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Cultural Representations in Digital Games (Editorial)

Mário Vairinhos
University of Aveiro, Portugal
mariov@ua.pt
0000-0002-4483-8126

Liliana Vale Costa
University of Aveiro, Portugal
lilianavale@ua.pt
0000-0003-2451-3073

Pedro Cardoso
University of Aveiro, Portugal
pedroccardoso@ua.pt
0000-0001-8546-4194

Welcome to this new issue of the Journal of Digital Media & Interaction. As we are heading towards New Year's Eve, it is our pleasure to devote this entire issue to the production of a Dossier dedicated to the exchange of meaning that our language may convey within physically simulated or fictionally recreated worlds in digital games. In fact, shared meanings shape our identity, emotions, and attachment to other beings (Hall, 1997), marking out a certain culture. When representing these meanings, our sensorial perceptions may defy the limits of time and space to migrate from daily practices and consciousness to the depicted or crafted gameplay environments (Castronova, 2005). As such, editing an issue that discusses the role of digital games to facilitate representation, identity, production, consumption, and regulation (*i.e.* the circuit of culture [du Gay, et al.,1997]) of signs and symbols is not only very ambitious but also constitutes a noble aim.

Games have been part of our identity from ancient to today's civilizations. These have been playing a key role in connecting people (players and game creators) of multiple universes, providing them with the abilities to explore, expand, subvert, reframe, intervene, restore, and rebuild historical and cultural realities, contexts, or settings. As players strengthen their interconnections with depicted territories, characters, and artifacts, game artists start to incorporate architecture, urban planning, history, and resource management knowledge in their practices. That way, an achiever's experience may no longer be sufficient and other associated pleasures in self-expression, creativity, and storytelling for place regeneration are also put at the forefront.

Hence, this Dossier aims at gathering state-of-the-art, study cases and critical analysis of the usage, (co)creation and assessment of cultural representations in digital games. Specifically, the papers contained in this JDMI issue discuss the representation of culture in some examples of games, methods used to involve the players in game design, and unravel some biases that may be brought to game production, and use of digital games as 'memory-making' texts. We expect the topics discussed in this Dossier to be of interest and readership to the research community in game design, cultural analysis of media, and research of socio-cultural aspects in gaming. It consists of five scientific contributions:

In "***Using Netnography for Studying the Language Transformation Process in the game Valorant***", Felipe Melquiades, Rafaelly Ferreira, and Diogo Araripe lay groundwork on players' language appropriation and transformation with the community of the multiplayer first-person shooter published by Riot Games entitled Valorant. As language understanding and usage tend to affect the adopted gameplay strategies and determine who is valorant or immortal (highest rank) and mercenary

(lowest rank), the authors draw our attention to official terms used in Valorant, terms borrowed from other (shooter) games, and player's appropriation and transformation of terms to their daily spoken language. This is a clear example of how language may reinforce the sense of agency in games, leading to hybridization of terms within game (sub)cultures.

Mónica Aresta, Pedro Beça, Rita Santos, and Ana Isabel Veloso develop a toolkit to assist in the game design process. This toolkit is documented in "***Defining a Conceptual Framework for a Toolkit to Game Design: the Gamers4Nature Project***", involving postgraduate students and professors knowledgeable in game design and using game design and development processes as part of their language. This kit based on Fullerton's perspective on game design attempts to deconstruct the design process for youngsters, who may not be familiar with this language and want to start to build their own game.

In "***Playing Sites of Memory: Framing the Representation of Cultural Memory in Digital Games,***" Stefano Caselli presents the use of digital games to convey cultural remembrance drawn upon the work of Pierre Nora. Caselli challenges us to (re)think of the way games may foster collective expression and shared knowledge of the past. A theoretical framework inspired by the work of the philosopher Paul Ricoeur is offered to understand the way digital games can represent and re-configure pre-existent cultural memories interpreting these as 'sites of memory.'

Considering that decoding and producing meanings implies a learning process, this issue also presents a '***Review on Adaptable Serious Games Applied to Professional Training.***' In this paper, Álvaro Pistono, Arnaldo Santos, and Ricardo Baptista highlight the importance of the adaptation of game elements within the professional training context.

Finally, "***Challenging students' perspectives with game design for older adults***" emphasize the importance of a player-centric design approach to fight against aging bias and stereotyping within the game industry. Simone Hausknecht, Fan Zhang, Julija Jeremic, Hollis Owens, and David Kaufman challenged sixty students in game design to involve thirteen older adults in the process and (re)think some of the design options and make games accessible to a broader audience. The authors also discuss the risk of using the 'I-Methodology', in which design decisions rely on the player's mental model, inscribing possible bias.

Together, these papers highlight the added value of cultural representations in digital games, emphasizing the dual role of players and game producers in transmitting and appropriating shared meanings of concepts, ideas, and feelings which may circulate, leave a legacy, and impact on society. These mentioned papers were selected from a total of eleven submissions, which have been the subject of a thorough and meticulous review.

We want to thank to all the authors who submitted their papers for this JDMI issue and the invaluable assistance of the reviewers and editorial members, who improved the quality of each paper. A special thank to Ana Oliveira, Andreia de Sousa, António Coelho, Bruno Giesteira, Catarina Lélis, Cristiano Max, Daniel Brandão, Eugène Loos, Eva Oliveira, Heitor Alvelos, Jeese Nery Filho, Luciana Lima, Maria João Antunes, Miguel Carvalhais, Mirian Tavares, Micael Sousa, Mónica Aresta, Nelson Zagalo, Oksana Tymoshchuk, Patrícia Gouveia, Pedro Amado, Pedro Beça, Pedro Ferreira, Ricardo Melo, Victor Navarro-Remesal, and Rui Raposo.

References

Castronova, E. (2005). Synthetic Worlds:The Business and Culture of Online Games, Chicago, USA: The University of Chicago Press

Du Gay, P., Hall, S., Janes, L., Mackay, H., Negus, K. (1997). Doing Cultural Studies: The Story of the Sony Walkman, London, UK: SAGE Publications.

Hall, S. (1997). Introduction. In S. Hall (Eds). *Representation: Cultural Representations and Signifying Practices.* London, UK: SAGE Publications Ltd.

Processo de transformação de linguagem a partir de um estudo netnográfico de Valorant

(Using Netnography for Studying the Language Transformation Process in the game Valorant)

Rafaelly Ferreira
Univ. Federal do Ceará, Brasil
rafaellyfferreira@gmail.com
0000-0003-0790-2739

Felipe Melquiades
Univ. Federal do Ceará, Brasil
felipemelquiades2013@gmai.com
0000-0003-0890-2458

Diogo Araripe
Univ. Federal do Ceará, Brasil
dibiararipe@gmail.com
0000-0002-1529-4254

Abstract
This article demonstrates a study on the process of language transformation and its influences on the Valorant electronic game community. The research was conducted through immersion in the game itself, and in the Facebook and Twitch communities.Through a netnography based on the ideas of Malinowski, Kozinets and Waslawick, a glossary was produced with the clipping of 59 terms used by the studied community. The terms were categorized and based on that hypotheses were raised on how the language adapted to the players' reality.

Keywords *Language, Netnography, Digital games, Valorant*

Resumo
Esse artigo demonstra um estudo sobre o processo de transformação da linguagem e suas influências na comunidade do jogo eletrônico Valorant. A pesquisa foi realizada através da imersão no próprio jogo, e nas comunidades do Facebook e da Twitch. Através de uma netnografia com base nas ideias de Malinowski, Kozinets e Waslawick, foi produzido um glossário com o recorte de 59 termos utilizados pela comunidade estudada. Os termos foram categorizados e com base nisso levantou-se hipóteses de como a linguagem adaptou-se à realidade dos jogadores.

Keywords *Linguagem, Netnografia, Jogos digitais, Valorant*

1. Introdução

Acompanhando o crescimento das redes sociais, foi possível ver o surgimento de novas gírias, expressões e formas de falar. A cada dia que se passa, mais pessoas se concentram nesses ambientes digitais para debater diversos assuntos, dentre eles, o de jogos. Podemos constatar isso ao entrar em diferentes plataformas, e através de uma simples busca, encontrar jogadores compartilhando suas experiências e debatendo entre si. Frente às transformações de linguagem sofridas no ambiente digital, foi possível abrir o questionamento se a linguagem também poderia estar sendo influenciada de alguma maneira pelo contexto de jogos.

Como objeto de estudo desta pesquisa foi escolhido o jogo Valorant. A escolha foi feita pela sua popularidade, que após um ano de seu lançamento, a produtora Riot Games anunciou que o jogo atingiu uma média global de 14 milhões de jogadores na plataforma PC (Pereira, 2021). Outra

característica que chamou a atenção dos pesquisadores é a presença de uma tradução em português do Brasil para os servidores. Além disso, o jogo atualmente possui uma comunidade brasileira ativa e com a realização de alguns campeonatos nacionais. Essas características potencializam o estudo dos elementos de linguagem presentes em sua comunidade.

A pesquisa segue os conceitos de Malinowski, Kozinets e Waslawick sobre método científico além dos conceitos de Wittgenstein sobre a linguagem. Este trabalho levanta dados sobre a comunidade de Valorant em três ambientes: (1) no próprio jogo, (2) no Facebook e (3) na Twitch. Por fim, o objetivo geral é a percepção do processo de transformação da linguagem na comunidade do jogo Valorant, enquanto que para os objetivos específicos tem-se:

1. Levantar termos e expressões utilizados pelos jogadores de Valorant.

2. Produzir um glossário baseado na tradução realizada pelos intérpretes.

3. Formular hipóteses de como ocorrem as transformações de linguagem dentro da comunidade online de Valorant.

Como forma de fundamentar esse trabalho em pesquisas anteriores, a seção 2 apresenta o referencial teórico para aprofundar definições sobre linguagem e métodos científicos antropológicos na tecnologia. Na seção 3, falamos sobre a metodologia utilizada para a coleta de dados. Na seção 4, são analisados os termos e expressões, levantados e categorizados em um glossário e por último na seção 5, são feitas as considerações finais desta pesquisa.

2. Referencial Teórico

A linguagem pode ser entendida como um espelho do mundo, formando representações para descrever o contexto ao seu redor através da razão (Wittgenstein, 1921). Desta forma, ela é determinada pela forma como o indivíduo percebe e descreve o mundo. Ao elevar essa sentença à coexistência de múltiplos indivíduos, temos um complexo sistema de símbolos criado e acordado em comunidade para a comunicação entre si (Kerr, 1965).

Wittgenstein (1921) introduz, também, a analogia de que a linguagem funciona como um jogo, pois ambos possuem um conjunto de regras e o aprendizado se dá através da utilização de palavras. Mas o ponto principal da relação é que em ambos a experiência de aprender se dá pela prática e não somente lendo as regras. Tal analogia explica o surgimento de novos dialetos e termos em contextos específicos, pois é através de vivências que a linguagem é construída.

Dentro do contexto de jogos, foco deste trabalho, observamos esse movimento de construção da linguagem acontecendo através da experiência de jogar e da comunicação entre jogadores. São nessas interações que os jogadores aprendem os termos utilizados pelas comunidades, como também criam novos e adaptam palavras de sua realidade para o contexto do jogo, assim como acreditava Juul (2005) ao propor que o jogo e a realidade dos jogadores se afetem mutuamente. Através destes conceitos, é possível teorizar que as comunidades de jogos produzem um vocabulário que ultrapassa o universo do jogo, assim sendo influenciado e influenciando o mundo real.

Frente a esse contexto, a linguagem, como um elemento da cultura e sendo influenciada pelo meio, faz com que seja necessário um entendimento do todo ao seu redor para compreender sua formação. Para isso, Malinowski (1984) propõe um método etnográfico antropológico no qual o antropólogo deve adentrar em comunidades, conviver e realizar atividades junto a elas, para de fato possuir o entendimento de uma cultura. Feito isso, os resultados dessa observação devem ser feitos através de relatórios e anotações diárias da experiência, para então realizar-se a análise dos dados coletados.

Desta forma, para Malinowski (1984), a pesquisa etnográfica consiste no estudo e descrição de um povo através da observação e documentação. A etnografia como método consiste numa pesquisa qualitativa, que segue alguns princípios, entre eles:

- Pesquisa de campo: refere-se ao local onde os indivíduos estudados vivem e interagem entre si, no caso em questão;

- Multifatorial: baseia-se no uso de duas ou mais técnicas de coleta de dados, no caso a observação e a documentação;

- Indutiva: o acúmulo descritivo de detalhe, onde a partir da coleta de dados, pode-se usar o montante para se obter uma conclusão;

- Holística: retrata de forma mais completa possível o grupo estudado.

Com o avanço da tecnologia na nossa sociedade e o advento das redes sociais, surge um novo tipo de método etnográfico, a Netnografia. Esse novo método diferencia-se do proposto por Malinowski, principalmente, por ser realizado exclusivamente através da Internet. Kozinets (2010) propôs diretrizes de adaptação aos procedimentos etnográficos para sua aplicação no ambiente digital permitindo uma investigação contextual online. O presente trabalho utilizou-se, assim, de uma mescla do método de Malinowski e das diretrizes etnográficas de pesquisa online estabelecidas por Kozinets.

Para a mescla dos métodos etnográficos escolhidos, utilizou-se dos direcionamentos Wazlawick (Wazlawick, 2009) para a definição de um bom objetivo dentro dos protocolos de pesquisa. O autor diz que o processo de observação parte da limitação do objetivo da pesquisa para que o leitor não crie expectativas. Para isso, é necessário um protocolo explicando o passo a passo do método utilizado para atingir o objetivo inicial da pesquisa e tudo o que gravita em redor dele. Assim, com base nesse planejamento buscamos garantir que o presente artigo atingisse sua finalidade.

3. Metodologia

O método etnográfico, para conseguir perceber a linguagem em diferentes meios, foi realizado a partir da coleta de dados em três ambientes diferentes: do jogo em si, grupos do Facebook e lives da Twitch. Seguindo os critérios de todas as etapas, foram registrados 59 termos e expressões percebidos na linguagem dos jogadores para a construção de um glossário. No escopo do glossário, foram listados: (1) Termos oficiais de Valorant BR, (2) Termos com influências de jogos externos, (3) Termos de língua estrangeira, (4) Termos aportuguesados, (5) Termos abreviados, e (6) Termos de nicho. Os termos e expressões foram mapeados também subentendendo que o primeiro passo para a transformação da

linguagem de um jogo é a utilização de palavras distintas as que fazem parte das regras e símbolos comuns daquele universo (Juul,2005).

3.1. Partidas de Valorant

Valorant é um jogo FPS (ou First-Person Shooters, em inglês) de tiro tático online e gratuito produzido pela produtora Riot Games. A dinâmica do jogo se dá na perspectiva em primeira pessoa para maior imersão. As equipas duelam em batalhas 5x5, revezando entre ataque e defesa. No modo de jogo tradicional, a equipa que ataca deve plantar e detonar um dispositivo explosivo (spike), enquanto a equipa defensora deve deter essa ação até o final do tempo ou desarmar o explosivo. Vale pontuar, pelo que a equipa que eliminar os cinco integrantes adversários também vence. A disputa acontece através de um melhor de 25 rounds, onde após 12 quem era atacante vira defesa e vence quem atingir 13 rounds vencidos primeiro (Mota, 2020).

É importante ressaltar que nenhum pesquisador teve contato com o jogo antes de realizar a pesquisa, então, através do site oficial de Valorant o jogo foi baixado por dois pesquisadores que realizaram o tutorial proposto para novos usuários para que alguns comandos básicos e objetivos fossem entendidos. Durante as partidas com a comunidade, esses pesquisadores realizaram a observação participante, entendendo os rituais da comunidade de forma imersiva, enquanto um terceiro pesquisador fazia o papel de anotar observações da partida e articular algumas dúvidas com dois intérpretes que acompanhavam na tradução de alguns termos. Os intérpretes estão inseridos na comunidade há mais de um ano. Todas as informações de diálogo foram registradas em um diário de campo que posteriormente alimentou um glossário (ver glossário ilustrativo, p. 19).

3.2. Análise de grupos do Facebook

Como estratégia para pesquisa de linguagem escrita e captura das reações da comunidade fora do ambiente, utilizou-se a rede social virtual Facebook. A escolha da rede como campo de estudo se justifica pela sua popularidade e o estímulo a interações em grupos de interesses similares. A rede é a maior do mundo, contando no quarto trimestre de 2020, com quase 2,8 bilhões de usuários ativos mensais ao redor do globo (Research Department, 2021), com grande potencial de congregação de indivíduos em grupos (Ribeiro, 2019).

Como estratégia de procura dentro do Facebook, foi estabelecida a palavra-chave: "valorant brasil", incidindo apenas em grupos. Como limitador de resultados, para tornar o escopo deste trabalho viável, decidiu-se focar no top 20 de resultados. Estes foram devidamente selecionados de acordo com os seguintes critérios de exclusão:

1. Grupos não brasileiros, ou seja, grupos com publicações escritas em outras linguagens além de português brasileiro;

2. Grupos com menos de 10 mil membros não foram coletados;

3. Grupos com atividade inferior a 15 publicações por dia;

4. Não ser um grupo público.

Após a aplicação dos critérios de exclusão obteve-se como resultado 3 grupos que tiveram os seguintes dados devidamente registrados: nome, tipo (privado ou público), número de membros do grupo, descrição, atividade (publicações por dia) e link do grupo. A tabela 1 compara alguns grupos da comunidade Valorant.

Tabela 1. Grupos Valorant

Nome	Valorant BR - memes	Valorant Brasil - Spikes	VALORANT - BR (OFICIAL)
Tipo	Grupo Público	Grupo Público	Grupo Público
Membros	31 mil membros	46 mil membros	39 mil membros
Descrição	Grupo para compartilhar memes e gameplay de Valorant.	Este é um grupo para interessados e players do game Valorant, da Riot Games. Nele não incentivamos coisas que atrapalham a experiência dos jogadores como hacks, smurfs, farms, toxicidade e preconceito. Vamos ajudar a construir uma comunidade respeitosa. Ele é gerido pela Spikers, uma organização/rede de canais focada em Valorant. Valorant é um jogo de tiro tático 5x5 de mecânica precisa, com personagens letais e ambientado em uma Terra do futuro. Nele, as habilidades criam oportunidades táticas para que suas mecânicas possam brilhar. playvalorant.com/pt-br spikers.org #Valorant #ProjetoA #ProjectA #RiotGames #FPS #eSports #spikers	Grupo oficial da Riot Games no Brasil. Leia as regras e responda as perguntas para entrar no grupo!!! ► Fórum - https://forum.br.leagueoflegends.com/ ► Site - https://playvalorant.com/pt-br/ ► Suporte - https://support-valorant.riotgames.com/hc/pt-br ► Discord - http://discord.gg/valorant-br
Atividade	60 publicações por dia	40 publicações por dia	110 publicações por dia
Link	https://www.facebook.com/groups/valorantmeme	https://www.facebook.com/groups/spikers.org/	https://www.facebook.com/groups/VALORANT.oficialbr/

A partir dos grupos selecionados, entramos nessas comunidades do Facebook para documentar registros das interações através de capturas de tela das publicações. Utilizou-se o filtro de maior relevância com um critério de no mínimo 20 comentários para garantir mais detalhes do contexto do tema que está sendo tratado em cada publicação. Tudo isto foi armazenado na plataforma Figma ® com o objetivo de preservar um retrato das informações no momento da coleta. Todos os dados desta

etapa estão disponíveis para acesso.[1] A análise dos dados foi feita através da leitura de cada comentário extraído e realizado a tradução com o auxílio dos intérpretes.

3.3. Análise de lives da Twitch

Como forma de fazer uma observação da comunidade interagindo de forma mais orgânica dentro das partidas de Valorant, também foi feita uma análise das interações entre os jogadores através da plataforma de streaming Twitch. Com mais de 100 milhões de espectadores mensais e 1,7 milhão de streamers únicos (Twitch, 2016 apud Montardo, et al., 2017), além de contar com o quarto maior tráfego de internet dos Estados Unidos,[2] o Twitch é um fenômeno social, midiático e cultural merecedor de atenção. Esta é uma plataforma de streaming de vídeo ao vivo que tem grande foco no streaming de games, abrangendo desde partidas casuais a competições de esportes eletrônicos.

Dentro do universo de vídeos disponíveis, a seleção das duas lives[3,4] foi feita seguindo critérios diferentes. A primeira foi selecionada levando em consideração:

1. Partidas casuais, sem vínculo com o cenário competitivo;

2. Estar na listagem de maior quantidade de visualizações da categoria "Valorant" no dia que o vídeo foi selecionado;

3. Diálogos da live no idioma português do Brasil;

4. Dinâmica em que o streamer dialogasse com a audiência.

Diante disso, o canal selecionado foi o paulanobre e para a análise foi definido que os pesquisadores deveriam acompanhar uma hora de live focando exclusivamente na documentação da linguagem falada, ou seja, ignorando o chat da plataforma. Todas as observações desse vídeo também foram registradas no diário de campo da pesquisa.

A segunda live foi selecionada, visando a participação ativa dos pesquisadores através do chat de mensagens da plataforma Twitch. O canal escolhido foi o segueCall, que é mantido por um grupo de jogadores, incluindo os intérpretes, o que permitiu uma maior abertura para tirar dúvidas e fazer perguntas. Os pesquisadores acompanharam a live, ao vivo, durante uma hora e registraram no glossário os termos e expressões captados através da interação com os participantes do momento.

4. Resultados

Durante a experiência na comunidade de Valorant produziu-se um glossário oriundo de 59 termos recortados pela observação da equipe durante as partidas jogadas, as lives na Twitch e

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[1]Capturas de telas coletadas no Facebook que foram analisadas:
https://www.figma.com/file/vCqcxhTPJ4JJebwOSn6FQH/Pesquisa-Valorant
[2] Apple Quietly Builds New Networks. Acesso em 23 ago. 2021, do site The Wall Street Journal:
https://www.wsj.com/articles/SB10001424052702304851104579361201655365302
[3]Primeiro vídeo analisado dia 23 de julho de 2021. Disponível em: https://www.twitch.tv/videos/1080592857
[4] Segundo vídeo analisado dia 13 de agosto de 2021. Disponível em: https://www.twitch.tv/videos/1117553400

as publicações dos grupos de Facebook. A equipe organizou os termos em seis categorias, sendo elas: termos de língua estrangeira, termos em processo de aportuguesamento, termos com influência de jogos externos, termos abreviados, termos de nicho e termos oficiais. Visto que as temáticas das publicações e das conversas também envolvem diversos elementos fora do contexto do jogo, aqui também foi utilizado como critério apenas o que está relacionado intimamente a Valorant. Com isso, elaborou-se hipóteses dos motivos para o surgimento dos vocabulários com tais características.

Devido ao grupo de pesquisadores não ter familiaridade com o jogo Valorant ou outros do gênero FPS foi bastante importante o momento de ser guiado por intérpretes da comunidade, uma vez que o tutorial do jogo não trouxe insumos o suficiente para a equipe entender as mecânicas básicas do jogo. A hipótese levantada é que Valorant escolhe dar ênfase às partidas, deixando o jogador aprender outros elementos básicos com o tempo, como as classes de agentes e a customização de armas (conhecidas como skins). Dessa forma, o apoio de guias integrou o grupo mais rápido.
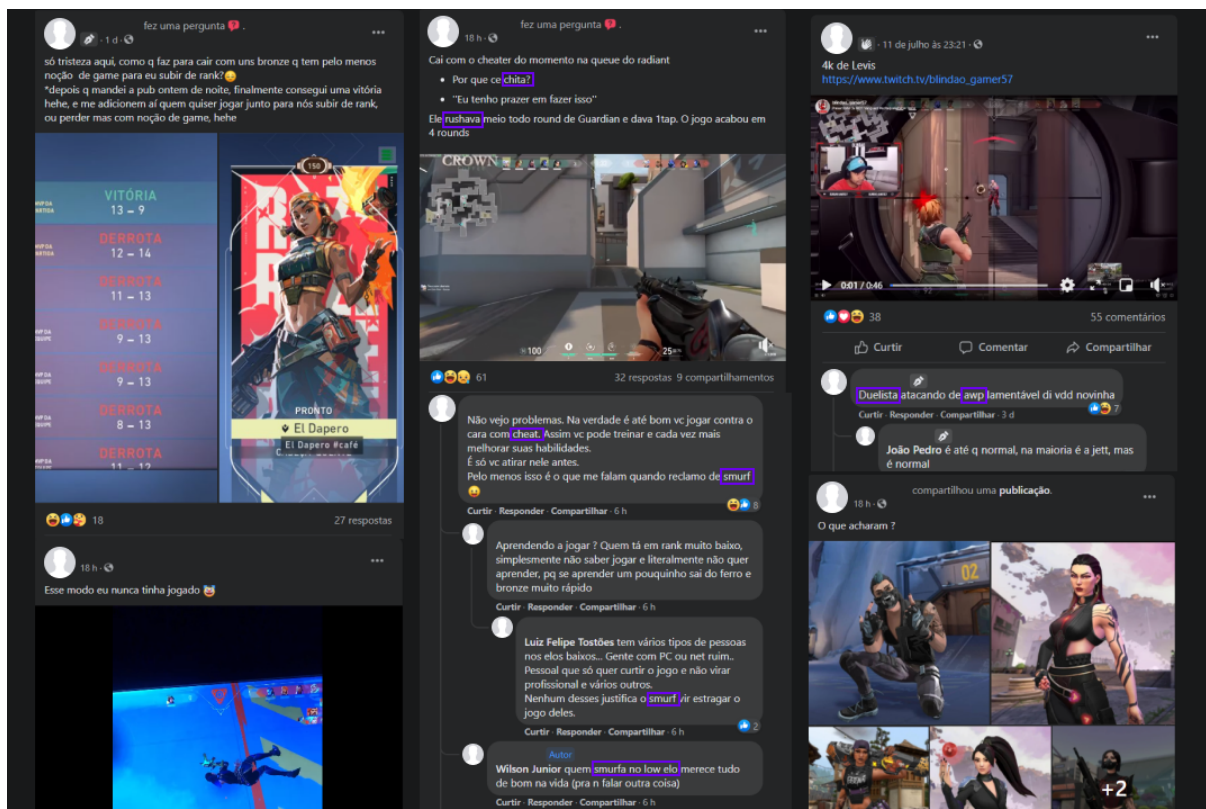
Figura 1. Amostra de publicações analisadas em grupos do Facebook

Na análise das cinco publicações, as temáticas abordaram diversos assuntos correlatos e não necessariamente correlatos à Valorant, mas que apresentavam termos do universo do jogo ou de jogos no geral. Boa parte dos comentários foram feitos em relação a novos lançamentos ou às dificuldades do jogo de subir de elo e problemas para lidar com smurfs ou hackers. Alguns comentários foram feitos com um teor mais humorístico ou de artefatos produzidos por fãs como edição de vídeos de gameplay e wallpapers. Em outra parcela das publicações tinha uma

temática de troca de suporte entre a comunidade como dicas de requisitos de computador e acessórios para jogar melhor ou dúvidas referentes a forma de pagamento de alguns itens dentro do jogo. Uma das publicações encontradas na amostra se tratava de uma denúncia de racismo dentro de uma partida do jogo.

Já na Twitch, a equipe acompanhou duas streams e percebeu o constante uso de linguagens e termos do Valorant e que eles eram estranhos para pessoas novatas na comunidade. A primeira live assistida foi de uma streamer famosa na comunidade de Valorant, paulanobre com 486 mil seguidores, e a segunda stream foi recomendada pelos intérpretes, segueCall com 73 seguidores. Notou-se que em ambas as lives os streamers utilizavam termos comuns a comunidade de Valorant, alguns até eram exclusivos do grupo de amigos, na qual só faziam sentido no contexto deles. Ademais, era comum os streamers responderem perguntas relacionadas ao jogo, seja dicas de gameplay, equipamentos, significado de termos, perguntas pessoais e outras perguntas do cotidiano dos streamers.

Por fim, na gameplay guiada por intérpretes, os membros participantes sentiram dificuldades em compreender comandos, interações e linguagens do universo de Valorant. Das duas seções de partidas experienciada pelos membros, ocorreu na primeira à introdução de termos, de comandos, de personagens, de modos de jogo e de interações pelos intérpretes. Já a segunda seção, foi realizada em um modo não ranqueado com a interação de jogadores aleatórios encontrados pelo gerenciador de partidas do jogo, dessa forma a equipe experienciou uma partida comum no cotidiano da comunidade de Valorant.

A equipe organizou os termos em seis categorias, sendo elas: termos oficiais de valorant, termos de língua estrangeira, termos de língua estrangeira com processo de aportuguesamento, termos com influência de jogos externos, termos abreviados e termos de nicho. Com isso, elaborou-se hipóteses dos motivos para o surgimento de termos com tais características.

Para os termos em língua estrangeira percebe-se uma tradução heterogênea em relação ao vocabulário oficial do jogo. Apesar do jogo ter sido lançado pela produtora Riot Games em português no Brasil a bomba se chama spike e os mapas (breeze, ice box, bind, haven, split e ascent) são todos de termos em inglês, mas as classes dos agentes (iniciadores, sentinelas, controladores e duelistas) são todos em português. A hipótese é que isso também se dá na transformação dessa linguagem, que ora prefere manter os estrangeirismos com ou sem adaptações para o português, ora prefere traduzir alguns termos como o "plant" para "plantar", que significa instalar uma bomba no campo do adversário.

Outra hipótese se dá para os termos que também são estrangeiros, mas que passam por um processo de transformação da linguagem conhecido como estrangeirismo, como por exemplo o termo "rushar" para indicar a ação do verbo rush do inglês, que significa apressar algo, que no contexto do Valorant seria agilizar o ataque ofensivo na partida. Apesar de aumentar algumas palavras, o processo pode acontecer para tornar o diálogo fluido entre os jogadores que possuem o português brasileiro como primeiro idioma. Tem-se também a hipótese de que o

contato dos jogadores brasileiros com jogadores de língua estrangeira faz com que o termo se popularize no contexto gamer, assim se espalhando para comunidades de outros jogos.

É importante perceber que alguns termos utilizados no Valorant também têm influências do jogo Counter Strike (CS), que é um dos jogos de ação mais populares do mundo segundo a distribuidora Valve,[5] em decorrência de termos como "lado TR" ou "lado CT" que se referem aos times "terroristas" ou "contra terroristas" no CS para sinalizar os times de ataque ou de defesa, respectivamente, apesar desses termos não serem utilizados oficialmente pela Riot. A equipe acredita que assim como os termos estrangeiros, as influências de jogos externos também se revelam nesses callouts[6] de mapa oriundos de outros jogos, uma vez que o jogo sofre influência da realidade de sua comunidade (Juul, 2005), logo na imigração entre jogos semelhantes os termos migram junto com seu público que se habituou a realidade anterior.

Analisando os comentários dos grupos e através das partidas jogadas, é perceptível que o processo de transformação da linguagem origina-se por meio da necessidade de uma comunicação rápida devido a dinamicidade do jogo. As próprias callouts são exemplos dessa necessidade, assim como acreditava Wittgenstein (1921) ao propor que a realidade do meio influencia na comunicação dos indivíduos. O processo ocorre através do uso de abreviações por siglas ("HS" abreviar "headshot"), redução de palavras (como no caso do "Plat 3" para indicar a patente "Platina 3") ou redução de frases ("Têm A ou "Tem 2A" para indicar que há um ou dois oponentes no ponto "A" do mapa).

Através da utilização de diversos termos do jogo, traduzidos ou não, geralmente relacionados a localização e habilidades dos personagens, a equipe notou que existem nichos de linguagem dentro da própria comunidade de Valorant, uma vez que novos termos existem e fazem sentido somente dentro de um grupo de amigos, ou de uma região (como percebido através de gírias regionais nas lives da Twitch), mas a maioria tem como prioridade a velocidade. Como exemplo o termo "tem rato" citado no glossário se trata de um termo que era conhecido apenas pela equipe de streamers da live segueCall para se comunicar mais rápido, mas não necessariamente abrange a compreensão de todos os jogadores da comunidade Valorant.

