Exploration through video games

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1 Introduction

Video games have long matured past their origins of a niche interest enjoyed by a few in the seclusion of their private homes. Now, those who enjoyed early generations of video games as children have grown up and become the creators of new media themselves. Though not without growing pains, the result is that video games have manifested themselves as a global industry and cemented their position within popular culture. Names like *Minecraft* (Mojang 2011) and *Fortnite* (Epic Games 2017) are widely recognized, even by the uninitiated, and major industries have partnered with game developers to create, e.g., *Horizon Zero Dawn* (Guerilla Games 2017) *Lego*, or used video games as inspiration, e.g., the movie *Free Guy*, to make products appealing to a wide audience.

Players enjoy video games for a wide variety of reasons (Bateman 2016). In *Reality is Broken*, designer Jane McGonigal (2011) suggests that players of video games flock to them because they provide them something that the real world does not. Some may empower the player to strategize, plan, and make decisions (Tondello and Nacke 2019; Yee 2015). Others allow them to affect storylines and characters, deciding not only their own destiny, but that of entire worlds as well (Fortes Tondello et al. 2018). Some offer a safe space to encounter the unknown, enabling players to experience scenarios and environments they would otherwise be unlikely to be exposed to (Kivikangas et al. 2011). They also connect players across the globe, stimulating both competition and collaboration, and positively affecting social well-being (Raith et al. 2021). Video games, that is, games that mediate play through electronic displays (simplified on the basis of Tavinor 2008), inherit much of their engaging properties from what can be said about games in general. Any professional chess player can likely attest to a physical game's ability to empower players to strategize and plan.

This thesis focuses specifically on video games. However, throughout the thesis, the term “game” is used to refer to “video games” for the sake of brevity.

What distinguishes video games from their non-digital form is that they involve non-human computation and thus are intimately linked to the rapid growth of computing devices. Advances in computer science lead to more capable computing devices, which in turn allows video games to involve increasingly complex interactive scenarios. With the involvement of the Internet, video games further allow for play between players all over the world, offering a virtual “third place”; a place outside of home or work for meeting other people (Steinkuehler and Williams 2006; Moritzen 2022).

To some, video games can offer a space to explore; the self, one’s relationships with others, or the world at large. At the start of the Covid-19 pandemic, millions of people enjoyed the calm getaway provided by *Animal Crossing: New Horizons* (Nintendo EPD 2020) in which they own and design their home on an idyllic island where no housing crisis exists (Russell 2022). LGBTQ+ players of *The Sims 4* (Maxis 2014) rejoice at the addition of customization features that allow them to create themselves as virtual people and play out their stories (Rowe 2022). With our own planet seemingly mapped out beyond what can be discovered by an individual, virtual worlds like the ones from *The Legend of Zelda: Breath of the Wild* (Nintendo EPD 2017) and *Elden Ring* (FromSoftware 2022) serve as the new frontier.

The core concept investigated in this thesis is that of *exploration* that is the result of curiosity (Grossnickle 2016). In this work, curiosity is understood as an intrinsic motivation for pursuing new knowledge or experiences, and often accompanied by positive emotions such as pleasure and excitement. Thus, intrinsically motivated exploration is understood as the behavior that results from curiosity. Based on the video game examples above, it can be observed that exploration in and through games is not a single phenomenon. Some forms are both the immediate goal in and direct result of game design efforts. Examples include the discovery of virtual environments, the solving of puzzles, or the seeking out of secrets, characters and storylines. Others emerge through the player’s interaction with the game systems, for example, in the case of the aforementioned experimentation with LGBTQ+ experiences in *The Sims* (Krobová, Moravec, and Švelch 2015). While such explorations cannot be guaranteed and do not necessarily oc-

cur for every player, they are the result of deliberate design decisions, made to make these and other forms of exploration more likely.

Such design efforts can be seen, not only in entertainment games, but also in games with purposes other than entertainment (often referred to as applied games or serious games, further described in Chapter 2). Games have been used to present players with virtual scenarios so that they can safely learn real-world behavior and experience the consequences of their decisions; e.g., evacuation strategies (Silva et al. 2013), firefighting (Williams-Bell et al. 2015), or social interactions (Ke and Moon 2018). They have even been used to engage in philosophical topics, such as considering questions like "What is soup?" (Gualeni 2018). One challenge in such projects is to assess whether conceptual exploration has indeed taken place, as well as form design guidelines in understanding how design decisions can enable and elicit it.

