

Paper to Pixels: A Chronicle of Map Interfaces in Games

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ABSTRACT

Game map interfaces provide an alternative perspective on the worlds players inhabit. Compared to navigation applications popular in day-to-day life, game maps have different affordances to match players' situated goals. To contextualize and understand these differences and how they developed, we present a historical chronicle of game map interfaces. Starting from how games came to involve maps, we trace how maps are first separate from the game, becoming more and more integrated into play until converging in smartphone-style interfaces. We synthesize several game history texts with critical engagement with 123 key games to develop this map-focused chronicle, from which we highlight trends and opportunities for future map designs. Our work contributes a record of trends in game map interfaces that can serve as a source of reference and inspiration to game designers, digital physical-world map designers, and game scholars.

Author Keywords

Game map interfaces; game cartography interfaces; first-person experiential methods; well-played history.

CCS Concepts

•Applied computing \rightarrow Computer games; •Humancentered computing \rightarrow Visualization theory, concepts and paradigms;

INTRODUCTION

Maps are invisible, everyday objects. Yet if we stop and look for them, they can be seen on smartphones as we find our way to some place, in shopping complexes showing us where each store is, and on telephone poles letting you know the last whereabouts of a family pet or garage sale. Maps help guide autonomous vehicles, show us how close deliveries are to our home or office, and let drone operators know where their drone is currently located.

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More than physical navigation, maps navigate the complex and dynamic world of human culture. Maps on news media show political and socio-economic divides. Maps can show us where people like ice cream over frozen yogurt or can be used by sports commentators showing us where specific athletes have placed a ball or puck over time.

Despite that ubiquity, maps in and of themselves are generally static, a relic of the paper to which they owe their creation. There is so much more that maps can provide users given the growing ubiquity of computation and the increasing digital traces of human existence (e.g., traffic patterns, commerce, nearby events) [85,119]. Through the sheer volume of digital data, there is a need to not only make maps more communicative but also connect human-generated detail to them in realtime – things which video games already do.

Games incorporate complex systems to navigate imaginary and concrete spaces alike. As a result, much of the functionality of maps has been expanding, augmented, and tested as video games have grown in size and complexity. Gameworlds like Vana'diel, Azeroth, Los Santos, or maps bound to the width of a television screen like that of *Dig Dug* have to appeal to players' needs by fostering a system that can attach a physicality to a flat visualization of a vast digital space. Beyond fulfilling players' goals and purposes, in-game maps are very explicitly used to communicate potentials and additional opportunities as players move from point A to point B [21,49,99,109]. This use of maps has followed video game development throughout its history yet much of this work is not present in *any* literature, even game design research itself.

We develop a chronicle of the design of video game map interfaces. The interactive game sub-systems that mediate maps in video games have been evolving alongside computer hardware and in tandem with the digitization of paper maps. However, much like the ways that we use maps in the physical world, the discussion of the *other* features of these systems has remained invisible and unspoken. We unravel the invisible history of those video game sub-systems – *game map interfaces* – to illuminate the designs in their respective cultural and technical

¹The virtual world of *Final Fantasy XI: Online* [G109]

²Part of the world in the *Warcraft* series [G20].

³The setting of *Grand Theft Auto V* [G97]

contexts. To that effect, we explore how games, gameworlds, genres, and premises all shift the needs of a game map interface. In doing so, we show what these interfaces mean for designers and how they are relevant to play and players.

Our chronicle is an account of game maps, in general, and game map interfaces, in specific. That history is rooted in the origin of board games as new methods of making maps were created in the late 1800's [64, G114]. Maps then develop as essential aspects of play through early war games [36] that then serve as inspiration for pen-and-paper role-playing games (RPGs) and early video games based on RPGs. Next, we illustrate trends that have manifested in digital games for maps. Back to the present, we identify game map interface trends that more directly resemble present-day smartphone map interfaces. The present research closes with a discussion of observations and insights about game map interfaces.

Our contribution is a design chronicle: a historical account of designs of map subsystems in games. This work enables readers to understand trends in map user interfaces and the parameters driving their designs. As with all interpretivist research, we do not claim an objective truth, but develop a landscape [17] of prior game map interface designs situated in a technical context. We expect designers and researchers to use this text to ground their understanding of prior designs, making future systems more usable and games more fun.

