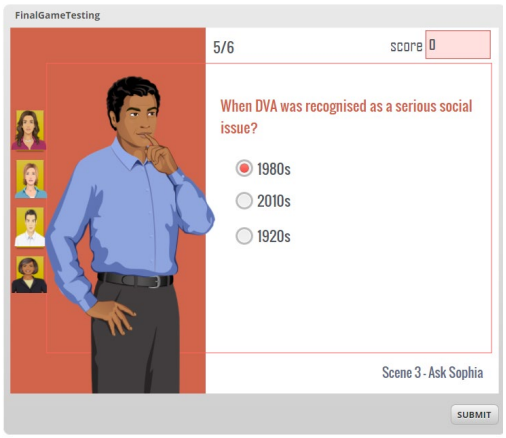


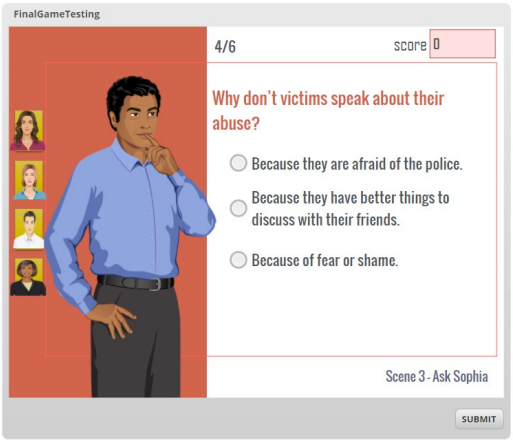


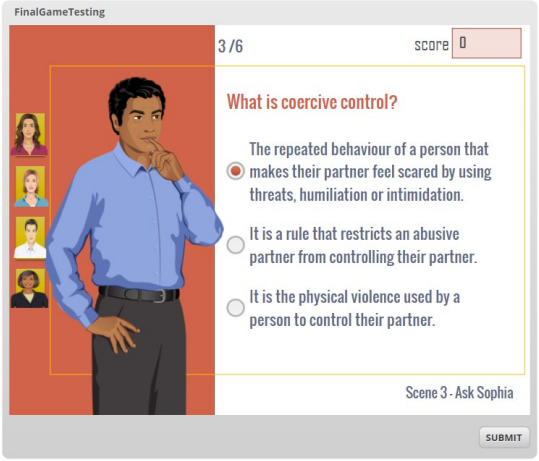
Instructional Phase – Scene 3 – Quiz 3

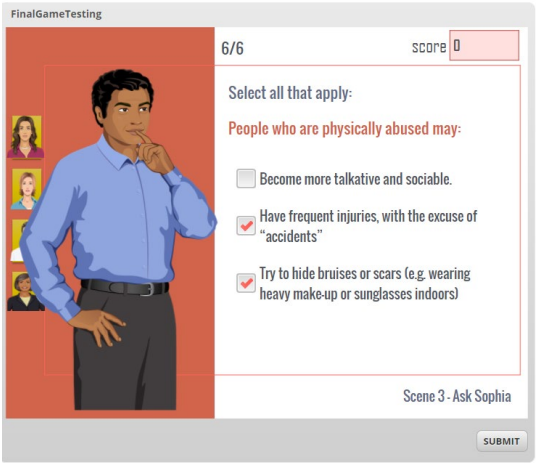




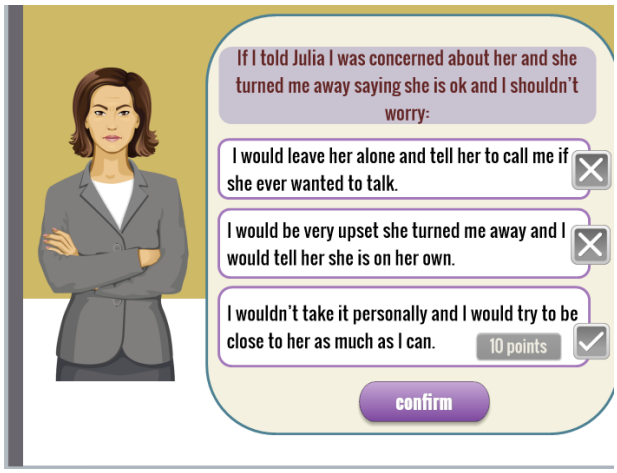


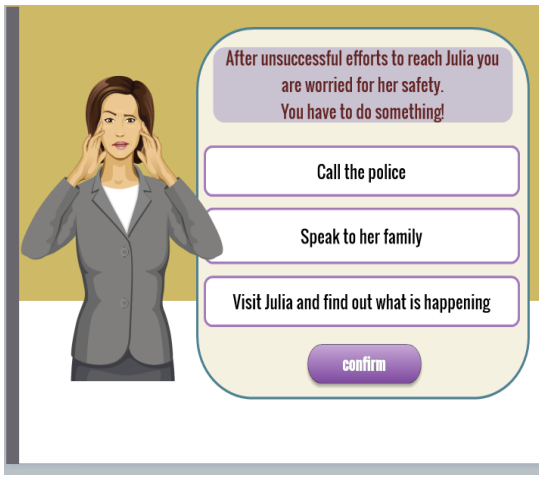


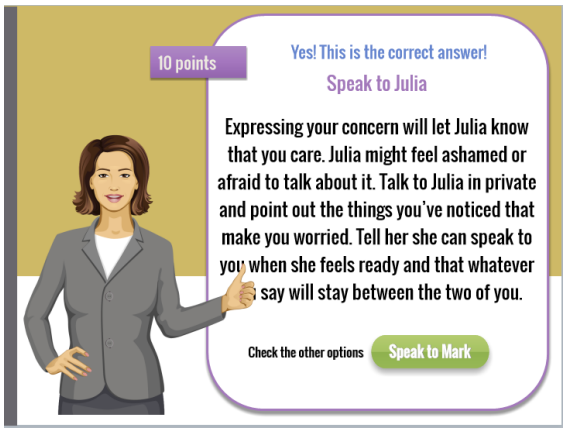




Instructional Phase – Scene 4 – Quiz 4



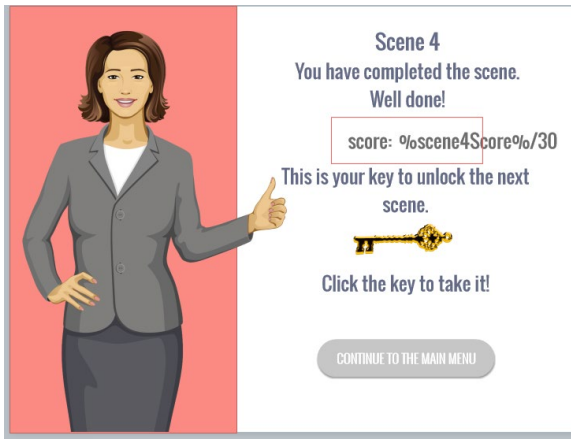


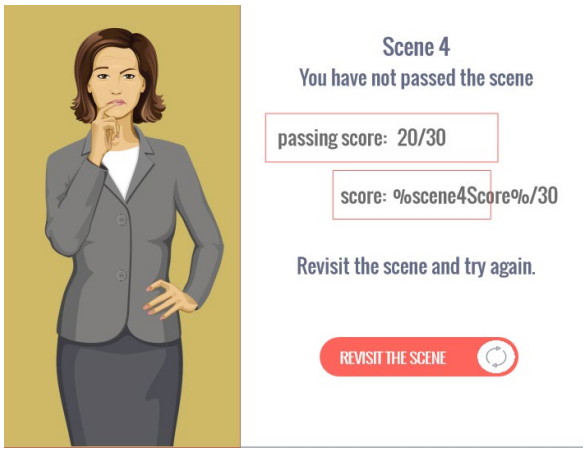



0 points
Oups! This is not the correct answer.
Call the police
You have suspicions but you are not completely sure. Sending the police may end up in Julia refusing everything because of fear and then Julia stays away from you.
Consider the other options
speak to her family