No apanhado geral, foi percebido que a maioria do vocabulário utilizado pela comunidade de Valorant é proveniente do próprio jogo ou de jogos externos. Isso indica, que existe uma forte influência entre jogos dentro da cultura gamer como um todo. Dos 59 termos coletados, 19 pertenciam à categoria de termos oficiais de Valorant, enquanto 14 pertenciam ao universo da comunidade gamer. Quanto ao uso de termos abreviados, que foi bastante destacado pela dinamicidade do jogo, foi identificada uma representação de 16,9% do vocabulário percebido neste estudo.

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[5] About CS:GO. Acesso em: 26 ago. 2021, do site Counter-Strike: Global Offensive: https://blog.counter-strike.net/index.php/about.

[6] Callout: No universo de Valorant são pontos estratégicos no mapa. Acesso em: 23 ago. 2021. https://www.techtudo.com.br/noticias/2021/04/valorant-guia-com-as-principais-call-outs-dos-mapas-do-jogo-esports.ghtml.

O fato de o jogo ter o inglês como língua base, influenciou boa parte do vocabulário da comunidade, mesmo no Brasil onde existiu a tradução dos termos do jogo. Os dados coletados mostram 27 (45,76%) termos em inglês no total, sendo 18 deles de outras categorias. Podemos construir a hipótese que isso acontece devido à forte influência da comunidade externa de jogos, que em seu início teve grande contato com jogos exclusivamente em inglês e apenas a pouco tempo passou a ter acesso a jogos traduzidos. Nesse contexto, podemos salientar que a tradução parcial dos termos do jogo Valorant, possibilitou o movimento de aportuguesamento de termos em uma espécie de regionalização do vocabulário. Foram identificados 6 aportuguesados. Em contrapartida, apenas 1 termo foi identificado como nichado, isso podendo ter acontecido pelo contexto limitado da presente pesquisa.

5. Conclusão

Nesse trabalho conseguimos perceber a influência do contexto sobre a linguagem na comunidade de Valorant por meio da imersão na vivência dos jogadores. Foi possível identificar que a comunicação é delimitada de acordo com as diretrizes do jogo, pelas experiências dos jogadores dentro do próprio jogo e pela interação da comunidade de jogos como um todo.

No que tange a dinâmica do jogo, observou-se que as regras do universo, assim como a tradução delas, moldam as regras da linguagem dos jogadores. Isso foi percebido pelo uso mesclado de termos em inglês e português, além do surgimento dos termos aportuguesados. Desta forma, notamos que o vocabulário é influenciado diretamente pelo jogo e pelo contexto geográfico em que a comunidade se estabelece.

Ao debruçar-se sobre a influência das experiências dos jogadores dentro e fora do jogo Valorant, observou-se que a linguagem também possui influências externas, como a apropriação de referências de outros jogos do gênero FPS. Nessa ótica ela tem por objetivo facilitar a compreensão de determinados grupos e é temporal ao acompanhar a evolução da tecnologia associada ao jogo eletrônico, assim como também pode causar estranheza aos noviços da comunidade. Vale ressaltar que os streamers analisados se mostraram abertos a responder dúvidas de seus espectadores, enquanto a comunidade do Facebook pareceu neutra neste aspecto.

Notou-se também que pelo caráter multiplayer do jogo, a linguagem sofreu variações dentro de grupos menores de jogadores. Assim, algumas equipes que jogam com recorrência em conjunto acabaram criando expressões e termos próprios que foram incorporados a uma mescla de expressões regionais.

Nesse contexto de interação coletiva, também, foi possível perceber que a transformação da linguagem foi influenciada pela velocidade exigida para o jogo. Devido à dinamicidade das partidas, a comunidade moldou-se ao uso de abreviações. Essa adaptação da linguagem foi feita do uso de callouts, que são os símbolos utilizados pelos jogadores (principalmente da modalidade competitiva), para chamar a atenção do próprio time sobre algo que está acontecendo em determinado ponto do mapa.

Por fim, como próximos passos desta pesquisa, pretende-se aprimorar o glossário explorando aspectos quantitativos. O objetivo é mapear a relevância dos termos captados e sua incidência para a comunidade de Valorant. Além disso, pretendemos analisar a influência de outros jogos, de gênero FPS, na linguagem de Valorant e como isso dificulta a entrada de jogadores sem conhecimento prévio. Esse interesse surgiu ao notarmos, durante o estudo, que o pesquisador com experiência mínima em contato com jogos digitais de FPS teve melhor desenvoltura no entendimento das expressões em relação aos pesquisadores que não tiveram.

References

Juul, J. (2005). Half-real: Video games between real rules and fictional worlds. Massachusetts, USA: MIT Press.

Kerr, F. (1965). Language as Hermeneutic in the later Wittgenstein. *Tijdschrift Voor Filosofie*, 27(3), 491–520. http://www.jstor.org/stable/40881170

Kozinets, R. V. (2010). Netnography: Doing Ethnographic Research Online. *International Journal of Advertising* 29(2), 328-330. https://doi.org/10.2501/S026504871020118X

Malinowski, B. K. (1984). *Argonautas do Pacífico Ocidental: um relato do empreendedorismo e da aventura dos nativos nos arquipélagos da Nova Guiné Melanésia*. São Paulo: UBU editora.

Mota, J. (2020). *Por que todo mundo está falando de Valorant?* RedBull. Retrieved December 30,2021, from https://www.redbull.com/br-pt/games-valorant-explicacoes

Montardo, S. P., Fragoso, S. D., Cruz, M. A., & Paz, S. (2017). Consumo digital como performance sociotécnica: Análise dos usos da plataforma de streaming de games Twitch. *Comunicação, mídia e consumo. São Paulo. Vol. 14, n. 40 (maio/ago. 2017), p. 46-69.*

Pereira, E. (2021). *Valorant atinge a marca de 14 milhões de jogadores ativos.* CosmoNerd. Retrieved December 30,2021, from https://cosmonerd.com.br/games/noticias-games/valorant-atinge-marca-de-14-milhoes-de-jogadores-ativos/

Research Department, S. (2021). *Facebook - Statistics & Facts*. Statista. Retrieved December 30,2021, from https://www.statista.com/topics/751/facebook/

Ribeiro, I. (2019). *Facebook traz a primeira campanha global ao Brasil.* Meio & Mensagem. Retrieved December 30,2021, from https://www.meioemensagem.com.br/home/midia/2019/09/23/facebook-traz-primeira-campanha-global-ao-brasil.html

Wazlawick, R. S. (2009). *Metodologia de Pesquisa em Ciência da Computação*. Rio de Janeiro, Brasil: Elsevier Editora Ltda.

Wittgenstein, L. (1921). *Philosophical Investigations*. New Jersey, USA: Wiley-Blackwell.

Glossário Ilustrativo Embarque Valorant

Categoria: Termos oficiais de Valorant BR		
N°	**Expressão**	**Significado**
1.1	Agente	Personagem jogável.
1.2	Ares	Uma arma do tipo metralhadora
1.3	Contrato	Uma missão em que toda a experiência adquirida em partida é destinada para desbloquear um Agente. Existem vários níveis de contrato com diferentes recompensas.
1.4	Controlador	Classe de personagem que tem por objetivo manipular o campo de batalha
1.5	Duelista	Classe de personagem que tem por objetivo abater inimigos
1.6	Glitchpop	Linha de skins
1.7	Iniciadores	Classe de personagem que tem por objetivo coletar informações dos inimigos
1.8	Passe de batalha	Elementos desbloqueáveis.
1.9	Saqueadora	Linha de skins
1.10	Sentinelas	Classe de personagem que tem por objetivo defender uma área
1.11	Sentinela da Luz	Linha de skins
1.12	Spike	O objeto principal das partidas, tendo por objetivo a instalação ou o desarmamento.
1.13	Split	Tipo de mapa de jogo
1.14	Spray	Mecânica interativa de desenhar nas paredes do jogo, simulando grafite.
1.15	Suprimir	Mecânica de jogo capaz de desabilitar as habilidades de um personagem por um período de tempo.
1.16	Temporada	Abertura do novo período ranqueado.
1.17	Títulos	Descrição personalizável de exibição no perfil do jogador.
1.18	Vandal	Uma arma do tipo fuzil
1.19	VP	Valorant Points, a moeda comercial do jogo.

Categoria: Termos com influências de jogos externos		
N°	**Expressão**	**Significado**
2.1	AFK	*Away from keyboard*: Não está participando da partida. Identificável pelo jogador imóvel em sua base.
2.2	AWP	Rifle do jogo Counter Strike
2.3	CT	"Lado Contra Terrorista" em Counter Strike, mas que em Valorant representa o lado que deve impedir o time inimigo de armar a Spike.
2.4	DPI	*Dots per inch*: Medida utilizada para determinar a sensibilidade do movimento realizado pelo dispositivo.
2.5	FPS (Contexto de conexão)	*Frames per second*: Quantidade de quadros gerado por segundo pelo processador do jogador.
2.6	FPS (Contexto de gênero de jogo)	*First person shooter*: Gênero de jogo com câmera em primeira pessoa que tem como interação principal o objetivo de atirar projéteis.
2.7	Instalock	Ato de selecionar um personagem instantaneamente após o início da fase de seleção, independente da opinião de colegas de equipe ou de uma estratégia planejada.
2.8	MOBA	Gênero de jogo para batalhas entre times em uma linha.
2.9	MVP	*Most Valuable Player*: Jogador com maior impacto na partida
2.10	"Vamo dá ff"	Afirmação de desistência. "/ff" é um comando interativo no chat do jogo que habilita a votação de rendição da equipe. Geralmente utilizada em momentos de desânimo e desesperança com o ritmo do jogo.
2.11	"Vamo uma personalizada"	Partidas personalizadas são gerenciadas pelos jogadores, ao qual os participantes ficam à critério dos envolvidos.
2.12	Skin	Cosmético vendido pela loja do jogo que modifica aparência e efeito de algo no jogo.
2.13	Smurf	Jogador que burla as regras de balanceamento do jogo ao jogar filas ranqueadas em um conta de patente inferior à sua conta oficial.
2.14	TR	"Lado Terrorista" em Counter Strike, mas que em Valorant representa o lado que devem armar a Spike.

Categoria: Termos de língua estrangeira		
N°	**Expressão**	**Significado**
3.1	Bang	Mecânica de reduzir a visão do inimigo com um flash de luz.
3.2	Cheat	Software de trapaça
3.3	Dash	Mecânica de movimentar o personagem através de um impulso.
3.4	Hacker	Pessoa que burla as regras do jogo através de softwares ilegais.
3.5	High elo	Indica uma patente elevada.
3.6	Kill	Abate
3.7	Party	Mecânica de agrupar jogadores para uma partida a convite de um membro.
3.8	Seasons	O mesmo que Temporada (1.16)
3.9	Smoke	Mecânica de cobrir algo com fumaça, utilizado para esconder algo.

Categoria: Termos aportuguesados		
N°	**Expressão**	**Significado**
4.1	Bangar	Utilizar a mecânica de Bang. Originado do termo inglês "Bang".
4.2	Plantaram	Momento em que a Spike é armada. Originado do termo inglês Plant.
4.3	Pingar	Apontar algo no mapa através de alertas. Originado do termo inglês "Ping".
4.4	Rushar	Ato de avançar sobre o time inimigo. Originado do termo inglês Rush.
4.5	Smokado	Algo coberto por fumaça. Originado do termo "Smoke"
4.6	Ultar	Utilizar a habilidade suprema do personagem. Originado do termo "*ult*", que por sua vez é a abreviação do termo inglês "*Ultimate*".

Categoria: Termos abreviados		
N°	**Expressão**	**Significado**
5.1	"Boneco Azul"	Identificador do personagem Yoru
5.2	"Boneco Verde"	Identificador da personagem Viper
5.3	"Eles plantaram na B"	Indica que o time inimigo armou a Spike no ponto B do mapa.
5.4	"HS"	Indica o abate de um inimigo por projétil na cabeça. Originado do termo inglês *Headshot*.
5.5	"Plat 3"	Indica a patente do jogador nas filas ranqueadas do jogo.
5.6	"Sova no meio"	Indica a presença do personagem Sova no meio do mapa
5.7	"Tem A"	Indica a presença de um inimigo no ponto A do mapa.
5.8	"Tem 2A"	Indica a presença de dois inimigos no ponto A do mapa.
5.9	"Tem céu"	Indica a presença de um inimigo acima dos jogadores aliados.
5.10	"Tem garagem"	Indica a presença de um inimigo em um ponto específico do mapa chamado Garagem.

Categoria: Termos de nicho		
N°	**Expressão**	**Significado**
6.1	"Tem rato"	Indica a presença de um inimigo nos esgotos do jogo. Utilizado pelos streamers segueCall.

Defining a Conceptual Framework for a Toolkit to Game Design: The Gamers4Nature Project

Mónica Aresta
University of Aveiro,
Portugal
m.aresta@ua.pt
0000-0002-7629-934X

Pedro Beça
University of Aveiro,
Portugal
pedrobeca@ua.pt
0000-0001-7332-4901

Rita Santos
University of Aveiro,
Portugal
rita.santos@ua.pt
0000-0001-9741-6210

Ana Isabel Veloso
University of Aveiro,
Portugal
aiv@ua.pt
0000-0002-5070-0756

Abstract
Seeking to capitalize the interest of younger audiences in game creation activities, the Gamers4Nature project aims to develop a toolkit designed to support game design by allowing the manipulation of the several elements that compose a game. Prior to the toolkit's development, there was the need to establish the respective conceptual framework. This paper describes the process of defining the project's conceptual framework. Based on Fullerton's perspective on game design, the framework was defined following a participatory design approach with the participation of different stakeholders (postgraduate students with extensive knowledge about game design and experts in the game design field). To ease the discussion sessions, a physical artifact (19 hexagonal pieces, and a honeycomb structured board) was developed. Results suggest that a non-linear approach to game design may promote not only the definition of the game's structure and gameplay but also allow a contextualised analysis of all its elements.

1. Introduction

In recent years, digital games have conquered part of the territory previously occupied by traditional games, bringing significant changes to the way we spend our free time (Connolly et al., 2012). Despite research on the impact of games on human behaviour has, for many years, focused on the negative aspects of digital games – in particular on the promotion of aggressive and violent behaviour (Anderson, 2004; Anderson & Bushman, 2001) and on the consequences for self-regulation of playing time (Ogletree & Drake, 2007), the development of addictive behaviours (Griffiths & Davies, 2002) and social isolation (Merhi et al., 2007) – the development of research in this area revealed the existence of positive impacts of digital games in terms of learning, motivation, knowledge acquisition, skills development and behavioural change (Boyle et al., 2012; Briot et al., 2011; Earp, 2015; Gee, 2008; Robertson, 2012; Vos et al., 2011). Whether through the application of gamification strategies (cf. Majuri et al., 2018) or by developing games centred on educational subjects or themes, the potential of games in activating transversal skills related to the ability to solve problems, creativity and exploration of information and communication technologies has been considered as an alternative or complementary to more traditional models of education (Earp et al., 2014). By presenting contextualized and meaningful learning activities into environments controlled by learners, games have the potential to arouse curiosity and interest in educational content (Vos et al., 2011), stimulate attention and

awareness, learn by doing, foster collaboration and exchange points of view and ideas and enhance the development of critical thinking skills (de Grove et al., 2012; Giannakos & Jaccheri, 2018; Gee, 2008).

With technological developments and the appearance of tools designed to be used by individuals with little experience in the field of programming, the line between game creators and players has softened, giving the latter the potential to design their own resources. Considering the creation of games as a very attractive activity and profession (Clement, 2021), young people feel motivated to create games similar to those they like to play (Good & Howland, 2017) – an interest supported by the recent growth of the games market, namely for mobile, which kept this area as one of great interest and motivation for young audiences. Seeking to capitalize this interest in the area of digital game development, the Gamers4Nature project (University of Aveiro, Portugal) developed a toolkit to game design, designed to facilitate the process of conceptualizing games through the manipulation and exploration of the various elements that comprise them.

Prior to the toolkit's development (i.e. in the ideational phase) there was the need to establish, define and validate the conceptual framework that would frame the Gamers4Nature toolkit. Defining a conceptual framework can be seen as the starting point of any research design (Ivey, 2015). Often translated through visual or written artifacts (Bickman & Rog, 1998) that present a hierarchically organized statement of the ideas that constitute the core concepts (Joel Michael et al., 2017), conceptual frameworks explain and scope the core concepts (i.e., the main ideas that are central to the addressed discipline or subject (National Research Council, 2007), the relationships between core concepts, and the related ideas that are critical for the comprehension of the core concepts (Joel Michael et al., 2017).

The Gamers4Nature conceptual framework definition process, developed through a User-Centred Design approach design (Sharp et al., 2019) approach, was guided by the following questions: RQ1) which game elements should be considered as core for the design and construction of a game?; and RQ2) what possible relationships can be identified or established between the elements?

Following the Introduction, Section 2 presents some background concepts around the games and games as systems. Section 3 introduces the Gamers4Nature project and its main goals, and contextualizes the conceptual framework evaluation process. Section 4 describes the adopted methodological approach and introduces the artifact developed to stimulate the brainstorming evaluation sessions. Section 5 presents the study's main results, which are discussed in Section 6. The paper ends with some final considerations and directions for future work.

2. Literature review

"Game design is the process by which a game designer creates a game, to be encountered by a player, from which meaningful play emerges" (Salen & Zimmerman, 2004, p. 80).

Present in childhood and throughout most of adult life, in leisure activities and in more structured contexts, games and playing have been part of human nature since ancient times,

playing an important role in the development of intellectual skills, physical capacities and social aspects of the individual (Boyle et al., 2012). Resulting from the human desire to play and from the human ability to pretend and represent, games emerge as activities that take place in the context of a make-believe reality and where participants – voluntarily submitting to pre-defined rules – strive to achieve a certain or several certain objectives (Adams, 2014). Simultaneously being a social activity and a cultural phenomenon (Huizinga, 2001), the game is an experience that keeps the player involved through the uncertainty of the result and the freedom of action within what is defined by the rules (Caillois, 1990).

Games are activities limited in time with pre-defined objectives and rules, artificial conflicts defined by rules, and with a measurable end (Salen & Zimmerman, 2004), designed to trigger in the participant a satisfaction that derives from the very act of playing (Huizinga, 2001). Tensions, rules and limits are components of the game valid only during the time and/or the space in which it takes place: when entering the game, the player enters a "magic circle", in a temporary arena within the real world where conventions, day-to-day hierarchies and norms are temporarily abolished (Huizinga, 2001).

2.1. Games as systems

Games evolve within a previously delimited field - limited in a material or imaginary, deliberate or spontaneous way - a temporary world with rules and tension that exist during a specific activity (Huizinga, 2001). This relationship between rules and the game is established by various authors, as shown by Salen and Zimmerman in the book "Rules of Play" (2004). For the authors, games are systems in which players engage in artificial and structured conflicts, defined by rules, and which resolve their uncertainty in a quantifiable and unequal outcome.

Adams (2014) states that games are built upon complex systems composed of several elements – rules, resources, players, results, uncertainty, involvement and objectives, among others – that are related in order to create a unique experience for the player. In this system, rules play an important role, providing the players with the necessary information to optimize their choices and to see the consequences of their actions.

From the perspective of a game as a system, Juul (2003, 2005) also describes games as systems based on rules, with negotiable consequences and variable and measurable results, processes and activities in which the player becomes emotionally involved while trying to influence their result. For the author, these games' characteristics can be organized in three dimensions: the game as a formal system; the interaction between the player and the game; and what relates to the game and the rest of the world.

In an approach that includes game design and development, Hunicke and her colleagues (2004) presented the MDA (Mechanics, Dynamics and Aesthetics) Framework, a lens for understanding games where the player's experience (Aesthetics) emerges through interactions (Dynamics) with the rules of the game (Mechanics).

Elias, Garfield and Gutschera (2012) approach the game as a system, reinforcing the importance of playing time, number of players and heuristics as basic rules in game design. For the authors, the perceived uncertainty and randomness of games are important to maintain the player's attention and interest, and heuristics (present in the reward and feedback system) are important as they allow the player to know if they are winning or losing, and what to do next.

Fullerton (2014) describes games as formal systems that involve players in a conflict, subject to rules, which results in an uneven outcome. For the author, a game has formal elements (players, objectives, procedures, rules, resources, conflicts, limits, outcome) that form the structure of the game and that are articulated to create in the player the experience of facing a game; and dramatic elements (challenge, game, premise, characters, history, world-building and dramatic arc) that emotionally involve the player and contribute to the player's commitment to the game. Fullerton states that games are systems, where formal elements contribute to a dynamic experience with which the players engage, and where objects interact with each other according to their properties, behaviors and relationships, changing the state of that system.

As for Macklin and Sharp (2016), these authors refer to actions, rules, objectives, game space and players as basic elements of game design, from which an infinite number of experiences emerge.

3. The Gamers4Nature toolkit to game design: background

The motivational power and relevance of digital games has been recognized for some years, with its potential in activating transversal skills related to the ability to solve problems, creativity and exploration of information and communication technologies being considered as an alternative to more traditional models of education (Earp et al., 2014). By presenting contextualized and meaningful learning activities into environments controlled by learners, games have the potential to arouse curiosity and interest in educational content (Vos et al., 2011), stimulate attention and awareness, learn by doing, foster collaboration and exchange points of view and ideas and enhance the development of critical thinking skills (de Grove et al., 2012; Giannakos & Jaccheri, 2018; Gee, 2008).

More than simply using games as an educational strategy – one that may not necessarily translate into educational benefits, as there is no consensus about the relationship between playing a game and its expected learning outcomes (Earp et al., 2014) – giving students the possibility of creating games with themes related to the learning curriculum may lead to a better understanding of the value of what is learned and to the acquisition of scientific concepts, as well as to the development of digital literacy throughout the design process (Huizenga et al., 2017).

As research indicates that involving students in the creation of their own games may increases the interest towards the addressed theme (Huizenga et al., 2017), it also points out some obstacles that emerge when adopting this strategy: low or undeveloped programming skills and a lack of interest in the educational subject (Pontual Falcão et al., 2018), a tendency to focus on the storytelling and

character development, and ignoring gameplay mechanics and content integration (Howland & Good, 2015; Ke, 2014).

Taking all these concerns into consideration and seeking to capitalize on students' interest in the area of digital game development, the Gamers4Nature project (University of Aveiro, Portugal) developed a toolkit to game design to be used by younger audiences (secondary education and undergraduate students) along game development sessions. One of the core principles that guided the design of the Toolkit was that the artefact should facilitate and support the process of conceptualizing games by allowing users the manipulation and exploration of the several elements that compose a game. Starting from this premise, it was considered that the first step would be to identify, amongst authors and researchers whose work focus on game design, the ones that approached game and game design as a structure made of elements (concepts) working together as parts of a mechanism or interconnected network – a system.

3.1. Choosing a base approach

As addressed by several of the authors mentioned in Section 2, game design emerges from the relationship between the result of the game development process and the player's experience felt during the game. From the analysed perspectives, three were considered as being aligned with the Gamers4Nature project's frame: i) Juul's (2003) perspective of game as a structure that evolves around its formal system, the relations between the player and the game, and between the game and the rest of the world; ii) Hunicke's et al. (2004) MDA framework; and iii) Fullerton's playcentric approach to game design (2014). Taking into account that the Gamers4Nature Toolkit's should ease and support the process of conceptualizing games by allowing the manipulation and exploration of the several elements that compose a game, Fullerton's (2014) perspective was considered as being the one that reflected the project's goals and therefore should be considered as the basis for the project's conceptual framework.

Fullerton (2014) breaks the game down into nineteen elements, organized into three categories – formal, dramatic and system elements. The formal elements form the structure of the game, articulating to create in the player the experience of facing a game. These elements are: the player (voluntary participant, who makes decisions, makes choices and can win the game); the objectives (they represent what the player tries to achieve, respecting the rules of the game); the procedures or actions (they determine what the player can do to achieve the objectives of the game); the rules (they define game objects and setup the permitted actions by the player); the resources (items that, when reached, help the player to achieve the objectives of the game); the outcome (it defines the end of the game); the conflict (situations that prevent the player from directly reaching the objective); and the limits (what separates the game from what is not the game: the real world). The dramatic elements give the game a context, involving and integrating the formal elements into a meaningful experience. These elements involve the player emotionally and contribute to the player's commitment to the game. In the author's perspective, the dramatic elements of a game are: the challenge (tasks that the player is called upon to perform during the game and that are designed to keep the player involved); play (process of

experimentation and exploration, during which the player becomes emotionally involved in the game); the premise (starting point of a story, scenario or metaphor that establishes the game's action); character (helps to build the story and to establish an emotional connection with the game); story (establishes a context and scenario for the game situation); universe (design of a fictional world, capable of giving greater depth to the game); and dramatic arc (story's development throughout the game). Finally, when mentioning that games are systems where the formal elements contribute to a dynamic experience with which the players get involved, Fullerton presents the objects, properties, behaviours and relationships as the basic elements of a system; in this structure, objects interact with each other according to their properties, behaviours and relationships, changing the state of the system.

4. Methodological approach

4.1. Data collection

The Gamers4Nature conceptual framework definition and evaluation process was developed through a User-Centered design approach (Sharp et al., 2019), with individuals with extensive knowledge about the game design process and experts in the game design field being invited to discuss the project's approach and to share their own perspective about what a game is. Data was collected through brainstorming sessions implemented through focus groups and individual interviews, aiming to answer the following questions: RQ1) which elements should be considered as essential for the design and construction of a game?; RQ2) what possible relationships can be identified or established between the elements?

Nine 9 ICT postgraduate from a Master's degree course with extensive knowledge about the game design process and 4 experts in the field of Game Design – three academic researchers from the game design field, and one game developer –were invited to participate in brainstorming sessions.

The focus groups and individual interviews took place during the month of May 2019. Focus groups had an average duration of 90 minutes and individual interviews an average duration of 50 minutes. Non-participant observation was used as the data collection technique. Interventions were recorded in audio format and later transcribed and analysed, with the results of each session presented in the next section.

4.2. Gamers4Nature brainstorming tool: the hexagonal cardboard pieces

It was intended that, along the brainstorming sessions, it each game element should be discussed independently and not within the groups defined by Fullerton (2014). This way, participants could freely talk about each game element, discard any they would not consider as being relevant for the game design process and suggest possible relationships and links between the different elements.

In order to focus the discussion on the game elements and promote a non-linear approach to the game design process throughout the brainstorming sessions, a physical artifact was created. Each one of Fullerton's game elements was represented by a piece of cardboard – a 3cm sided hexagon with the element's name printed on each side. When used in the construction or deconstruction of ideas, hexagonal shapes are effective in aggregating different perspectives or in branching concept maps.

Moreover, and as suggested by Sousa et al. (2021), the use of the several pieces would allow participants to add and remove mechanisms and, at the same time, to accurately identify each game element and the role it plays on the game system. They are the ideal way to convey the non-linearity and freedom of exploration characteristic of digital games and, at the same time, convey the idea of game as a system.

In order to avoid any prior hierarchy of the game elements, each card had only the name of the game element (in Portuguese and in English) and the project logo printed on it. This way, participants would have the conditions to explore and address each game elements freely, without being conditioned by any information able to transmit its importance, connection of hierarchy.

Figure 1 - Hexagonal pieces "game elements", used in the sessions

As one of the brainstorming session's goal was to identify what possible relationships can be identified or established between the elements, it was necessary to encourage – but not to guide – participants to establish relations and articulations between the elements. In order to promote that discussion, a tray (A3 format) with a honeycomb structure that replicated the hexagonal structures of the pieces was also developed.
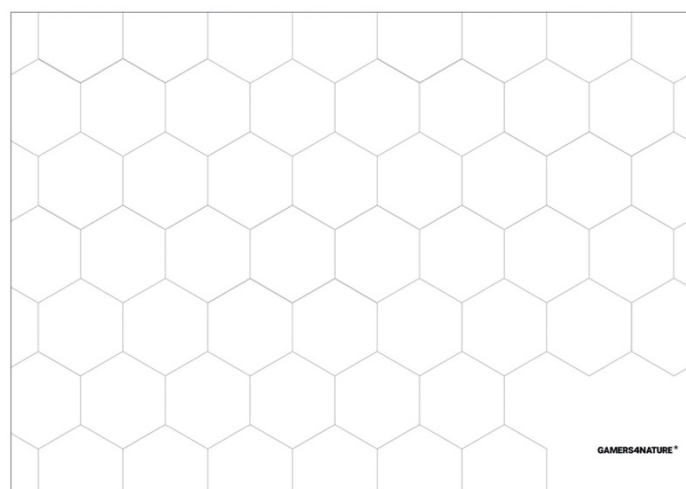

Figure 2 - Board with honeycomb structure used in the sessions

Each participant received a set of hexagonal pieces and honeycomb tray at the beginning of the brainstorming sessions. Following the presentation of the project and project objectives, participants were first invited to explore the artefact and then, following the think aloud protocol, to share their individual and personal perspective about what a game is, what elements compose a game and what relations (if any) can be established between the several game elements.

5. Results

5.1 – Focus Group I – starting with the premise, define a challenge and then build the story

The first focus group session was attended by 4 former master's students, two female and two males. All participants had plenty experience in programming and game development, and one participant was also very experienced in art, animation, story and narrative, areas in which the remaining participants reported having only some experience.

Participant 1 [P1] introduced game as an experience delimited by rules and boundaries, where procedures and the game's narrative dimension (premise, character, story, dramatic arc and world building) are what makes the player stay in the game. Participant 2 [P2] presented game as an experience articulated between narrative (story, premise and resources) and mechanics (play and challenge). Participant 3 [P3] also addressed game as being composed of a "narrative-related core", where the player reaches the outcome through the premise, story and dramatic arc. Challenges and conflicts are related with the game core mechanics, and rules set up the "line of the game". As for Participant 4 [P4], it was mentioned that game starts with the player, who tries to reach an outcome while going through the game's procedures. Characters and story are elements that can give the game an emotional dimension, and therefore should be included in the game design.

Figure 3 shows the result of using the board and the pieces by each Group I participant. Darker pieces represent the elements each participant considered as core elements when considering game design, and lighter pieces represent elements that, although being relevant for the game design process, were not considered as fundamental when creating a game.

Figure 3 - Maps built by the first Focus Group participants

5.2. Focus group II - the importance of narrative in game design

The second focus group session was attended by 5 former master's students, all male. Three participants had plenty of experience in programming and game development, and two had only some experience in this field. Only one participant reported having a lot of experience in story and narrative.

Participant 5 [P5] introduced game as an experience where premise, challenge, character and world building are central elements. Participant 6 [P6] presented game as the articulations between a core built upon narrative and mechanic elements and another core made of objects, behaviours and relationships that establish the game's experience. Participant 7 [P7] addressed game as being composed of rules, objectives, boundaries and narrative elements. Participant 8 [P8] mentioned that game starts with the player, which moves along a narrative and tries to reach an outcome through resolving conflicts, trying to reach the game's objectives and following the allowed procedures. As for Participant 9 [P9], a game starts with a challenge, exploring a narrative dimension – built upon characters, premise and world building –while following the game's objectives and rules. Resources and boundaries are also considered as important dimensions of a game.