BACKGROUND

The present research contextualizes the relationship between maps, map interfaces, and games. We begin by discussing maps for the physical world. Because game terminology has been contentious at times, we establish our own stance by defining *play*, *rules*, *game mechanics*, and *gameworlds*.

Digital Physical-World Map Interfaces

As information communication technology proliferated and got smaller, new ways to engage digital maps began to appear [70]. Digital maps are used for personal navigation [54,99], large-scale planning [75], and/or collaborative problem solving [38,102,105]. Since cartography is both the art and science of map design, these objects are not objective, but purposeful [75,110,114,115]. A designer uses a map's purpose to drive the characteristics and functionality for the populations interacting with it [19,47]. Recent digital tools support the easy creation of custom maps, although research suggests that users' needs are met only through a collage of technologies [19]. Personal navigation rarely involves modifying the map, except, perhaps, to set a destination, save a place for later, or attach notes. Large-scale planning typically involves constructing a map from raw data, a slow process [75].

Many limitations of map design rest with the weaknesses of the Global Positioning System (GPS) and other systems like it⁴ [12, 16, 25, 50, 101, 123]. These systems are the primary

means by which digital map systems locate a person's position, but they are easily put off by things like buildings, solar storms, or even clouds [123]. To make GPS more accurate, other technologies provide support (e.g., positioning with WiFi, Bluetooth, cellular) [50, 122]. Techniques for indoor mapping are still in a theoretical period due to these hardware constraints [50, 122].

Game Mechanics

Games and game design are typically seen as separate from other types of software design, though this is often a contentious point [82]. Game design's separation from software design has resulted in constantly changing terminology. We establish the terms we will use in this section.

Rules are the structures of a game that constrain player choices [98], while play is the act of figuring out how the rules work [14]. These logical procedures frame the choices to which a player has access. Rules define the outcomes of choices, resulting in new, observable game states. To that end, play is the essential experience of the system that the rules create.

Culture refers to a number of contexts within which the game exists, including the game itself [98]. When games and gaming began to become an industry, the map was a manifestation of the culture of the game. This was because the map was literally and tangibly the space upon which play and mechanics manifested. Other aspects of culture might be prior games in a franchise or prior games of that type. The last context is the zeitgeist and its various forms.

The combination of rules, play, and culture lead to designed moments of choice for players: *game mechanics* [1,59,98]. Game mechanics are defined by the designer and are decision points at which players trade-off various possible outcomes.

Gameworlds and Gameworld Interfaces

Players' avatars and other embodiments [11] inhabit *gameworlds*, virtual worlds that are limited to foster unique opportunities for exploration and meaning-making [57]. The systems (i.e., rules, play, culture, game mechanics) that allow the player to interact with the world are typically invisible, as an assistant to player exploration.

The invisible systems serve as a metaphorical body, but some aspects of gameworlds are not completely knowable by a player. Visible systems are typically aspects of the gameworld that exceed available cognitive load [51] for players. Designers bridge these barriers of cognitive load and presence with *gameworld interfaces* [4]. Game map interfaces are one instance of gameworld interfaces, which also include character statistics, object inventory sub-systems, etc. Each of these communicate with the player about their current relationship with the gameworld. Each of these interface elements aid in providing limitations that engage players in play, reflecting an act of *getting it all to work* [14].

DEFINITION OF MAP INTERFACES

Before moving forward, we need to establish a vocabulary with which to discuss game sub-systems of interest here: *game map, game map interface, read-only map interface*, and *game*

⁴"GPS" is both the colloquial term for satellite-based navigation and the specific name of such a system built by the USA. Other players have deployed similar satellite-based navigation systems (e.g., Galileo (EU), GLONASS (Russia), Beidou (China)) and most sensors offer improved accuracy by using multiple systems.

cartography interface. A game map is any visualization or representation of a gameworld in any medium (e.g., cloth or paper [41], digital). We use game map interface as a catch-all term for all game maps that are presented through a video game's UI (e.g., dedicated map gameworld interfaces, mini maps). Game map interfaces come in two flavors: read-only map interfaces and game cartography interfaces.