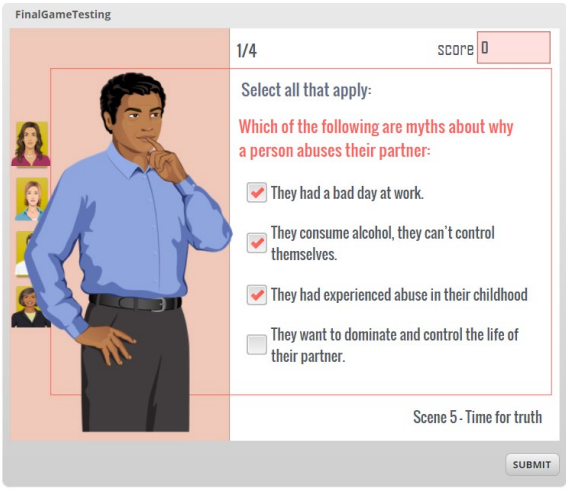

0 points
Oups! This is not the correct answer.
Speak to her family
Speaking to her family might create a panic environment and make Mark even more aggressive towards Julia or Julia may stay away from you.
Be careful!
Consider the other options
Visit Julia

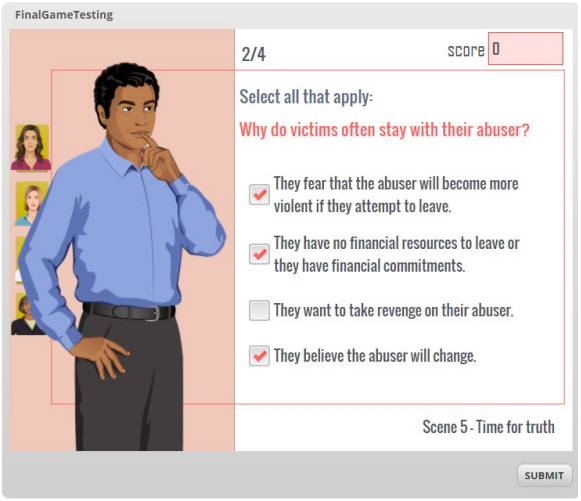

10 points
Yes! This is the correct answer!
Visit Julia
This is a good option if you visit Julia without the presence of Mark. Be supportive, tell her you're concerned about her and offer your help. You might be the only person Julia has to help her.
Check the other options
call the police

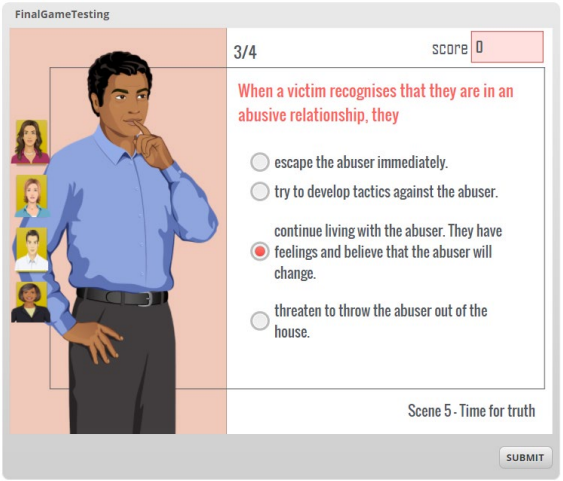

Scene 4
You have completed the scene.
Well done!
score: %scene4Score%/30
This is your key to unlock the next scene.
Click the key to take it!
CONTINUE TO THE MAIN MENU

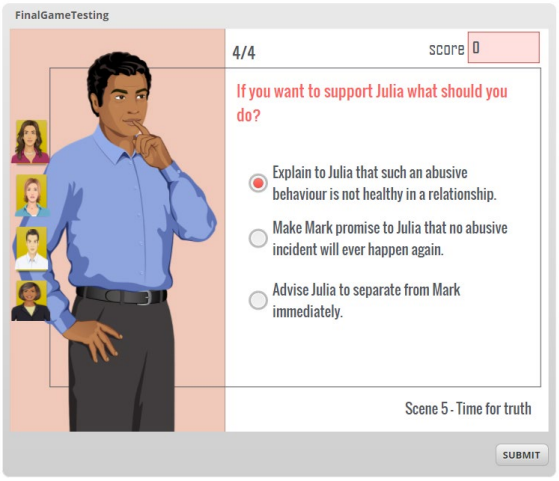

Scene 4
You have not passed the scene
passing score: 20/30
score: %scene4Score%/30
Revisit the scene and try again.
REVISIT THE SCENE