Figure 4 shows the result of the use of the board and pieces by Group II participants. Darker pieces represent the elements each participant considered as core elements when considering game design, and lighter pieces represent elements that, although being relevant for the game design process, were not considered as fundamental when creating a game.
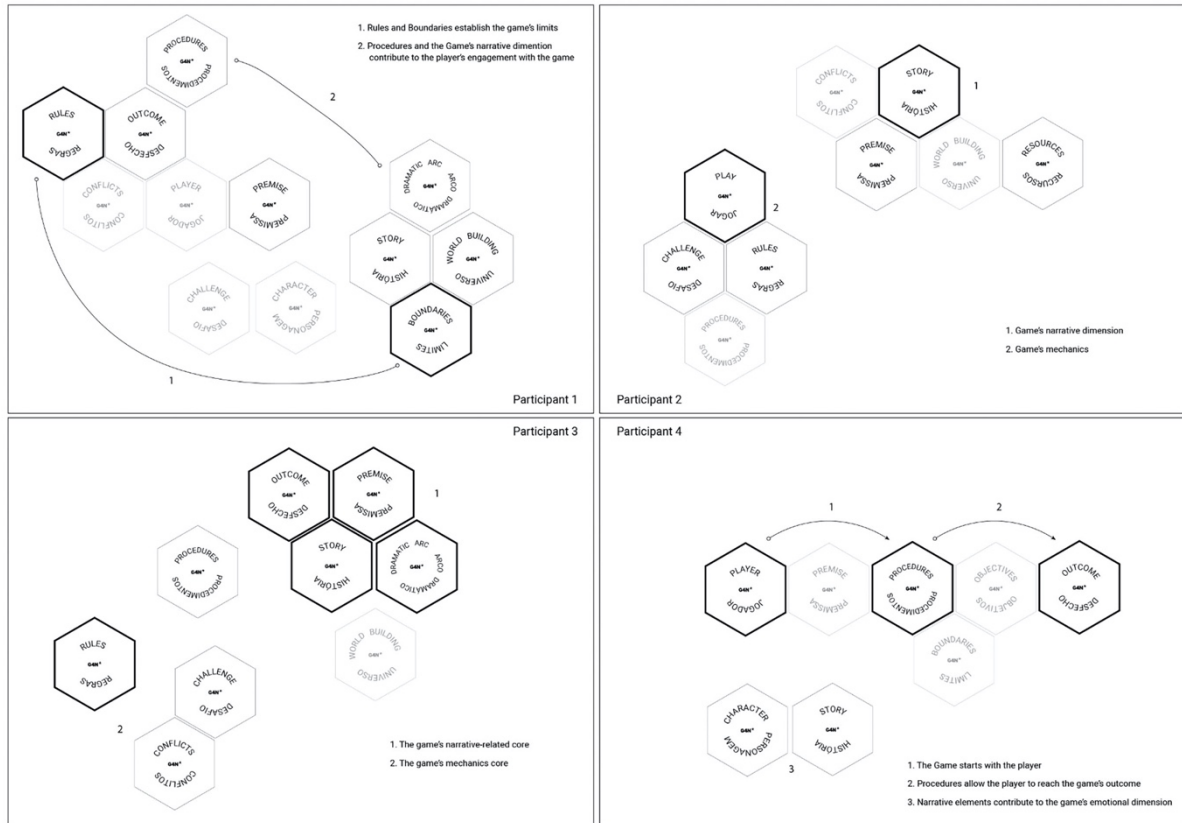
Figure 4 - Maps built by the second Focus Group participants

5.3. Expert A, challenge as the element that separates a game from an interactive experience

In response to the question "what are the fundamental elements in the design of a game?", Expert A (a professor of Game Design in a Higher Education Institution) defined the challenge as a central element for the design of a game. In the interviewee's opinion, it is the challenge that holds the player throughout the game. It must be engaging to keep the player interested, and it can be represented in the form of an entire game needs a challenge component to be minimally involving. Without this component, "*it is an interactive experience, not a game*".

Referring that any game - in order to be considered as such - must have an outcome or a termination condition, the expert related the objectives of the game to that termination condition. To demonstrate this relationship, consider a game in which the objective is to reach a certain number of points: when reaching that number of points, the condition for ending the game is reached, and the game is over. The actions or procedures (mechanics) – which define and limit the player's movements – are fundamental for the player to achieve the objectives of the game, leading to the outcome initially mentioned. The rules define the limits of the experience, while the act of playing is deeply related to the mechanics of the game and its playability.

As non-essential elements in the construction of a game, the participant considered the conflict. Interpreted from the perspective of the player's internal conflict, it appears in games capable of establishing a very strong emotional bond with the characters and the events, placing the player in front of choices leading them to reflect on their own identity, attitudes and behaviour; the dramatic arc, universe and character, which help to maintain interest in the game but whose existence is not fundamental in all games; and the story and the premise, which according to the interviewee already represent a granularity that does not exist in the other elements. Properties, behaviours and

relationships were considered to belong to the dynamics of the game, and resources as something that could be addressed in two levels: game resources (assets that the player/ character has to obtain) or as peripherals (e.g. the use of haptics).

Figure 5 represents the map constructed by the participant during the interview and the relationships between the different elements that he considers essential in the design of a game. The process of exploring the pieces and organizing the ideas resulted in a structure that branches out from a central element: the challenge.
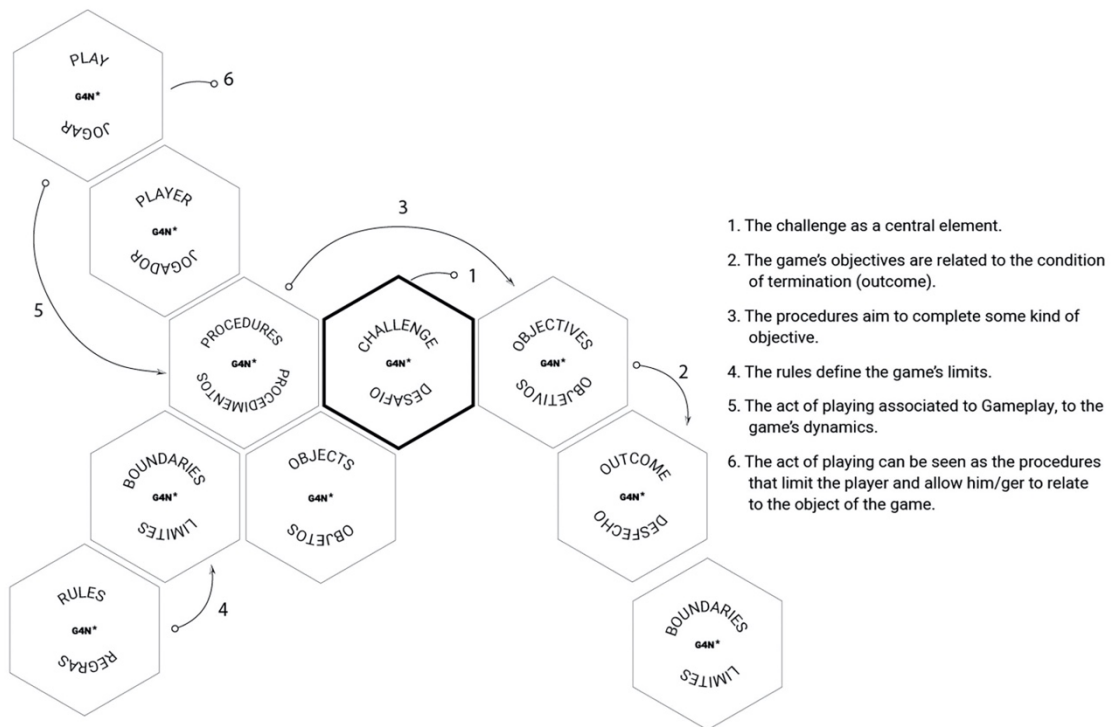
Figure 5 - Map built by Expert A: the challenge as a central element

5.4. Expert B, premise as the basic concept of the game's narrative

After exploring the pieces and safeguarding that all elements are fundamental to the design of a game, Expert B (a game design professor teaching in a Higher Education Institution) further explored the role of some of them. Starting with the premise – which he defined as the concept that helps to create the game's narrative – the interviewee built a map in a linear way, oriented from left to right, where the story, the result of the development of the premise, helps to define the player and to create and develop the characters. For the interviewee, the conflict may be related to the conflicts that the players face during the game, having also mentioned the existence of a relationship between the dramatic arc, the history and the conflict. As for the game procedures, these would be related to the rules, challenges and behaviours.

Figure 6 represents the map built by the participant during the interview, as well as the relationships between the different game elements. The elements that were used by the interviewee but that were

not covered in more detail are represented by a lighter tone. The process of exploring the pieces and organizing the ideas resulted in a structure that expands from a starting element: the premise.
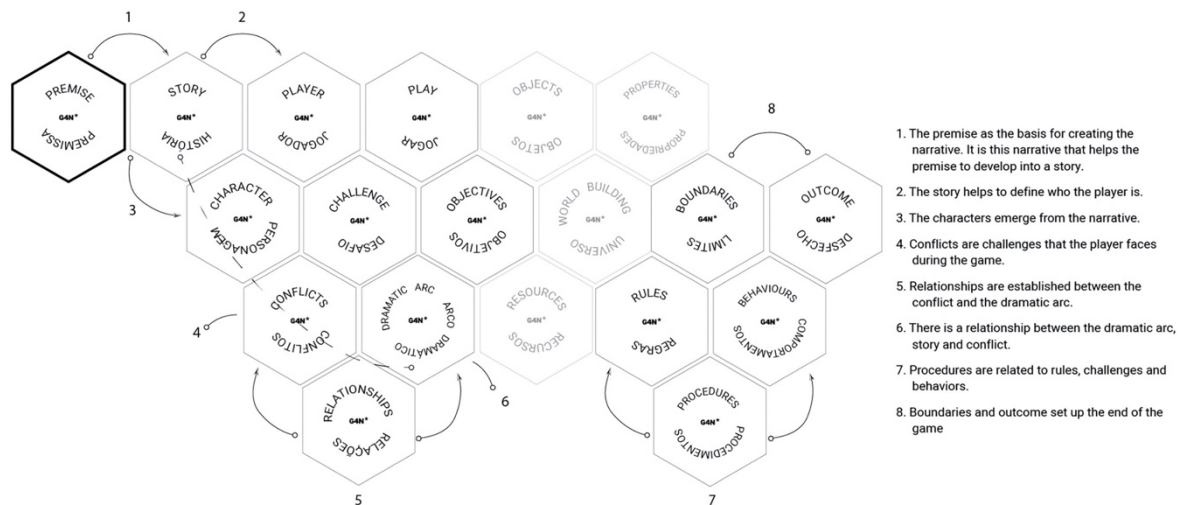

Figure 6 - Map built Expert B: the premise as a starting point

5.5. Expert C, symbolic, explorers or story creators, three player profiles

Expert C (a teacher in the field of video games in a Higher Education Institution) approached the question "what are the fundamental elements in the design of a game?" from the perspective of the player's motivation, the reasons and motivations that lead a player to play.

For the teacher, there are three main player profiles: symbolic or abstractionist players; those driven by the power of simulation and creativity present in games; and those who enter the game for the story and narrative. Symbolic or abstractionist players focus mainly on challenge, procedures and rules, objectives, resources, relationships and properties. They are intense, hardcore players who try to push the game to the limit and explore all its facets. Players of the second profile, driven by the ability to simulate and experiment with games' creativity, explore the game in order to understand what works and what does not work, to discover what is possible in the game world. For this profile, the premise is the starting point for the game, the first point in the exploration of an entire universe; they explore all possible outcomes, trying to understand their limits. Players who are driven to the game by the desire to explore the stories and narratives, prefer mainly simulation games, where they can learn from the characters, save scenarios and experience realities. For this profile, the story and the dramatic arc, the conflicts between characters and the behaviours in the game appear as the most important elements.

Figure 7 shows the three user profiles mentioned by the interviewee, as well as the elements associated with each profile. In this approach, centred on the motivation of the player, the elements appear grouped in a structure similar to a map of small islands.
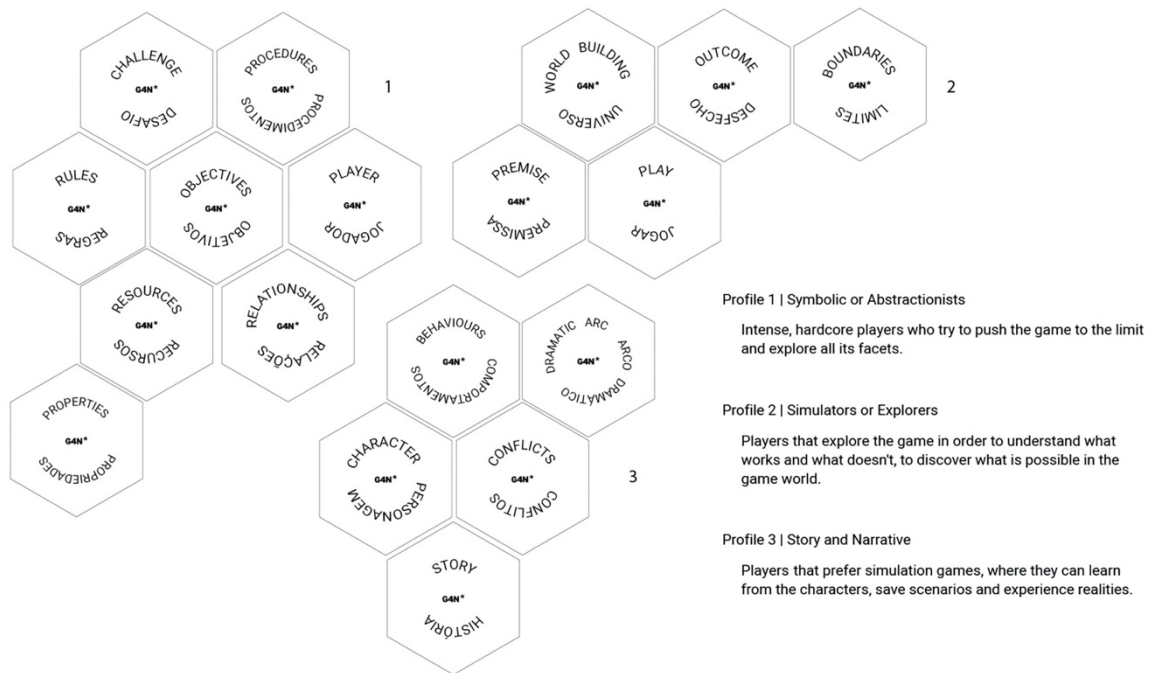
Figure 7 - Map built by the third interviewee: user profiles

5.6. Individual Interview IV - Expert D, objectives, mechanics and gameplay, the core elements in game design

Expert D (a game developer currently working in the game development and creation industry) mentioned that according to his experience, there is no single strategy for creating games and that different teams can adopt different strategies in the organization of work. He stated a preference to start by defining the concept of the game and only then working on its mechanics. Challenged to identify the elements he considers essential in the design of a game, the interviewee referred to the Gamers4Nature project framework to state that, if there is already a main objective – environmental problems awareness – the objectives would appear as a starting point for building a game.

From the interviewee's perspective, mechanics are defined from the objectives: rules, behaviours and properties, which help to establish the experience of playing, the gameplay. In parallel, but not necessarily articulated with the previous dimension, resources or assets can be added to the game as a strategy to increase the challenge and involve the player even more. Related to the objectives, the outcome will establish the end of the game, although it can be considered a starting point. In the interviewee's opinion, one can start by defining the end of the game (victory condition, final scenario) and work on the construction of the route leading to that end. In what concerns the limits, the interviewee related them to time limits, time management and team effort of those who work in developing the game design.

Figure 8 represents the map built by the participant during the interview, as well as the relationships he established between the different game elements. The process of exploring the pieces and organizing the ideas resulted in a map organized into two structures: definition of the game design core

(objectives, mechanics and gameplay) and peripheral elements that, contributing to the game, will not be essential for its construction.
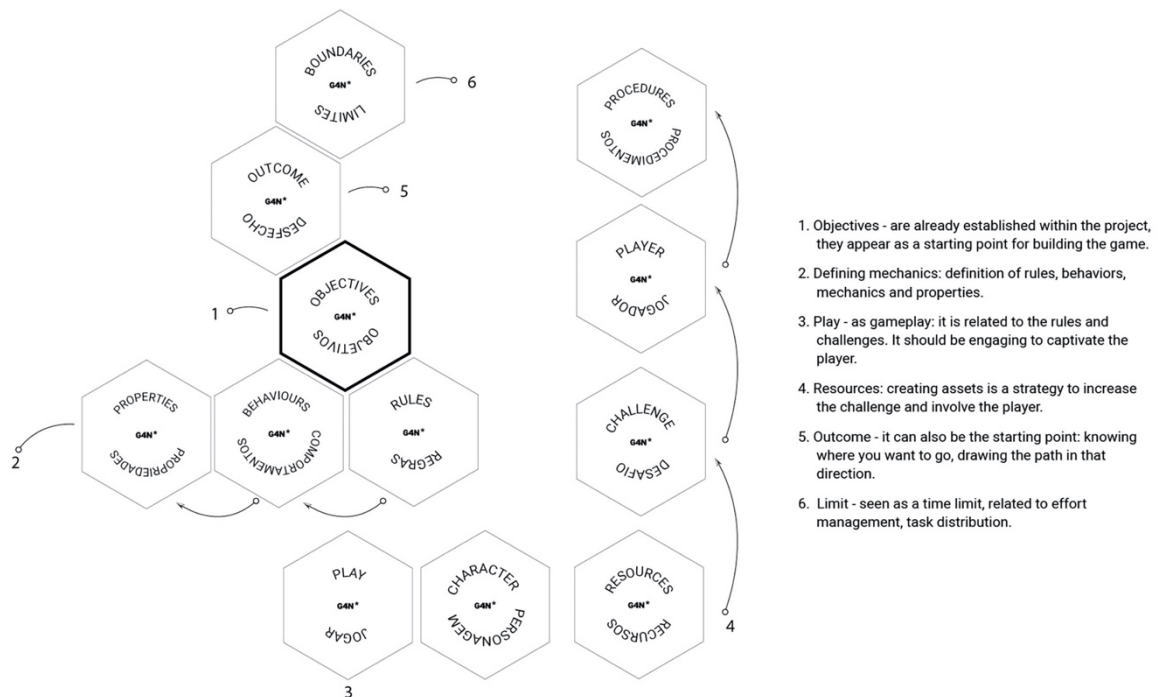

1. Objectives - are already established within the project, they appear as a starting point for building the game.

2. Defining mechanics: definition of rules, behaviors, mechanics and properties.

3. Play - as gameplay: it is related to the rules and challenges. It should be engaging to captivate the player.

4. Resources: creating assets is a strategy to increase the challenge and involve the player.

5. Outcome - it can also be the starting point: knowing where you want to go, drawing the path in that direction.

6. Limit - seen as a time limit, related to effort management, task distribution.

Figure 8 - Map build by Expert D: the core elements of the construction of a game

6. Discussion

The analysis of data collected during the brainstorming sessions allowed the identification of which elements, according to the participants, were considered as core for the design of a game (RQ1) and the relations and associations that, also according to participants, could be established between different game elements (RQ2).

The use of the hexagonal cardboard pieces allowed participants to explore and share their ideas and articulate thinking, to establish relationships and identify connections between the 19 game elements and to demonstrate the various perspectives of what could be the design of a game.

6.1. Core elements to be considered when designing a game

During the focus group sessions held with former master students, story was the elements most referred to (six participants), followed by rules, premise and challenge (five participants) and boundaries, character and dramatic arc (four participants). Objectives, outcome, procedures and world building were mentioned by three participants, and two mentioned resources and conflict. Three participants of the first focus group suggested "feeling" as a possible element to add to the Toolkit to Game Design.

As for the individual interviews, when asked to identify which elements they considered to be essential in game design, all experts mentioned challenge, objectives, play, boundaries, outcome and

rules; character, player and procedures were mentioned by three experts and two mentioned story, premise, world building, resources, dramatic arc and conflict.

Figure 9 visually represents former Master students and game design experts' perspective about the importance of each game element. The most addressed elements are represented by the wider hexagons. Properties, objects, behaviours and relationships (system elements) were considered by both the focus groups participants and the interviewees as being elements that require a deeper knowledge of games design and dynamics. Participants suggested that those elements should be introduced in a second game design phase (when users were already familiar with the core elements); therefore, these elements are not represented in figure 9.
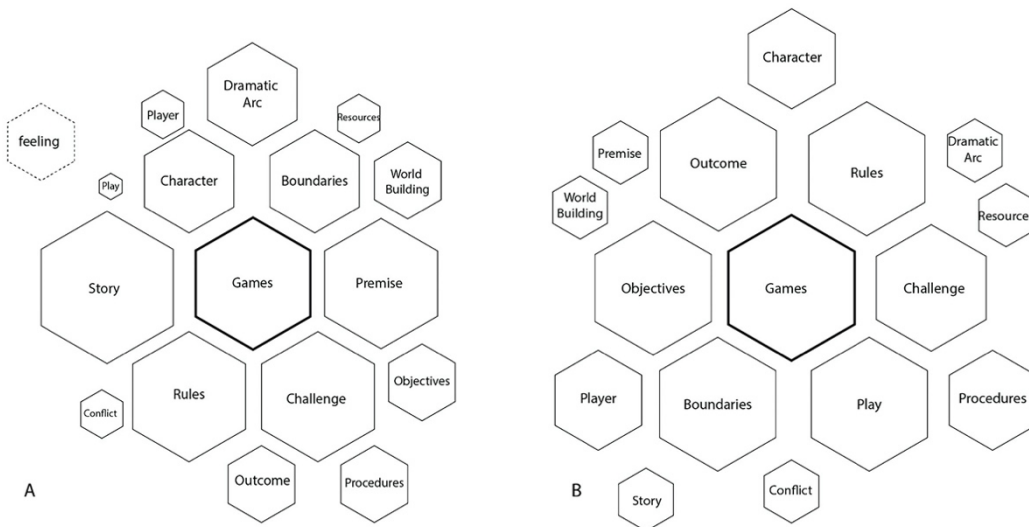
Figure 9 – Game core elements: former Master students (A) and game design expert's (B) perspectives

6.2. Relationships established between the game elements

Throughout the focus group and individual interviews sessions and by using the cardboard pieces, participants addressed the relations that, according to their knowledge and experience, exist or may exist between the different game elements and therefore should be considered when designing a game.

According with their perspective, there are elements that relate with each other in order to create and define the game's narrative: premise, character, story, dramatic arc, character, history and conflict. These elements form the game's narrative dimension, working together in order to engage the player with the game and giving the game its emotional dimension.

Other elements work together to support and define the game's mechanics. Challenge, rules and boundaries delimit the game and define the limits of the experience, and objectives and procedures are related with the game's outcome, as they define the player's movements and the game's termination condition.

7. Conclusions and Future Work

This paper focuses on the process of assessing the conceptual framework of the Gamers4Nature Toolkit to game design, developed to be used by younger audiences along game development sessions. One of the main ideas that scaffolded the design of the Toolkit was that the artefact should facilitate the process of conceptualizing games by allowing its users the manipulation of the several elements that compose a game.

The first step was to define the project's – and therefore the toolkit's – conceptual framework. Several authors, who address games as systems and reflect about game's several elements, were considered for the framework's definition (Fullerton, 2014; Hunicke et al., 2004; Juul, 2003), with Fullerton's (2014) perspective being chosen as it reflected the project's goals.

The Gamers4Nature conceptual framework definition and evaluation process was developed through a User-Centered design approach (Sharp et al., 2019), with brainstorming session held with the postgraduate from a Master's degree course with extensive knowledge about the game design process (N=9) and experts in the game design field (N=4).

For the orientation of the sessions held with former master's students with knowledge and experience in the area of game design, academics and a game developer, an artifact composed of 19 hexagonal pieces (3cm each side) and a honeycomb structured board was developed. This artifact, handed to the participants at the beginning of each session, made it possible to explore the various concepts associated with the different game elements, as well as establishing associations and relationships between those elements.

By using the pieces, participants were able to explore ideas, articulate their thinking and establish dependency or symbiotic relationships between game elements. This exploration resulted in the construction of different structures capable of translating the various perspectives of game design. The possibility of exploring the different elements individually, to build structures capable of translating lines of thought and to establish relationships between the different elements was highly valued by the participants who used the artifact as a tool to support the systematization and exploration of ideas and concepts and they considered it to be a useful tool in promoting reflection.

Nevertheless, the limitations that should be considered in the validation process, namely the fact that participants were invited through convenience sampling and all already had strong or deep knowledge about the process of designing a game, the current results indicate that the approach to game design adopted in the Gamers4Nature project – based in Fullerton's (2014) approach – is adequate and able to be used in the development of the project's Toolkit. Future work will include the use of the Gamers4Nature Toolkit to Game Design in game design sessions with younger audiences (upper-secondary and undergraduate students) and in in different settings (e.g. one day sessions and Game Jam sessions), thereby exploring and strengthening the validation of the adopted approach.

Acknowledgments

References

Adams, E. (2014). *Fundamentals of game design* (3rd edition). Berkley, CA: New Riders.

Anderson, C. A. (2004). An update on the effects of playing violent video games. *Journal of Adolescence*, *27*(1), 113–122. https://doi.org/10.1016/j.adolescence.2003.10.009

Anderson, C. A., & Bushman, B. J. (2001). Effects of violent video games on aggressive behavior, aggressive cognition, aggressive affect, physiological arousal, and prosocial behavior: A Meta-Analytic Review of the Scientific Literature. *Psychological Science*, *12*(5), 353–359. https://doi.org/10.1111/1467-9280.00366

Bickman, L., & Rog, D. (1998). *The SAGE Handbook of Applied Social Research Methods*, Thousand Oaks. CA:SAGE Publications, Inc.

Boyle, E. A., Connolly, T. M., Hainey, T., & Boyle, J. M. (2012). Engagement in digital entertainment games: A systematic review. In *Computers in Human Behavior* (Vol. 28, Issue 3, pp. 771–780). https://doi.org/10.1016/j.chb.2011.11.020

Briot, J. P., de Azevedo Irving, M., Mendes De Melo, G., Vasconcelos, J. E. F., Alvarez, I., Martin, S., & Wei, W. (2011). A serious game and artificial agents to support intercultural participatory management of protected areas for biodiversity conservation and social inclusion. *Proceedings - 2011 2nd International Conference on Culture and Computing, Culture and Computing 2011*, 15–20. https://doi.org/10.1109/Culture-Computing.2011.12

Caillois, R. (1990). *Os jogos e os homens: a máscara e a vertigem - Trad José Garcez Palha.* Lisbon, PT: Cotovia.

Clement, J. (2021, December 21). *Number of indie games released on Steam worldwide from 2015 to 2017*.

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 and Education*, *59*(2), 661–686. https://doi.org/10.1016/j.compedu.2012.03.004

de Grove, F., Bourgonjon, J., & van Looy, J. (2012). Digital games in the classroom? A contextual approach to teachers' adoption intention of digital games in formal education. *Computers in Human Behavior*, *28*(6), 2023–2033. https://doi.org/10.1016/j.chb.2012.05.021

Earp, J. (2015). Game Making for Learning: a Systematic Review of the Research Literature. *International Conference of Education, Research and Innovation*, 6426–6435. Retrieved December 30,2021 from http://tinyurl.com/earp-lit-review

Earp, J., Dagnino, F., & Ott, M. (2014). Learning through Game Making: an HCI Perspective. *Universal Access in Human-Computer Interaction*, 513–524.

Elias, G., Garfield, R., & Gutscheram K. (2012). *Characteristics of Games*, Massachusetts, USA: The MIT Press.

Fullerton, T. (2014). *Game Design Workshop: a playcentric approach to creating innovative games* (3rd ed.). Massachusetts, USA: A K Peters/CRC Press Taylor & Francis Group.

Gee, P.J. (2008). Learning and Games. In K. Salen and K. Tekinbaş (Eds.) *The Ecology of Games: Connecting Youth, Games, and Learning*, Massachusetts, USA: The MIT Press, pp. 21–40.

Giannakos, M. N., & Jaccheri, L. (2018). From players to makers: An empirical examination of factors that affect creative game development. *International Journal of Child-Computer Interaction*, *18*, 27–36. https://doi.org/10.1016/j.ijcci.2018.06.002

Good, J., & Howland, K. (2017). Programming language, natural language? Supporting the diverse computational activities of novice programmers. *Journal of Visual Languages and Computing*, *39*, 78–92. https://doi.org/10.1016/j.jvlc.2016.10.008

Griffiths, D., & Davies, M. N. O. (2002). Excessive online computer gaming: implications for education. In *Journal of Computer Assisted Learning*, 18(3), 379-380. Doi: 10.1046/j.0266-4909.2002.00248.x

Howland, K., & Good, J. (2015). Learning to communicate computationally with Flip: A bi-modal programming language for game creation. *Computers and Education*, *80*, 224–240. https://doi.org/10.1016/j.compedu.2014.08.014

Huizenga, J. C., ten Dam, G. T. M., Voogt, J. M., & Admiraal, W. F. (2017). Teacher perceptions of the value of game-based learning in secondary education. *Computers and Education*, *110*, 105–115. https://doi.org/10.1016/j.compedu.2017.03.008

Huizinga, J. (2001). *Homo Ludens* (S. Perspetiva). São Paulo, BR: Editora Perspectiva.

Hunicke, R., Leblanc, M., & Zubek, R. (2004). MDA: A Formal Approach to Game Design and Game Research. *AAAI Workshop on Challenges in Game AI*, 30–45. Retrieved Dec 30, 2021 https://users.cs.northwestern.edu/~hunicke/MDA.pdf

Ivey, J. (2015). How important is a conceptual framework? *Pediatric Nursing*, *41*(3), 145–153.

Joel Michael, X., Martinkova, P., McFarland, J., Wright, A., Cliff, W., Modell, H., & Pat Wenderoth, M. (2017). Validating a conceptual framework for the core concept of "cell-cell communication." *HOW WE TEACH Generalizable Education Research Adv Physiol Educ*, *41*, 260–265. https://doi.org/10.1152/advan.00100.2016

Juul, J. (2003). The Game, the Player, the World: Looking for a Heart of Gameness. In M.Copier and J. Raessens (Eds.) *Level Up: Digital Games Research Conference Proceeding*, Utrecht: Utrecht University, 30–45.

Juul. (2005). *Half-Real: Video Games between Rules and Fictional Worlds*. Cambdridge: MIT Press.

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

Macklin, C., & Sharp, J. (2016). *Games, Design and Play: a detailed approach to Iterative Game Design*. Massachusetts, USA: Addison-Wesley.

Majuri, J., Koivisto, J., & Hamari, J. (2018). Gamification of education and learning: A review of empirical literature. *GamiFIN Conference 2018*, 11–19.

Merhi, O., Faugloire, E., Flanagan, M., & Stoffregen, T. A. (2007). Motion sickness, console video games, and head-mounted displays. *Human Factors*, *49*(5), 920–934. https://doi.org/10.1518/001872007X230262

National Research Council. (2007). Taking Science to School: Learning and Teaching Science in Grades K-8. Washington, DC: The National Academies Press. https://doi.org/10.17226/11625

Ogletree, S. M., & Drake, R. (2007). College students' video game participation and perceptions: Gender differences and implications. Sex Roles, 56(7), 537-542. https://doi.org/10.1007/s11199-007-9193-5

Pontual Falcão, T., Mendes de Andrade e Peres, F., Sales de Morais, D. C., & da Silva Oliveira, G. (2018). Participatory methodologies to promote student engagement in the development of educational digital games. *Computers and Education*, *116*, 161–175. https://doi.org/10.1016/j.compedu.2017.09.006

Robertson, J. (2012). Making games in the classroom: Benefits and gender concerns. *Computers and Education*, *59*(2), 385–398. https://doi.org/10.1016/j.compedu.2011.12.020

Salen, K., & Zimmerman, E. (2004). *Rules of Play: Game Design Fundamentals* Massachusetts, USA: MIT Press

Sharp, H., Preece, J., & Rogers, Y. (2019). *Interaction Design: beyond human-computer interaction* (Ed.; 5th Edition).New Jersey, USA: Wiley.

Sousa, M., Zagalo, N., & Oliveira, A. P. (2021). Mechanics or Mechanisms: defining differences in analog games to support game design. *2021 IEEE Conference on Games (CoG)*, Copenhagen, Denmark, 1–8. DOI: 10.1109/CoG52621.2021.9619055

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

Playing Sites of Memory: Framing the Representation of Cultural Memory in Digital Games

Stefano Caselli
University of Malta, Malta
stefano.caselli.19@um.edu.mt
[0000-0002-1751-8426](#)

Abstract
Basing on an understanding of digital games as cultural objectivations, this article suggests interpreting them as sites of memory, or in other words as 'carrier' of cultural memory. By merging game studies, literary studies, and memory studies, we aim at providing a theoretical framework useful to frame different kinds of representation within (and beyond) digital games towards cultural memory. The framework is inspired by Paul Ricoeur and his threefold model of textual mimesis and favours an approach to digital games that takes into account how they represent and re-configure pre-existent cultural forms, and therefore get refigured into novel ones during, after, and beyond the game experience.