It follows that, in addition to games facilitating exploratory behavior in the player, they can be used as vehicles for the exploration of larger academic questions. In this context, games are used to investigate, as well as generate and disseminate knowledge. Hence, exploration in (applied) games, and academia in particular, is a complex and multifaceted topic that comes into play at multiple levels of the development and research process.

The topic of this thesis is thus the broad understanding of *exploration through games*, with a particular focus on games applied in academic pursuits. While ample literature exists on game design, exploration is but a sub-topic that has seen limited dedicated study. The aim of this thesis is to address that gap through the discussion of three distinct though interrelated research efforts:

1. A design case study of a video game made for classrooms, purposefully created to elicit conceptual exploration.
2. An examination of players' experience with different forms of exploration and how they are elicited by different types of games. Based on this work, design patterns for different forms of exploration are formulated.
3. A subset of these design patterns (focused on spatial exploration) is incorporated into a game for research, and subsequently used in an empirical study.

Together, these studies provide insight into exploration by players, as well as, on a higher level of abstraction, the practice of using games for research purposes. The resulting work is an investigation of exploration in and through games of different forms within research projects, which informs and inspires both research on exploration within the fields of game studies and game design, and the use of games in academic research projects in general.

1.1 Key Concepts and Research Objectives

Exploration, as previously stated, is the expression of curiosity — two key concepts underlying this work that will be explored in Chapter 2. As will be discussed, it is possible to be curious without showing exploratory behavior. A key distinction made in the study of curiosity is between *state* curiosity (i.e., being curious, or having the drive to explore) and *trait* curiosity (i.e., a person's disposition to becoming curious), with trait curiosity having been shown to influence state curiosity (Kashdan and Roberts 2004).

Games have been posited as a suitable medium to study curiosity (To et al. 2016), as they involve many related concepts that can help to understand how and why people become curious. Due to their interactive nature, they are furthermore capable of eliciting exploratory behavior in a controlled environment, and allow for that behavior to be recorded for study (Jirout and Klahr 2012).

As also discussed in Chapter 2, no single formally accepted definition of what constitutes a *game* exists. In the context of this work, games are considered intentionally bounded systems, designed to facilitate cognitively or affectively engaging scenarios through interaction. Additionally, it is not a requirement for a game to be *fun*, as is often associated with them as a medium. Rather, this work takes the position that games are complex systems that can give rise to a number of emotional and behavioral states (Karpouzis and Yannakakis 2016), with the end goal of resulting in a satisfying experience (Stenros 2017). In doing so, the working definition also allows for the inclusion of applied or serious games (Schmidt, Emmerich, and Schmidt 2015), further defined in Chapter 2.

The empirical work presented in this thesis, described in Chapters 3, 4, 6 and 7, examines exploration in and through games in its various forms. Building upon this work,

Chapter 8 takes up the broader discussion of using games for academic research. Together, these chapters thus form a comprehensive overview of each of the factors that come into play when applying games in an academic setting. In taking this broad perspective, it is the intention of this thesis to provide a basis for a professionalization of exploration through games in academic environments. This can help those who come from different fields with an interest in using games in their academic practice, as well as those already more familiar with using games in this context with insights into the more in-depth analysis that is necessary when designing and deploying games for this purpose.

1.2 Research Approach

The study of video games is relatively new compared to other academic fields. This has resulted in a multidisciplinary research practice that is based on a range of theory and methods brought in by academics from their own fields (G. S. F. Mäyrä 2008). Games are also a complex media form in which a variety of practices, including art, design, and technology come together to form a unique and emotional player experience (Newman 2002). Because of this, games also require an interdisciplinary approach in order to properly assess and understand them. For most research questions related to video games, it is not sufficient to analyze a game as a technical construct without consideration for the emotional experience that results from interacting with it, in the same way that studying players without considering technical or design aspects does not suffice (G. S. F. Mäyrä 2008).