Instructional Phase – Scene 5 – Quiz 5

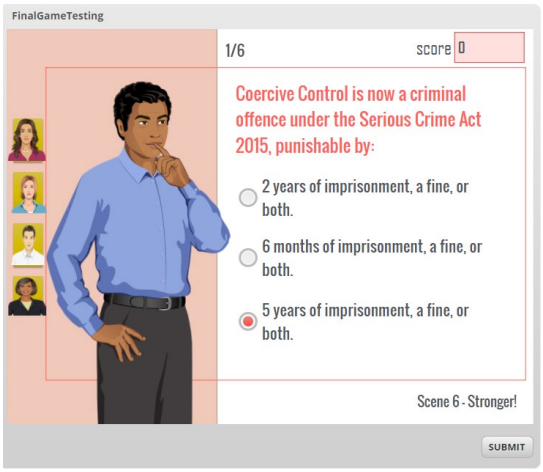


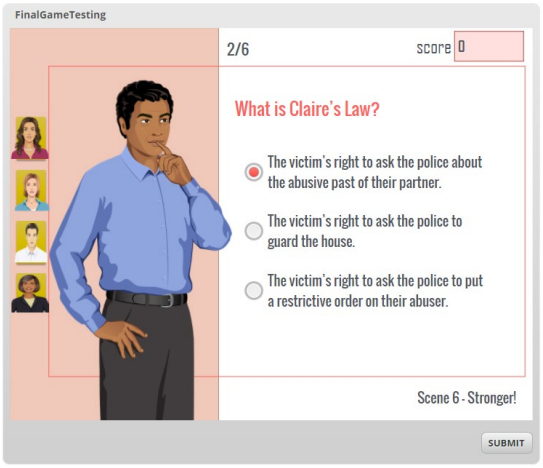


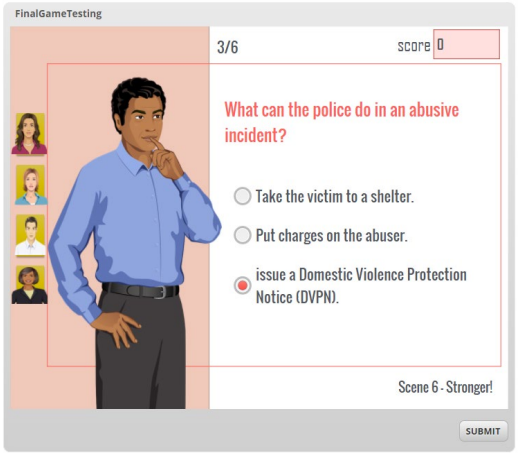


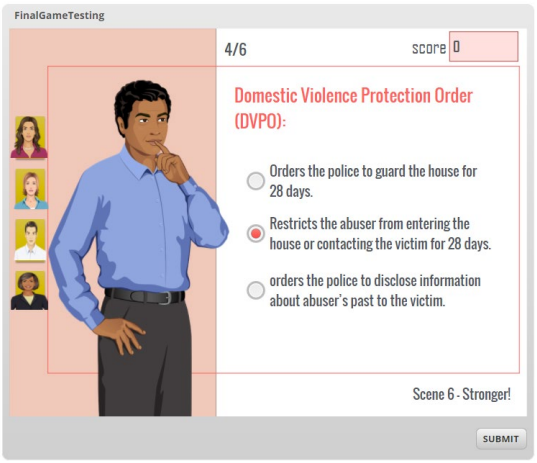


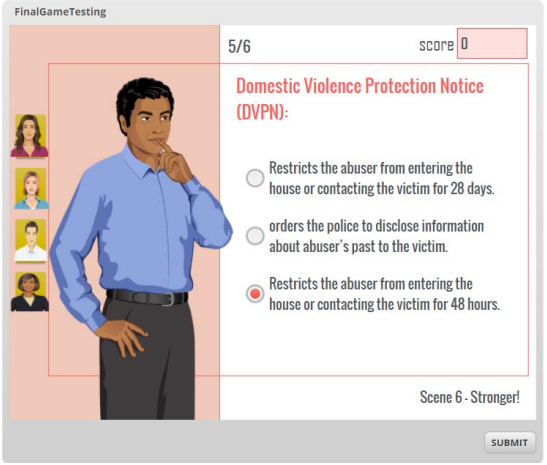
Instructional Phase – Scene 6 – Quiz 6

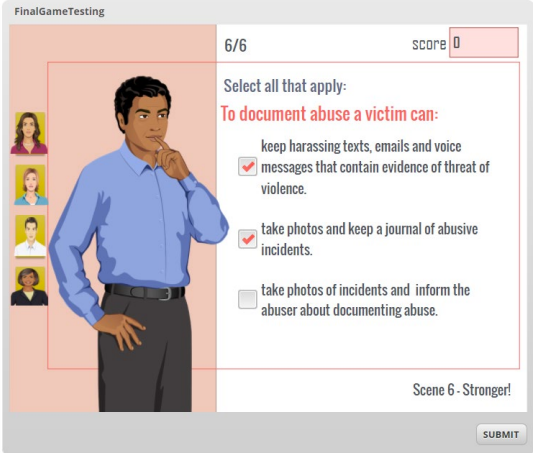












Appendix E – Domestic Violence and Abuse Resources

Research on Domestic Violence and Abuse (DVA)

Before designing the game on domestic abuse, it was necessary to research and gain a good inside about the topic of DVA. The research focused on the following:

(a) Digital Courses on DVA:

i. HighSpeedTraining – Domestic Violence and Abuse Course for social workers https://www.highspeedtraining.co.uk/
ii. Educational Umbrella – Coping with Domestic Abuse
iii. https://www.educationumbrella.com/
iv. Reed.co.uk Courses – Domestic Violence and Abuse: digital course. https://www.reed.co.uk/courses/

(b) Online resources:

i. Woman's Aid, DVA Organisation, https://www.womensaid.org.uk/
ii. Refuge against Domestic Violence, https://www.refuge.org.uk/
iii. Loveisrespect.org, https://www.loveisrespect.org/
iv. HelpGuide, Your trusted guide to mental health and wellness. https://www.helpguide.org/articles/abuse/domestic-violence-and-abuse.htm

(c) Office for National Statistics

i. Abusive incidents reported to the police in the year 2018 in England and Wales.
https://www.ons.gov.uk/

(d) Documentary on Domestic Abuse

i. BBC documentary on Domestic Violence and Abuse (BAFTA AWARD nominated documentary), https://www.youtube.com/watch?v=YZS1JSwBNKM

(e) Workshops and events

i. University of Westminster: Green Dot - The role of a bystander in domestic abuse, https://www.westminster.ac.uk/current-students/support-and-services/sexual-violence-and-harassment/green-dot-active-bystander-initiative (2019)

ii. A book presentation called “Beautifully Flowed”, a true story of a single mother of three about the domestic abuse she experienced by her husband. Written and narrated by the writer Arinola Araba. (Barking and Dagenham Library). (2018)

iii. Interview with a survivor of domestic abuse, who now is a staff member in a DVA organisation. (2018)

iv. An evening with Emma Thompson and Stephen Fry presenting Helen Bamber Foundation – Working with survivors of human cruelty. (2017)

v. Theatre play on domestic violence and abuse. Camden Town – London. (2017)

The issue of domestic violence and abuse (DVA)

The research thesis chooses the issue of domestic violence and abuse to be the case study for learning and designs and develops a digital role-play serious game around this issue. The choice of the social issue as the subject of learning was made after serious consideration. First, integration empathy has a significant role in the research and study of this project as an element that is believed to influence the level of learning outcome. Second, creativity is also an element that completes the DELEC framework as suggested in this research thesis and therefore the role-playing game facilitates related creative activities in achieving deeper learning. Third, in terms of originality, the issue of domestic violence is found in a few role-play games compared to games that tackle the issue of bullying or cyberbullying.

The issue of domestic violence and abuse has become a critical social problem for modern societies, worldwide, not because the problem didn’t exist in the past, neither because it has gradually deteriorated. The importance lies to the fact that in the current days, incidents of domestic abuse are revealed and reported much more than in the past. Victims of domestic abuse, out of fear and shame, were hiding their abuse and they suffered in silence. Even the law was given no authority to anyone to investigate incidences of domestic abuse. “Whatever happens behind the closed doors stays within the closed doors”. In the current era, whatever happens behind the closed doors is becoming a social matter and considers all individuals within communities. The law has changed giving power to the authorities to intervene in protecting victims and severely punishing acts of violence if charges are put on. The authorities and the community provides support to the victims who are encouraged to speak and fight violence. Non-profit organisations and local councils provide services, help, and support to individuals who wish to escape from this dysfunctional

situation from general encouragement to support for reporting violence and get legal advice to put charges on abusers. So far DVA (Domestic Violence and Abuse) organisations have helped hundreds of victims escape domestic abuse.

Statistics on domestic violence and abuse, according to The Office for National Statistics in the UK for 2018, has revealed an estimation of 2.0 million adults aged 16 to 59 years to have experienced domestic abuse (1.3 million women and 695.00 men). The same Office in 2016 noted 1.8 million adults aged 16 to 59 experienced domestic abuse, with an estimated 1.2 million female victims and 651,000 male victims. The police recorded 599,549 in the year ending 2018 showing an increase of 23% in reporting to the police showing an increased willingness by the victims to come forward.

Education plays a crucial role in undertaking the responsibility of raising awareness among adolescents about this serious social issue of domestic violence and abuse. Preparing adolescents and adults in identifying and reporting such incidents supports the victims and discourage abusers, resulting in potentially decrease the problem and building a happier and healthier society.

Domestic violence happens when a person uses physical violence, coercive control, threats, intimidation, isolation, sexual, or financial abuse to have their partner under control in a relationship. Domestic violence is defined by a single act or a pattern of behaviour that violates the right of a person to have a healthy, supportive and safe relationship. Domestic violence occurs between intimate partners of heterosexual or same-sex relationships, married couples, family members, and partnerships. An abuser is called the person who is imposing the abuse and victim or survivor is the person who is targeted for abuse.

Violence and abuse are likely to happen again if it has already occurred more than once or twice and they are escalating over time, snowballing in both frequency and severity. It is common for abuse to develop into a pattern or cycle of abuse.

Types of abuse

There are many types of domestic abuse. For this project, the types or forms of abuse are limited to five for the sake of learning content.

The five types of abuse are:

1. Emotional/ Coercive Control
2. Physical

3. Economic
4. Digital
5. Sexual

1. Emotional Abuse / Coercive Control

Emotional abuse includes the acts and manipulations used by an abuser to destroy or reduce the confidence and the self-esteem of the victim. Acts may consist of putting down, insulting, name-calling, threatening, humiliating and making their partner feel small and guilty.

Coercive control is the use of threats, from a person designed to make their partner scared. This controlling behaviour is used to isolate them from their friends and family support and regulating their everyday behaviour.

Coercive control is now a criminal offence, (a crime) under the Serious Crime Act 2015, punishable by a prison sentence for up to 5 years, a fine or both for severe offences.

2. Physical abuse

It is the most recognisable form of abuse. It can result in physical injury and some cases it can be life-threatening. In many occasions, it does not leave observable marks or scars, for example, when a person has their hair pulled, or eggs were thrown at them is physical violence too. Over time physical violence escalates and gets worse. It includes: Being pushed, punched or slapped, beaten with sticks or belts, having the head banged against walls and many more.

3. Economic abuse

When a person controls all the money in the family or relationship and decides how the money should be spent without taking into account the opinion or the needs of their partner or the members of the family. Usually, a person restricts their partner from accessing money, debit/credit cards. In other occasions, a person may make their partner quit their job or even control all the money they earn while working. The abuser may freely spend money on themselves, but refuse to provide enough money for their partner or family.

4. Digital abuse

Digital abuse occurs when communication technologies and social networking are used to harass, stalk or intimidate a partner through text messages and calls. This

behaviour is part of verbal or emotional abuse expressed online or on social media. Digital abuse may also include threats of publishing photos online or posting negative/insulting comments on social media.