Keywords *memory studies, sites of memory, cultural memory, game studies, literary studies.*

1. Introduction to Digital Games as Sites of Memory

By drawing upon recent approaches that frame digital games towards cultural memory studies and vice versa, this article aims to provide a framework addressing digital games as cultural objectivations. The subfield of historical games, among others, is increasingly inspired, or directly borrowed, from memory studies and scholars (see Hammar 2017, 2019a, 2019b, 2020; Cooke, & Hubbell 2015; Pötzsch, & Šisler 2016; Šisler 2016), which heightens the importance of bridging the knowledge of memory, literary, and game studies. Hence, we suggest understanding digital games as 'sites of memory', a concept that relies on two fundamental assumptions: first, that digital games can convey cultural memory and take part in a broader, transmedia memory framework; second, that this conveyance can be fruitfully addressed and understood by approaching digital games as texts.

Before we proceed, it is therefore necessary to take a step back and define what a 'site of memory' is, or can be, and how we find this idea useful to tackle the relationship between games and cultural memory. The concept 'sites of memory' draws upon the work of Pierre Nora and is "certainly the most prominent and internationally most frequently practiced approach to cultural remembrance" (Erll, 2011, p.27). In what follows, we will frame digital games towards this concept for operational purposes only. Additionally, and according to the meaning of the term introduced by Nora, we will use 'site of memory' without any reference to spatiality as a privileged field for the emergence of remembrance or memory: here, 'site' is used not to point out an environment or a space but rather "any significant entity, whether material or non-material in nature" (Nora, 1996, p.xvii). According to Nora, a site of memory is a cultural objectivation in the broadest sense of the term, including not only material

objects such as texts but even present or past events, such as rituals or commemorations. By considering the concept of 'cultural objectivation' as broad as those of 'texts', 'artefacts', and 'media', we shall understand all of them interchangeably to include both texts like books, paintings, tales, songs and ballads, sculptures, monuments, signboards, movies, photographs, recordings, architectures, and buildings, and even performances, rituals, and so on and so forth. It may be evident that, according to this understanding, even digital games can be intended, analysed, and experienced as cultural objectivations. Nonetheless, it is worth considering that not all cultural objectivations are, according to Nora, sites of memory.

To be a site of memory, a cultural objectivation must fulfil a certain memorial function in society and must evoke memories as part of this function. Nora gives primary importance to this dimension of sites of memory: "[t]o begin with, there must be a will to remember. If we were to abandon this criterion, we would quickly drift into admitting virtually everything as worthy of remembrance" (Nora, 1989, p.19). Other memory scholars, and especially those interested in media memory, speak in terms of 'mnemonic functionalisation' on that purpose. Inspired by Stuart Hall (Hall, 1973), Erll distinguishes for example between two sides of mnemonic functionalisation, namely: (1) production-side functionalisation, which refers to cultural objectivations that intentionally encode "messages for posterity" (Erll, 2011, p.124), such as monuments or memorials, and all the cultural objectivations that are made to "elicit processes of remembering in the future" (idem, p.125); and (2) reception-side functionalisation, which refers to the very fact that a site of memory "exists when people think it does. As soon as a medium is perceived and used as such, it turns into a medium of memory – even if it was never intended to be one" (ibid.). Reception-side functionalisation, therefore, mostly refers to retrospective functionalisation, that deals with cultural objectivations that were not intended to be used as sites of memory in a first place – or rather, regardless of the intentions of their creators, designers, or performers (assuming that there are such: even things from the natural world can be intended as sites of memory). Therefore, a site of memory is not a given but rather "comes into being through a complex interplay of various material and social factors" (Erll, 2011, p.125). Additionally, "every lieu de mémoire is symbolic by definition" (Nora, 1992, p.x), i.e., it must have a symbolic meaning for the community it functions towards (Nora, 1989, p.9). We are uninterested here in deepening the concept of symbol or symbolisation: we may limit ourselves to use 'symbol' to describe something that stands for something else, in a way that is analogue to representation. What is worth noting is that mnemonic symbols can be 'imposed' and 'constructed': in other words, just like functionalisation, the "symbolic and memorial intention [can be] inscribed in the object itself" (imposed) or they can be constructed by "unforeseen mechanisms, combinations of circumstances, the passage of time, human effort, and history itself" (Nora, 1992, p.x).

By considering digital games as sites of memory, we then choose to align with two different perspectives: that of production-side functionalisation and imposed symbolic dimension, and that of reception-side functionalisation and constructed symbolic dimension. In other words, the distinction introduced by Nora and subsequent memory scholars will allow us to analyse how digital games favour remembrance of a collective past from both the perspective of their designers and their users.

It is worth specifying that, despite reflecting on the production-side of sites of memory can provide fruitful insights for designers interested in dealing with the past through digital games, it is on the reception-side that meanings are produced, events are remembered, symbols recognised, and mnemonic functions implied. It is therefore worth emphasizing that the two sides cannot be entirely separated, if not operationally and for analytic purposes.

Before proceeding, it is also worth noting that the very ideas of cultural memory and of sites of memory are bound to representation, to the point that the concept of cultural memory tends to be associated with representation and represented content (see Huyssen, 1995; Erll, 2011). A comprehensive definition of representation would take us far from the matter in hand here. Inspired by Kendall Walton, we operationally define representation as a synonym of 'fiction' in the broadest sense of the term: representations are props for make-believe games (Walton, 1990, pp.59-60) that associates certain meanings or roles to certain objects. To use an example provided by Walton himself, suffice it to think of two children that plays according to a rule that associates bears to stumps. When the two children find a stump, they react as it is a bear. Within their game, therefore, the stump is a representation of a bear (idem, pp.37-40).

Regardless of the emphasis some memory scholars put on collective rituals and collective procedural memory as an un-representational form of cultural memory, most of the analysis focused on cultural memory still focus on content, representation, metaphor, and symbols. We may therefore dedicate particular attention to representation in analysing memory-making and digital games. This does not mean that digital games are limited to representation: in digital games, represented cultural memory can be manipulated, transformed, affected by players (see Hammar, 2017, 2019a, 2019b). The framework we will provide is nonetheless aimed at suspending judgement on digital games intended as simulations, and therefore on the use of procedural rhetoric (see Bogost, 2007) or the metaphorical use of certain game mechanics to convey meaning (see Möring, 2013), and therefore at providing an overview of different kinds of memory-making in games.

The following paragraphs will be dedicated to the building of our framework, inspired by literary studies and memory studies.[1] The framework will tackle different kinds of mimesis in digital games, and it can be useful for both game designers and users.

2. Digital Games as Memory-making Texts

Just like other texts, digital games can be understood as a medium of cultural memory, i.e., as sites of memory. In other words, just like other texts, digital games can "fulfil a multitude of mnemonic functions, such as the imaginative creation of past life-worlds, the transmission of images of history, the negotiation of competing memories, and the reflection about processes and problems of cultural memory" (Erll, 2011, p.144). We may use the tripartite model of mimesis introduced by Paul Ricoeur to analyse how texts intended as media of memory afford memory-making. Despite the model is aimed at describing literary texts, we find it productive to use it towards texts in general, and digital games in particular.

Ricoeur (1984) introduces the model of the 'circle of mimesis' tracing the significance of mimesis, i.e., representation, back to Aristotle. He identifies three different levels of representation in literature: the prefiguration of the text; the textual configuration; and the refiguration by the readers. We may summarise them in the attempt of transforming such model into an operational framework for our present purposes.

'Prefiguration' stands for the 'preunderstanding' of reality. Every experience of reality is, according to Ricoeur, symbolically, semantically, and temporally preformed: "[…] there is no human experience that is not already mediated by symbolic systems and, among them, by narratives" (idem, p.74) [1]. In other words, no experience of reality is experienced without a previous identification of its structural features (idem, p.54). It is worth specifying 'reality' here is not to be intended as the reality of an alleged objective world 'as it is' but rather the reality of the memory culture, or network, a text is produced within and towards. Erll suggests approaching mnemonic prefiguration by focusing attention on the areas of pre-understanding that concern cultural memory (Erll, 2011, p.153). Accordingly, we use Wolfgang Iser's term 'textual repertoire' to point out "all the familiar territory within the text [being it] in the form of references to earlier works, or to social and historical norms, or to the whole culture from which the text has emerged" (Iser, 1978, p.69). To speak of mnemonic prefiguration means observing how a text refers to the repertoire of different dimensions of memory culture, and how, and therefore focusing on, among other aspects, how certain mnemonic communities mediate, in different media forms, their shared past.

By 'configuration', Ricoeur means the process that mediates between prefiguration and refiguration (1984, pp.64-70). Once prefigured elements become part of the text, they get arranged in certain orders, or 'emplotted' (ibid.), and therefore become fictional: configuration "opens the kingdom of the as if" (idem, p.64). Configuration cannot but lead to deviate from previously established textual traditions:

> "There is always a place for innovation inasmuch as what is produced […] is always, in the last analysis, a singular work, this work. This is why the paradigms only constitute the grammar that governs the composition of new works-new before becoming typical. In the same way as the grammar of a language governs the production of well formed sentences, whose number and content are unforeseeable, a work of art – a poem, play, novel – is an original production, a new existence in the linguistic kingdom" (idem, p.69).

At the same time, even highly deviated narratives or texts rely at a certain degree on cultural framework of tradition that precedes and encapsulates them: even "[t]he labor of imagination is not born from nothing. It is bound in one way or another to the tradition's paradigms. But the range of solutions is vast" (ibid.). A text re-configures, constructs, and re-arrange prefigured elements of a memory culture. Erll claims on this purpose that "[a text is not simply] a re-presentation of reality; in fact, configuration is an active, constructive process, a creation of reality" (Erll, 2011, p.154). To speak of mnemonic configuration means analysing how prefigured elements from different dimensions of a memory culture are arranged in a text, and how they create fictional worlds (and fictional memories) from pre-existing elements extrapolated by the actual world.

'Refiguration' refers to the reception and interpretation of a given text by the readers. It is in the act of reading, according to Ricoeur, that fiction is reconnected with (and reconfigured by) the world of action: "it is only in reading that the dynamism of configuration completes its course. And it is beyond reading, in effective action, instructed by the works handed down, that the configuration of the text is transformed into refiguration" (Ricoeur, 1988, p.159). The interpretation of a text is not only something individual (despite of course framed towards a community of interpreters and upon a repertoire and tradition of previous interpretations): it also becomes something collective, as individual interpretations influence cultural practices ('actions') and therefore produce novel prefigured elements. One of the broadest effects of textual refiguration that Ricoeur mentions is temporal orientation, intended as the influence that narrative structures have in our understanding of the passing of time, of the meanings of certain events, and of our acknowledging the passing of time and the relationship between past and present. In addition to this influence, that derives from the formal structure of texts, more evidently texts influence and affect culture through their content. This is one of the major interests of cultural memory scholars. Inspired by Ricoeur, Erll claims that:

> "Representations of historical events (such as wars and revolutions) and characters (such as kings and explorers), of myths and imagined memories can have an impact on readers and can re-enter […] the world of action, shaping, for example, perception, knowledge and everyday communication, leading to political action – or prefiguring further representation (and this is how the circle of mnemonic mimesis continues to revolve)" (Erll, 2011, p.155).

In other words, it is through the constant transformation of prefiguration in configuration (emplotment), configuration in refiguration (reading and interpretation), and refiguration in prefiguration (the impact interpretation has on readers and their behaviours and beliefs) that certain 'interpretive communities' (communities that share a same way of reading and interpreting, i.e., that collectively refigure certain representations – see Fish, 1980) raise. By paraphrasing Ricoeur's "[w]e are following therefore the destiny of a prefigured time that becomes a refigured time through the mediation of a configured time" (Ricoeur, 1984, p.54), we may observe that texts configure prefigured elements and meanings, that then become refigured by their reading and interpretation, therefore mediating between a pre-existing and surrounding memory culture and its 'potential restructuring' (Erll, 2011, p.156). We may summarise this threefold model for textual representation and cultural memory, inspired by Erll, as follows (Figure 1).

Throughout the rest of the article, we will use this framework to analyse and discuss digital games. More specifically, we will provide a framework to analyse prefigured cultural elements and textual representations within digital games, as well as and different dimension of cultural refiguration (mental, social, material) that derive, or are affected by, certain interpretations of digital games.
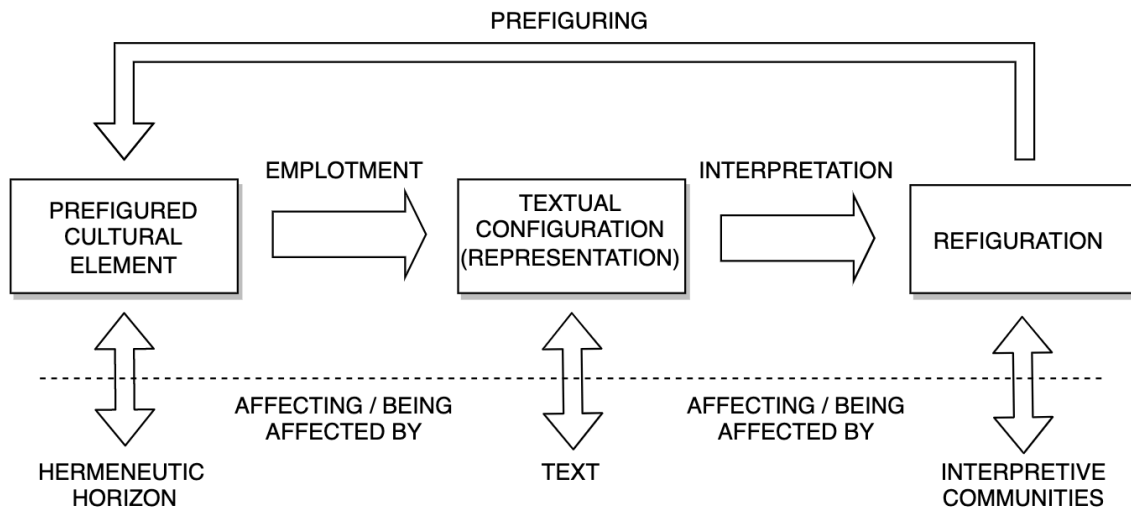
Figure 1. Framework for textual representation and cultural memory, drawing upon Ricoeur and Erll.

3. Mnemonic Prefiguration and Digital Games

In the first kind of representation, we focus on is mnemonic prefiguration. Here, and from this paragraph on, 'representation' is used as a synonym of 'mimesis' in Ricoeur to include even nonliteral representations but also metaphors, fictionalisations, references, or iconisation.

Mnemonic prefiguration refers to elements that belong to, and are mediated by, the cultural horizon (see also 'hermeneutic horizon' in Gadamer, 1977; or 'repertoire' in Iser, 1978) that pre-exists and surrounds the production of a digital game. By focusing on mnemonic prefiguration, we may enquiry which elements are being prefigured by a digital game, which cultural dimension do these elements originally have, and how they have been transformed and mediated by the cultural framework towards which the digital game in question is designed. In other words, enquiring mnemonic prefiguration in digital games means to focus on remediation, premediation and their dynamics towards digital games. To enquiry about mnemonic prefiguration means, in a first place, asking what is being represented within a game. More precisely, enquiring what is being represented implies also understanding what dimension of memory culture is being represented, and therefore how what is being represented is framed towards a broader sociocultural framework. We define a mnemonic prefigured element as an element that is remembered by a mnemonic community, and therefore as a mediated memory collectively shared and individually actualized across the members of such community. It is therefore worth inspecting how such element is borrowed by the broader sociocultural framework of textual representations before it is transformed and framed towards the fictional world in question. Therefore, acknowledging how such elements are influenced by ideologically or hegemonically biased frameworks is also pivotal here.

Another thing we find it worth specifying before proceeding is that the prefigured elements we will deal with are not to be intended as actual events, characters, or elements. We can understand as prefigured elements both the Second World War, an actual historical event, and the Division of Arnor, which took place during the Second Age in the fictional world of the Middle-earth (1954 The Lord of the Rings by Tolkien); both Otto von Bismark's uniform and Ezio Auditore's (Ubisoft Montreal 2009 - Assassin's Creed II) hidden blades. Erll speaks of 'memory of literature' to designate the return, in literary texts, of elements from earlier works of art in terms of intertextuality, intermediality, processes of canon formation and literary historiography (Erll, 2011, p.68). Similarly, we would like to emphasize once more that prefigured elements have to be interpreted as the 'memory of fiction' that texts inherit from previous mediated forms of cultural expression, regardless of their truth value.

Basing on the previous paragraphs, we may then provide a framework to address mnemonic prefiguration in digital games. Such framework will be twofold, as it addresses both the production-side and the reception-side of digital games, and is therefore to be intended as directed both to designers of digital games and their users (being them game scholars, memory scholars, historians). The part of the framework provided here must be intended as a tool that may prove useful for avoiding misunderstandings and misconceptions from the production side, and for studying and inspecting representational cultural memory in digital games from the reception side – it is therefore not to be intended as something strict but rather fluid, dynamic, and mainly for operational purposes.

Considering a prefigured element X that a game designer is willingly to represent in its digital game, it is profitable to:

- Identify implied mnemonic communities.

   To begin with, game designers that are interested in functionalising their worlds as sites of memory may identify the mnemonic communities they are referring to. Who are the implied users of the digital game in question? In other words, which are the implied mnemonic communities that the game is directed to, and that will be able to functionalise the game in question as a site of memory? Other questions that may rise that are similar to this one are: is any of the mnemonic communities of users the designer is implying for the digital game in question sharing a whole different vision of X? Are the different visions of the implied mnemonic communities going to clash? Why do these visions clash, and is the representation of X the designer would like to have within the game inclined towards any of them?

   Such set of question is a precondition for those that follows, as it can direct the effort of the designer towards a specific hermeneutic horizon that he/she is aware of. None of the subsequent questions is in other words thinkable without reference to specific mnemonic communities.

- Acknowledge X as a prefigured.

Once acknowledged both the implied mnemonic communities that the designers would like to construct, it is worth tracing back a mnemohistory of *X*. The depth and precision of such mnemohistory of course depends on the intention of the designer. To trace back a mnemohistory of *X* means to focus on its cultural memory dimension (material, social, or mental – see Erll, 2011) as well as on its previous remediations (see Bolter, & Grusin, 1999).

- Functionalise *X* as a site of memory – represent *X*.

  Basing on the previous questions and observation, designers may choose how *X* is going to be represented within the digital game in question, and how is it going to be recognized, interpreted, and understood.

By using this framework, game designers may put the representation they would like to implement in their game in relation with a broader cultural memory framework – therefore not only avoiding possible misunderstanding and misreadings (i.e., possible mismatches between the production-side and the reception-side functionalisation of the site of memory) and favouring the construction of certain implied designers but, most importantly, acknowledging the complexity of the memory framework they are borrowing elements from, and therefore reflecting on hegemonically biased representational traditions, on ideologically-influenced clichés, and so on and so forth (see Hammar, 2017, 2019a, 2019b; Hammar, & Woodcock, 2020; Mukherjee, 2016, 2017; Sterczewski, 2019). Without such a close consideration of the surrounding memory framework the risk of being exposed to unwanted hegemonic biases cannot but increase. At the same time, it may happen that a designer does not intentionally represent something within a digital game, and that nonetheless users recognize the game as a site of memory. In that case, the designer may find useful to approach the game from the perspective of the users, therefore acknowledging if something is being unintentionally represented (or if something is unintentionally resonating with some mnemonic community of users). In this case, the reception-side of the framework provided above may be as follows.

Considering a representational element *Y* within a digital game, or the game itself intended as a representation of the past (once the simulation is over) on the other hand, it is profitable to:

- Functionalise *Y* as a site of memory – as a representation of *X*.

  Reception-side functionalisation, as already noticed, prescinds entirely from the intentions of the designer. In other words, users/interpreters may ask themselves what *Y* is representing and acknowledge that *X* is something that deals with their past, therefore taking part in a broader framework of representations of the past.

- Acknowledge *X* as prefigured.

  Once acknowledged that *Y* is representing *X*, and that *X* is something that deals with the past, it is worth for the receivers to trace back a mnemohistory of *X*. The depth and precision of such mnemohistory of course depends on the intention of the user, or scholar, and of course can be interpreted as: acknowledging the cultural memory dimension of *X*; and acknowledging previous remediations of *X*.

- Identify implied mnemonic communities.

Another concern that must be accounted in dealing with mnemonic prefiguration within digital games is the hermeneutic horizon towards which such prefiguration can be recognized, and therefore functionalised. No analysis of digital games intended as sites of memory can prescind from referring to specific mnemonic communities, since there are no meanings, interpretations, or memories that prescind from hermeneutic and cultural horizons.
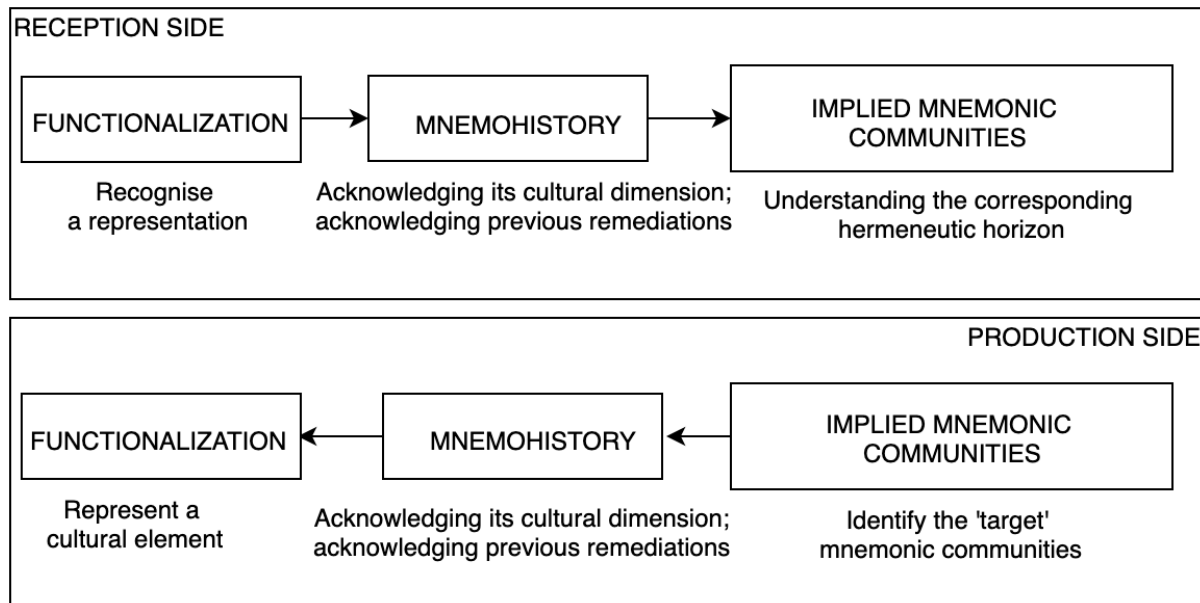

Figure 2. Prefiguration and functionalization.

By using this approach and framework, users of games may recognize and interpret what they experience within a digital game towards a broader cultural memory framework – regardless both the intentions they imply the designers have and those actual designers have had during the design.

4. Textual configuration in digital games

To merge the lexicon of Ricoeur and that of Walton, we may claim that once prefigured elements become part of a story (in a literary text), become represented, or become elements of a make-believe game, their ontological status changes (Erll, 2011, p.154) – i.e., they become fictional. Textual configuration refers to the arrangement of prefigured elements, and the construction of networks of meaning (ibid.) that are internal to fictional worlds. This of course regardless of the truth-value of what happens in the fictional world in question: even historical fictions that have a certain degree of accuracy are nonetheless to be intended 'fictions', as we have seen throughout the previous paragraphs. Mnemonic icons, symbols, and representations of elements that belong to the cultural memory of certain communities, get re-arranged and transformed once they become part of a fictional world.

To enquiry textual configuration of mnemonic prefigured elements means, in a first place, asking how such elements are being represented within a digital game, and how they get in relation with

others as parts of a fictional world. We define textual configuration as the creation of a set of relations, concepts, and narratives that lay at the basis of a fictional world: the arrangement of buildings and natural elements in space, the appearance of façades, written texts, and characters, the relationship between two virtual entities, the morphology of a virtual continent, a specific set of actions and behaviours, and so on and so forth – textual configuration includes all "the internal laws of a [text]" (Ricoeur, 1984, p.53), or (with reference to Roy Sommer) the 'narrative potential of fictional texts', i.e., "an assumption substantiated by the text regarding the possible effects of the narrative strategies which structure and organize its content and are thus essential for its meaning" (Sommer, 2000, p.328, as cited in Erll, 2011, p.157).

Basing on the previous paragraphs, we may provide a framework to address textual configuration in digital games. Such theoretical framework is to be intended as directed both to game designers and users (being them game scholars, memory scholars, historians), and therefore will not distinguish, as the previous one, between reception-side and production-side functionalisation.

Being a textual feature, textual configuration is better considered from the perspective of textual analysis. We shall then construct our framework basing on a narratological model, and especially that introduced by Seymour Chatman (Chatman, 1978, p.26). That provided by Chatman is one of the most successfully reused classifications in narratology, and it is thought to be used to address narratives in both literary texts and films. We therefore use his model to identify various 'building blocks' of a digital game intended as a text: of course, we are not implying here that digital games have to tell stories to be interpreted as texts. As will be clearer as follows, the framework we will provide is suitable both for digital games that provide users with interactive narratives and for games that, on the other hand, are devoid of narrativity and are, for example, only composed by digital environments that users are free to explore.

Considering a prefigured element *X*, in order to represent it and re-arrange it, together with others, one may choose to:

- Represent *X* as content.

  According to narratology and structuralist readings of narrative texts, 'content' refers to the story, or the fabula. To put it simply, we term 'content' what is being told within a text, or rather all the elements and events that are part of the fictional world that can be experienced from a text. It is worth noting that every kind of content is influenced by, among other things, the genre and kind of the digital game in question, and therefore by all the clichés and genre conventions that pre-exist it as a text (see 'tradition' or 'repertoire'). We distinguish, according to Chatman, two different ways to represent *X*:

  o Representing *X* as an existent.

    Existents occur in a fictional space (Chatman, 1978, p.96) and are the fundamental constituents of a fictional world as well of its narrative. In other words, every virtual object is to be taken as an existent in narratological terms: characters, buildings, landscapes,

trees, transportations, weapons, clothes, furniture, clouds, creatures, and so on and so forth. By representing *X* as an existent, designers may choose to iconise it and attach it on the back of feather, or rather to transform it into a character, monster, or whatever, depending of course on the very original nature of *X*. Moreover, each virtual object has its own agency and affordances just like each cinematic objects has its own role within the narrative of a movie. If *X* is a character, it may perform certain actions, it may have certain behavioural patterns, a certain voice, a background, and so on and so forth. On the other hand, *X* can also be a written logo on a sign. It is up to the designer to construct a representation of *X* that fits all the others that are within the same game.

o Representing X as an event.

Events occur in a fictional time, and they involve actions of fictional existents (Chatman, 1978, p.96). This means that, at least in a minimal sense, every event or chain of events could construct a story. In digital games, it is worth specifying that there is a difference between represented events and events that users can affect or create, i.e., simulated events. By representing *X* as an event, we point out processes that get merely represented and towards which users have no influence or agency of any sort. Such events, pre-scripted by design, are analogue to those one may find in television or literature – they are received, 'read', and interpreted by users (Aylett, 1999). Represented events could be cutscenes, pre-scripted dialogues, animated sequences, or written texts that introduce, intersperse, or close the gameplay sections.

• Represent X as discourse.

Discourse is usually intended as 'the expression plane' of fiction (Chatman, 1978, p.146). Fictional memory and processes of remembering have always been a dominant topic in fiction: "[n]umerous texts portray how individuals and groups remember their past and how they construct identities on the basis of the recollected memories" (Neumann, 2008, p.333), or more broadly "are concerned with the mnemonic presence of the past in the present, […] re-examine the relationship between the past and the present, and […] illuminate the manifold functions that memories fulfil for the constitution of identity" (ibid.). This is observable for what concerns both the individual and the collective levels of memory, and texts can explicitly reflect on the nexus of memory and identity or can represent such nexus 'implicitly' (see also Neumann, 2008, p.333). Fictional memory, differently from more or less intentional referential memory traces, icons, or elements (Y that represents *X*), is what Neumann terms 'the mimesis of memory', i.e., "the ensemble of narrative forms and aesthetic techniques [through which texts] stage and reflect the workings of memory" (Neumann, 2008, p.334), and devoid of any sort of reference to culturally prefigured elements. 'Mimesis' here is used as Ricoeur's 'mimesis3' to point out 'configuration', i.e., to indicate the productive quality of fictions instead of their mimetic qualities (ibid.).

Instead of furthering deepen this kind of representation, we may group under it all those discursive and rhetorical devices that allow designers to present the content of their games,

and therefore to construct fictional memory: pre-scripted cinematic sequences may for example feature, on the plane of expression, camera angles, video editing, soundtracks; virtual texts may have their own narrators, as well as their rhetorical textual devices, expressions, tone, et cetera. Other than that, digital games may provide users with narrators that accompany them through their exploration or progression – the adventure digital game *What Remains of Edith Finch* (Giant Sparrow 2017), for example, features several comments of a narrator as the user explores the game. In such cases, narrational discourse is explicitly present within the game in question and can be designed as in other kinds of text (see Chatman, 1978, pp.146-261), using, e.g., retrospection or analepsis (Genette, 1972, p.40).

Representing memories through discourse in a digital game means also, for example, to remediate forms of expressions, or formal structures, rather than contents, such as previous non-virtual technologies and aesthetics (McCrea, 2009); modes of representation or styles; et cetera. The implementation of narrative voices, as well as focalizations, chronotopoi, or other narrational devices are of course other strategies to create fictional memories.

This part of the framework may help framing different mnemonic icons, or mnemonic elements, towards a broader narratological network of textual analysis. Both designers and users may find profitable to observe textual configurations and prefigured mnemonic elements within text using it. Additionally, this framework may be used to address memory-making in unhistorical representations of digital games. By speaking of textual configuration, one may observe how even a fictional world's depiction of an alien race of pale-skin hairless humanoids such as the Helghan in *Killzone* produced by Guerrilla Games 2004 is contributing to our memory of Nazi Germany, favouring collective memory-making around our cultural understanding and re-interpretation of the Third Reich. On the other hand, by using this framework one may acknowledge how certain elements of the past are configured and re-imagined differently, selectively, or reductively (see Caselli, & Toniolo, 2021).

5. Refiguration of digital games

Digital games can be refigured in many ways across memory cultures. Just like other texts, digital games can, and do,

> *"[mould] memory culture […] through its structure and forms, but of course, and more obviously so, also through its contents: representations of historical events (such as wars and revolutions) and characters (such as kings and explorers), of myths and imagined memories can have an impact on readers and can re-enter […] the world of action, shaping, for example, perception, knowledge and everyday communication, leading to political action - or prefiguring further representation (and this is how the circle of mnemonic mimesis continues to revolve)"* (Erll, 2011, p.155).

Some games get iconized and become memes, or symbols, used within the political debate, such as 2019 *Untitled Goose Game* developed by House House; others aim at persuading, informing, or mobilise users, such as *September 12th: A Toy World by Frasca* in 2010 or *Darfur is Dying* by Ruiz, in 2006, or more broadly at commenting the actual world; still others can move users to explore, traverse, and know the actual world (see augmented reality games such as Pokémon Go by Niantic, Inc. in 2016, or games designed to promote actual museums, sites, or places such as Prisme7 by

Game in Society & Bright in 2020, designed to represent and simulate the heritage of the Centre Pompidou.

A proper framework to deal with refigured digital games may address all the elements in a memory culture that derive from a game, i.e., that are remediations of something that appears in a game. Despite it is hard to provide an extensive list of how digital games can be refigured in a memory culture, the subsequent framework is aimed at providing a taxonomy of how digital games can circulate and affect other media forms, therefore moulding the memory culture that receives them, and within which they get activated and negotiated. Being that refiguration is something that can be observed and carried out by the members of a mnemonic community and is not something that can be designed by game designers, the subsequent framework will only refer to receivers, being those users, scholars, journalists, or whoever may be interested in the influence that digital games may have in the surrounding memory culture.