Game User Research (GUR) describes a field of study, predominantly pursued within the entertainment game industry that has also gained a foothold in academic practice. It is integral to commercial game development in understanding players, and how to design, build, and launch successful games (Desurvire and El-Nasr 2013). Inherent to GUR is a multimodal approach to measuring and assessing user experience. This happens throughout development in iterative cycles, utilizing a combination of qualitative and quantitative research methods (e.g., focus groups, surveys, and interviews, but also the logging of player behavior through metrics, eye tracking, and assessing experience through biometric measures). Empirical work discussed in Chapter 3, 4, 6, 7 of this thesis follows GUR principles and methods integrated in a research through de-

sign approach (Zimmerman, Forlizzi, and Evenson 2007), in which new knowledge is generated through iterative cycles of design practice.

1.3 Research Questions and Chapter Outline

The main research question explored by this thesis is:

> **Main Research Question**
> How do games facilitate exploration?

The work is structured into nine chapters, of which the current introduction is the first. Chapter 2 presents an overview of the theoretical concepts underlying this research. It includes a working definition of games for the purposes of the research, as well as a literature review on their uses for non-entertainment purposes, in particular those purposes related to curiosity (i.e., game-based learning). The foundational research on curiosity and the resulting behavior of exploration is furthermore discussed, as well as how it has been used in the study of games. The chapter identifies opportunities for further study, which form the basis and scope for the rest of the work.

Following this, the thesis addresses the following sub-questions:

> **Sub-Question 1**
> How can a game facilitate conceptual exploration?

A common goal in using applied games is to induce conceptual exploration of a non-entertainment topic. Based on the existing understanding of conceptual exploration, Chapter 3 presents a design case study that examines how a game can be used to facilitate conceptual exploration, encouraging curiosity for the exploration of a non-entertainment topic. While other games have been developed that share this purpose, different cases utilize different design approaches, and validation studies show differing results in terms of effectiveness (De Freitas 2018). The chapter describes how exploration is elicited through design, and results in desired player behavior (i.e., exploration). In doing so, the study brings to light, in a most transparent manner, how game design decisions can be used to elicit conceptual exploration in players. Addi-

tionally, it shows how even aiming to elicit a single type of curiosity is a complex task, motivating a broader investigation into different types of curiosity and how they are elicited through game design.

Sub-Question 2
What types of games elicit exploration?

Branching out from a singular case in which the process of eliciting conceptual exploration is exemplified, the thesis next considers how exploration may be elicited across a wide variety of games, and brings in the perspective of players to determine what types of games are best at eliciting various types of exploration. Chapter 4 describes an exploratory, quantitative study that examines successful commercial entertainment games and the types of exploration they elicit in players. The study is based on the 5-dimensional curiosity questionnaire (Kashdan et al. 2018), and uses its five dimensions of curiosity to form a selection of games that fit each dimension. Players furthermore offer their own suggestions for titles that invoked certain types of exploration. In doing so, this chapter provides the first research contribution in the form of a selection of games that should be considered for further study in curiosity and the accompanying forms of exploration.

Sub-Question 3
What design patterns can be hypothesized for games that elicit exploration?

Out of the corpus of games produced in Chapter 4, the game genres that were considered most capable of eliciting exploration by players are studied in more detail. Based upon these findings, Chapter 5 shows the formulation of hypothetical design patterns for different types of exploration, which form the basis for the chapters that follow.

Sub-Question 4
How can design patterns for exploration be implemented and evaluated for empirical study?

Following the formulation of design patterns, Chapter 6 describes how such design patterns can be used in practice. Using the previously formulated patterns for spatial exploration as an example, they are subsequently implemented in a game to study whether they succeed in inducing exploratory behavior.

Sub-Question 5
How do design patterns for exploration influence player behavior and experience?

Further building upon the case outlined in the previous chapter, Chapter 7 then presents the empirical study of the design patterns for exploration, discussing considerations in using the game as an experiment stimulus in an empirical study and describing the methodology and process in conducting such a study. It describes factors to be considered in using games to measure player behavior and experience, and how those influence the design of quantitative studies. It also shows that, while the design patterns indeed affect player behavior and experience, there are other factors (e.g., the presence of in-game goals or monetary compensation for study participation) involved in exploratory behavior as well that should be considered when similar topics are studied in detail. Together, Chapters 6 and 7 provide a practical example on how the empirical study of exploration in games can take place, forming a foundation for future research in this area.