It is digital abuse if a person:

- Tells their partner who they can or cannot be friends with them on social media.
- Send their partner negative, insulting /threatening emails, or messages on social media.
- Steals or insists on being given their partner's passwords.
- Looks through their partner's phone frequently, checks up on texts and outgoing calls.

5. Sexual abuse

Sexual abuse is any act of forcing someone to participate in unwanted sexual activity. Abusers may use force, threats or take advantage of a person who is unable to refuse consent. Many types of sexual violence exist, including but not restricted to: rape, sexual assault, sexual harassment, rape within marriage or relationships.

The warning signs of abuse

Nobody can claim with certainty if there is abuse behind the closing doors. However, there are some alarming signs and symptoms of emotional abuse and domestic violence. There are the warning signs: (https://helpguide.org/articles/abuse/domestic-violence-and-abuse.htm)

1. People who suffer from domestic abuse may:
   - Seem anxious to please their partner.
   - Change their attitude when their partner is around, feeling afraid and do whatever their partner asks.
   - They frequently have to report to their partner their location and whom they meet with and why.
   - Receive harassing, insulting or intimidating phone calls or texts from their partner.
   - Talk about their partner's temper jealously or possessiveness.
2. People who suffer from physical abuse may:
   - Have frequent injuries, and they find excuses for "accidents".

- Gives excuses to avoid friends' gatherings, or fails to attend without explanation.
- Wear clothes that hide bruises or scars (e.g. wearing long sleeves in the summer or sunglasses indoors).

3. Isolation occurs when a person may:
   - Be restricted from meeting their family and friends
   - Be restricted to go out in public without their partner.
   - Have no access or control to money, credit cards or car.
4. People who are emotionally abused may:
   - Show low self-esteem, although they used to be confident.
   - Show significant personality changes (e.g. an outgoing person becomes withdrawn)
   - Become anxious and depressed.

How a person supports a friend that is a victim of domestic violence

If there are worries that a friend is being abused at home, then a person should discuss their worries with their abused friend, showing them their support. Usually victims of abuse out of fear or shame do not speak about their abuse. Therefore, their friends should encourage them to speak ensuring them that there is trust between them and it is safe to speak to them.

A person should never discuss their concerns of an abused friend with the partner - abuser because they could put themselves and their abused friend at risk of harm. They could also impede any criminal investigation by allowing the abuser to destroy evidence.

Victims choose to live with the abuser.

Although recognising they are abused, many victims continue living with their abusive partner because (a) they do not want to separate the family, (b) they have economic commitments like mortgages, (c) they have feelings for their abusive partner and believe their partner will change. However, the abuse can continue for years. Victims can start protecting themselves by:

1. Documenting abuse
   a. They can keep a journal of all violent incidences and the harassing text messages to include the sender, recipient, date and time.

b. After an abusive incident, victims should visit their doctor and report what had happened and ask the doctor to document their visit.
c. They should keep hidden an “emergency wallet”, travel documents and a list of the phone number as well as a second sim card in case they have to escape home.
d. Use incognito mode on their browser when browsing for resources about abuse by using CTRL+SHIFT+N when opening a new tap. The browsing history will not be saved.
e. Local councils and non-profit DVA organisations provide help and support to anyone who wants to speak about abuse providing 24/7 free line to DV experts to get support, find their options and learn about their legal rights. The organisations can also provide a shelter, a safe place for victims to stay. Few of those organisations registered in the UK are:
    i. Woman’s Aid
    ii. Refuge
    iii. Rights of Women
    iv. Men’s advice line
    v. Mankind initiative
    vi. Survivors UK Ltd.

When the victim feels ready to escape the abuser

When victims overcome their fears and regain their self-esteem and the value of their lives, they decide to escape the abuser and some cases putting charges on them.

When escaping the abuser victims should change their phone number and block their partner from calling or sending messages. Finding a solicitor and learning their rights can empower them to take legal action against their abuser displaying all the evidence they have documented during living with their abuser.

Calling the police

In case of an emergency and if the victim does not feel safe they can call the police, 999. The police can:

(1) Find out what happened;
(2) Remove or arrest the abuser;
(3) Arrange first aid or other medical assistance;

(4) Help the victim access domestic violence agencies.

The police have the authority to issue a Domestic Violence Protection Notice (DVPN) with which abusive partner is given notice and removed from the property for 48 hours. During these 48 hours, the victim can plan their next steps.

The victim has the right to request police to put in place a Domestic Violence Protection Order (DVPO) which protects the victim by restricting the abusive partner from returning to the residence or contact the victim for up to 28 days.

Claire's Law

According to Claire's Law, the victim has the right to ask the police and get information about the abusive past of their partner filed to the police by previous partners.

What has changed in the law of DVA since 2015?

Domestic violence is a national health concern with significant impacts on individuals and communities. The victims of domestic violence around the world, are in their majority of women, who suffer the most severe forms of violence (McQuigg and Ronagh, 2011). The majority of survivors, 85%, are women assaulted by male partners. The other 15% of cases, constitute men survivors assaulted by women or men and women survivors in same-sex relationships. People in same-sex relationships face additional isolation and fear due to social attitudes toward gender roles and sexual orientation.

Gaps in the law left a window to perpetrators for emotional abuse without criminal consequences. Coercive control and emotional abuse, the most frequent incidences of domestic abuse, were not considered as a crime until recently. However, since the end of 2015, this has changed. A new law in the UK and Wales announced to criminalise perpetrators who use psychological and emotional abuse. Where perpetrators actions have severe negative influences on victims' daily life, and as a consequence, the victims suffer distress or fear for their life, then perpetrators are found guilty under the Serious Crime Act 2015 and are liable to a maximum of five years in prison, a fine or both. For smaller offences, an abuser may face jail for up to six months, a fine or both.

Changing the law for domestic violence recognises the right of people to live free of domestic violence. It is also important because it allows agencies to be able to intervene to domestic violence incidences before the violence escalates, reinforcing

that bruises do not have to be in view for an abusive relationship to exist. Additionally, it is believed to make a real difference to those victims and their children who live in fear.

Appendix F – Demographics Questionnaire

1. Gender

- ○ Female
- ○ Male
- ○ Prefer not to say

2. Age

- ○ 18-24
- ○ 25-34
- ○ 35-44
- ○ 45-55
- ○ >55

3. Ethnicity

- ○ Black
- ○ White
- ○ Chinese
- ○ Asian (excluding Chinese)
- ○ Mixed
- ○ Other
- ○ I prefer not to say

5. What is the field of your studies?

Short-answer text

6. Do you play computer/tablet/mobile games for entertainment?

- ◯ Everyday
- ◯ Very often
- ◯ Rarely
- ◯ I don't really play digital games.

7. Do you use e-learning (digital educational) applications for your learning?

- ◯ No, never.
- ◯ Yes, a few times.
- ◯ Yes, most of the times.