Considering an element Z of a memory culture and a representational element Y within a digital game (regardless how it is configured within the game in question), or the game itself intended as a text, and specified that every Z function toward a specific set of mnemonic communities, we may distinguish between:

- Material refiguration of Y: Y can be re-mediated by the material dimension of a memory culture.

  Here, Z is to be intended as an artifact, a medium, a technology, or a text. The goose from *Untitled Goose Game* (House House, 2019) represented in billboards and posters during anti-Brexit rallies in October 2019 is a clear example of such refiguration. Concepts such as that of de- and resemiotization (Lachmann, 1993), mnemonic iconisation (Erll, 2011), and remediation (Bolter, & Grusin, 1999) are all pivotal in inspecting and discussing material refiguration. Virtual characters, spaces, objects, symbols can (and do) be painted on walls, become subjects of movies or multimedia franchise, take part in the public debate, or become, even despite themselves, ideologically charged symbols. Intertextual references and processes of canonization are all to be intended as examples of material refiguration but also fanfictions and other forms of participatory fandom entailed in the contemporary popular culture (see Barton, 2014).

- Mental refiguration of Y: here, Z has to be intended as a schema, a concept, a code, or a mental disposition enabled through symbolic mediation (Erll, 2011, pp.103-104).

  The representations of the past that are shared within mnemonic communities contribute determining the very hermeneutic horizon of their members. In other words, users of digital games tend to be influenced by how these games depict the past even in their mental dispositions, or in the very way they understand and interpret their present. This is particularly observable in how contemporary relationships of power determine how we recollect our own past, influencing popular media and therefore digital games (Hammar, 2019). In this sense, games are to be intended as nothing but a technology, or medium, that contributes

constructing (Hammar speaks in terms of 'manufacturing') dominant cultural memory among others, for example marginalizing groups or counter-hegemonic ideologies, dehumanizing or underrepresenting antagonists and subalterns (ibid.; see also Beverley, 2001, p.54; Calafell, 2016; Hall, 1997; Pandey, 1995; Said, 1979; Spivak, 2010). Every representation of the past, both explicit or metaphoric, affect our very way to understand and recollect it even when we enquiry, receive or understand novel representations of it. In other words, mental refiguration refers to all those concepts and mental dispositions that derive from digital games.

- Social refiguration of *Y*: here, *Z* has to be intended as a practice, a ritual, or a commemoration that 'carries' cultural memory.

Cosplaying can be a good example of such practices: in cosplaying, fans produce their costumes inspired by fictional characters and appropriate of existing stories or imaginaries through performativity (Lamerichs, 2011; see also Butler, 2004), therefore momentarily escaping from their actual identities and entering in an imaginative world through role/identity-transformation (Rahman et al, 2012). Cosplaying can be inspired by, among several popular media, digital games, and can therefore imply the transformation of a fan in a virtual character – therefore offering a clear example of social refiguration of a digital game.

As a matter of fact, closely interconnected with social and mental refiguration of representational aspects of digital games as sites of memory are all those practices, performances, behaviours, knowledges, schemata, and concepts that themselves happen, get performed, or actualized, within digital games.

Many are the examples of funerals and commemorations held within digital games, such as that of *Final Fantasy XIV: A Realm Reborn* by Square Enix 2013, to mourn the death of users (Elliott, 2020) or celebrities (users paid tribute with spontaneous memorials or ceremonies, e.g., for the death of the mangaka Kentaro Miura of May, the 19th 2021). Other times, virtual worlds such as *Second Life* by Linden Lab in 2003 have become sites for museums, memorials, and monuments dedicated to collective traumas or events (such as 9/11 or the digitization of other traumatic memories: see Trezise, 2011). Such practices are not pre-designed or represented but instead actively invented and performed by users as de-facto participatory cultural expressions.

6. Conclusions

The framework provided so far, inspired by Ricoeur and contemporary memory studies, aims at merging hermeneutics and literary studies to approach digital games intended as sites of cultural memory. Such methodological approach is useful to address how certain elements of digital games are framed towards a broader memory framework; get re-arranged and transformed within gameworlds; and can therefore produce cultural effects outside of them (figure 3).

By using this framework, different kinds of mimesis can be recognised, analysed, and interpreted according to the need of game designers, users, or scholars, in a more systematic and thorough way.
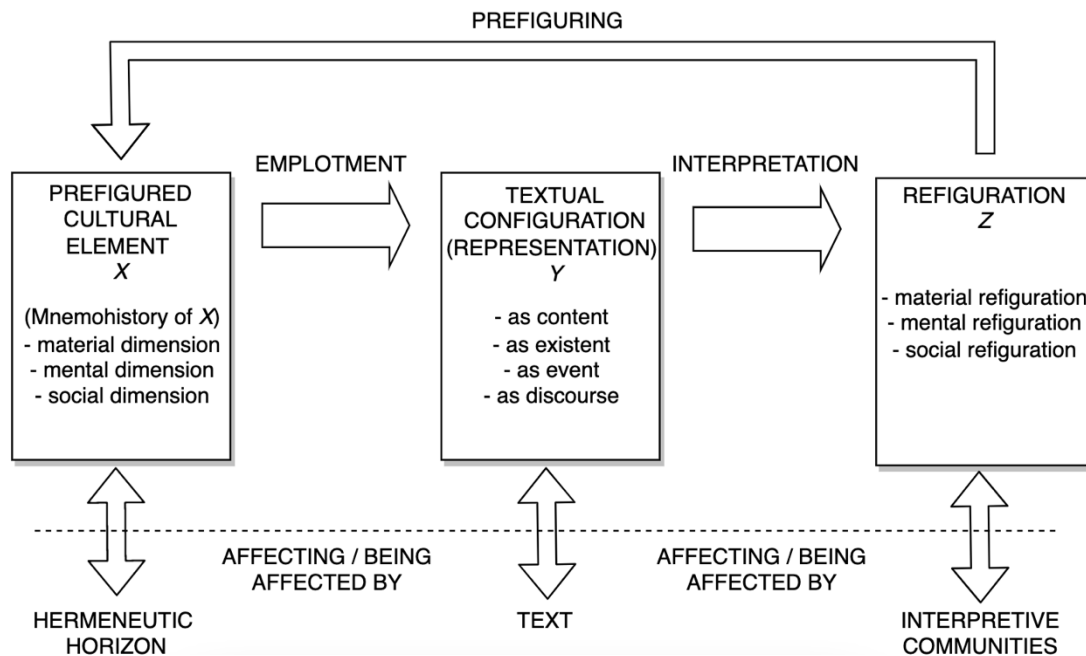

Figure 3. Framework for textual representation and cultural memory.

Further avenues of this research may include:

- applying the framework to specific case studies, namely: digital games that get functionalised as sites of memory from both production and reception sides (first attempts of this can be found in Caselli, 2021; Caselli, & Toniolo, 2021);

- intertwining representational aspects, outlined, and analysed so far, and simulative aspects of digital games. An understanding of how players can actively re-configure and affect, other than understand, recognise, and interpret all the representational aspects presented, is pivotal: this framework is a first attempt of merging literary studies, memory studies, and game studies but it needs to be complemented by a close observation of the dynamics of simulation to grasp the complexity and mnemonic potential of digital games intended as sites of memory. In this sense, all its sections may be enriched by insights from digital hermeneutics, game aesthetics, and game design.

Endnotes

[1] Since our theoretical framework draws upon narratology and hermeneutics, we may focus on the concepts of representation and narrative, broadly intended, without dealing with game studies topics such as interactive storytelling or narrative architecture (Jenkins, 2003).

References

Aylett, R. (1999). Narrative in Virtual Environments -Towards Emergent Narrative. In Proceedings of the AAAI fall symposium on narrative intelligence (pp. 83-86). Retrieved Dec 30, 2021 from https://www.aaai.org/Papers/Symposia/Fall/1999/FS-99-01/FS99-01-014.pdf

Barton, K. M. (Ed.). (2014). *Fan CULTure: Essays on participatory fandom in the 21st century*. Jefferson, NC: McFarland.

Beverley, J. (2001). The im/possibility of politics: Subalternity, modernity, hegemony. In I. Y., Rodriguez, I. Y. (Ed.). *The Latin American subaltern studies reader* (pp.47-63). Durham: Duke University Press.

Bogost, I. (2007). *Persuasive games: The expressive power of videogames*. Cambridge, MA: The MIT Press.

Bolter, J. D. & Grusin, R. (1999). *Remediation. Understanding new media*. Cambridge, MA: The MIT Press.

Butler, J. (2004). Bodily inscriptions, performative subversions. In S., Salih & J., Butler (Eds.). *The Judith Butler reader* (pp.90-119). Malden, MA: Blackwell.

Calafell, B. M. (2016). *Monstrosity, performance, and race in contemporary culture*. New York, NY: Peter Lang.
https://doi.org/10.3726/978-1-4539-1719-0

Caselli, S. (2021). Counter-Strike e il counterstrike americano: giocare per ricordare la guerra al terrorismo. In L., Papale & F., Toniolo (Eds.) *Valve Corporation. Videogiochi, visioni e virtuosismi di un'azienda rivoluzionaria* (123-139). Milano: Biblion.

Caselli, S. & Toniolo, F. (2021). Sposare una Z23. Feticizzazione del passato e antropomorfismo moe a sfondo storico nel videogioco. *Diacronie. Studi di storia contemporanea*, 47(3), 127-146.

Chatman, S. (1978). *Story and discourse: Narrative structure in fiction and film*, Ithaca: Cornell University press.

Cooke L., & Hubbell, G. S. (2015). Working out memory with a Medal of Honor complex. *Game Studies*, 15(2).

Elliott, J. K. (2020, April 17). 'Final Fantasy' gamers hold online funeral for player who died of COVID-19. *Global News*. Retrieved from https://globalnews.ca/news/6832247/coronavirus-video-game-funeral/

Erll, A. (2011). *Memory in Culture*. Hampshire: Palgrave Macmillan.
https://doi.org/10.1057/9780230321670

Fish, S. (1980). *Is there a text in this class? The authority of interpretive communities*, Cambridge, MA: Harvard University Press.

Gadamer, H. G. (1977). Philosophical hermeneutics. Berkeley: University of California Press.

Genette, G. (1972). *Narrative discourse*, Oxford: Basil Backwell.

Hall, S. (2007). Encoding and decoding in the television discourse, In Ann Gray et al. (Eds.) *Colloquy of the Council of Europe Selected Working Papers,* 1st ed., Ch.22, London, UK: Routdledge
https://doi.org/10.4324/9780203357071

Hammar, E. L. (2017). Counter-hegemonic commemorative play: marginalized pasts and the politics of memory in the digital game Assassin's Creed: Freedom Cry. *Rethinking History*, 21(3), 372-395.
https://doi.org/10.1080/13642529.2016.1256622

Hammar, E. L. (2019a). Manufacturing consent in video games. The hegemonic memory politics of *Metal Gear Solid V: The Phantom Pain* (2015). *Nordlit*, 42. Retrieved Dec. 30 from https://septentrio.uit.no/index.php/nordlit/article/view/5016
https://doi.org/10.7557/13.5016

Hammar, E. L. (2019b) Producing play under mnemonic hegemony: the political economy of memory production in the videogames industry. *Digital Culture & Society*, 5(1), 61-83. https://doi.org/10.14361/dcs-2019-0105

Hammar, E. L. (2020). Playing virtual Jim Crow in Mafia III - prosthetic memory via historical digital games and the limits of mass culture. *Game Studies*, 20(1). Retrieved Dec. 30, 2021 from http://gamestudies.org/2001/articles/hammar

Hammar, E. L., & Woodcock, J. (2020). The political economy of wargames: the production of history and memory in military video games. In H. Pötzsch (Ed.) *War games*. *Memory, militarism and the subject of play* (pp.53-71). https://doi.org/10.5040/9781501351181.ch-004

Huyssen, A. (1995). *Twilight memories. Marking the time in a culture of amnesia*. New York, NY: Routledge.

Iser, W. (1978). *The act of reading: a theory of aesthetic response*. Baltimore: Johns Hopkins University Press.

Jenkins, H. (2003). Transmedia Storytelling: Moving Characters from Books to Films to Video Games Can Make Them Stronger and More Compelling. MIT Technology Review. http://www.technologyreview.com/news/401760/transmedia-storytelling/

Lachmann, R. (1993). Kultursemiotischer Prospekt. In A., Haverkamp & R., Lachmann, (Eds.) *Memoria: Vergessen und Erinnern, Poetik und Hermeneutik* (pp.xvii-xxvii). Munich: Fink.

Lamerichs, N. (2011). Stranger than fiction: Fan identity in cosplay. *Transformative Works and Cultures*, 7 (2011), https://doi.org/10.3983/twc.2011.0246

McCrea, C. (2009). Gaming's hauntology: Dead media in Dead Rising, Siren and Michigan Report from Hell. In B., Perron (Ed.) *Horror video games: Essays on the fusion of fear and play* (pp.220-238), Jefferson, NC: McFarland & Co.

Möring, S. (2013). The metaphor-simulation paradox in the study of computer games. *International Journal of Gaming and Computer-Mediated Simulations*, 5(4). https://doi.org/10.4018/ijgcms.2013100103

Mukherjee, S. (2017). *Videogames and postcolonialism: Empire plays back*. Cham: Palgrave Macmillan. https://doi.org/10.1007/978-3-319-54822-7

Mukherjee, S. (2018). Playing subaltern: Video games and postcolonialism. *Games and Culture*, 13(5), 504-520. https://doi.org/10.1177/1555412015627258

Neumann, B. (2008). The literary representation of memory, in A., Erll, A., Nünning & S. B., Young (Eds.) *A companion to cultural memory studies: an international and interdisciplinary handbook* (pp.333-343), Berlin: Walter de Gruyter.

Nora, P. (1992). Introduction to Realms of Memory, Volume III. In L. D., Kritzman (Ed.) *Realms of memory. The construction of the french past, volume iii: symbols* (pp.ix-xii), New York, NY: Columbia University Press.

Nora, P. (1989). Between memory and history: les lieux de mémoire. *Representations*, 26, 7-24. https://doi.org/10.2307/2928520

Nora, P. (1996). From Lieux de memoire to Realms of Memory. In L. D., Kritzman (Ed.) *Realms of memory. Rethinking the french past, volume i: conflicts and divisions* (pp.xv-xxiv), New York, NY: Columbia University Press.

Pandey, G. (1995). Voices from the edge: the struggle to write subaltern histories. *Ethnos. Journal of Anthropology*, 60(3-4), 223-242. https://doi.org/10.1080/00141844.1995.9981519

Pötzsch, H. & Šisler, V. (2016). Playing cultural memory: Framing history in Call of Duty: Black Ops and Czechoslovakia 38-89: Assassination. *Games and Culture*, 14(1), 3-25. https://doi.org/10.1177/1555412016638603

Rahman, O., Liu, W. S., & Cheung, B. H. M. (2012). "Cosplay": imaginative self and performing identity. *Fashion Theory - Journal of Dress Body and Culture*, 16(3), 317-341. https://doi.org/10.2752/175174112X13340749707204

Ricoeur, P. (1984). *Time and Narrative. Volume I*. London: The University of Chicago Press.

Ricoeur, P. (1988). *Time and Narrative. Volume 3*. London: The University of Chicago Press.

Said, E. W. (1979). *Orientalism*, New York, NY: Vintage Books.

Sommer, R. (2000). Funktionsgeschichten: Überlegungen zur Verwendung des Funktionsbegriffs in der Literaturwissenschaft und Anregungen zu seiner terminologischen Differenzierung. *Literaturwissenschaftliches Jahrbuch*, 41, 319-41.

Šisler, V. (2016). Contested memories of war in Czechoslovakia 38-89: Assassination: designing a serious game on contemporary history. *Game Studies*, 16(2). Retrieved Dec. 30, 2021 from http://gamestudies.org/1602/articles/sisler

Spivak, G. C. (2010) Can the Subaltern Speak? In R. C., Morris (Ed.) *Can the Subaltern Speak? Reflections on the History of an Idea* (pp.21-78), New York, NY: Columbia University Press.

Sterczewski, P. (2020). Machine(s) of narrative security: mnemonic hegemony and polish games about violent conflicts. In H. Pötzsch (Ed.) *War games*. *Memory, militarism and the subject of play* (pp.111-135). https://doi.org/10.5040/9781501351181.ch-007

Trezise, B. (2012). Touching virtual trauma: performative empathics in Second Life. *Memory Studies*, *5*(4), 392-409. https://doi.org/10.1177/1750698011426355

Walton, K. L. (1990). *Mimesis as Make-Believe. On the Foundations of the Representational Arts*. Cambridge, MA: Harvard University Press.

A Review of Adaptable Serious Games Applied to Professional Training

Álvaro Marcos Pistono
UTAD, Portugal
al70343@alunos.utad.pt
0000-0001-6863-0453

Arnaldo Manuel Pinto Santos
Universidade Aberta, Portugal
arnaldo.santos@uab.pt
0000-0001-5139-6728

Ricardo José Vieira Baptista
Universidade Aberta, Portugal
ricardjose@fe.up.pt
0000-0002-0317-6381

Abstract
Serious Games have been used in professional training to increase employee engagement and improve training initiatives. This review intends to identify the application of Serious Games in professional training and how these games have been developed, evaluated, and adapted to relate to the learning outcomes. It aims to map the use of Serious Games in professional training, verifying which forms of adaptation are used, learning outcomes, and models and frameworks of Serious Games that include game elements. Different learning outcomes associated with Serious Games were identified, in the general context and professional training, with knowledge acquisition being the most investigated result and questionnaires the most used type of assessment. It was found that several technologies are used in the adaptation of Serious Games. This literature review highlighted gaps in Serious Games research, especially in adaptive games applied in the context of professional training, such as the absence of frameworks for adaptive Serious Games and the lack of a framework for Serious Games that relates game elements to learning outcomes.

Keywords: *Serious Games, Adaptation, Professional training, Learning outcomes, Framework*

1. Introduction

Serious Games are games with serious purposes besides entertainment. The junction of the games and serious activities' universes can generate positive results, as in health and military training applications, among others.

Clark Abt, a reference in this area, defines Serious Games in the following passage of his book:

> *"We are concerned with serious games in the sense that these games have an explicit and carefully thought-out educational purpose and are not intended to be played primarily for amusement."* (Abt, 1970/1987, p.9)

In this definition, the educational purpose's presence highlights the difference in its use from entertainment games.

Mayer (2014) defines Serious Games for learning as:

> *"Games for learning include both game features, intended to motivate learners to engage in game playing, and instructional features, intended to foster appropriate cognitive processing during game playing."* (Mayer, 2014, p.29)

The similarities between the learning process and the act of playing are cited by O'Brien & Toms (2008). Both are usually long, complex, and difficult; besides, the games are associated with learning because the player needs to learn how to play. The same authors complement this finding by observing

that, just like games, learning is an interactive process that challenges learners and has rules for new knowledge and skills acquisition.

Serious games are used in various areas and with diverse content to engage the users in serious activities.

There are many studies about Serious Games in several areas. One of the areas in which they are widely used is science education, as described in the literature review conducted by Kara (2021), which points out that these games have been used since elementary school.

In professional training, they have been used in various contexts for more than two decades, in various training courses, for instance, on compliance or related to specific procedures.

Among the different aspects considered as relevant for the development of efficient Serious Games, "fun" has been one of the most important, as investigated by Ferreira de Almeida & dos Santos Machado (2021), as it is an inherent property of games. Thus, preventing Serious Games from becoming boring or simply ceasing to be fun is key to maintaining the game characteristic.

Larson (2020) cites that gamification initiatives in the workplace are beneficial to companies to, for example, strengthen employee recruitment and retention, increase program adherence, and improve job performance. This author cites:

> *"Motivation, recruitment, and training have been key focus areas for application of gamification in the enterprise setting."* (Larson, 2020, p.319)

Corporations are interested in Serious Games as a potential tool to improve training effectiveness (Bachvarova, Bocconi, van der Pols, Popescu, & Roceanu, 2012). However, these authors highlight the necessity to measure the application of what the learners have learnt during the game:

> *"… there is the need to assess not only what the employee has learnt, but also how this knowledge is applied."* (Bachvarova, Bocconi, van der Pols, Popescu, & Roceanu, 2012, p.222)

Serious Games contributions to improving learning outcomes, such as acquiring knowledge or skills improving, are evidenced in some research, both in the academic and corporate markets.

Nevertheless, there are challenges for the efficient application of Serious Games and among them are the adaptation and the evaluation of their results. The absence of adaptation in the games can result in a loss of efficiency in learning when users perceive the game dynamics and evolve without achieving the learning objectives, and in the impossibility of applying the game again to the same users, as they already know its content (Lopes & Bidarra, 2011).

Martin, Casey, & Kane (2021) argue that dynamic game adjustment is important to provide both a challenging and fun experience and effective learning, avoiding tasks being too easy or difficult, and keeping the player's focus on a learning task within a game.

Mayer (2014) highlights, however, that there are still few existing evidence-based approaches used to assess the contribution of Serious Games to learning.

With the main objective of investigating how Serious Games have been used concerning their adaptation of both content and resources in professional training, this review aims to map the use of Serious Games in professional training, to verify what forms of adaptation are used in Serious Games and to identify models and frameworks of Serious Games that predict adaptation of the game elements.

The initial motivation for this research was to identify the added value of game elements to learning outcomes as the starting point to develop a conceptual framework of adaptive Serious Games that could clarify the relation between their adaptation and the learning outcomes.

Based on this motivation, research questions have been formulated, shown in Table 1 as review questions for this literature review.

Table 1. Review Questions

Primary Review Questions	Secondary Review Questions
1. What is the influence of the game elements?	1.1 What are game elements? 1.2. How can game elements influence players? 1.3. How have Serious Games been used in professional training? 1.4. For what purposes are Serious Games used in professional training? 1.5. How are the outcomes of Serious Games measured? 1.6. Are there documented results on the influence of Serious Games on professional training?
2. How should the game elements be adapted?	2.1. How can Serious Games be adapted? 2.2. How does the adaptation of Serious Games influence the results of the games? 2.3. Are there documented results on the influence of the adaptation of Serious Games on learning?
3. How to classify and organise the game elements to adapt and meet previously established objectives?	3.1. Are there Serious Game development models? 3.2. Are there Serious Game frameworks? 3.3. How are Serious Game frameworks related to learning objectives? 3.4. Are there adaptable Serious Games frameworks? 3.5. Are there adaptable Serious Games frameworks related to learning outcomes?

Initially, this article presents the use of Serious Games in professional training and, in the general context, the types of evaluation, investigation and measured outcomes in these games. Then, the forms of adapting the Serious Games and the technologies used are shown. Serious Games models and frameworks are also listed, and evidence of the relationship between adaptable Serious Games and learning outcomes is investigated.

Section 2 of this article presents the methodology used to carry out this literature review on the adaptation of Serious Games in professional training, followed by the results found, in sections 3 – Results and 4 – Discussion. Finally, the conclusions and some suggestions for future research are presented in section 5.

2. Methodology

The present literature review is justified by two of the three reasons given by Kitchenham (2004) for conducting literature reviews:

- To establish a knowledge base for positioning new research activities.

- To identify gaps in current research that may suggest future investigations.

It is hoped, in this literature review, to map current research on adaptive serious games used in professional training and identify gaps in research in this context.

According to the protocol predicted by Kitchenham (2004), the stages of a literature review were conducted, i.e., search, data extraction, recording and synthesis of results.

In the search stage, research was carried out at three different moments, with three specific objectives:

1. First, individual initial searches were conducted to determine the initial search set;

2. After reading the articles resulting from the initial searches, new searches were conducted with new keywords identified in these publications and new articles and books were inserted from the references the initial search set;

3. For each review question, new searches were conducted to confirm previous searches.

In the first search stage, individual searches were carried out so that it was possible to identify the number of existing publications related to each topic. These initial searches, performed in the SCOPUS, Web of Science and Google Scholar databases, are listed in Table 2, where the search criteria and the results for each database are also shown.

Table 2. Initial Searches

Objective	Obtain an initial set of content.			
	Words / sentences	Results		
		Google Scholar	Web of Science	SCOPUS
Individual searches	"Serious Games" OR "jogos serios"	1,110	5,985	8,482
	"games in education" OR "educational games" OR "jogos na educação" OR "jogos educacionais"	767	2,310	4,084
	gamification OR gamificação	3,830	6,360	7,299
	adaptabilidade AND "jogos sérios"	0	0	0
	adaptability AND "Serious Games."	12	27	40
	eLearning AND "Serious Games."	45	22	39
	e-learning AND "Serious Games."	31	158	700
	"formação profissional" AND "jogos sérios"	1	0	0
	"Serious Games" AND "corporate training"	2	10	20
	"jogos sérios" AND "treinamento corporativo"	0	0	0
	("educação corporativa" OR "corporate training") AND ("jogos serios" OR "Serious Games" OR gamification OR gamificação)	9	16	32
Total after repeated results exclusion		5,650	11,443	19,093

From these initial searches' results, it was decided to use only the SCOPUS database, as it returned more results for the researched themes.

After the individual searches, the results were jointed and filtered using the inclusion and exclusion criteria described in Table 3.

Table 3. Inclusion and Exclusion Criteria

Inclusion criteria	At least 20 citations or type of document = "review" or search result: ("educação corporativa" OR "corporate training") AND ("jogos serios" OR "Serious Games" OR gamification OR gamificação)
Exclusion criteria	Areas of knowledge different from information systems, management or psychology
Results	141

It is important to note that although there is a large number of publications regarding Serious Games, Gamification and Educational Games in recent years when applying the inclusion, exclusion and classification criteria, the years 2019 and 2020 did not present publications that meet these criteria.

An example of this progression between the number of publications is shown in figures 1 and 2, where it is possible to observe the number of publications relative to Educational Games.
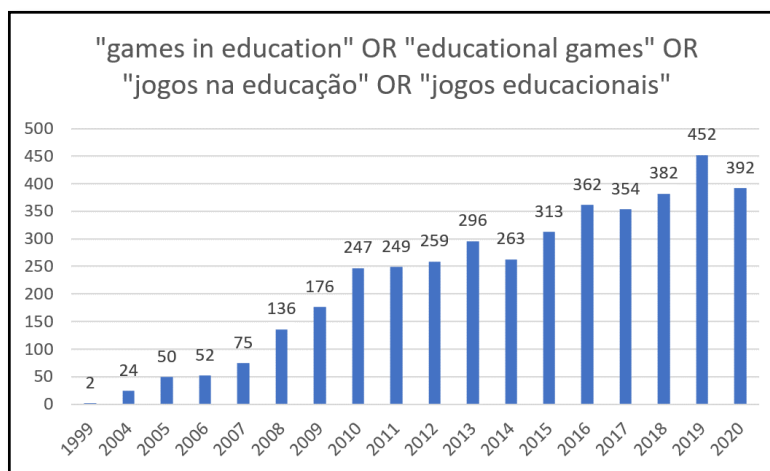
Figure 1. Publications per Year about Educational Games
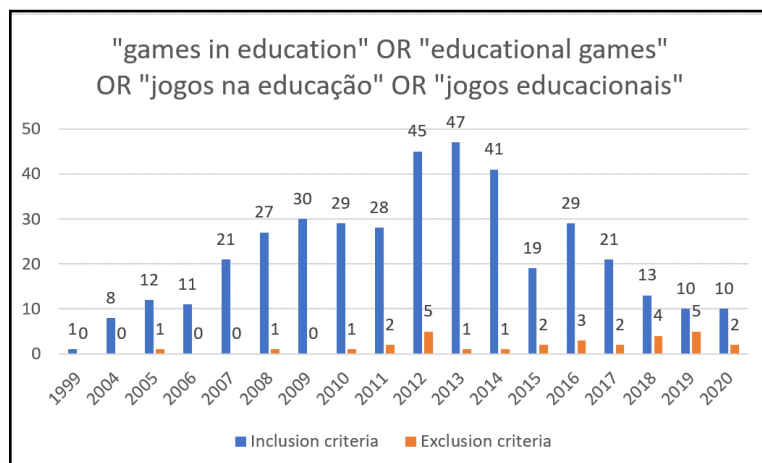
Figure 2. Inclusion and Exclusion Criteria Applied to Educational Games Related Publications per Year

After reading the abstracts, the 141 remaining results were classified according to the criteria described in table 4.

Table 4. Results Classification Criteria

Priority	Classification criteria	Results
0	At least 20 citations or type of document = "review" or related to the themes professional training / corporate education or adaptability or modelling or framework	32
1	Up to 19 citations or related to professional training / corporate education or adaptability or modelling or framework	49
2	Applications reports or peripheral issues	60

Twenty-seven (27) among the 32 results classified as priority 0 were read, as the full content of 5 of them were not accessible.

Other articles and books were added to the initial research: The gamification of learning and instruction: game-based methods and strategies for training and education (Kapp, 2012); Play to Learn (Boller & Kapp, 2017); Computer games for learning: An evidence-based approach (Mayer, 2014); Deconstructing Engagement: Rethinking Involvement in Learning. Simulation and Gaming (Whitton & Moseley, 2014).

After these readings, other keywords have been identified and, with them, new individual searches performed, described in Table 5. In these searches, the same prior criteria of inclusion, exclusion and classification of results were used, which represented additions in the list of contents to be analysed, shown in table 5.

Table 5. Second Search Cycle

Goals	• Extend the scope of searches, using identified keywords in the initial search. • Validate the initial searches.		
	Words / sentences	**Results**	**Inclusions**
Individual searches	adaptability AND (elearning or "e-learning" or "corporate training") and ("Serious Game" or "games in education" or "educational games")	6	1 result with priority 0; 4 results with priority 1.
	(elearning or "e-learning" or "corporate training") and ("Serious Game" or "games in education" or "educational games") and (LIMIT-TO (DOCTYPE,"re"))	18	0
	adaptivity AND "Serious Game."	56	1 result with priority 0 (no access); 4 results with priority 2.
	Adaptivity AND ("Serious Games" OR "jogos serios") AND ("games in education" OR "educational games" OR "jogos na educação" OR "jogos educacionais") AND (gamification OR gamificação) AND (elearning AND "Serious Games")	0	0
	adaptability AND ("Serious Games" OR "jogos serios") AND ("games in education" OR "educational games" OR "jogos na educação" OR "jogos educacionais") AND (gamification OR gamificação) AND (elearning AND "Serious Games")")	0	0
	(adaptive or adaptivity or personalisation or personalisation or "learning style") and ("Serious Games" OR "games-based learning")	804	1 result with priority 0 (no access); 1 new result with priority 1; 1 new result with priority 2.

Those articles' references that met the inclusion and exclusion criteria and were classified as priority 0 were included in this review.

To answer some of the secondary research questions, new searches were conducted, with specific sets of keywords, aiming to validate the previous searches, to identify the publications related to each

topic and to check whether any other publication, besides the ones previously analysed, should be considered in this review.

The additional validation/complementation searches are shown in Table 6, where all publications, regardless of their priority classification, were included.

Table 6. Additional Validation/Complementation Searches

Goals	● Validate previous searches; ● Identify publications related to each topic; and ● Check if any other publication, which has not yet been contemplated, should be considered in this review.	
Topic	Words / sentences	Inclusions
1.2. How can game elements influence players?	("digital game" OR "video game") AND (measure OR result OR outcome OR engagement) AND (learning OR cognitive OR knowledge OR skill)	4
1.3. How have Serious Games been used in professional training? 1.4. For what purposes are Serious Games used in professional training?	("Serious Game" OR "educational game" OR "games in education" OR "game in education" OR "game on training") AND ("corporate training" OR "professional education")	0
1.6. Are there documented results on the influence of Serious Games on professional training?	("Serious Game" OR "educational game" OR "games in education" OR "game in education" OR "game on training") AND ("corporate training" OR "professional education") AND (measure OR result OR outcome)	10
2.2. How does the adaptation of Serious Games influence the results of the games? 2.3. Are there documented results on the influence of the adaptation of Serious Games on learning?	Adapt AND ("Serious Game") AND (measure OR result OR outcome OR engagement) AND (learning OR cognitive OR knowledge OR skill)	6
3.1. Are there Serious Game development models?	"Serious Game" AND model AND develop	13
3.2. Are there Serious Game frameworks?	"Serious Game" AND framework AND develop	7

The same exclusion criteria mentioned in table 3 were applied to the new inclusions and after verifying which publications had not been considered in previous searches, the result set had 53 publications.