Many games provide a *read-only map interface*. These resemble a paper map but often include a marker to indicate a player's current location.

Recent games have begun to remove that read-only status from their maps, opening the game map for player-created annotations and notes in-game: a *game cartography interface* [112]. Game cartography interfaces allow the player to manipulate maps [112]. This manipulation can be afforded in a variety of ways (e.g., adding annotations, choosing representations).

HISTORICAL WAYS OF KNOWING

We use *historical ways of knowing*, synthesizing diverse sources [69]. This work develops a chronicle, laying out the design of game maps in-order. The resulting account is based in the authors' understanding of the history of video games; other scholars, working from other perspectives, are likely to arrive at alternative conclusions – we inhabit a position of partial perspective [44]. Here, we describe our sampling approach and bounds of our corpus, explain our approach to building this chronicle, and conclude with reporting conventions.

Researchers' Standpoint

As a highly important factor in assessing the quality of interpretivist research, we need to acknowledge the standpoint (in the sense of Hartsock's standpoint theory [45]) from which our work stems. Only by providing sufficient background on our experience we can lend credibility to the work. We do not call to this standpoint as a means to assert objectivity, but to enable the reader to assess the work's value for their own purposes and illustrate the limitations our positions necessarily entail.

All of the authors are human-computer interaction (HCI) researchers; three of them have additional experience in crisis response research, which focuses on maps, whereas two of them have a formal education in humanistic areas with a particular focus on critical theory in their scholarship. The authors collectively speak from a white US/European perspective.

As existing databases are insufficient to identify games, we relied on our personal knowledge in identifying suitable games that fit into our particular corpus with additional help from the tenets of purposeful sampling [84].

Sampling and Scope of Corpus

A core part of this work involves working from our own knowledge as gamers and scholars to build up a corpus, guided by our research focus. We work from a number of sources to develop a purposeful sample [84] and create the corpus for this work. Sources included books [26, 27, 29, 31–33, 62, 63, 78, 86, 97], web fora [80,116], blog posts [71,72,96], videos [24,53,77,94], game databases [40–43], podcasts [39, 58, 89], and, most importantly, games themselves [G1–G123].

In the present research, we are interested in game map interfaces. This means that our game corpus primarily includes games with a gameworld with a game map with which the player makes sense of the gameworld. We did not focus on games that used spatial mechanics, like strategy games, although a few are considered for context. Similarly, mixed reality games, which incorporate physical world geography (e.g. [65]), are not a part of the corpus.

Developing the Chronicle

We developed our historical account of maps in games through reading and playing primary and secondary sources to understand what systems were designed and in what context. More specifically, we synthesized our reading and playing and reflected, as designers, on the game maps encountered. Our approach to studying these games is from the perspective of HCI and crisis response researchers, grounded in humanistic methods of critical contextualisation [7]. Specifically, we looked to how the games afford interaction, what feedback they develop, and how what we learn from them might be applied to user interfaces in general. This process is similar to how Norman [81] and Tufte [113] approach analyzing designs.

As we encountered particular games, we performed a combination of playing [108], watching videos of play, and/or reading manuals or other ancillary materials. We took screenshots and journaled about the experience. Much of the present research relies on first-person experiential data (akin to Höök [52]). We thus understand game map interfaces in terms of the source games' mechanics and UIs.

We acknowledge that new games are released constantly and that we are only able to bring our particular perspective to bear. Working from a well-played [28] perspective helped us to build out our corpus and draw connections between the games encountered. Our expectation is that this produces a *useful* chronicle, or to more HCI-centered spaces, a *landscape* [17] of how maps have been used in video games over time. The result is a representation of affordances over time and, while not *every* relevant game is included, the affordances all games share are.

Reporting Conventions

We develop a *Ludography*, a References section that provides cite-able sources for our data corpus. This data corpus does not include *every* game with a game map, only those that we identified as important via our literature search and well-played understanding of the history of games, developing a purposeful sample [84] of 123 games.

We use a special notation for citing games in our Ludography, using a prefix 'G' for "game" (e.g., *The Legend of Zelda: Breath of the Wild* [G78]). In the case of needing to cite a game *series*, we cite all relevant games from the Ludography.