8. Have you ever attended a course on domestic violence and abuse (DVA)?

- ◯ Yes
- ◯ No

Appendix G – Row Data

Groups	feelNow	friend	preDK	preScore	postScore	Retain	difPostPre	difRetPre	att1	att2	att3	att4	att5	att6
Group A	1	2	4	100	150	140	50.00	40.00	1	1	1	1	1	1
Group A	1	2	10	40	140	130	100.00	90.00	1	1	1	1	1	1
Group A	1	1	0	80	150	120	70.00	40.00	1	1	1	1	1	1
Group A	2	1	1	110	150	140	40.00	30.00	1	1	1	1	2	1
Group A	2	1	2	90	150	150	60.00	60.00	1	1	1	1	3	3
Group A	1	2	0	80	130	70	50.00	-10.00	1	5	1	1	4	5
Group A	2	1	0	120	120	110	0.00	-10.00	1	2	1	1	1	1
Group A	1	1	16	0	150	130	150.00	130.00	1	1	1	1	1	1
Group A	2	1	7	50	120	150	70.00	100.00	1	1	1	1	1	2
Group A	2	1	2	70	130	120	60.00	50.00	1	4	1	2	1	3
Group A	2	1	4	70	160	160	90.00	90.00	1	1	1	1	1	1
Group A	1	1	2	60	130	110	70.00	50.00	1	3	5	1	1	3
Group A	1	2	0	60	120	120	60.00	60.00	1	3	1	3	8	1
Group A	2	1	0	50	140	140	90.00	90.00	1	4	3	1	1	3
Group A	2	1	3	80	150	160	70.00	80.00	1	1	1	1	1	1
Group A	1	1	6	80	140	130	60.00	50.00	1	1	1	1	1	1
Group A	2	2	2	100	130	120	30.00	20.00	1	1	1	1	1	1
Group A	1	2	7	80	140	130	60.00	50.00	1	1	1	1	2	2
Group A	3	1	0	150	160	160	10.00	10.00	1	1	1	1	1	1
Group A	1	1	6	60	150	110	90.00	50.00	1	1	1	1	1	1
Group A	1	1	3	60	140	110	80.00	50.00	1	1	1	2	1	1
Group A	1	2	2	110	160	120	50.00	10.00	1	1	1	1	1	2
Group A	2	2	3	60	140	90	80.00	30.00	1	1	1	1	1	1
Group A	1	2	8	30	150	140	120.00	110.00	1	1	1	1	1	2
Group A	2	1	0	110	140	110	30.00	0.00	1	3	3	1	1	1
Group A	1	2	1	90	150	130	60.00	40.00	1	1	1	1	1	1
Group A	1	2	9	70	140	110	70.00	40.00	1	1	1	1	1	1
Group A	1	2	1	90	160	140	70.00	50.00	1	1	1	1	2	1
Group A	1	1	1	110	150	140	40.00	30.00	1	1	1	1	1	1
Group A	3	1	2	80	140	130	60.00	50.00	1	1	3	1	1	1
Group A	1	1	1	100	160	130	60.00	30.00	1	1	1	1	1	1
Group A	2	2	11	30	120	130	90.00	100.00	1	1	1	2	1	1

Group A	1	2	10	40	100	80	60.00	40.00	1	1	1	1	1	1
Group A	1	2	4	70	120	120	50.00	50.00	1	1	1	1	1	2
Group A	4	1	5	70	120	90	50.00	20.00	1	2	1	1	2	5
Group A	1	1	3	90	160	110	70.00	20.00	1	1	1	1	1	1
Group A	1	2	8	60	140	130	80.00	70.00	1	1	1	1	1	2
Group A	4	2	1	100	130	110	30.00	10.00	1	1	1	1	1	1
Group A	1	1	2	110	160	130	50.00	20.00	1	1	1	1	1	1
Group A	1	1	4	90	120	100	30.00	10.00	1	1	1	1	1	1
Group A	3	1	6	60	140	100	80.00	40.00	1	3	1	1	1	1
Group A	1	1	5	40	150	140	110.00	100.00	1	1	1	2	1	2
Group A	1	1	0	130	160	100	30.00	-30.00	1	1	1	1	1	1
Group A	2	1	0	50	150	150	100.00	100.00	1	1	1	1	2	1
Group A	1	1	3	90	160	130	70.00	40.00	1	1	1	1	1	1
Group A	3	1	2	110	160	130	50.00	20.00	1	1	1	1	1	2
Group A	2	1	0	120	150	140	30.00	20.00	1	1	1	1	1	1
Group A	1	1	3	90	160	120	70.00	30.00	1	1	1	1	1	1
Group B	#NULL!	#NULL!	2	60	110	100	50.00	40.00	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
Group B	#NULL!	#NULL!	1	60	120	100	60.00	40.00	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
Group B	#NULL!	#NULL!	1	80	100	110	20.00	30.00	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
Group B	#NULL!	#NULL!	1	60	80	60	20.00	0.00	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
Group B	#NULL!	#NULL!	2	60	120	130	60.00	70.00	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
Group B	#NULL!	#NULL!	1	90	150	140	60.00	50.00	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
Group B	#NULL!	#NULL!	1	80	100	110	20.00	30.00	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
Group B	#NULL!	#NULL!	1	50	120	#NULL!	70.00	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
Group B	#NULL!	#NULL!	2	60	120	120	60.00	60.00	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
Group B	#NULL!	#NULL!	1	100	150	140	50.00	40.00	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
Group B	#NULL!	#NULL!	1	90	70	100	-20.00	10.00	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
Group B	#NULL!	#NULL!	1	70	70	60	0.00	-10.00	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
Group B	#NULL!	#NULL!	1	70	110	110	40.00	40.00	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
Group B	#NULL!	#NULL!	2	40	110	100	70.00	60.00	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
Group B	#NULL!	#NULL!	1	50	140	#NULL!	90.00	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
Group B	#NULL!	#NULL!	2	90	130	#NULL!	40.00	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
Group B	#NULL!	#NULL!	1	80	120	90	40.00	10.00	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!

Group B	#NULL!	#NULL!	2	50	120	#NULL!	70.00	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
Group B	#NULL!	#NULL!	1	100	130	130	30.00	30.00	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
Group B	#NULL!	#NULL!	1	60	120	120	60.00	60.00	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
Group B	#NULL!	#NULL!	1	50	140	80	90.00	30.00	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
Group B	#NULL!	#NULL!	2	50	120	130	70.00	80.00	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
Group B	#NULL!	#NULL!	1	90	120	110	30.00	20.00	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
Group B	#NULL!	#NULL!	2	50	80	70	30.00	20.00	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
Group B	#NULL!	#NULL!	2	120	110	#NULL!	-10.00	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
Group B	#NULL!	#NULL!	1	20	70	#NULL!	50.00	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
Group B	#NULL!	#NULL!	1	90	120	#NULL!	30.00	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
Group B	#NULL!	#NULL!	0	100	110	#NULL!	10.00	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
Group B	#NULL!	#NULL!	1	90	120	#NULL!	30.00	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
Group B	#NULL!	#NULL!	1	80	160	#NULL!	80.00	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
Group B	#NULL!	#NULL!	2	110	130	#NULL!	20.00	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
Group B	#NULL!	#NULL!	1	80	140	#NULL!	60.00	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!

ini1Score	ini2Score	ini3Score	ini5Score	ini6Score	sc1Score	sc2Score	sc3Score	sc4Score	sc5Score	sc6Score	Emp1VHap	Emp1VWo	Emp1VAfr	Emp1VAng
30	50	60	40	0	30	50	60	30	40	60	0	0	1	0
30	40	60	40	0	30	40	60	30	40	60	0	0	1	0
30	50	60	40	0	30	50	60	20	40	60	0	0	0	1
30	40	50	30	0	30	40	50	30	40	50	0	1	1	0
30	50	30	30	0	30	50	60	30	40	50	0	1	1	0
20	20	30	30	0	20	40	60	30	40	50	0	0	1	0
20	30	50	40	0	20	50	50	30	40	50	0	0	1	1
30	50	60	40	0	30	50	50	30	40	60	0	1	0	0
20	50	30	40	0	20	50	60	20	40	60	0	1	1	0
20	30	20	40	0	20	40	60	30	40	60	0	0	1	0
20	40	60	40	0	20	40	60	20	40	60	0	0	1	0
20	30	40	40	0	20	40	50	20	40	50	0	1	1	0
20	30	60	10	0	20	50	50	30	40	60	0	0	1	0
20	20	40	40	0	20	50	60	20	40	50	0	1	0	0
30	50	50	40	0	30	50	60	30	40	50	0	1	1	0
30	50	50	30	0	30	50	60	20	30	50	0	1	1	0
30	40	50	30	0	30	40	50	30	30	50	0	1	1	0
20	50	40	10	0	20	50	60	20	30	60	0	1	1	0
30	50	60	40	0	30	50	60	20	40	60	0	1	0	0
30	50	50	40	0	30	50	60	20	40	50	0	1	1	0
30	50	50	40	0	30	50	60	30	40	50	0	1	1	0
20	50	30	40	0	20	50	60	30	40	60	0	1	1	0
20	40	50	30	0	20	40	60	20	30	50	0	1	1	0
30	50	40	30	0	30	50	60	20	30	60	0	0	1	0
30	20	60	30	0	30	50	60	20	30	60	0	0	1	0
30	40	50	30	0	30	40	60	20	30	50	0	1	1	0
30	40	60	40	0	30	40	60	20	40	60	0	1	0	0
30	40	60	20	0	30	40	60	30	30	60	0	1	1	0
30	50	60	40	0	30	50	60	30	40	60	0	0	1	0
20	50	50	40	0	20	50	50	20	40	50	0	1	1	0
30	50	60	40	60	30	50	60	30	40	60	0	1	1	0
30	50	60	30	50	30	50	60	20	30	50	0	0	1	0