In this literature review, all publications classified as priority 0, related to all searches mentioned above and references of these first ones also classified as priority 0 were read. Besides that, all articles classified as priority 1 and 2 for the additional validation/complementation searches were read.

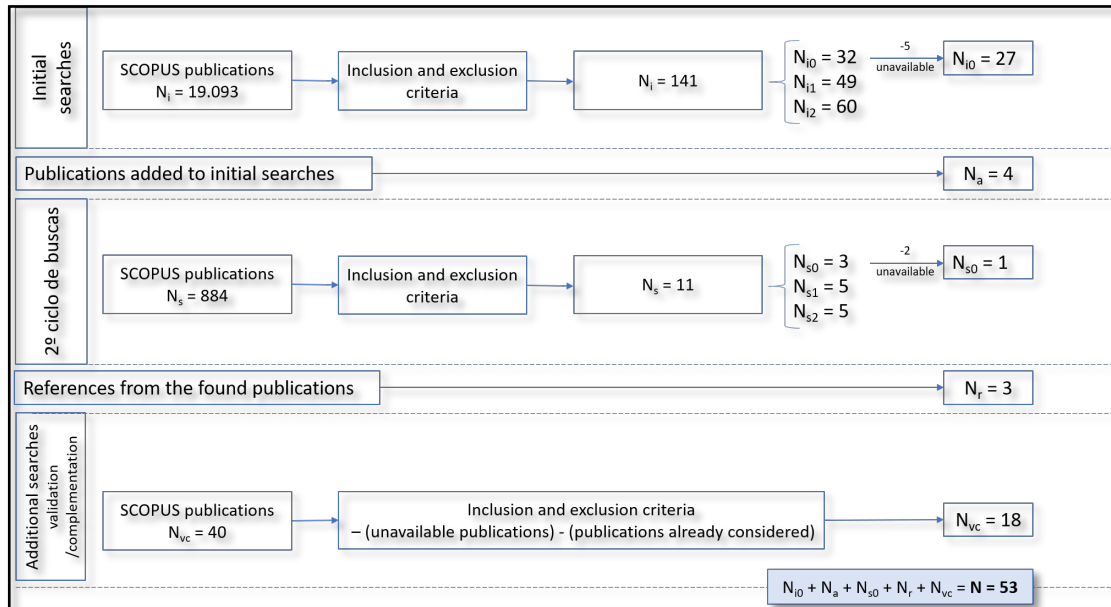All searches performed in this literature review can be summarized in figure 3.

Figure 3. Searches Performed in the Literature Review

Figure 4 shows the distribution of the 53 publications analysed in this research. It is possible to see a higher concentration between 2012 and 2017, corresponding to 64.3% of the total amount of papers considered here, with 2016 standing out with 9 publications.
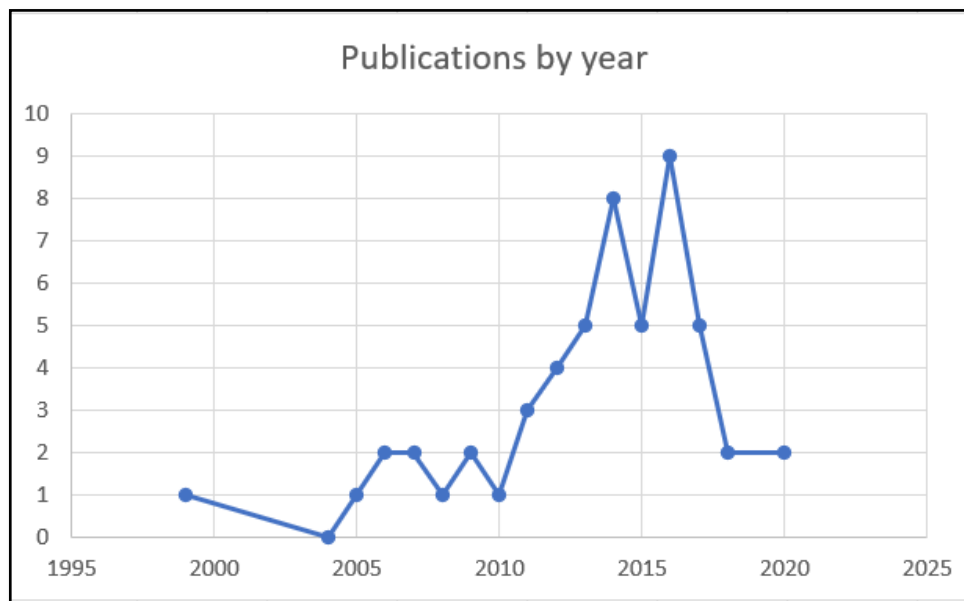

Figure 4. Analysed Publications by Year

It should be highlighted that, as mentioned before and shown in figures 1 and 2, although there is a large number of publications in this research's scope in recent years, 2019 and 2020 publications did not meet the inclusion, exclusion and classification criteria and, thus, are not present in the cited 53 publications in this research.

In figure 5, the five main sources of publications used in this research, Institute of Electrical and Electronics Engineers - IEEE, Springer, Elsevier, IGI Global and SCOPUS (where the publication is only identified in this index), are responsible for 52.8% of the publications analysed.
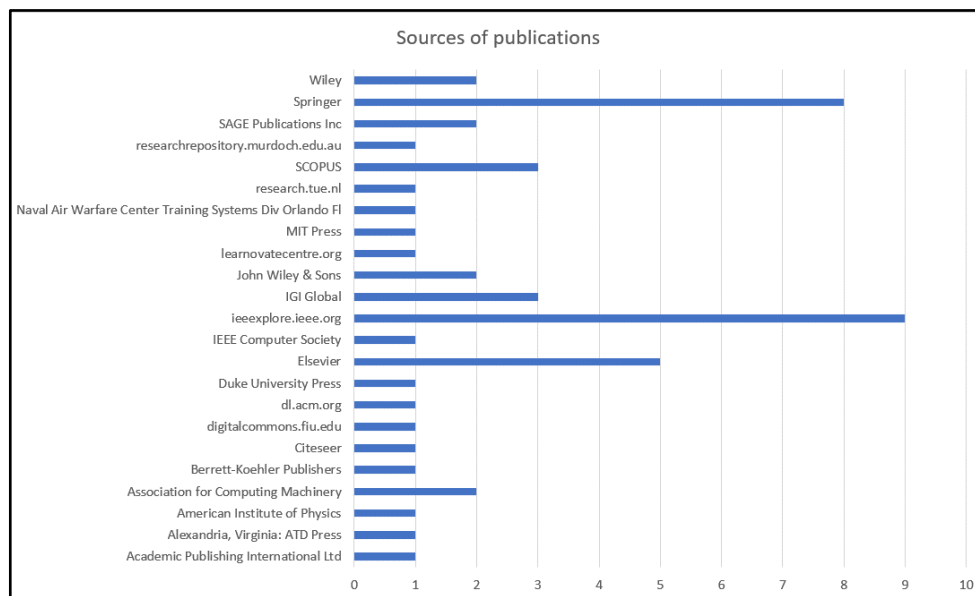
Figure 5. Sources of the Analysed Publications

This literature review presents the contribution of 150 authors, listed in table 7, where the quantity of publications of each one is identified.

Table 7. Authors of the Analysed Publications

Authors	Number of publications
De Freitas, S., Kapp, K.	3
Amory, A., Arnab, S., Bellotti, F., Berta, R., Boyle, EA, Carvalho, MB, Connolly, TM, De Gloria, A., Hainey, T., Labat, J., Lim, T., Sillaots, M., Van der Spek, ED, van Oostendorp, H.	2
Adame, B., Adams, C., Almeida, P., Alvarado, N., Andreoli, R., Bahji, SE, Benhlima, S., Bennis, L., Bidarra, J., Bidarra, R., Bockholt , M., Boller, S., Boyle, JM, Burgoon, J., Cai, W., Calderón, A., Cardoso, P., Carron, T., Carter, C., Coleman, TE, Corolla, A ., Donovan, L., Dunbar, N., Earp, J., El Alami, J., Emmerich, K., Engberg-Pedersen, A., Faggiano, A., Feng, Y., Fernández-Manjón, B ., Figueiredo, M., Freire, M., Gray, G., Greitzer, FL, Guigon, G., Gunter, GA, Hamari, J., Hanneghan, M., Hansen, PK, Hauge, JB, Hauge, JM, Hays, RT, Helms, NH, Hernández, RJ, Hu, J., Huang, WH, Huston, K., Jantke, KP, Jarvis, S., Jenkins, J., Jensen, M., Jesmin, T ., Kenny, RF, Kiili, K., Kirkpatrick, D., Kirkpatrick, J., Koivisto, J., Kuchar, OA, Lainema, T., Langi, AZ, Larson, K., Lead, P., Lee , YH, Lees, M., Lefdaoui, Y., Linssen, J., Lopes, R., Louchart, S., Luo, L., Magalhães, R., Malandrino, D., Mandran, N., Manero, B., Marfisi-Schottman, I., Marne, B., Mayer, RE, McMahon, M., Miller, C., Mitgutsc h, K., Moita, M., Money AG, Monteiro, J., Moreira, L., Moseley, A., Munir, Naicker, K., Ninaus, M., Nunamaker, JF, Ott, M., Pabon , LC, Pedro, L., Pereira, J., Pirozzi, D., Ranaldi, M., Rasim, Rauterberg, M., Ribeiro, C., Riedel, JC, Rinde, A., Rodrigues, J., Rosmansyah , Y., Ruiz, M., Santangelo, G., Santos, A., Sarsa, H., Sbert, M., Scarano, V., Sedano, CI, Sekar, B., Serrano-Laguna, Á., Smeddinck, JD, Sousa, L., Streicher, A., Suttie, N., Tahir, R., Tang, SOT, Tasuya, S., Tettegah, SY, Thillainathan, N., Twyman, N., Ulrich, F ., Uskov, A., Valacich, J., Vermeulen, M., Vick, EH, Vincent, J., Wang, AI, Wattanasoontorn, V., Whitton, N., Wilson, DW, Wilson, S., Wouters , P., Yin, H., Zhou, S.	1

The literature review publications, 7 of the 53 analysed, are listed in Table 8, where it is possible to observe the different themes associated with the present review.

Table 8. Themes of the Literature Reviews Analysed

Theme	Reference
Effectiveness of instructional games	Hays (2005)
Practices used in Serious Games research	Wouters, van der Spek, & van Oostendorp (2009)
Engagement in games for entertainment	Boyle, Connolly, Hainey, & Boyle (2012)
Empirical studies on gamification	Hamari, Koivisto, & Sarsa (2014)
Evaluation of Serious Games	Calderón & Ruiz (2015)
Empirical evidence of the impacts and outcomes of computer games and Serious Games	Boyle et al. (2016)
Serious games and gamification in professional training	Larson (2020)

After all these searches, data extraction was carried out and the results are synthesised in the next section, according to the research questions.

3. Results

The results found in this literature review were synthesised according to the most common synthesis methods steps, described by Dresch, Lacerda, & Júnior (2020), as follow.

3.1. Review Question 1: What is the influence of the game elements?

In order to identify the influence of game elements on users, it is first necessary to determine what game elements are and how they make up a game.

Boller & Kapp (2017) define game as:

> *"A game is an activity that has a goal, a challenge (or challenges), and rules that guide achievement of the goal; interactivity with either other players or the game environment (or both); and feedback mechanisms that give clear cues as to how well or poorly you are performing. It results in a quantifiable outcome (you win or lose, you hit the target, and so on) that usually generates an emotional reaction in players." (Boller & Kapp, 2017, p.4)*

Game elements are components or features that enhance the players' experience and aid their immersion in the game (Boller & Kapp, 2017). These elements can be both challenges and objectives and interactive activities or the game mechanics themselves.

A large number of game elements and their diversity were the subject of the literature review of the games conducted by Sillaots and Rinde (2016). The authors listed 103 game elements (Sillaots, 2016) and verified their frequency of use and relationships.

Game elements have also been used in gamification initiatives. Therefore, investigating the use of game elements in this kind of initiative enables identifying their influence.

As an example, the research conducted by Hamari, Koivisto, & Sarsa (2014) has identified that points, leaderboards, and badges are the most commonly used game elements in gamification initiatives.

Table 9 summarizes what is described in Kapp (2012) regarding the influences of game elements.

Table 9. Influence of Game Elements according to Kapp (2012)

Game element	Influence
Abstractions of concepts and reality	• Minimise complexity • Facilitate identification of the cause and effect's relationship • Isolate extraneous factors, providing increased focus • Reduce the time needed to understand concepts
Goals	Add purpose, focus, and measurable results.
Rules	Limit the players' actions.
Conflict, competition and cooperation	Creates an interesting environment by combining limits to progress (conflict), overcoming opponents (competition), and teamwork to achieve collective results (cooperation).
Time	Stimulates players' actions and forces them to act under pressure.
Reward structures (badges, points, rewards, and leaderboards)	Encourage participation. Leaderboards, for example, have been motivating factors for games to be played again and again.
Feedback	Reminds the player of the correct behaviours, thoughts, and actions
Levels	• Help the narrative progress • Build and reinforce skills • Motivate players to advance to the next levels
Storytelling	• Adds meaning • Contextualizes • Guides actions
Curve of interest	Holds the players' interest from the beginning to the end of the game
Aesthetics	Creates an immersive environment, improving the gaming experience
Replay or do-over	It allows players to fail, encouraging exploration, curiosity, and discovery-based learning.

Mayer (2014) mention the influences of games as:

> *"Like any successful art form, a good game creates enjoyment, elicits emotional response, provokes thought, and/or motivates action." (Mayer, 2014, p.24)*

Another notable feature of games is the engagement of their players, described by Boyle, Connolly, Hainey, & Boyle (2012) as a subjective experience that happens during a game, associated with fun, immersion, "flow", and presence.

Whitton & Moseley (2014) highlight the differences between engagement in each kind of activity related to Serious Games:

> *"Two disciplines that approach the idea of engagement in fundamentally different ways are education and games design." (Whitton & Moseley, 2014, p.2)*

These same authors analyzed the different definitions and models of engagement related to education and games and proposed a model of engagement used in both situations, called the authors' "engagement with learning" model. This model combines the different types of engagement into two groups, superficial engagement, associated with behaviours and extrinsic motivation, and deep engagement, related to more significant psychological interaction during an experience. It is highlighted that two types of deep engagement are related to games: Passion and incorporation.

Broadly, Jantke (2010) defines Serious Games as any games used for applications beyond entertainment.

Professional training is one of the applications of Serious Games for, at least two decades, in several contexts: Military (Hays, 2005; Greitzer, Kuchar, & Huston, 2007; Engberg-Pedersen, 2017); Telecommunications (Almeida et al., 2011); General businesses (Donovan & Lead, 2012; Kapp, 2013; Uskov & Sekar, 2014; Boller & Kapp, 2017); Healthcare (Wattanasoontorn, Hernández, & Sbert, 2014);

Manufacturing companies (Riedel, Feng, Hauge, Hansen, & Tasuya, 2015); Hospitality (Pabon, 2016); Finance (Larson, 2020).

They have been used in professional training by many companies of different verticals in knowledge acquisition, skills practice, and attitude change.

Although Serious Games are used in several areas of the corporate market, both in training and in other activities, such as in recruitment and marketing/sales (Donovan & Lead, 2012), the measurement of their actual effects on learning is considered by Sousa et al. (2016) one of the biggest challenges for the acceptance of Serious Games as an effective educational method.

The process of Serious Games evaluation should consider several approaches, such as the four levels of evaluation of Kirkpatrick & Kirkpatrick's (2006) and, as advocated by Emmerich & Bockholt (2016), the six components of the Mitgutsch & Alvarado (2012) framework for Serious Game evaluation.

The Serious Game's assessment can be performed in several ways, through questionnaires, interviews, access/activity records (logs), discussions, videos, frameworks, observations, among other methods listed by Calderón & Ruiz (2015). These same authors found that questionnaires are the most used type of assessment of Serious Games, as shown in Figure 6.
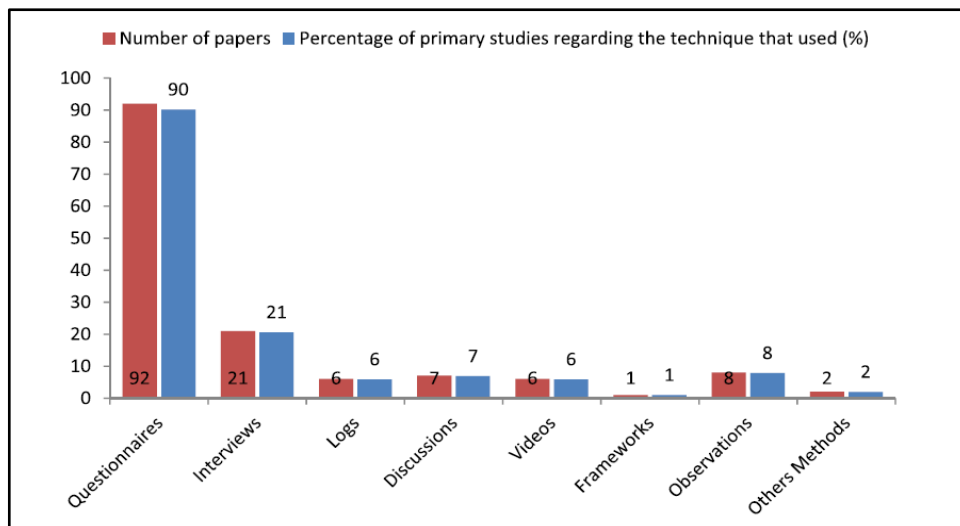

Figure 6. Types of Assessment Used in Serious Games, According to Calderón & Ruiz (2015)

Wouters, van der Spek & van Oostendorp (2009) researched the effects of Serious Games and their learning outcomes. These authors verified the effects of Serious Games concerning their elements/features, such as better recall of relevant knowledge and better spatial cognition, and comparisons with other media types, such as improved acquired knowledge and higher motivation than other media types.

Mayer (2014) states that:

> "The most appropriate research method for assessing the generality of instructional effects of games and game features is a quasi-experimental comparison in which the differences between treatment and control groups are examined for various subgroups, learning contexts, or types of content." (Mayer, 2014, p.53)

Although there is research on Serious Games, Mayer (2014) highlighted that there are still few existing evidence-based approaches to assess the contribution of Serious Games to learning.

In the literature review on the empirical evidence of the impacts and outcomes of using digital games and games for learning conducted by Boyle et al. (2016), research on Serious Games was grouped by type, as shown in Figure 7, into correlational, qualitative, quasi-experimental, RCT and survey.
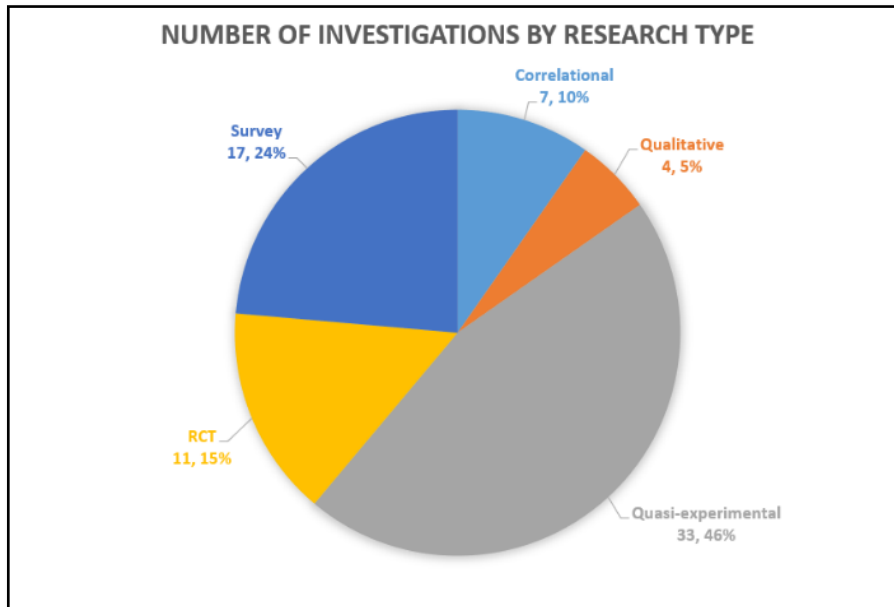

Figure 7. Number of Investigations on Games for Learning by Research Type

In this review, Boyle et al. (2016) identified that the most investigated outcome was knowledge acquisition, as shown in Figure 8.
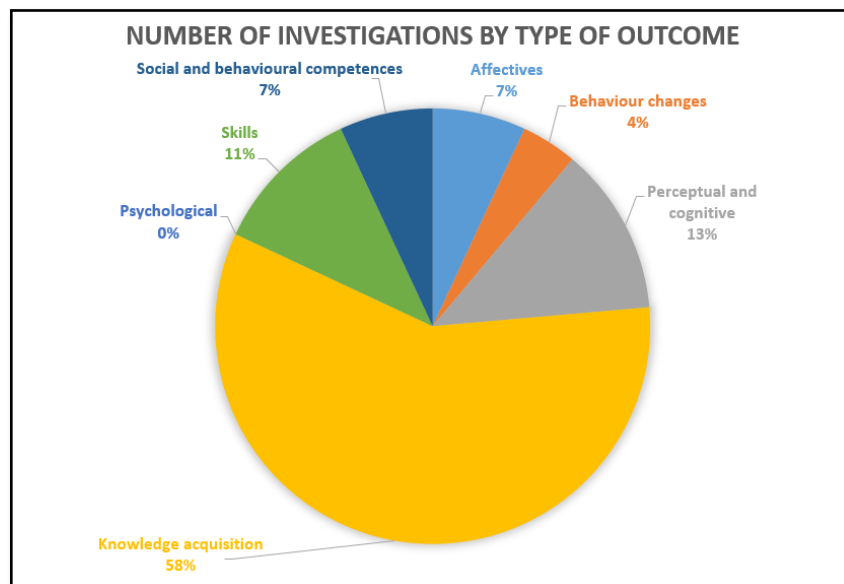
Figure 8. Number of Investigations on Games for Learning by Investigated Outcomes

3.2. Review Question 2: How should the game elements be adapted?

When investigating how Serious Games can be adapted, it was found that they can be adapted in two different ways, cited by Streicher & Smeddinck (2016):

• Adaptability, through the manual choices or parameterisations; and

• Adaptivity, through dynamic changes over time, to adjust game contexts.

These same authors, when searching for state of the art on customisation and adaptation of Serious Games, identified three psychological models that have been used in the adaptation of serious games: Flow (to keep players engaged, as shown in figure 9); FBM - Fogg Behavior Model (to motivate players to participate in the game) and SDT - Self-Determination Theory (which relates intrinsic motivation to the satisfaction of players' needs).
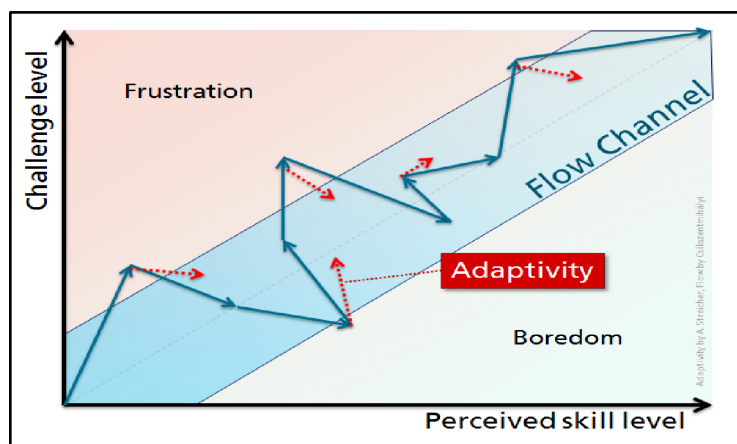

Figure 9. Relationship between Skill, Difficulty and the Flow State

Streicher & Smeddinck (2016) comment that adaptation can vary:

> "Examples range from more sophisticated path planning algorithms for massive amounts of NPC steering, to dynamically extendable models like behavior trees for intelligence-akin behavior, or to machines learning algorithms to learn human-like behavior." (Streicher & Smeddinck, 2016, p.10)

The architectures and methods used in adapting Serious Games are described in Rasim, Langi, Munir, & Rosmansyah's (2016) research, as shown in Figure 10. The architectures used are based on rules, plans, organisations' descriptions, player fluency, learning styles, cognitive states and pedagogical scenarios. At the same time, the methods may or may not be agent-based

Rasim, Langi, Munir, & Rosmansyah (2016) relate adaptation of Serious Games to both technology optimisation and pedagogy:

> "Adaptive serious games have two important disciplines, they are optimization of technology related to machine learning, and enjoyable learning related to science education/pedagogy." (Rasim, Langi, Munir, & Rosmansyah, 2016, p.2)

Related to the adaptivity challenges in Serious Games, Lopes & Bidarra (2011) argue that all game components are potentially adaptable through dynamic adjustments, i.e., game objects and worlds, game mechanics, NPCs - Non-Player Characters, narratives, and scenarios or missions:

> "Potentially, all components that are considered at game development can become adaptive." (Lopes & Bidarra, 2011, p.89)
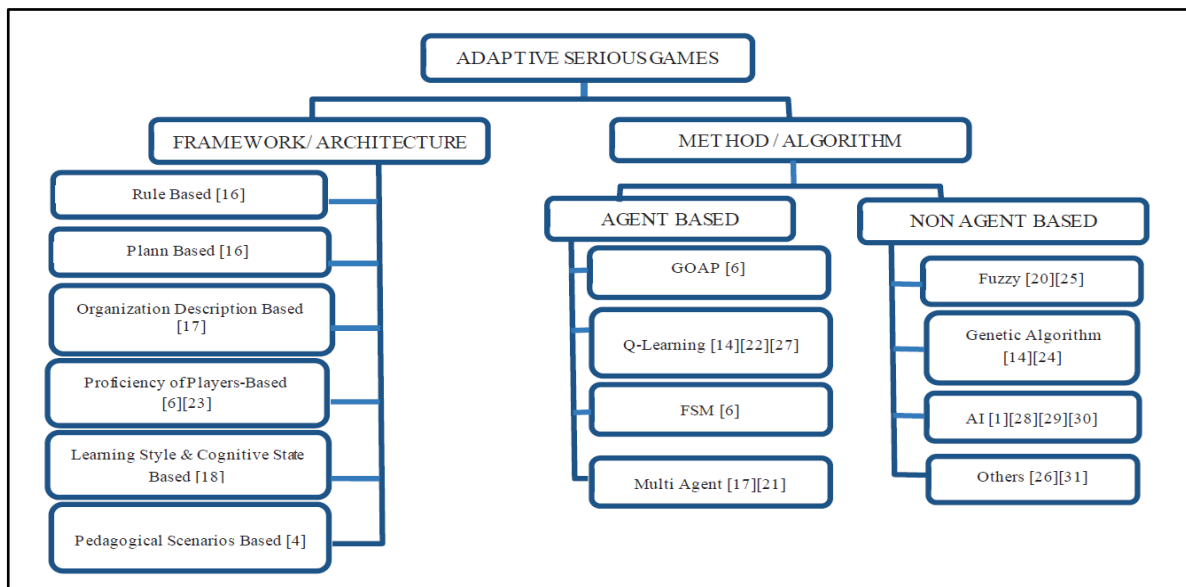
Figure 10. Architectures and Methods Used in Adapting Serious Games - Rasim, Langi, Munir, & Rosmansyah (2016)

3.3. Review Question 3: How to classify and organise the game elements to adapt and meet previously established objectives?

In this research, some models of Serious Games were found, organised in table 10 in a chronological order, where it is possible to verify the evolution of the approaches in the development of Serious Games.

Table 10. Serious Game Models

Model	Reference
GOM	Amory, Naicker, Vincent, & Adams (1999)
GOM II	Amory (2007)
RETAIN	Gunter, Kenny & Vick (2008)
DODDEL	McMahon (2009)
S2P adapted for Serious Games	Bahji, Lefdaoui, & El Alami (2011)
MoPPLiq	Marne, Carron, Labat, & Marfisi-Schottman (2013)
GTM	Tang, Hanneghan, & Carter (2013)
GLiSMo	Thillainathan (2013)
LM-GM	Arnab et al. (2015)
DICE	Bennis & Benhlima (2015)
ATMSG	Carvalho et al. (2015)
DISC	Vermeulen, Guigon, Mandran, & Labat (2017)

The Serious Games frameworks in the literature review are listed in Table 11, with their main characteristics.

These frameworks seek to relate theories of instruction and learning to the mechanics and elements of games, both with to design and development (de Freitas & Jarvis, 2006; Luo, Yin, Cai, Lees, & Zhou, 2013; Huang & Tettegah, 2014; Kiili, Lainema, de Freitas, & Arnab, 2014; Emmerich & Bockholt, 2016; Andreoli et al., 2017; Coleman & Money, 2020) as to evaluation (Mitgutsch & Alvarado, 2012; Wilson et al., 2016; Andreoli et al., 2017; Ulrich & Helms, 2017; Tahir & Wang, 2018).

Among the frameworks for Serious Games found, the Flow Framework, described by Kiili, Lainema, de Freitas, & Arnab (2014), stands out. This framework comprises four types of elements, listed in figure 11: Flow antecedents (necessary to provide an optimal experience); Flow state characteristics (describe what happens to players when they are in the flow state); Significant factors for learning (relevant factors for learning to occur); and mind lenses (relate learning to flow).