A CHRONICLE OF GAME MAP INTERFACES

This section describes the history of the use of maps by players, as driven by the design of game maps. Despite a well-maintained history of video games and technologies, it is difficult to determine dates and technologies in their *exact* order. It is often unclear how far particular games propagated

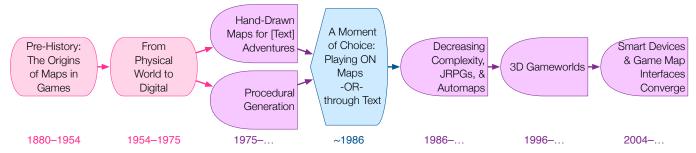


Figure 1. Trends in game map interfaces, separated by notable developments in use of maps. Dates are based on release dates for the earliest games that represent the trend in our data corpus. Ellipses indicate trends that are ongoing. A Moment of Choice occurred sometime around 1986.

or how they influenced each other. While we have information about release dates, some games were played prior to an official "release", many games continue to develop post-release, while others gained popularity and created influence later on.

To reflect this fuzziness, we develop overlapping *trends* of game design, driven by a number of factors. We use release dates, despite the aforementioned issues, to identify the starts of trends, since they *do* provide concrete dates for particular UIs. It is worth noting that people still play games from earlier trends and that modern games may be designed as "retro" or "throwbacks to an earlier era". Hence, games from every trend continue to be played and designed in the present time.

We begin with a discussion of the origins of how games came to be played on maps and how games transitioned from physical to digital spaces. Next, game development splits into parallel ages. The first parallel age is where text adventures and dungeon crawls drove a need for hand-drawn maps. The second parallel age is procedural generation of dungeons to explore and a reboot, of sorts, in the form of Japanese role-playing games (JRPGs) or light RPGs. This automated generation of maps enabled creating gameworlds that obviated a need for drawing and were no longer constrained by a grid.

After describing the tumultuous development of text-based and procedurally-created game maps, we illustrate how the increasing complexity of gameworlds drove a need for more robust map interfaces. Finally, we discuss the convergence of game map interfaces and digital physical-world map interfaces, like Google Maps and MapQuest. Figure 1 shows the trends, including the two in parallel and where they converge.

Pre-History: The Origins of Maps in Games (1880–1954)

Napoleon Bonaparte's military campaigns were so successful that when he was finally defeated, the entirety of the act of waging war had changed. In its place was what would become known as the "wargame" and these were new ways to train officers [36,121]. The shift in training for war had tremendous ramifications in that they shifted away from the grid-based games that mimicked *Chess*. In their place were map-based, input-based games played on top of a table The most important of these is *Kriegsspiel* [G122] which was created to train officers about topographical mapping technology. This training

also afforded for calculating probabilities of success through spatial awareness of battlefields [36].

Many features of *Kriegsspiel* have become prominent in games in the present. This war game was the first to use a form of hit points. Unlike the game it was based on – *Chess* – this game afforded each piece a degree of damage it could sustain before being rendered destroyed. *Kriegsspiel* also introduced rules for hit probability, hit tables, and umpires – currently called Dungeon Masters (DMs) or Game Masters (GMs)⁶ – to adjudicate play [61].

We mention *Kriegsspiel* as an origin point for modern gaming as it is directly linked to *Dungeons & Dragons* (*D&D*) [61,64,87]. Recent research has unearthed new details about an unpublished game called *Braunstein*, which combined elements of a *Kriegsspiel*-derived game called *Strategos* [G114] with *Diplomacy* [66,87,104]. One of the players of *Braunstein*, Dave Arneson, attempted to keep a *Braunstein*-like game going after the original creator left. He called this game *Blackmoor* [66,87,104]. Originally, Arneson wanted to develop a large-scale economically-driven cooperative game; however, players abandoned this idea and moved toward exploring nearby dungeons with the help of a new set of medievalinspired miniatures rules called *Chainmail*. In *Blackmoor*, players collaboratively mapped out an unexplored dungeon.