Sub-Question 6
How can games be used as tools for academic exploration?

After the closer examination of exploration from the perspective of a designer creating an experience for the player, the thesis concludes by expanding the view of exploration through games by examining their use within academia. Chapter 8 examines the games created as part of the studies presented in Chapters 3, 6 and 7 and uses them, in combination with a review of relevant literature, in order to map the use of games for academic exploration — i.e., the generation, evaluation, or dissemination of knowledge. This chapter takes a meta-perspective on the work discussed in prior chapters, moving away from the games' direct goals of inducing exploration in players, and instead

taking the view of the academic stakeholder, who uses these games as tools in their exploration of a larger topic. As such, this chapter maps the various uses of games for exploration and identifies important facets in their use and design, to serve as a basis for further discussion and research efforts.

Finally, Chapter 9 summarizes the findings of the research by revisiting the research questions. It answers the main research question by providing a foundation for research on exploration through games on three levels. First, it exemplifies how games can facilitate conceptual exploration. Second, it provides insight into how such games may be designed and studied through the use of design patterns. Third, it covers the level of academic exploration, where games are used as tools to explore and generate knowledge. By combining these different perspectives on exploration through games, the thesis forms a solid foundation for various types of future studies with games on exploration and related topics. The thesis concludes by highlighting the contributions of the work.

1.4 Underlying Publications

Parts of this dissertation are based on peer-reviewed publications. The list below shows an overview of these publications (ordered by date). Additionally, each chapter lists the publications that the chapter is based on.

Gómez-Maureira, Marcello A., Max van Duijn, Carolien Rieffe, and Aske Plaat. 2022. "Academic Games - Mapping the Use of Video Games in Academic Contexts." In *International Conference on the Foundations of Digital Games*. FDG '22. ACM.

Gómez-Maureira, Marcello A., Isabelle Kniestedt, Giulio Barbero, Hainan Yu, and Mike Preuss. 2022. "An Explorer's Journal for Machines: Exploring the Case of Cyberpunk 2077." *Journal of Gaming & Virtual Worlds* 14 (1): 111–35.

Gómez-Maureira, Marcello A., Isabelle Kniestedt, Max van Duijn, Carolien Rieffe, and Aske Plaat. 2021. "Level Design Patterns That Invoke Curiosity-Driven Exploration: An Empirical Study Across Multiple Conditions." *Proceedings of the ACM on Human-Computer Interaction* 5 (CHI PLAY): 271:1–32.

Gómez-Maureira, Marcello A., Isabelle Kniestedt, Sandra Dingli, Danielle M. Farrugia, and Björn B. Marklund. 2020. “CURIO 2.0: A Local Network Multiplayer Game Kit to Encourage Inquisitive Mindsets.” In *International Conference on the Foundations of Digital Games*, 1–10. FDG ’20. New York, NY, USA: ACM.

Gómez-Maureira, Marcello A., Isabelle Kniestedt, Max J. van Duijn, Carolien Rieffe, and Aske Plaat. 2019. “Shinobi Valley: Studying Curiosity For Virtual Spatial Exploration Through A Video Game.” In *Extended Abstracts of the Annual Symposium on Computer-Human Interaction in Play Companion Extended Abstracts*, 421–28. Barcelona Spain: ACM.

Gómez-Maureira, Marcello A., and Isabelle Kniestedt. 2019. “Exploring Video Games That Invoke Curiosity.” *Entertainment Computing* 32 (December): 100320.

Gómez-Maureira, Marcello A. 2018. “CURIO: A Game-Based Learning Toolkit for Fostering Curiosity.” In *Proceedings of the 13th International Conference on the Foundations of Digital Games*, 1–6. Malmö Sweden: ACM.

Gómez-Maureira, Marcello A., and Isabelle Kniestedt. 2018. “Games That Make Curious: An Exploratory Survey into Digital Games That Invoke Curiosity.” In *Entertainment Computing – ICEC 2018*, edited by Esteban Clua, Licinio Roque, Artur Lugmayr, and Pauliina Tuomi, 76–89. Lecture Notes in Computer Science. Cham: Springer International Publishing.