Table 11. Main Characteristics of Serious Games Frameworks

Main characteristics of the frameworks	References
• 4DF – Four-Dimensional Framework • Framework for development of Serious Games • Four main aspects: Context; learner specification; representation; and pedagogical model or approach	de Freitas & Jarvis (2006)
• Framework for evaluating Serious Game design • The basis for studying the relationship between design elements and Serious Game objectives	Mitgutsch & Alvarado (2012)
• Framework for interactive and iterative scenario generation for Serious Games illustrated	Luo, Yin, Cai, Lees, & Zhou (2013)
• Framework focusing on the influence of player cognitive load on learning outcomes • Three perspectives: Environments; characters; and activities	Huang & Tettegah (2014)
• Flow Framework • Dimensions: Antecedents of flow; flow state characteristics; significant factors affecting the design of the learning experience and game-based learning artefacts; and mind lenses • Illustrated in figure 11	Kiili, Lainema, de Freitas, & Arnab (2014)
• Framework for evaluation-driven Serious Game design • The design and evaluation phases are interlinked and should be repeated until the end of the Serious Game design	Emmerich & Bockholt (2016)
• Framework for iterative evaluation of Serious Games • Theoretical, technical, empirical and external bases	Wilson et al. (2016)
• Framework for Serious Games, with a focus on cultural heritage, that iteratively increments not only functionality but also content • Four phases: Preliminary; conceptual; development; and evaluation	Andreoli et al. (2017)
• COTS Serious Game evaluation framework • Four main dimensions and peripheral dimensions related to game mechanics	Ulrich & Helms (2017)
• LEAGUE – Learning, Environment, Affective, cognitive reactions, Game factors, Usability and UsEr • The conceptual framework for evaluating Serious Games concerning their scope, definition, and use	Tahir & Wang (2018)
• SCDGBL – Student-centred Digital Game-Based Learning • The conceptual framework for game-based learning with the learner as the central element	Coleman & Money (2020)

Kiili, Lainema, de Freitas, & Arnab (2014) conclude:

> *"We found that the students' flow experience in the game was high and the findings indicated that sense of control, clear goals and challenge-skill dimensions of flow scored the highest." (Kiili, Lainema, de Freitas, & Arnab, 2014, p.367)*
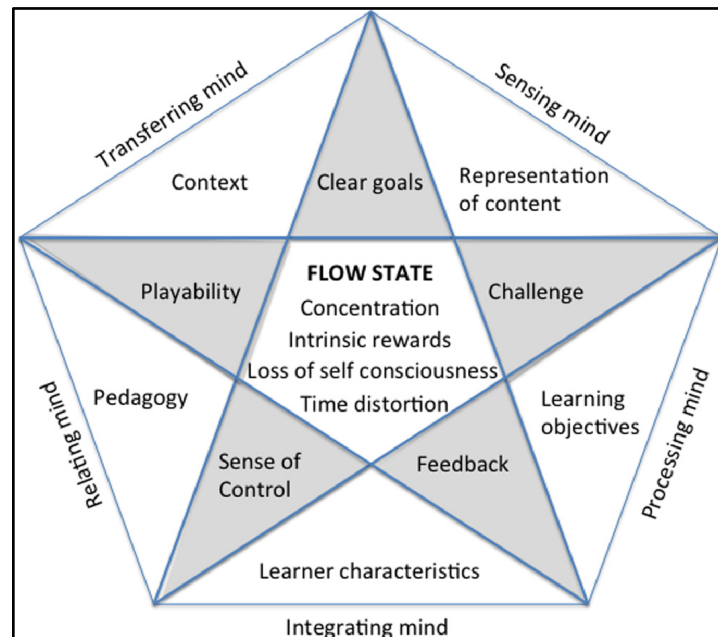
Figure 11. Flow Framework - Kiili, Lainema, de Freitas, & Arnab (2014)

It is considered relevant to state that only Luo, Yin, Cai, Lees, & Zhou's (2013) Framework predicts the Serious Game's adaptation, from the generation of scenarios, depending on the player's performance and on the game missions' objectives, as schematised in figure 12. These authors have developed a framework to adaptive scenario generation, described as:

> *"In our work, the scenario generation for training is modeled as an interactive and iterative process, where the trainer and trainee are involved in a generation-training-evaluation cycle."* (Luo, Yin, Cai, Lees, & Zhou, 2013, p.347)
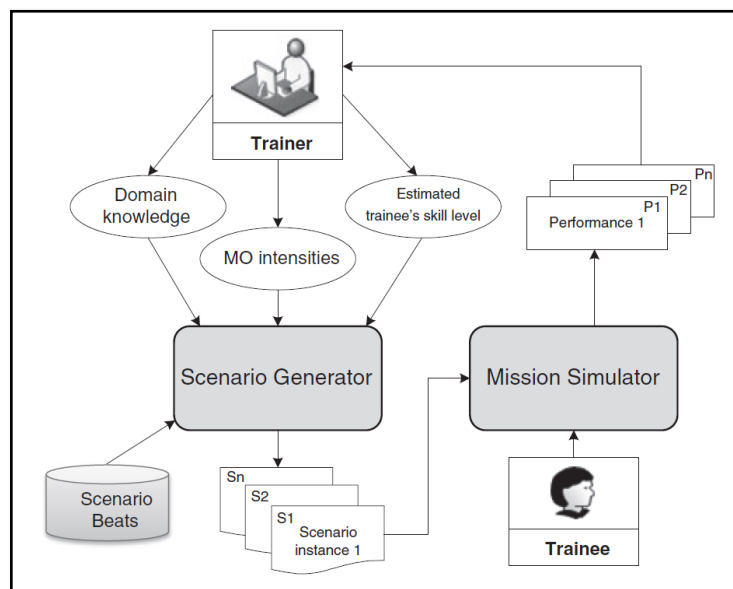

Figure 12. Luo, Yin, Cai, Lees, & Zhou's (2013) Framework for a Mission-Based Scenario Generation

In addition to the searches described in the previous section, to check the existence of research on the influence of adaptation of Serious Games in the professional training concerning learning outcomes, an additional query was performed in the SCOPUS database, using the sentence '(framework OR model) AND ("serious game" OR "educational game" OR "game for education") AND adapt* AND

("corporate training" OR "professional training")', which returned only two results, none of them presenting data on the adaptation of Serious Games in the professional training.

4. Discussion

In this literature review, it was found that different learning outcomes have been documented from the use of Serious Games, such as knowledge and skill acquisition, attitude change, motivation and communication (Wouters, van der Spek, & van Oostendorp, 2009).

These results focus mainly on the context of formal education (in areas such as science, biology, writing, mathematics and geography), but also military applications, health care (medicine) and commercial activities (CRM).

These results document positive, negative, and neutral contributions in practical applications, besides inconclusive investigations.

It was also possible to verify that the most investigated learning outcome in Serious Games is acquired knowledge (Boyle et al., 2016) and questionnaires are the most used type of assessment (Calderón & Ruiz, 2015). Moreover, the most used type of research, quasi-experimental research, corresponds to 45.8% of the research on Serious Games (Boyle et al., 2016).

Mayer (2014) concludes that the main contribution of game research is the union of cognitive and motivational domains:

> *"A major theoretical contribution of game research is to integrate both cognitive and motivational processes in a theory of learning with games. As theories become better specified, they can suggest specific research predictions for empirical testing." (Mayer, 2014, p.341)*

However, Mayer (2014) defends a necessity of more studies associated with learning outcomes of Serious Games:

> *"Improvements are needed in assessing learning outcomes …"* (Mayer, 2014, p.340)

As stated by Lopes & Bidarra (2011), all game elements are potentially adaptable, from scenarios to game mechanics, with emphasis on intelligent agents (such as NPCs) as the most used elements in online adaptations (during gameplay).

The technologies used for adapting Serious Games, according to Rasim, Langi, Munir, & Rosmansyah (2016), can be agent-based (GOAP, Q-Learning, FSM, Multi-Agent) or not (Fuzzy, Genetic Algorithm, AI, among others), as illustrated in Figure 10.

It has been found that the use of artificial intelligence in adapting Serious Games mainly focuses on dynamic difficulty adjustment and adjusting game mechanics and content (Streicher & Smeddinck, 2016).

There is still little documented evidence on the influence of adapting Serious Games on learning outcomes. Van Oostendorp, Van der Spek, & Linssen (2014) cite that the adaptive version of the

Serious Game was much more efficient regarding learning outcomes and that this adaptation showed no differences regarding engagement.

Table 12 shows a summary of the answers to the review questions and the identified gaps in the research.

Table 12. Answers to Review Questions

Review question	Answers found	Identified gaps
1. What is the influence of the game elements?	• Influences of game elements described by Kapp (2012), shown in table 9. • Empirical evidence some game elements' added value, described by Mayer (2014). • Whitton & Moseley (2014) related games to two types of deep engagement: Passion and incorporation.	• The added value of game elements. • Influence of games on learning outcomes.
2. How should the game elements be adapted?	• Lopes & Bidarra (2011) argue that all game components are potentially adaptable. • Streicher & Smeddinck (2016) describe the three psychological models that have been used in adapting Serious Games: Flow; FBM - Fogg Behavior Model; and SDT - Self-Determination Theory. • Van Oostendorp, Van der Spek, & Linssen (2014) reported that their Serious Game adaptive had much higher efficiency regarding learning outcomes when compared to the non-adaptive game.	• Relationship between adapting Serious Games and learning outcomes in the context of professional training.
3. How to classify and organise the game elements to adapt and meet previously established objectives?	• Only the Luo, Yin, Cai, Lees, & Zhou (2013) framework predicts adaptation of the Serious Game.	• Absence of a framework for adaptive Serious Games. • Lack of a framework for Serious Games that relates game elements to learning outcomes.

In this literature review, the analysed publications could be grouped into research areas shown in table 13. These areas are related to the application of Serious Games in professional training and how these games have been developed, evaluated, and adapted.

Table 13. Research Areas of the Analysed Publications

Engagement in Serious Games
Evaluation of Serious Games
Effectiveness of Serious Games
Learning outcomes associated with Serious Games
Serious games research
Serious games models and frameworks
Adaptation of Serious Games
Application of Serious Games in professional training

5. Conclusions and future research

This literature review sought to map the use of Serious Games in professional training. To this end, three cycles of searches were performed, which, after applying the inclusion, exclusion, and classification criteria, formed a set with 53 publications (figure 3).

In this review, to investigate some aspects, as the influence of game elements and the types of existing research on Serious Games, it was necessary to extend its context beyond the professional training.

It is noteworthy that this literature review was limited to publications in English and Portuguese until December 2020. The conclusions related to the three proposed review questions are:

5.1. What is the influence of the game elements?

Although there are publications regarding the influence of game elements, as cited by Kapp (2012) and listed in Table 9, more research is needed to determine empirical evidence of these influences, especially regarding the added value of some game elements (Mayer, 2014).

It was also noted that a significant influence that games can provide is deep engagement.

5.2. How should the game elements be adapted?

Potentially, all game elements could be adaptable, which could ensure greater player engagement and greater possibilities for the application of Serious Games.

Adaptation of Serious Games, which can be achieved from parameterisation by the player or from dynamic changes during the game, is usually based on psychological models, such as Flow.

It can be highlighted that Van Oostendorp, Van der Spek, & Linssen (2014) reported that their adaptive Serious Game had much higher efficiency regarding learning outcomes when compared to the non-adaptive game.

5.3. How to classify and organise the game elements to adapt and meet previously established objectives?

This research has identified models and frameworks for the development and evaluation of Serious Games that can classify and organise the elements of a Serious Game.

Although they present different parameters and dimensions, they all consider the existence of the domains of learning and games; and seek to relate the mechanics and elements of games to theories of instruction and learning. However, only Luo, Yin, Cai, Lees, & Zhou's (2013) Framework predicts adaptation of the Serious Game, based on scenario generation, depending on player performance and the game missions' objectives.

Although there are several applications and investigations regarding Serious Games, in the scope of this literature review, i.e., adaptable Serious Games in professional training, with evidence of learning outcomes, it was not possible to identify specific investigations in this context. Some of the publications analysed, which come closest to this context, are related to Serious Games in academic education.

Also, this research has identified a dearth of frameworks linking learning outcomes and professional competencies.

By analysing the results obtained in this review, it was possible to identify and relate the concepts of the most commonly used dimensions in serious game frameworks, which served as a basis for future research to create a framework predicting adapting serious games to optimise learning outcomes.

The identified gaps in research indicate a need to adapt the existing frameworks, including adaptive features and learning outcomes as part of the predicted dimensions, and to deeply investigate the aggregated value of game elements in Serious Games, mainly the instructional ones.

In this context, it is suggested that future researches should be done within professional training, where Serious Games are used adaptively to check their efficiency concerning player engagement and learning outcomes, such as:

- The added value of some game elements when in serious adaptable games;

- Relationship between adaptation of some game elements and learning outcomes;

- Relationship between learning outcomes and professional competencies.

- Design of frameworks for the adaptation of Serious Games;

- Design and development of models for the adaptation of Serious Games;

- RCT type investigations to evaluate adaptive Serious Games concerning player engagement, knowledge acquisition, skill improvement during game interaction and in actual work contexts.

It is hoped that with investigations of those sorts, with the appropriate scientific rigour, it will be possible to relate the behaviour of game elements to learning outcomes in professional training. Furthermore, contribute to the instructional method improvements in this context and certify the Serious Games application in situations and with proven resources.

This literature review is the first step of research to develop a development and evaluation framework of adaptive Serious Games in professional training to improve learning outcomes.

The purposes of this framework are:

- To include learning outcomes as framework dimensions;

- To group those dimensions in two sets: Learning and game;

- To consider forms of adaptation in those two groups of dimensions;

- To be able to support both development and evaluation of adaptable serious games;

- To improve Serious Games by comparing the application of the framework in the design/ development stage (development team) and evaluation (Serious Game target).

It is expected that this investigation and its resulting framework help to develop and eval the application of effective Serious Games in the professional training context. As cited by Kirkpatrick & Kirkpatrick (2006), training could be evaluated in the learner perspective or in the institution view, as acquired knowledge or return of investment, for instance. So, this framework should predict levels of evaluation and different kinds of learning outcomes. This work paves the way into an extended review on multiple databases relative to the use of Serious Games applied to Professional Training and assessment of its effectiveness.

References

Abt, C. C. (1987). *Serious games*. Lanham, MD: University Press of America.

Almeida, P., Pedro, L., Moita, M., Magalhães, R., Santos, A., & Moreira, L. (2011). Serious Games as an onboarding organizational tool for new employees.. *6th Iberian Conference on Information Systems and Technologies (CISTI 2011)*, IEEE, Chaves, Portugal, 1–6. https://ieeexplore.ieee.org/abstract/document/5974334/

Amory, A. (2007). Game object model version II: a theoretical framework for educational game development. *Educational Technology Research and Development: ETR &* D, 55(1), 51–77. https://doi.org/10.1007/s11423-006-9001-x

Amory, A., Naicker, K., Vincent, J., & Adams, C. (1999). The use of computer games as an educational tool: identification of appropriate game types and game elements. *British Journal of Educational Technology: Journal of the Council for Educational Technology*, 30(4), 311–321. https://doi.org/10.1111/1467-8535.00121

Andreoli, R., Corolla, A., Faggiano, A., Malandrino, D., Pirozzi, D., Ranaldi, M., Santangelo, G., & Scarano, V. (2017). A Framework to Design, Develop, and Evaluate Immersive and Collaborative Serious Games in Cultural Heritage. *J. Comput. Cult. Herit.*, 11(1), 1–22. https://doi.org/10.1145/3064644

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: Journal of the Council for Educational Technology,* 46(2), 391–411. https://doi.org/10.1111/bjet.12113

Bachvarova, Y., Bocconi, S., van der Pols, B., Popescu, M., & Roceanu, I. (2012). Measuring the Effectiveness of Learning with Serious Games in Corporate Training. *Procedia Computer Science*, 15, 221–232. https://doi.org/10.1016/j.procs.2012.10.074

Bahji, S. E., Lefdaoui, Y., & El Alami, J. (2011). The Learning Model S2P as a Conceptual Framework for Understanding the Serious Game. *Proceedings of the 14th IASTED International Conference "Computers and Advanced Technology in Education (CATE 2011)*, July 11–13, Cambridge, UK, 1-5.
https://www.researchgate.net/profile/Salah_Eddine_Bahji/publication/256980833_The_Learning_Model_S2P_as_a_Conceptual_Framework_for_Understanding_the_Serious_Game/links/5636 827b08aeb786b703f231/The-Learning-Model-S2P-as-a-Conceptual-Framework-for-Understanding-the-Serious-Game.pdf

Bennis, L., & Benhlima, S. (2015). Comparative study of the process model of Serious Game Design through the generic model DICE. 2015 *Intelligent Systems and Computer Vision (ISCV)*, 1–5. https://doi.org/10.1109/ISACV.2015.7105539

Boller, S., & Kapp, K. (2017). *Play to learn.* Alexandria, Virginia: ATD Press.

Boyle, E. A., Connolly, T. M., Hainey, T., & Boyle, J. M. (2012). Engagement in digital entertainment games: A systematic review. *Computers in Human Behavior*, 28(3), 771–780. https://doi.org/10.1016/j.chb.2011.11.020

Boyle, E. A., Hainey, T., Connolly, T. M., Gray, G., Earp, J., Ott, M., Lim, T., Ninaus, M., Ribeiro, C., & Pereira, J. (2016). An update to the systematic literature review of empirical evidence of the impacts and outcomes of computer games and Serious Games. *Computers & Education*, 94, 178–192. https://doi.org/10.1016/j.compedu.2015.11.003

Calderón, A., & Ruiz, M. (2015). A systematic literature review on Serious Games evaluation: An application to software project management. *Computers & Education*, 87, 396–422. https://doi.org/10.1016/j.compedu.2015.07.011

Carvalho, M. B., Bellotti, F., Berta, R., De Gloria, A., Sedano, C. I., Hauge, J. B., Hu, J., & Rauterberg, M. (2015). A theory-based activity model for Serious Games analysis and conceptual design. *Computers & Education,* 87, 166–181. https://doi.org/10.1016/j.compedu.2015.03.023

Coleman, T. E., & Money, A. G. (2020). Student-centred digital game-based learning: a conceptual framework and survey of state of the art. *Higher Education*, 79(3), 415–457. https://doi.org/10.1007/s10734-019-00417-0

de Freitas, S., & Jarvis, S. (2006). A framework for developing Serious Games to meet learner needs. The Interservice/Industry Training, Simulation & Education Conference (I/ITSEC), 4 - 7 December, Orlando, Florida. Retrieved December 30 2021, from https://researchrepository.murdoch.edu.au/id/eprint/27662/

Donovan, L., & Lead, P. (2012). The use of Serious Games in the corporate sector. A State of the Art Report. Learnovate Centre (December 2012). https://www.learnovatecentre.org/wp-content/uploads/2013/06/Use_of_Serious_Games_in_the_Corporate_Sector_PRINT_FINAL.pdf

Dresch, A., Lacerda, D. P., & Júnior, J. (2020). Design Science Research: Método de Pesquisa para Avanço da Ciência e Tecnologia. Bookman Editora. Retrieved Dexember 30 2021 from https://play.google.com/store/books/details?id=M63XDwAAQBAJ

Emmerich, K., & Bockholt, M. (2016). Serious Games Evaluation: Processes, Models, and Concepts. In R. Dörner, S. Göbel, M. Kickmeier-Rust, M. Masuch, & K. Zweig (Eds.), Entertainment Computing and Serious Games: International GI-Dagstuhl Seminar 15283, Dagstuhl Castle, Germany, July 5-10, 2015, Revised Selected Papers (pp. 265–283). Springer International Publishing. https://doi.org/10.1007/978-3-319-46152-6_11

Engberg-Pedersen, A. (2017). Technologies of Experience: Harun Farocki's Serious Games and Military Aesthetics. *Boundary 2*, 44(4), 155–178. Retrieved December 30, 2021 from https://read.dukeupress.edu/boundary-2/article-abstract/44/4/155/130459

Ferreira de Almeida, J. L., & dos Santos Machado, L. (2021). Design requirements for educational serious games with focus on player enjoyment. *Entertainment Computing*, 38, 1-11. https://doi.org/10.1016/j.entcom.2021.100413

Greitzer, F. L., Kuchar, O. A., & Huston, K. (2007). Cognitive science implications for enhancing training effectiveness in a serious gaming context. *ACM Journal on Educational Resources in Computing*, 7(3), 2 – es. https://doi.org/10.1145/1281320.1281322

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: ETR & D*, 56(5), 511–537. https://doi.org/10.1007/s11423-007-9073-2

Hamari, J., Koivisto, J., & Sarsa, H. (2014). Does Gamification Work? -- A Literature Review of Empirical Studies on Gamification. *2014 47th Hawaii International Conference on System Sciences*, 3025–3034. https://doi.org/10.1109/HICSS.2014.377

Hays, R. T. (2005). The effectiveness of instructional games: A literature review and discussion [Technical Report]. Retrieved December 30 from https://apps.dtic.mil/sti/pdfs/ADA441935.pdf

Huang, W.-H. D., & Tettegah, S. Y. (2014). Cognitive Load and Empathy in Serious Games: A Conceptual Framework. In J. Bishop (Eds.) *Gamification for Human Factors Integration: Social, Education, and Psychological Issues* (pp. 17–30). IGI Global. https://doi.org/10.4018/978-1-4666-5071-8.ch002

Jantke, K. P. (2010). Toward a taxonomy of game-based learning. *2010 IEEE International Conference on Progress in Informatics and Computing*, 2, 858–862. https://doi.org/10.1109/PIC.2010.5687903

Kapp, K. M. (2012). The gamification of learning and instruction: game-based methods and strategies for training and education. New York, USA:John Wiley & Sons.

Kapp, K. M. (2013). The gamification of learning and instruction Fieldbook: Ideas into practice. New York, USA: John Wiley&Sons. https://books.google.com/books?hl=pt-BR&lr=&id=cdtnAQAAQBAJ&oi=fnd&pg=PR25&dq=%22The+gamification+of+learning+and+instruction%22&ots=lupdfvnVru&sig=qZYwN6kzW3Mwr1xXJD3oM9dNSss

Kara, N. (2021). A Systematic Review of the Use of Serious Games in Science Education. *Contemporary Educational Technology*, 13(2), ep295. https://doi.org/10.30935/cedtech/9608

Kiili, K., Lainema, T., de Freitas, S., & Arnab, S. (2014). Flow framework for analysing the quality of educational games. *Entertainment Computing*, 5(4), 367–377. https://doi.org/10.1016/j.entcom.2014.08.002

Kirkpatrick, D., & Kirkpatrick, J. (2006). Evaluating training programs: The four levels. San Francisco, California: Berrett-Koehler Publishers. https://books.google.com/books?hl=pt-BR&lr=&id=BJ4QCmvP5rcC&oi=fnd&pg=PR9&dq=%22Evaluating+Training+Programs%22&ots=Mn-0c9uZ9V&sig=VA3k33POKeyp01B5l5AqPypHbak

Kitchenham, B. (2004). Procedures for performing systematic reviews. Keele, UK, Keele University, 33(2004), 1–26. https://www.elizabete.com.br/rs/Tutorial_IHC_2012_files/Conceitos_RevisaoSistematica_kitchenham_2004.pdf

Larson, K. (2020). Serious Games and Gamification in the Corporate Training Environment: a Literature Review. *TechTrends*, 64(2), 319–328. https://doi.org/10.1007/s11528-019-00446-7

Lopes, R., & Bidarra, R. (2011). Adaptivity Challenges in Games and Simulations: A Survey. *IEEE Transactions on Computational Intelligence in AI and Games*, 3(2), 85–99. https://doi.org/10.1109/TCIAIG.2011.2152841

Luo, L., Yin, H., Cai, W., Lees, M., & Zhou, S. (2013). Interactive scenario generation for mission-based virtual training: Interactive scenario generation. Computer Animation and Virtual Worlds, 24(3-4), 345–354. https://doi.org/10.1002/cav.1525

Marne, B., Carron, T., Labat, J., & Marfisi-Schottman, I. (2013). MoPPLiq: A Model for Pedagogical Adaptation of Serious Game Scenarios. *2013 IEEE 13th International Conference on Advanced Learning Technologies*, 291–293. https://doi.org/10.1109/ICALT.2013.90

Martin, S.M., Casey, J.R and Kane, S. (2021). *Serious Games in Personalized Learning – New Models for Design and Performance.* New York: Routledge.

Mayer, R. E. (2014). Computer games for learning: An evidence-based approach. Cambridge, Massachusetts: MIT Press.

McMahon, M. (2009). Using the DODDEL model to teach Serious Game design to novice designers. Ascilite, 646–653. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.412.919&rep=rep1&type=pdf

Mitgutsch, K., & Alvarado, N. (2012). Purposeful by design? A Serious Game design assessment framework. FDG '12: Proceedings of the International Conference on the Foundations of Digital Games, 121-28. https://doi.org/10.1145/2282338.2282364

O'Brien, H. L., & Toms, E. G. (2008). What is user engagement? A conceptual framework for defining user engagement with technology. Journal of the American society for Information Science and Technology, 59(6), 938-955. https://doi.org/10.1002/asi.20801

Pabon, L. C. (2016). Training Through Serious Games: The Relationship Between Travel Agent Engagement, Knowledge of Cruise Products and Cruise Sales. *FIU Electronic Theses and*

Dissertations, 1-187. https://doi.org/10.25148/etd.FIDC000713

Rasim, Langi, A. Z. R., Munir, & Rosmansyah, Y. (2016). A survey on adaptive engine technology for Serious Games. *AIP Conference Proceedings*, 1708(1), 050003. https://doi.org/10.1063/1.4941161

Riedel, J. C., Feng, Y., Hauge, J. M. B., Hansen, P. K., & Tasuya, S. (2015). The adoption and application of Serious Games in corporate training—The case of manufacturing. *2015 IEEE International Conference on Engineering, Technology and Innovation/International Technology Management Conference* (ICE/ITMC), 1–9. https://ieeexplore.ieee.org/abstract/document/7438684/

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). https://doi.org/10.1007/s11042-017-4467-6

Sillaots, M. (2016, June 5). *Game Elements*. Retrieved December 30, 2021 from http://ludoguru.org/gameelements/GameElements.pdf

Sillaots, M., Jesmin, T., & Rinde, A. (2016). Survey for mapping game elements. Proceedings of the 10th European Conference on Game-Based Learning ECGBL, 617–626. Retrieved December 30, 2021 from https://www.researchgate.net/profile/Martin_Sillaots/publication/326837965_Survey_for_Mapping_Game_Elements/links/5b68305345851584787f278f/Survey-for-Mapping-Game-Elements.pdf

Sousa, L., Figueiredo, M., Monteiro, J., Bidarra, J., Rodrigues, J., & Cardoso, P. (2016). Developments of Serious Games in Education. In J.Rodrigues et al (Eds.) *Handbook of Research on Human-Computer Interfaces, Developments, and Applications* (pp. 392–419). IGI Global. https://doi.org/10.4018/978-1-5225-0435-1.ch016

Streicher, A., & Smeddinck, J. D. (2016). Personalized and Adaptive Serious Games. In R. Dörner, S. Göbel, M. Kickmeier-Rust, M. Masuch, & K. Zweig (Eds.), *Entertainment Computing and Serious Games: International GI-Dagstuhl Seminar* 15283, Dagstuhl Castle, Germany, July 5-10, 2015, Revised Selected Papers (pp. 332–377). Springer International Publishing. https://doi.org/10.1007/978-3-319-46152-6_14

Tahir, R., & Wang, A. I. (2018). Codifying game-based learning: The league framework for evaluation. European Conference on Games Based Learning. Academic Conferences International Limited. https://www.researchgate.net/profile/Rabail_Tahir2/publication/330009767_Codifying_Game-Based_Learning_The_LEAGUE_framework_for_Evaluation/links/5c92329192851cf0ae89fdb3/Codifying-Game-Based-Learning-The-LEAGUE-framework-for-Evaluation.pdf

Tang, S. O. T., Hanneghan, M., & Carter, C. (2013). A Platform Independent Game Technology Model for Model-Driven Serious Games Development. *Electronic Journal of E-Learning*, 11(1), 61–79. https://researchonline.ljmu.ac.uk/id/eprint/184/

Thillainathan, N. (2013). A Model-Driven Development Framework for Serious Games. In Informatik 2013 Doctoral Consortium, Koblenz, Germany.https://doi.org/10.2139/ssrn.2475410

Ulrich, F., & Helms, N. H. (2017). CREATING EVALUATION PROFILES FOR GAMES DESIGNED TO BE FUN: An Interpretive Framework for Serious Game Mechanics. *Simulation & Gaming*, 48(5), 695–714. https://doi.org/10.1177/1046878117709841

Uskov, A., & Sekar, B. (2014). Serious games, gamification and game engines to support framework activities in engineering: Case studies, analysis, classifications and outcomes. *IEEE International Conference on Electro/Information Technology*, 618–623. https://doi.org/10.1109/EIT.2014.6871836

van Oostendorp, H., Van der Spek, E. D., & Linssen, J. (2014). Adapting the Complexity Level of a Serious Game to the Proficiency of Players. EAI Endorsed Trans. *Serious Games*, 1(2), e5.

https://research.tue.nl/files/42091477/sg.1.2.e5.pdf

Vermeulen, M., Guigon, G., Mandran, N., & Labat, J. (2017). Teachers at the Heart of the Learning Games Design: The DISC Model. *2017 IEEE 17th International Conference on Advanced Learning Technologies* (ICALT), 145–149. https://doi.org/10.1109/ICALT.2017.41

Wattanasoontorn, V., Hernández, R. J. G., & Sbert, M. (2014). Serious Games for e-Health Care. In Y. Cai & S. L. Goei (Eds.), *Simulations, Serious Games and Their Applications* (pp. 127–146). Springer Singapore. https://doi.org/10.1007/978-981-4560-32-0_9

Whitton, N., & Moseley, A. (2014). Deconstructing Engagement: Rethinking Involvement in Learning. *Simulation and Gaming*, 45, 433–449. https://doi.org/10.1177/1046878114554755

Wilson, D. W., Jenkins, J., Twyman, N., Jensen, M., Valacich, J., Dunbar, N., Wilson, S., Miller, C., Adame, B., Lee, Y.-H., Burgoon, J., & Nunamaker, J. F. (2016). Serious games: An evaluation framework and case study (Sprague R.H. & Bui T.X. (eds.); Vol. 2016-March). IEEE Computer Society. https://doi.org/10.1109/HICSS.2016.85

Wouters, P., van der Spek, E. D., & van Oostendorp, H. (2009). Current Practices in Serious Game Research: A Review from a Learning Outcomes Perspective. In T. Connolly (Eds.) *Games-Based Learning Advancements for Multi-Sensory Human-Computer Interfaces: Techniques and Effective Practices* (pp. 232–250). IGI Global. https://doi.org/10.4018/978-1-60566-360-9.ch014

Challenging Students' perspectives
with Game Design for Older Adults

Simone Hausknecht
Simon Fraser Univ., Canada
simone_hausknecht@sfu.ca
0000-0003-2666-3980

Fan Zhang
Simon Fraser Univ., Canada
fza26@sfu.ca
0000-0002-3874-9928

Julija Jeremic
Simon Fraser Univ., Canada
julija_jeremic@sfu.ca
0000-0001-5594-0057

Hollis Owens
Simon Fraser Univ., Canada
howens@sfu.ca
0000-0002-9512-0368

David Kaufman
Simon Fraser University, Canada
dkaufman@sfu.ca
0000-0003-4621-1404

Abstract
Older adults are a group that is often overlooked by the game industry, even though they make up a reasonable portion of gamers. It is important for game designers to be able to consider different users and the needs involved. In this study, game design students were challenged with the task of making a video game for older adults that had some level of learning and social interaction. A total of sixty students, 13 older adults, an instructor, and the researchers were involved in the study. Seven games were created over two semesters. Older adults participated in the design by providing feedback. The students initially were disappointed with this assignment and resistant to the task, but as the project continued, they were able to embrace the challenge and see the benefits of designing for older adults. It challenged them to think from a different perspective and consider game design that is accessible to a wider audience. What they thought was intuitive (e.g. easy for the player to understand and use) did not always turn out to be so for the older cohort. This required the students adjust their design to suit a wider audience. User-centered design with a cohort different from their own was a beneficial approach to getting students to think of a broader audience.

1. Introduction

Older adults have increasingly made up a noticeable portion of the gaming demographic. In 2021, sixteen percent were over the age of 55 (ESA, 2021). Previous research suggests that older gamers are mainly casual gamers (66%), who prefer puzzle games, card, arcade, or word games (De Schutter, 2011, ESA, 2016). However, as specific cohorts move into older adult categories these preferences may change. Digital games can offer an important role in providing the motivation and excitement that allow older adults to pursue areas to improve social well-being, lifelong learning, digital literacy, and intergenerational connections (Astell, 2013; Schell, et al 2016; Hausknecht, 2013).

Previous studies suggest that older adults enjoy a variety of benefits from digital games including fun, social connections to others, and cognitive (De Schutter, 2011; Hausknecht, 2013; Schell, Hausknecht, Zhang, Kaufman, 2016). For example, a study conducted by Schell, and colleagues (2016) reported on an eight-week Wii Bowling tournament in seniors' centres. They found that older adults increased their social connectedness and reduced loneliness levels during the time frame. In a follow-

up study, they found that many of the social connections remained for a longer period of time (Hausknecht et al., 2015). However, this study was not without some challenges such as some players needing to compensate due to vision impairment and balance issues (Schell et al., 2015). These challenges did not hinder enjoyment. Other studies have noted that older adults, particularly those with an impairment, may struggle with games (IJsselsteijn, Nap, de Kort, & Poels, 2007; Gerling, Schulte, & Masuch, 2011). As a cohort, older adults are both unique in their interest and game style. Yet, designs should not be based upon stereotypes of what they may or may not like. Extending from our previous work, this study examines a collaborative project in which a research team and post-secondary students came together to design digital games, with some learning content, for older adults.

1.1 Importance of Learning in Later Life

The importance of lifelong learning and the role it plays in enhancing later life has been well established (Findsen & Formosa, 2011). The World Health Organization (2015) maintains that healthy ageing includes engagement with life and lifelong learning as an important aspect. In addition, the United Nations (2008) also called on governments to use education and learning to address the various issues arising from the increased aging population such as job training and increasing literacy. Learning activities are not only beneficial for the individual, but often have a positive effect on community engagement and wellbeing (Merriam & Key, 2014). Merriam and Key (2014) suggest that community wellbeing, "the notion of a locality where people are socially interconnected in healthy and prosperous ways" (p.130) can be promoted through lifelong learning. They point to the overwhelming evidence that learning is beneficial to wellbeing and communities.