20	40	60	30	50	20	40	60	30	30	50	0	1	1	0
20	40	60	30	40	20	40	60	30	30	50	0	1	1	0
20	30	60	20	20	20	50	60	30	40	60	0	0	1	0
30	50	60	40	50	30	50	60	30	40	50	0	0	1	0
30	50	60	40	40	30	50	60	30	40	50	0	0	1	0
30	40	60	40	50	30	40	60	30	40	50	0	0	1	0
30	40	60	30	60	30	40	60	30	30	60	0	1	1	1
30	40	50	30	60	30	40	50	30	30	60	0	0	1	0
30	30	50	30	50	30	40	50	30	30	50	0	1	0	0
30	50	60	40	40	30	50	60	30	40	60	0	1	1	0
30	40	60	40	60	30	40	60	20	40	60	0	0	1	0
30	50	60	20	50	30	50	60	20	30	50	0	0	1	0
30	40	60	30	60	30	40	60	30	30	60	0	1	1	0
30	50	60	40	40	30	50	60	30	40	60	0	0	1	0
20	40	60	40	50	20	40	60	20	40	50	0	1	1	0
30	50	60	30	50	30	50	60	20	30	50	0	0	1	0
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!

#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!

Emp1VOth	Emp1VTex	Emp1PNeu	Emp1PWo	Emp1PAfr	Emp1PAng	Emp1POth	Emp1PTex	Empathy1	Emp2VHap	Emp2VWo	Emp2VAfr	Emp2VAng	Emp2VOth	Emp2VTex
0		0	0	5	0	0		5	0	0	1	0	0	
0		0	0	0	0	1		5	0	0	1	1	0	
0		0	3	0	1	0		3	0	0	0	1	0	
1	unhappy	0	5	0	4	0		5	0	0	0	1	1	upset
0		0	5	4	5	0	sad	5	0	1	1	0	0	
0		0	5	0	0	0		5	0	1	0	0	0	
0		0	5	5	0	0		5	0	0	1	0	0	scared
0		0	4	0	0	0		3	0	1	1	0	0	
0		0	1	1	1	0		5	0	1	1	0	0	
0		0	5	0	0	0		5	0	0	1	0	0	
0		0	5	4	2	0		5	0	0	1	0	0	
0		0	4	0	5	0		5	0	0	0	1	0	
0		0	5	5	0	0		4	0	1	0	0	0	
0		0	5	5	0	0		5	0	1	1	0	0	
0		0	5	5	5	0		5	0	1	1	0	0	
0		0	5	2	1	0		4	0	1	1	0	0	
0		0	1	1	1	0		3	0	0	1	0	0	
0		0	5	4	0	0		5	0	1	1	0	0	
0		0	5	0	0	0		5	0	0	1	0	0	
0		0	4	4	5	0		5	0	1	1	1	0	
0		0	5	2	0	0		4	0	0	1	0	0	
0		0	5	3	5	0		5	0	1	1	0	0	depresse
1		0	5	4	3	0		5	0	1	1	0	0	
0		0	4	0	0	0		4	0	0	1	0	0	
0		0	5	0	0	0		5	0	1	1	0	0	
0		0	5	0	0	0		5	0	1	0	0	0	
1	Conflict	0	5	0	2	1	Concern	5	0	0	1	0	1	Ashamed
0		0	4	4	4	1		5	0	1	1	1	0	
0		0	5	5	3	0		4	0	0	1	0	0	
0		0	5	0	3	1	upset	5	0	1	1	0	0	
0		0	4	3	4	1	helpless	5	0	1	1	1	0	
0		0	5	2	0	0		3	0	0	1	0	0	

0		0	5	4	0	0		5	0	1	1	0	0	
0		0	5	3	0	0		4	1	1	1	1	0	
0		0	5	0	0	0		5	0	0	1	0	0	
0		0	5	0	4	0		5	0	1	0	1	0	
0		0	5	3	5	0		4	0	1	1	0	0	
0		0	5	5	5	0		4	0	0	1	0	0	low self
0		0	5	5	1	0		4	0	1	1	0	0	intimida
0		0	5	0	5	0		5	0	1	1	0	0	
0		0	5	0	0	0		4	0	0	1	0	0	
0		0	2	0	2	0		2	0	1	1	0	0	ashamed,
0		0	5	4	0	0		5	0	1	1	0	0	
0		0	4	4	0	0		5	0	1	0	1	0	
0		0	5	5	2	0	sad	4	0	1	1	0	0	helpless
0	Guilty	0	5	4	5	0		3	0	0	1	1	0	Hopeless
0		0	5	4	0	0		5	0	1	1	0	0	
0		0	5	5	1	0		5	0	1	1	0	0	
#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	
#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	
#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	
#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	
#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	
#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	
#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	
#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	
#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	
#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	
#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	
#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	
#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	
#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	
#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	
#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	

#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!		#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!

Emp2PNeu	Emp2PWo	Emp2PAfr	Emp2PAng	Emp2POth	Emp2PText	Empathy2	tscore	creative	gen	age	eth	educ	studies	elearning
0	0	5	5	0		5	240	150	2	3	2	3	Drama	2
0	0	5	0	0		5	230	140	1	3	2	3	Biology	2
0	0	0	5	0		5	260	70	1	4	2	3	Philosophy	2
0	2	5	0	0		5	240	140	1	1	2	1	Business In	2
0	5	0	0	0		5	260	110	1	1	2	1	Business In	2
0	5	0	0	0		5	240	90	2	2	2	1	Computer	2
0	5	0	5	0		5	240	110	1	1	4	1	Business in	1
0	5	0	0	0		5	260	120	1	3	3	3	Computer	2
0	5	5	5	0		5	250	130	1	1	1	1	Business in	2
0	5	5	5	0		5	250	90	1	2	2	1	Business in	1
0	0	0	0	1	sympathe	5	240	130	1	1	4	1	Business In	2
0	5	5	5	0		5	220	100	2	1	4	1	BIS	2
0	1	5	3	0		5	250	110	2	1	2	1	business in	2
0	5	5	0	0		5	240	70	1	1	6	1	BIS	1
0	5	5	5	0		5	260	120	1	1	1	1	Business In	2
0	5	2	1	0		5	240	140	1	1	2	1	Computer	2
0	1	1	1	0		4	230	110	1	1	4	1	Software E	2
0	5	5	5	0		5	240	130	2	2	2	1	Biotechnol	2
0	5	0	0	0		5	260	110	1	4	3	2	Languages	1
0	5	5	5	0		5	250	130	2	1	4	1	BIS	3
0	5	5	0	0		5	260	120	1	1	2	1	Computer	1
0	5	3	5	0		5	260	120	2	2	2	1	Computer	2
0	5	3	5	0		5	220	130	2	1	1	1	Computer	2
0	5	0	0	0		5	250	80	2	1	5	1	Computer	2
0	5	0	0	0		5	250	110	1	1	4	1	Software e	3
0	5	0	0	0		5	230	120	2	1	2	1	Multimedia	2
0	5	2	0	0		5	250	140	2	2	2	1	Digital Mec	2
0	5	5	5	0		5	250	120	2	5	4	2	Mathemati	3
0	5	5	0	0		5	270	140	1	2	2	3	Computer	3
0	5	0	0	0		5	230	80	1	1	4	1	psychology	1
0	1	1	1	1	powerles	5	270	110	1	4	5	2	Law	2
0	5	1	2	0		3	240	160	2	1	2	1	Computer	1