As dungeon exploration rules expanded, D&D began to manifest. D&D is a tabletop RPG that originally focused on exploring dungeons [20,74,120]. D&D was released in 1974 and quickly became the most popular game in the world [20,74,120]. Players would seek to replicate their experience with new computer technology, forming the basis of much of the early video game industry [64].

From Physical World to Digital (1954–1975)

Throughout the 1970's, as terminal computers became commonplace in universities and other technology-oriented institutions, early programmers attempted to mimic D&D [26, 79, 86, 106]. In D&D, players move through imaginary worlds, described by a DM, to engage in interaction with each other and DM-controlled non-player characters, solve puzzles, explore, and fight. A core component of many D&D games is the "dungeon crawl", which focuses less on narrative

⁵Grid-based versus other forms of techniques to measure movement on physical maps would not be finalized until the early 1960's with *Gettysberg* [G96] and *Chancellorsville* [G95] from Avalon Hill.

⁶These are, unfortunately, highly gendered terms and the authors suggest Game Mixtress as a nonbinary alternative.

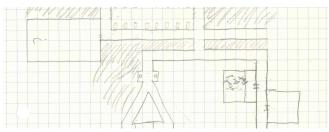


Figure 2. A graph paper map from a first-edition game of D&D, circa 1983. (Copyright the authors.)

components and more on positioning and numerical game mechanics [23]. Players' characters explore a grid-constrained space and use rules for exploration and combat in a dungeon crawl. Players often drew maps by hand on grid paper (e.g., Figure 2) to progress [18].

Such games are played via an abstract, shared narrative [23], and so drawing a map serves to ground play. This enabled players to explore a space with the additional tension of combat with dungeon residents. For example, on Figure 2, note the question mark on the left, the various door markings on walls, and the scribbled note on the right. Annotations and modifications like these are made by players to indicate what was discovered and what remained unexplored.

Programmers could not encapsulate the non-numeric experience of D&D in computational space. Narratives in these games are driven by another human player (e.g., GM, DM) and replicating those experiences required computational capabilities beyond the machines available at the time. However, the dungeon crawl component readily lent itself to programming. Strangely, many different, disconnected groups of programmers concurrently built dungeon-crawl-style play using grid-like automation -Rogue-likes [26]. The development of Rogue-likes occurred in parallel with the text adventure (Figure 1) Each type of game has its own implications for how the gameworld was (or was not) mapped by players.

Hand-Drawn Maps for [Text] Adventures (1975-...)

One of the two parallel trends in early D&D-inspired game creation was the text-adventure game [3,9,76,79]. Like pen-and-paper games, text adventures consist of gameworlds described by text (e.g., "You are in a maze of twisty little passages, all alike."), which worked well with available terminal interfaces (i.e., text-based feedback and keyboard input) [26,79]. To interact, players type in actions they wish to perform, e.g., movement via "south" or "left", attacking monsters, or picking up items [26,79].

Hand-drawing maps was an essential activity in text adventure games as they had very few graphics [86]. One of the earliest known text adventure games was based on a combination of an early D&D campaign and spelunking in unexplored parts of Mammoth Cave in and around Kentucky [56,68]. This game was called *Adventure* and it was left mostly unfinished [68]. This game had no set objective and the only thing that was

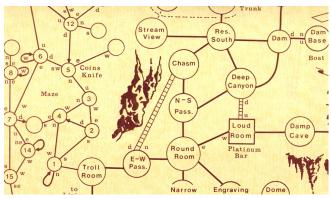


Figure 3. The first paper hint map for Zork [G53], which one could mail order. Most rooms connect in a way that enables them to be mapped on a grid (right side), but the maze (left side) violates those assumptions. (Copyright Infocom, Inc., 1981; excerpt reproduced as fair use.)

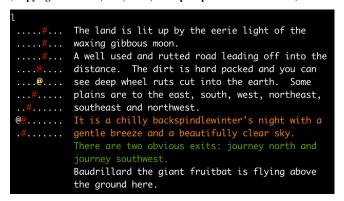


Figure 4. Different representations of the current space in *Discoorld MUD* [G13] through text and an ASCII mini map. (Screenshot taken ©① the authors.)

needed for combat or puzzles was the correct item. Other programmers picked up where *Adventure* left off and expanded the game to include values for most actions and other game mechanics [56, 76, 79]. The later game resulted in pushing other creators to mix human needs like hunger, water, and sleep into their games. Essential text-adventure games from the trend of hand mapping include *Colossal Cave Adventure* [G32], and the *Zork* series (Figure 3) [G53].