Learning habits have been associated with an increased sense of well-being in older adults (Jenkins & Mostafa, 2015). In a longitudinal study, Jenkins and Mostafa (2015) compared older adult participants' subjective well-being with their learning behaviors. They found that there was a significant relationship between learning behavior and reported well-being. Nevertheless, these results seemed to only apply to informal learning. In another large study in which researchers surveyed 2645 older adults (aged 50 +) in Australia, Boulton-Lewis, Buys and Lovie-Kitchin (2006) found that good mental and emotional health had a significant relationship with engagement in learning activities. In vulnerable older adults, lifelong learning may play a crucial role in helping them adapt to changes occurring within their world and body (Narushima, Liu, Diestelkamp, 2018).

Technology provides a great opportunity for older adults to engage in informal learning. Digital games can be an engaging way to learn and play (Hausknecht, 2013; Sauvé, Kaufman & Plante, 2019). The possible cognitive benefits of digital games for older adults have had promising results (Hausknecht, 2013). Play combined with learning could provide a wide range of learning options and provide a digital space for varying interest.

1.2. Human-centred Design, User-centered Design, and Participatory Design for Representation

Although older adult gamers make up a quarter of the gaming population, they are often a neglected target demographic group. The game design industry administrators and game designers rarely target this audience (Jeremic, 2020). A further difficulty is that intergenerational interactions are becoming increasingly limited through societal age segregation such as schools, workplace, housing, and families living in different regions (Hagestad & Uhlenberg, 2005). This may mean that young designer's interactions with older adults may be limited. These factors can also contribute to a lack of awareness of differences in the needs of older adults compared to a younger gaming community. Further difficulties may arise due to an I-methodology design approach. This is an approach where designers design a game with the perception that they are representative of end users (Akrich, 1995). Although the designer may, or may not, be aware of this, it has implications. Some have argued that when an I-methodology design approach is used then the diversity of gamers may be neglected, including aspects as age and gender (Loos, 2014; Romero & Ouellet, 2016). Thus, introducing game design students to varied end users can increase awareness of diverse end users.

Approaches to innovative designs have undergone a change with increased interest in incorporating the feedback and needs of end users and other stakeholders (Sanders, 2002). Previous studies have also pointed to the need for more participatory design processes to allow for a better representation of such aspects such as age and gender (Romero & Ouellet, 2016). One approach has been to incorporate others (beyond the design team) in the process of design (Sanders, Brandt, & Binder, 2010). User-centered game design (UCD) has become increasingly popular. It allows for game designers to better understand the end users and their needs. This is important to limit the bias of the game industry (International Game Developers Association, 2016). User-centered design is an iterative process whereby the user is considered at all stages of development (Gulliksen et al. 2003). It seeks to collect data around users' behaviors, needs and practices to provide more intuitive systems and interfaces (Perry, Aragon, Cruz, Peters, & Chowning, 2013).

To address specific needs and interests of older adult gamers, some researchers have started to design games specifically for older adults. For example, Gerling, Schulte and Masuch (2011) created the game SilverPromenade which was designed for frail elderly. In this study, they used a participatory design incorporating older adults in a care home into the process and attempting to adjust for the specific limitations that arose. Extending from user-centered design, Vanden Abeele and Van Rompaey (2006) suggested that these ideas need to be pushed further to incorporate the end user early in the process. Vanden Abeele and Van Rompaey (2006) adopted a human-centered (HC) procedure to design game concepts for and with older adults. Several other game developers have also recently applied an HC approach (*e.g.* Sauvé, Kaufman, & Plante, 2019). This procedure started with observing older adults' positive experiences in their daily life. Then, older adults and researchers generated game-ideas and co-designed the selected ideas into some game concepts. Loos (2014) suggested that Vanden, Abeele and Van Rompaey's HC procedure was a way to avoid some of the pitfalls of I-methodology.

The aim of this study was to explore and examine the game design students' experiences of working and designing for older adults. This included their process of designing for a cohort outside their own and the challenges they faced. Our main research question was:

1. What are the experiences of game design students when designing for an older adult population?

2. Methods

The study was conducted over nine months in 2016 during a game design course at an art institute in Vancouver. A collaborative approach to the research, design, and learning experience was used. The design process involved a combination of user-centered and participatory approaches incorporating input from researchers, the instructor, and older adults into the games developed by the students. All stakeholders had some input into the game design and provided feedback throughout; however, as this was a student course project, there were some limitations to the contributions as the students had the final decisions on what feedback to incorporate.

A letter of agreement was written up between the research university and the Art Institute in 2015. Ethics approval was given by Simon Fraser University Research Ethics Board (REB) study number 2015s0481. Consent forms were given to all students. One student did not want their comments used in the research, and these were not included.

2.1. Participants and collaborators

This collaboration involved five researchers, thirteen older adults, sixty students from a college, and one instructor all from Vancouver, Canada. The researchers were made up of three graduate students, a postdoctoral scholar, and a Professor (over 65 years old). The older adults were recruited from the community and the University's Seniors 55+ programs. The students in the study attended a Game Design program and were seeking a degree as either game designers, programmers, or artists. Most of the students were in their early 20s and less than 10% were female.

2.2. Interactions and design sessions

There were five sessions in which the researchers and older adults attended to provide feedback and guidance to the student designers. The students formed teams of 5-12 students. For this class, students were required to create a digital game for older adults with some form of learning incorporated into the design. Specific criteria:

- create a digital game for older adults that can be played on tablets and/or personal computers;

- create games that can be played both alone and with other players (consider social aspects);

- consider the possibility of creating a game that can be played by an intergenerational team;

- embed subject matter content into the games that is appropriate and motivating to older adults (learning);

- conduct evaluation of the games with groups of older adults.

The process occurred during a nine-month project course in which they collaborated to create a video game that met the above criteria. After the initial sessions, older adults were brought in for consultation. Although the initial criteria suggested creating a multiplayer game, this was more a conceptual exercise due to the level of students and the time restrictions. It was quickly agreed that multiplayer games were beyond the scope of the project.

In our first session, the researchers explained the project and gave the students a profile of what we had learned about older adults and digital gameplay based on previous research. We also presented them with topics of interest based on the 55+ programs of interest at the researchers' university. In this session the researchers, students, and instructor did brainstorming exercises. The students were asked to consider this information and create a pitch for a game idea by the next session. In the second session, students pitched ideas to the instructor and researchers (with one researcher being an older adult). The ideas that were most suitable and engaging were chosen. In previous years, the class had been given free reign on the project, so the researchers noted some initial resistance to the restrictions. Table 1 presents the list of games chosen and then created by the students.

For the third, fourth, and fifth sessions, groups of 5-7 older adults tested the games and provided feedback. In the third session, a group of older adults joined the researchers to comment on the art, storyline, and game ideas as they had progressed. There weren't any prototypes at this point, and the games were still in early production. It allowed the students to get feedback on whether the concept was appealing to the older adults. The older adults were given the opportunity to comment and give the students ideas on what they would like.

In the fourth and fifth sessions, older adults tested the prototypes and provided feedback on the games. Both the researchers and the game design teams asked questions to the older adults shared their findings with each other. This process also involved extensive observation of game play. Figure 1 provides an example of one of the games created and an older adult testing it.

Table 1. Seven games designed for older adults

Game	Game concept
Chromalife	*"Chromalife is a 2D puzzle platformer designed to try and bridge the gap into learning about multiculturalism and inclusivism. We did that through color-based puzzle mechanics and creating a gorgeous art style to show off our story in full, in a nutshell."*
Daredevle Fishing	*"It's a fishing simulation game. It has an emphasis on education through once you've caught the fish, it gives you information about it. General information so they can use. All the models must be realistic so you can recognize it outside of the game. How to use specific lures. It's a fictional lake but it presents it as if it was a realistic lake using knowledge and other facts to make it realistic."*
Dig It	*"Dig It is an archeological collection game where the user travels the world to geographically accurate dig sites. Digs up either fossils, gems and/or artifacts. Takes them back to their museum, displays them and then runs an exhibition to show them publicly where they get a score based on what they have displayed."*
Modern Mischief	*"It's an action stuff and educational video game.So we're just thinking of museums and studying up on modern art just to get to know the paintings a bit in terms of artist, year and the painting style."*
Too Many Cooks	*"Too Many Cooks is a mini-game collection that centers around a virtual kitchen. The idea is that you would learn about cooking, although not terribly specifically how to cook, while you play a series of games that tests your dexterity and memory, etc."*
Violet Light	*This game is an adventure solving game where players solve the crime of a friend who has been murdered.*
Virtual Virtuoso	*"The idea is to teach piano in a portable and pressure-free environment. We do that through the use of sheet music on-screen and also ear training. I think that's a pretty good synopsis."*

Figure 1. Example of the game Dig it

2.3. Data Collection and analysis

Throughout the term, researchers observed the game design process and interactions. At the end of the nine months, the researchers conducted semi-structured focus group interviews with each game design team (7 groups) and a separate one with the instructor. Each interview was conducted by two researchers (SH + another researcher). As the projects were group projects, focus groups were the most appropriate as they provided group dynamics and perspectives. The main topics covered through the interview were a description of the process of designing a game

for older adults, challenges and benefits, experience of involving older adults in the process, impact on professional understanding, and how would you do it differently.

A thematic analysis was used to capture themes from each focus group of the teams. Braun and Clarke's (2006) six phase approach to thematic analysis was used. This involved becoming familiar with the data, generating initial codes, searching for themes, reviewing the themes, defining, and naming the themes, and producing the report. For the analysis, each team was considered as an individual entity; while the overarching themes were examined to find themes that appeared across most of the game design teams. NVIVO 11 was used to assist with the analysis. The transcripts were added to the system and then each phrase was examined for the main content and a code was applied. The codes were then organized into themes. The observations and the instructor's interview were also examined to see if there was a triangulation of the findings. For example, the instructor's interview was also broken into codes and then these were examined against the emerging themes.

3. Results

The first section outlines the main finding of the thematic analysis in relation to the student experience of the process, while the second section highlights the results of what, if anything, they learned in designing for an older adult cohort.

3.1. From resistance to new perspectives: experience designing for older adults

The students started with a high level of resistance to the project, feeling annoyed that they had constraints on their game designs and that their target audience was older adults. This evolved over time as they began to create their games and began to appreciate the end users.

3.1.1   Starting with resistance

Over half of the teams commented on how many of the students started with a level of resistance to designing for older adults. It was apparent that they were hoping to design for their own cohort. The researchers and instructor observed this resistance in the initial consultation. During the focus group interviews this was also noted by some of the teams.

> And a lot of people were grumbling about this when this was announced like I have to spend 9 months making a tablet game for seniors. Like I don't want anything to… because people already envision themselves like I'm going to go work in this company. I'm making high tempo shooting games. This will not help me at all. I hate it. Right?

Some groups highlighted their surprise at the end of the project on their change of opinion, where they admitted their initial reactions and how these evolved.

> I had a lot of fun doing this actually. I was quite surprised at how much I enjoyed it. Honestly, when I was initially told I was making a game for older adults, I was thinking to myself this might be the worst thing ever. But it really was quite an interesting experience. I definitely would be interested in doing this again.

Yeah, specifically addressing design for older adults, it's interesting to move from, to be blunt like relative shivering at the start to actually really enjoying the project now.

This adjustment from their original perspective that designing for older cohorts would be a terrible experience to one of enjoying the project is an important transition as the initial resistance was based on stereotypes and what older adults represent. As the project progressed, there was a change in these attitudes.

3.1.2   Gaining an appreciation for the user and their feedback.

All the game design teams commented on the usefulness of the older adult feedback. The students enjoyed working with the older adults and gaining insight into differences and similarities. They commented on how having the older adult feedback was very important to their designs and the progress on the games as one mentioned "*I would say that the older adults' feedback is the most important part of any of the testing or feedback that we got in general*".

This was particularly important because they were not aware of the demographic or how they differed from their own cohort. The students began to realize that designing for self was very different than designing for others.

It [the feedback] was super valuable because we've never designed anything for a demographic that isn't us. So the first two play tests were super valuable insight as to what we should actually be focusing on. Because up until then, we had just been guessing.

For me, at the start it wasn't as hard because I wasn't thinking about it as much. And then when you guys came in the first play test, it was like this is out and this is out. It was so hard. So that was kind of a wakeup call for the project. I think, where it's just like, oh, my God. Like we've been trying to make this game and it was all about the mechanics and we forgot that it was about our target market for a piece of music.

The students also noted that they needed the feedback from the older adults as compared to their own cohort and other game design students, or themselves, as noted that, *"we can't possibly fathom how older adults would prefer it until you see it yourself"*.This seemed to lead to some students beginning to understand the importance of designing for others.

That was probably the most useful feedback I would say, because I mean I can ask a hundred people that are in their late 20s what they would prefer and I could ask 10 people or 5 people in the range that we're aiming for and the 5 people's feedback is going to be more accurate than the hundred people in their mid-20s.

This was also a challenge with feedback from their cohort versus the feedback given by older adults. It was difficult for them to negotiate what was useful when they tested it with their cohort.

It was also still very difficult to incorporate it because, again, whenever we play tested, we would do it on younger people and they would say, "Oh, it's too easy." Okay. So then maybe turn it up a little bit harder while also trying to think of the older adults. It was difficult. It was very difficult.

The instructor also commented on the importance of the feedback to students' understanding, describing it as a *"kind of eye-openers to things they had to be more concerned about".* This led teams to consider the feedback and use it. The feedback influenced their approach and shaped the game significantly as one team suggested:

> We took their feedback very seriously. And we actually tuned way too much after that. Like if you can compare the previous version the older adults were playing and this version, there is a huge drastic difference.

Students also had to negotiate and use their judgement between what feedback was worth using and what was not.

> I think whenever you're getting feedback you have to take it with a grain of salt as some of it you probably don't want to consider. But I think for the most part, a lot of the feedback we got was gold because we were really walking blind on this project. And it was refreshing to actually have a bit of grounding as to how we were actually doing compared to how we feel we were doing.

> I like to talk to them and ask what suggestions they have. Because sometimes they can have really good ideas… sometimes they think they want something, but they don't really want that. They want something different.

Students commented that they adjusted based on the users' feedback as, "we did make a bunch of changes based off of that last play test session." These changes were noted as crucial to making a good game for older adults.

> First off, I don't think the project would have turned out the way that it did without that feedback. And second off, I don't think the game would have been as good as it is without that feedback. We added in a lot of options that make the game more fun as a result of that feedback because now, instead of having frustrated players, we have players that feel like they're… that have come up to me after playing and are like, "I feel like I can go out and play some piano."

3.1.3   Challenged ideas and gave new perspective on design

Almost all groups commented on how the project challenged their ideas, provided new perspectives, and required them to think in different ways to solve problems. Some of the students commented on how it made their teams approach the design in different ways and explore different perspectives since, "*it forces you in a different mindset."* Many students gained a more diverse approach and had comments such as:

> I think the best thing about doing this was it made us think outside the box, made us really look into people in a different light. Designing a good game that's not for us, it's for somebody else.

> Gives us experience and new perspective and opens up our mind for more different challenges and different experiences and experiments. Like we can make more kinds of games, different kinds of games, experimental games like how we can actually exercise… how can we take our games, what games we like, and make them available to the older adults with a different skin.

Some saw it as an opportunity to see different perspectives. For example, one student suggested it changed their perspective of how to design, "*I don't think I'd think the same way about design if I hadn't had the opportunity to actually design a game for an older adult."* Other students commented on how they appreciated how it pushed them beyond their current view of people of different cohorts and how that relates to their designs:

> Improve my ability to design better because it makes me go beyond what I know, beyond my comfort zone. So as a designer I think that's amazing the opportunity to see other people that have a different concept of fun than you have.

> The other thing that I worked with the UI and art and I realized that when you make UI for seniors it's also different because you have to think which reference they have, which icons they're going to understand, and they wouldn't understand because their reference are different. So that's something that I didn't think I would need to worry about.

Although there was initial resistance, the situation required them to move beyond what was comfortable. This provided new perspective. It was also later perceived as a benefit to working in the industry.

3.1.4 Benefits to their future work in the game design industry

At the end of the project, most groups commented on how they felt it was a great educational experience that would have real world benefits when they were out in the industry. Through having to design for different cohorts, it meant understanding how to design beyond the scope of their own cohort. Students described it as a "*more accurate representation*" of what working for a company would look like. They gained the realization that they won't simply be designing for themselves.

> I think this experience working with you guys, I think it's a more reflective experience as to what we'll see when we start working in the industry. Because very few studios actually have free rein to make their own games.

A couple of groups commented on how the older adult gamer could be an important industry, and they saw it as an opportunity to have a niche as one student commented:

> If I can start designing these games now for a demographic that is about to take off, we may be able to create an entirely new sector of industry based around this type of educational cognitive game play. And I think it's very important especially knowing that my grandparents are looking forward to playing this game.

> This is going to become a very large market very, very soon. Because all of us have grown up playing games and, as I said, I'm nearly 30. So in about 30 years, I'm going to be that demographic playing these games.

This idea of the specific constraints being useful for the industry was not limited to the designers, but also the artists.

> A benefit actually, I think it's our ability to adapt to your guys' target market. So like with the constraints that we have, we have to make it a certain way and that in turn will help us in the industry since we have to follow another, like a lead character artist or a lead artist design as well… Yeah, that adaptability is really good.

One student met with a future employer and found that it was useful as a selling point. (This student was later offered a job by the company).

> I met a designer from a game company recently for coffee and just brought the game with me. I just decided to show him what it was, just how it is, kind of explained the design choice of this, why we kind of did everything. And by the end of it he was like, "Can I have your resume?"

At the end of the project, some students thought the experience gave them an advantage over previous years that did not have to focus on a specific user demographic.

> Every other production group beforehand is literally just they create their ideas, and they go. Right? Whereas this is better for us because it's styled the same way as the industry where we have a target audience, and this is who we're building for and let's focus on that. So that alone, that experience has been like awesome because it's taught us exactly how it's done in the industry.

3.2. Lessons in designing for others

One of the main outcomes was that the students had to negotiate with design aspects that they "*take for granted*" or believe are "*intuitive*." However, as the project progressed and the older adults came in to provide feedback and test the games, they soon realized that what appeared intuitive to them was not necessarily intuitive to others.

3.2.1. Intuitive design is not always intuitive

Many of the teams discussed how what they thought would be intuitive, where players would easily be able to understand and interact with the game, was not always intuitive to everyone. This was nicely summed up by one student as:

> We spent quite a time actually questioning whether or not stuff that we took as maybe a bit intuitive. We actually had to question ourselves as to whether or not it actually was as intuitive as we thought it was, which was an interesting problem to deal with.

The feedback made the students question themselves and what they know. One student commented on how "*Like especially I keep bringing it up at the last milestone test when you guys came in, it was like, oh, maybe I'm like not as intuitively good as I thought*." However, intuition and skill seemed to not always be clear as one student seemed to suggest it was the older adults who were not intuitive about games as he commented "*What we found out was the hardest part about that was establishing solid communication with our player because they're quite different from our usual audience who's very intuitive about certain controls*."

Quite a few students talked about aspects they took for granted that everyone would know how to play in a certain way with comments such as "*I definitely took for granted that most people I know play platformers from time to time.*" Working on the project made them reflect on different aspects in the design that they simply took for granted.

> We took for granted is that we need to be more patient with some things. Like for some of us that have played Guitar Hero, for example, the notes move really fast, and we are sort of used to it. But for other people that have never played that game, we went... It should be good enough since we can play it. And it turns out it was really not the way to go.

I never thought of that really, but there are conventions within gaming of like this symbol means this. But it doesn't mean that in the rest of the world, you know.

3.2.2. Accessibility: Designing for all as an approach

To tackle the issue of designing for older adults, but not always having them nearby to consult, some teams approached it by making the games accessible to everyone. In general, this is important as it made students think beyond their current situation. One student commented that "*we need to make them accessible*". Others mentioned that they challenged each other as this conversation between team members highlights:

> Respondent1: Okay, it's technically we did this as a challenge for like designing for everyone because we actually, when me and S. talked we were like, okay, older adults and younger children are like pretty much the same.

> Respondent2: One with the maturity.

Respondent1: Yeah. It's how they're mature. We started with that, okay, we'll target everyone so that it appeals for a wider audience so that older adults will be like,"hey, this is a game which can be played by everyone".

Respondent2: It doesn't come off as feeling this is just for us because, I mean, as much as that can be kind of fun, it kind of comes up I wouldn't say stagnant but it's a game for us… This is a game you could teach an 8-year-old to play, and you teach an 80-year-old to play.

Some groups commented on how it shouldn't be just for older adults, but should appeal to a wide range, if it is done right. Thus, they moved from the initial idea of a game for older adults not being appealing to gaining a deeper perception of good design. One team member pointed out that "*If an older adult likes it and if it's done right then younger people will as well, which is I think what we really tried to go for*." Another member commented, "I *think anybody can play the game now*."

4. Discussion

This study examined the experience of game design students who were challenged with a project to design for an older adult cohort versus the freedom to design a game for themselves. Such experiences require students to think as user-centered designers. This process made the teams reflect and acknowledge the weaknesses of designing with an I-methodology. For example, what the students took for granted as "*intuitive*" often is not as intuitive as they believed. When an I-methodology design approach is used then the diversity of gamers may be neglected including such aspects as age and gender (Loos, 2014; Romero and Ouellet, 2016). Simply getting feedback and suggestions from their peers does not allow them to understand the needs of a diverse demographic of game players.

The students' initial resistance also shows their perceptions of older adults as being uninteresting and highlights the ageism that can occur within game designers. Ageism is an ongoing issue within society that needs to be dealt with but often goes unnoticed (Palmore, 2001). Once the students engaged in the process it gave them insight into designing for diverse users, and they found it was an engaging experience that required considering alternative perspectives. Working with the older adults provided useful insights.

The user-centered approach allowed the students to gain insights beyond their own experiences and think of design in different ways. For some, it was a matter of making games that are engaging for a wider audience. With an increased move towards Universal design and accessible design for technology programs and games (Grammenos, Savidis, & Stephanidis, 2009), it is useful to have first-hand opportunities for students to be able to consider how to do this. User-centered design is becoming more common for technology design. Yet, students still often design for *"themselves".* This can be useful for beginners, learning the skills required for game design. Nevertheless, this study suggests a benefit of including a target audience that is a different demographic from the students and is often overlooked within the game design industry. The students appreciated this as it forced them to think about design from a different perspective. As mentioned by Romero and Ouellet (2016), game design is a great exercise in critical thinking

and problem solving. Challenging students to look beyond their understanding and use critical thinking to solve problems can enhance their experience.

4.1. Limitations and Future Directions

There were a number of limitations on the project mainly due to the coordination of the various collaborators. In retrospect, it would have been beneficial to have more sessions with older adults and a larger number of them. Students suggested that they would have liked more input from older adults and felt their limited access was a problem. Older adult participants were limited to those who were able to come out to the school. This meant that anyone with accessibility issues was unlikely to volunteer. Furthermore, the volunteers were recruited through the University over 55 program which may attract a specific type of older adult. Although the focus of this paper is on the students, more interactions could have led to further insights.

One guideline for future inclusion of older adults in game design is to bring them into the process early and often. It is also important to be aware of the vast differences in the needs and interests of older adults. Thus, increasing the number and age range of participants would be advantageous. The students were surprised to observe that certain aspects that seemed "*intuitive*" to them were not as obvious for the older adults. It is important for the students to get an opportunity to observe what is working, to talk to the older adults while they play, and to think critically beyond the student cohort norms.

5. Conclusions

The objective of this paper was to explore the experiences and processes of game design students who were tasked with designing for a cohort outside their own, specifically older adults. The students went through a process of rejecting the assignment to finding the experience to be extremely beneficial to their understanding of designing for other users. Including diverse users as a factor for game design students can help them think about their audience in broader terms and avoid the problems of I-methodology. Although there may be some initial challenges, it allows students to gain important skills moving forward in their careers. Using participants who are different from the students, such as older adults, challenges students to not only think about design from the user perspective but also challenges them to consider their own assumptions about others.

Acknowledgments

References

Akrich, M. (1995). User representations: practices, methods and sociology. In A. Rip, T. Misa, J. Schot, (Eds.), *Managing technology in society. The approach of constructive technology assessment* (pp. 167-184). London: Pinter Publishers.

Astell, A. (2013). Technology and fun for a happy old age. In A. Sixsmith & G. Gutman (Eds.), *Technologies for active aging* (pp. 169-187). International Perspectives on Aging, vol 9. Springer, Boston, MA. https://doi.org/10.1007/978-1-4419-8348-0_10

Boulton-Lewis, G. M., Buys, L., & Lovie-Kitchin, J. (2006). Learning and active aging. *Educational gerontology*, *32*(4), 271-282. doi:10.1080/03601270500494030

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, *3*(2), 77-101. doi:10.1191/1478088706qp063oa

De Schutter, B. (2011). Never too old to play: The appeal of digital games to an older audience. *Games and Culture, 6*(2), 155-170. https://doi.org/10.1177/1555412010364978

Doroudian, A., Hausknecht, S., & Kaufman, D. (2018, July). Creating an online escape room game for older adults: Needs assessment, design process, and usability testing. In *International Conference on Human Aspects of IT for the Aged Population* (pp. 516-525). Springer, Cham.

Entertainment Software Association (2016). Press Release. Retrieved on Novemeber 25, 2016 from http://www.theesa.com/article/more-than-40-million-americans-age-50-plus-play-video-games/

Entertainment Software Association (2021). 2021 Essential Facts About the Video Game Industry - Sales, demographic and, usage data. Retrieved on December 29, 2021 from https://www.theesa.com/resource/2021-essential-facts-about-the-video-game-industry/

Findsen, B., & Formosa, M. (2011). *Lifelong learning in later life: A handbook on older adult learning*. Rotterdam, NL: Sense Publishers

Gerling, K. M., Schulte, F. P., & Masuch, M. (2011). Designing and evaluating digital games for frail elderly persons. In T. Romão et al. (Eds.), *Proceedings of the 8th International Conference on Advances in Computer Entertainment Technology*. New York, NY: ACM Press. doi: 10.1145/2071423.2071501

Grammenos, D., Savidis, A., & Stephanidis, C. (2009). Designing universally accessible games. *Computers in Entertainment (CIE)*, *7*(1), 1-29. https://doi.org/10.1145/1486508.1486516

Gulliksen, J., Göransson, B., Boivie, I., Blomkvist, S., Persson, J., & Cajander, Å. (2003). Key principles for user-centred systems design. *Behaviour and Information Technology*, *22*(6), 397-409. https://doi.org/10.1080/01449290310001624329

Hagestad, G. O., and Uhlenberg, P. (2005). The social separation of old and young: A root of ageism. *Journal of Social Issues*, 61(2), 343-360. https://doi.org/10.1111/j.1540-4560.2005.00409.x

Hausknecht, S. N. (2013). *Older adult gamers: patterns of use and opinions on the benefits of digital gameplay* [Masters dissertation, Education: Faculty of Education].Retrieved December 30,2021 from Simon Fraser University Summit Repository http://summit.sfu.ca/system/files/iritems1/14068/etd8196_SHausknecht.pdf

Hausknecht, S., Schell, R., Zhang, F., & Kaufman, D. (2015, May). Older adults digital gameplay: a follow-up study of social benefits. In *International Conference on Information and Communication Technologies for Ageing Well and E-Health* (pp. 198-216). Springer, Cham.

IJsselsteijn, W., Nap, H. H., de Kort, Y., & Poels, K. (2007). Digital game design for elderly users. In B. Kapralos, M. Katchabaw, & J. Rajnovich (Eds.), *Proceedings of the 2007 Conference on Future Play* (pp. 17-22). New York, NY: ACM. https://doi.org/10.1145/1328202.1328206

International Game Developers Association (2016). Developer Satisfaction Survey: 2014 & 2015: Survey Background and Sample Overview [Diversity in the Game Industry Report] Retrieved Dec 30, 2021 from https://igda.org/resources-archive/diversity-in-the-game-industry-report-2016/

Jenkins, A. and Mostafa, T. (2015). The effects of learning on wellbeing for older adults in England. *Ageing and Society*, 35 (10), pp 2053-2070. https://doi.org/10.1017/S0144686X14000762

Jeremic, J. (2020). Older adults, old age, and ageism in game education curricula. In H. B. Viana, D. C. D. B. Neri de Souza, & F. Neri de Souza (Eds.), *Novas tecnologias e novas práticas educacionais* [New technologies and new educational practices] (pp. 187-212). Sao Paulo, Brazil: UNASPRESS. doi:10.19141/978-85-8463-165-0.p.187-212

Kim, A., and Merriam, S. B.: Motivations for learning among older adults in a learning in retirement institute. Educational Gerontology, 30(6), 441-455. (2004). https://doi:10.1080/03601270490445069

Loos, E. (2014). Designing Meaningful Intergenerational Digital Games. In *International Conference on Communication, Media, Technology and Design* (pp. 46–51), 24 - 26 April 2014, Istanbul, Turkey. Retrieved December 30, 2021 from https://dspace.library.uu.nl/handle/1874/302902

Merriam, S. B., & Kee, Y. (2014). Promoting community wellbeing: The case for lifelong learning for older adults. *Adult Education Quarterly, 64*(2), 128-144. https://doi.org/10.1177/0741713613513633

Narushima, M., Liu, J., & Diestelkamp, N. (2018). I learn, therefore I am: A phenomenological analysis of meanings of lifelong learning for vulnerable older adults. *The gerontologist*, *58*(4), 696-705. doi:10.1093/geront/gnx044

Palmore, E. (2001). The ageism survey: First findings. *The Gerontologist*, **41**, 572–575. https://doi.org/10.1093/geront/41.5.572

Perry, D., Aragon, C., Cruz, S., Peters, M. a., & Chowning, J. T. (2013, July). Human centered game design for bioinformatics and cyberinfrastructure learning. In *Proceedings of the Conference on Extreme Science and Engineering Discovery Environment Gateway to Discovery - XSEDE '13* (pp.1-8). San Diego, CA, USA. https://doi.org/10.1145/2484762.2484833

Romero, M., & Ouellet, H. (2016, July). Scaffolding Digital Game Design Activities Grouping Older Adults, Younger Adults and Teens. In J. Zhou, G. Salvendy (Eds.), *Human Aspects of IT for the Aged Population. Design for Aging. ITAP 2016. Lecture Notes in Computer Science*, vol 9754. Springer, Cham, 74-84. https://doi.org/10.1007/978-3-319-39943-0_8

Sanders, E. B. N. (2002). From user-centered to participatory design approaches. In J. Frascara (Eds.), *Design and the social sciences: Making connections*, London, UK: CRC Press, 1-8.

Sanders, E. B. N., Brandt, E., & Binder, T. (2010, November). A framework for organizing the tools and techniques of participatory design. In *Proceedings of the 11th biennial participatory design conference* (pp. 195-198). ACM. https://doi.org/10.1145/1900441.1900476

Sauvé L., Kaufman D., Plante P. (2019) Designing a User-Friendly Educational Game for Older Adults. In: Herzog M., Kubincová Z., Han P., Temperini M. (eds) Advances in Web-Based Learning – ICWL 2019. ICWL 2019. Lecture Notes in Computer Science, vol 11841. Springer, Cham. https://doi.org/10.1007/978-3-030-35758-0_4

Schell, R., Hausknecht, S., & Kaufman, D. (2015, May). Barriers and Adaptations of a Digital Game for Older Adults. In Proceedings of the 1st International Conference on Information and Communication Technologies for Ageing Well and e-Health *ICT4AgeingWell* (pp. 269-275). Doi: 10.5220/0005524002690275

Schell, R., Hausknecht, S., Zhang, F., & Kaufman, D. (2016). Social benefits of playing Wii Bowling for older adults. Games and Culture, 11(1-2), 81-103. https://doi.org/10.1177/1555412015607313

United Nations (2008). Implementation of the International Plan of Action for the United Nations Literacy Decade : note. Retrieved December 30, 2021 from https://digitallibrary.un.org/record/634508

Vanden Abeele, V. A., & Van Rompaey, V. (2006, April). Introducing human-centered research to game design: designing game concepts for and with senior citizens. In *CHI'06 extended abstracts on Human factors in computing systems*,1469-1474. https://doi.org/10.1145/1125451.1125721

World Health Organization. (2015). World report on ageing and health. Geneva, SW:World Health Organization.