0	5	0	0	0	5	230	120	1	1	4	1	Computer	2
0	5	3	3	0	3	230	140	2	1	6	1	computer g	2
0	5	0	0	0	5	260	110	1	2	2	2	Business A	2
0	5	0	4	0	5	260	160	1	3	2	2	Psychology	3
0	5	2	4	0	4	260	140	2	3	2	3	art / art his	1
0	5	0	5	0	5	250	120	2	3	2	3	Mathemati	1
0	5	5	0	0	4	250	120	1	3	2	3	Biology	2
0	5	5	5	0	5	240	70	1	3	2	2	Chemistry	1
0	5	0	0	0	5	230	120	1	3	2	2	Biology	2
0	3	0	5	1 sad	4	270	120	1	4	2	3	Physics	3
0	5	4	0	0	5	250	160	1	3	2	2	Maths	1
0	5	5	5	0	5	240	90	1	3	2	2	economics	1
0	5	5	0	1 powerles	5	250	140	1	3	2	2	Architectur	2
0	5	5	5	0	4	270	140	1	3	2	2	Medicine	1
0	1	1	0	0	5	230	140	1	2	2	2	Music	1
0	5	5	0	0	5	240	100	1	3	2	3	Architectur	2
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	2	1	4	1	Humanities	2
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	1	4	2	3	Education	3
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	1	3	2	2	Mathemati	2
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	1	1	3	1	Psychology	1
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	1	2	1	3	Computer S	2
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	1	5	2	4	Education	2
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	1	4	4	1	Mathemati	3
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	1	2	2	3	Archaeolog	1
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	2	2	2	3	Philosophy	2
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	2	3	2	3	Computer S	2
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	1	3	2	2	Food Contr	2
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	1	3	4	1	Computer S	2
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	1	3	4	1	Beautician	2
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	1	5	2	1	Philosophy	2
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	1	3	2	1	Dentistry	2
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	1	3	1	1	Manageme	3
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	1	2	2	2	Education	2

#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	2	1	2	1	Marketing	2
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	1	2	2	2	European	2
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	1	2	2	1	Pharmacist	1
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	1	3	4	2	Computer S	2
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	1	3	5	3	Computer S	2
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	2	3	2	3	Computer S	2
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	2	3	3	1	Theology	2
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	2	3	2	1	Marketing	2
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	2	1	3	1	Computer S	2
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	1	3	2	2	Maths	2
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	2	1	3	1	Computer	2
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	2	2	2	1	Physiother	2
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	1	2	2	2	Medical Ph	2
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	1	2	2	3	Medical Ph	2
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	1	2	2	2	Medical Ph	2

games	DVAcourse	EQ1	EQ2	EQ3	EQ4	EQ5	EQ6	EQ7	EQ8	EQ9	EQ10	EPT11	EPT12	EPT13
4	N	5	5	4	1	4	4	4	1	1	2	4	4	5
4	N	4	5	4	1	4	4	5	1	1	1	3	3	4
2	N	3	5	3	1	3	4	4	2	1	4	5	4	4
1	N	5	5	5	1	5	5	5	1	1	1	5	5	5
1	N	5	5	5	1	#NULL!	3	5	5	1	2	5	5	5
2	N	5	5	5	3	1	5	5	5	1	1	5	5	5
3	N	5	5	5	2	4	4	5	1	3	1	4	4	4
3	N	3	3	5	4	5	5	5	1	1	3	4	4	4
1	N	5	5	2	1	3	3	5	1	1	1	4	4	3
2	N	5	3	3	2	4	4	5	2	1	1	5	5	1
1	N	5	5	3	1	3	3	5	1	1	1	4	5	5
3	N	5	5	5	1	5	5	4	3	1	3	5	5	5
2	N	4	3	4	3	2	2	4	3	3	2	3	2	3
2	N	5	4	4	2	3	3	4	4	3	3	3	2	3
3	Y	5	5	5	1	4	4	5	1	1	1	4	4	5
1	N	4	4	4	2	3	2	4	1	1	1	2	3	5
1	N	4	3	3	2	3	3	4	2	4	3	3	2	2
3	N	5	5	4	1	3	3	5	1	1	1	5	4	5
4	Y	5	5	4	1	4	3	4	1	1	1	5	4	4
2	N	5	5	4	1	3	3	3	4	2	2	4	4	4
1	N	4	5	4	1	3	3	4	1	1	1	4	2	5
4	N	5	5	4	1	5	5	3	1	1	1	3	2	4
2	N	4	4	5	1	5	5	5	1	1	1	5	5	4
2	N	4	5	5	2	4	4	4	1	1	2	3	4	4
1	N	5	5	4	1	3	3	4	1	1	3	3	4	5
1	N	4	5	4	1	4	4	5	1	1	1	5	4	5
2	N	5	4	1	1	4	3	4	1	1	1	4	2	5
3	N	5	5	5	1	2	2	4	1	1	1	4	3	4
2	N	5	5	1	1	4	3	5	2	1	1	4	4	5
3	N	5	5	5	1	4	4	5	3	1	1	5	5	5
3	N	4	4	4	1	2	2	4	3	1	1	4	5	5
1	N	3	3	4	2	4	4	5	1	1	2	3	2	5

2	N	5	5	5	1	5	4	5	1	1	1	5	5	3
1	N	4	4	4	1	5	4	5	1	1	1	4	2	5
2	N	3	4	4	3	4	4	4	2	1	4	5	4	4
2	N	4	4	4	2	4	4	4	2	2	1	4	4	4
4	N	5	5	5	1	4	3	4	2	1	1	5	5	5
1	N	5	5	5	1	4	4	5	5	1	2	5	5	5
1	N	4	4	4	1	3	1	3	3	1	1	3	3	5
1	N	5	5	5	1	4	4	5	2	1	3	5	5	5
4	N	5	5	5	1	5	5	5	4	1	2	4	4	5
4	N	3	4	5	1	4	2	5	1	1	1	4	3	4
3	N	4	4	4	1	4	3	3	1	1	2	4	4	4
2	N	5	3	5	3	5	4	3	3	1	1	4	5	4
1	N	4	5	5	1	4	4	4	1	1	1	3	5	5
3	N	4	5	5	1	4	4	4	1	1	1	4	3	4
3	N	5	5	5	1	4	4	5	1	1	1	5	4	5
2	N	5	5	4	1	2	2	2	3	1	1	5	5	5
2	N	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
3	N	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
2	N	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
4	N	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
1	N	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
4	N	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
4	N	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
3	N	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
4	N	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
1	N	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
3	N	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
3	N	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
3	N	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
3	N	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
4	N	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
2	N	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
3	N	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!

2	N	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
4	N	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
4	N	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
3	N	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
1	N	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
1	N	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
2	N	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
3	N	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
3	N	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
3	N	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
2	N	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
4	N	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
3	N	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
4	N	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
4	N	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!

EPT14	EPT15	US16	MOT17	MOT18	SCR18	SCR19	SCR20	SCR21	SCR22	SAT23	CR24	CR25	RV26	SCR27
4	2	4	4	3	5	4	4	2	4	4	4	4	4	4
4	2	5	4	4	5	5	5	1	4	4	4	4	5	5
3	2	4	3	4	3	5	3	4	4	4	4	4	4	3
4	2	5	5	4	5	4	4	4	5	4	5	5	4	2
4	1	5	5	3	5	5	3	3	5	5	4	4	3	5
5	2	1	5	5	5	5	5	3	3	5	3	3	5	5
4	4	5	5	2	5	5	5	3	5	5	5	5	5	5
3	2	5	5	1	5	5	5	#NULL!	#NULL!	5	5	5	#NULL!	5
3	1	5	5	3	4	4	5	4	5	5	5	5	4	5
3	1	5	5	5	4	4	4	3	4	5	5	4	5	4
5	2	5	5	4	5	5	4	#NULL!	#NULL!	5	5	4	#NULL!	5
5	1	5	5	2	5	5	5	#NULL!	3	3	5	5	5	5
2	3	4	4	4	5	4	3	2	4	3	3	4	3	4
3	3	3	4	3	4	3	3	3	2	3	2	5	2	3
3	3	5	5	2	5	5	5	3	5	5	5	5	5	5
4	2	5	4	3	3	5	4	#NULL!	3	5	2	3	#NULL!	4
4	3	4	4	2	4	4	4	3	3	4	3	3	3	4
3	2	5	5	3	5	5	5	4	3	4	3	2	2	5
4	2	4	5	3	5	5	4	5	3	3	4	4	4	3
3	3	2	2	3	4	4	2	4	4	5	3	3	4	4
5	3	5	5	5	5	5	4	1	5	5	4	5	4	5
4	5	5	5	2	4	3	4	#NULL!	3	2	4	3	4	2
4	2	5	5	2	3	5	3	#NULL!	4	3	5	4	5	3
4	3	4	4	4	4	5	4	2	3	5	3	4	4	5
5	4	2	4	2	1	1	1	1	1	#NULL!	3	3	1	1
4	1	5	4	4	4	5	4	#NULL!	#NULL!	5	5	5	5	5
2	5	4	4	2	4	5	3	#NULL!	4	4	2	1	4	5
3	4	5	3	4	2	4	3	2	1	4	3	4	4	2
4	2	4	5	3	4	5	4	#NULL!	4	5	4	4	4	5
5	1	5	5	2	5	5	5	3	4	4	5	5	5	5
3	3	4	3	5	4	3	3	#NULL!	4	4	3	2	#NULL!	4
2	1	1	3	4	4	5	2	3	2	5	5	5	2	5

4	5	4	4	3	4	5	5	#NULL!	4	5	4	4	5	4
5	3	4	5	4	4	4	4	1	4	5	5	4	5	5
4	2	4	4	4	4	4	4	3	4	5	4	3	4	4
3	2	4	4	4	4	4	3	#NULL!	#NULL!	4	4	4	5	4
3	2	5	4	3	5	3	4	2	4	4	4	4	5	5
2	5	5	5	5	5	5	5	#NULL!	#NULL!	3	5	4	5	5
3	1	4	3	5	2	4	2	#NULL!	#NULL!	3	4	4	4	3
2	5	5	5	3	5	4	5	1	5	5	5	5	5	5
3	5	4	5	3	4	5	4	2	#NULL!	5	5	5	5	5
4	1	5	5	3	1	5	1	2	#NULL!	5	2	3	4	1
3	4	4	5	3	4	5	3	#NULL!	#NULL!	3	3	3	#NULL!	4
3	4	3	4	2	3	4	4	2	4	4	3	2	3	4
4	2	5	3	2	4	5	4	#NULL!	#NULL!	4	3	3	5	5
2	1	5	3	4	4	5	4	2	3	5	2	2	4	5
2	2	4	5	3	5	4	3	2	5	4	5	5	4	5
2	2	4	3	2	2	4	3	3	3	5	3	4	4	3
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!

#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!

SAT28	SAT29	SAT30	SumEmp	totIniScore	FinalScore	EmpPersor	VictimEmp	PlayerEmp	LevelEmpT	EPT14R	EPT15R	EmpPerTra	EQ4R	EQ8R
5	4	4	10	210	420	19	3	25	10	2	4	19	5.00	5.00
4	4	4	10	200	400	16	4	16	10	2	4	16	5.00	5.00
4	2	5	8	210	330	18	2	9	8	3	4	20	5.00	4.00
5	3	5	10	180	380	21	5	16	10	2	4	21	5.00	5.00
5	4	5	10	170	370	20	4	19	10	2	5	22	5.00	1.00
5	1	5	10	130	330	22	2	10	10	1	4	20	3.00	1.00
4	2	3	10	170	350	20	3	20	10	2	2	16	4.00	5.00
5	5	5	8	210	380	17	3	9	8	3	4	19	2.00	5.00
5	4	4	10	170	380	15	4	18	10	3	5	19	5.00	5.00
5	4	5	10	140	340	15	2	20	10	3	5	19	4.00	4.00
5	3	5	10	190	370	21	2	12	10	1	4	19	5.00	5.00
3	5	3	10	160	320	21	3	24	10	1	5	21	5.00	3.00
3	4	3	9	150	360	13	2	19	9	4	3	15	3.00	3.00
3	4	3	10	150	310	14	3	20	10	3	3	14	4.00	2.00
5	3	5	10	200	380	19	4	30	10	3	3	19	5.00	5.00
4	1	4	9	190	380	16	4	16	9	2	4	16	4.00	5.00
3	4	3	7	180	340	14	3	6	7	2	3	12	4.00	4.00
4	1	5	10	150	370	19	4	24	10	3	4	21	5.00	5.00
4	1	4	10	210	370	19	2	10	10	2	4	19	5.00	5.00
5	1	2	10	200	380	18	5	28	10	3	3	18	5.00	2.00
4	3	5	9	200	380	19	3	17	9	1	3	15	5.00	5.00
4	2	5	10	170	380	18	4	26	10	2	1	12	5.00	5.00
3	3	5	10	170	350	20	5	25	10	2	4	20	5.00	5.00
5	3	4	9	180	330	18	2	9	9	2	3	16	4.00	5.00
#NULL!	3	3	10	170	360	21	3	10	10	1	2	15	5.00	5.00
5	3	4	10	180	350	19	3	10	10	2	5	21	5.00	5.00
3	1	3	10	200	390	18	4	15	10	4	1	16	5.00	5.00
4	3	4	10	180	370	18	5	28	10	3	2	16	5.00	5.00
5	3	5	9	210	410	19	2	23	9	2	4	19	5.00	4.00
4	3	4	10	190	310	21	4	14	10	1	5	21	5.00	3.00
3	2	4	10	270	380	20	5	16	10	3	3	20	5.00	3.00
5	1	2	6	250	400	13	2	15	6	4	5	19	4.00	5.00

4	2	4	10	230	350	22	4	14	10	2	1	16	5.00	5.00
5	5	4	7	220	370	19	6	19	7	1	3	15	5.00	5.00
5	3	3	10	180	370	19	2	10	10	2	4	19	3.00	4.00
4	3	4	10	260	420	17	3	18	10	3	4	19	4.00	4.00
4	2	4	8	250	400	20	3	24	8	3	4	22	5.00	4.00
4	5	1	9	250	370	22	2	25	9	4	1	20	5.00	1.00
3	2	3	8	250	370	15	5	21	8	3	5	19	5.00	3.00
5	2	5	10	240	310	22	3	25	10	4	1	20	5.00	4.00
5	2	4	9	220	350	21	2	10	9	3	1	17	5.00	2.00
4	1	5	6	250	390	16	4	13	6	2	5	18	5.00	5.00
3	1	4	10	260	410	19	3	18	10	3	2	17	5.00	5.00
4	3	4	10	240	330	20	3	23	10	3	2	18	3.00	3.00
4	1	4	9	250	390	19	4	23	9	2	4	19	5.00	5.00
5	1	4	7	250	410	14	3	29	7	4	5	20	5.00	5.00
4	2	4	10	240	370	18	4	11	10	4	4	22	5.00	5.00
5	3	3	10	250	340	19	3	21	10	4	4	23	5.00	3.00
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!

#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!
#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!	#NULL!

EQ9R	EQ10R
5.00	4.00
5.00	5.00
5.00	2.00
5.00	5.00
5.00	4.00
5.00	5.00
3.00	5.00
5.00	3.00
5.00	5.00
5.00	5.00
5.00	5.00
5.00	3.00
3.00	4.00
3.00	3.00
5.00	5.00
5.00	5.00
2.00	3.00
5.00	5.00
5.00	5.00
4.00	4.00
5.00	5.00
5.00	5.00
5.00	5.00
5.00	4.00
5.00	3.00
5.00	5.00
5.00	5.00
5.00	5.00
5.00	5.00
5.00	5.00
5.00	5.00
5.00	4.00

5.00	5.00
5.00	5.00
5.00	2.00
4.00	5.00
5.00	5.00
5.00	4.00
5.00	5.00
5.00	3.00
5.00	4.00
5.00	5.00
5.00	4.00
5.00	5.00
5.00	5.00
5.00	5.00
5.00	5.00
5.00	5.00
#NULL!	#NULL!
#NULL!	#NULL!
#NULL!	#NULL!
#NULL!	#NULL!
#NULL!	#NULL!
#NULL!	#NULL!
#NULL!	#NULL!
#NULL!	#NULL!
#NULL!	#NULL!
#NULL!	#NULL!
#NULL!	#NULL!
#NULL!	#NULL!
#NULL!	#NULL!
#NULL!	#NULL!
#NULL!	#NULL!
#NULL!	#NULL!
#NULL!	#NULL!

#NULL!	#NULL!
#NULL!	#NULL!
#NULL!	#NULL!
#NULL!	#NULL!
#NULL!	#NULL!
#NULL!	#NULL!
#NULL!	#NULL!
#NULL!	#NULL!
#NULL!	#NULL!
#NULL!	#NULL!
#NULL!	#NULL!
#NULL!	#NULL!
#NULL!	#NULL!
#NULL!	#NULL!
#NULL!	#NULL!
#NULL!	#NULL!