Text adventure games became multi-player through the advent of networked multi-user dungeons (MUDs) [8]. As players wandered these gameworlds, they would have to draw a map of the dungeon on paper so that they could make sense of where they were going and where they had been (or use addons that provide game cartography interfaces [Mike "Zugg" Potter, personal communication]). Early MUDs included MUD [G115], AberMUD [G31], and TinyMUD [G6].

Even in cases where a text adventure did include maps in the game, the representation was of a single room rendered via ASCII characters. ASCII works well for small pictures but these games often had maps that would exceed available screen space. This made it impossible to map larger areas

⁷While *Rogue* was an early example, many *Rogue*-likes were *not* made in response to *Rogue*, nor was it the first in the genre [26].

⁸Mike "Zugg" Potter is a software developer who founded Zugg Software (http://zuggsoft.com), which develops mapping software for MUDs and other games.



Figure 5. An example of *Rogue*-like *Angband* [G4]. The strip on the left side shows game status. The bulk of the right side is the procedurally generated gameworld. The "at" sign represents the player and the gameworld space is represented as pound signs (walls) and periods (floors). Other objects are also visible. (Screenshot taken ©① the authors.)

without losing meaning (see Figure 4). Thus, the immediate context overview might be provided by the game but a global view would need to be created externally.

Within this trend, we see text-based adventure games and games with rudimentary 3D interfaces. In both cases (with some notable exceptions), gameworlds are organized into grid-constrained blocks that were connected at the cardinal directions, sometimes with vertical transitions (e.g., moving up and down). The on-grid constraints eased a need for processing power; even 3D interfaces would only allow you to look in specific directions, so there was no need for proper 3D rendering of arbitrary viewpoints. As a genre, text-based adventures are the only genre that nowadays struggles to retain players [48].

These designs were amenable to drawing squares representing the gameworld on graph paper, which was generally required to avoid getting lost [86, 107]. A number of adventure games developed these rudimentary 3D interfaces: *Ultima* [G81] (Figure 6) and the *Wizardry* series [G102, G103].

Procedural Generation (1975-...)

Contemporaneous with the first text adventure games were *Rogue*-likes [26]. These games were displayed using a top-down view of a dungeon. The player's character could move around on the map, one tile (represented by an ASCII character) at a time, and engage with all game mechanics in this way. *Rogue*-likes are important in the history of game maps because they represent the first games in which the player revealed and played *on* the map itself by moving an avatar around in a space. Figure 5 shows the *Rogue*-like, *Angband* [G4] in action, with a partially revealed map that simultaneously functioned as the literal playing field.

A combination of mimicking D&D and technical limitations led to the use of procedural generation for these games [15,26]. Early computers had very little memory and static dungeons would not result in a compelling experience. To ensure a compelling and ever-changing experience (e.g., as one might get from DM), game designs focused on using procedurally

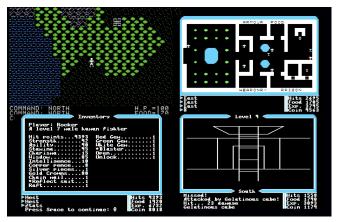


Figure 6. Zoning in *Ultima* [G81]; in the top right, there is a town including the player character, the bottom right shows a dungeon, in the top left the world map is located and the bottom left there is a store. (Screenshot taken ©① the authors.)

generated dungeon layouts. *Procedural generation* uses sets of rules and controlled randomness to create content [103].

A key benefit of using procedural generation is that such designs reduced memory costs: gameworlds did not need to be stored beyond the current playthrough [26]. While players used maps as interfaces, there was little value for them to store or annotate them. Each dungeon would be erased from memory when completed or when the player's character died and all relevant information was displayed on one screen anyway.

A Moment of Choice: Playing ON Maps -OR- Through Text (~1986)

Both graphic and text-adventure games existed in parallel for many years. These two points of history form a classic *moment of choice* [13]. Whichever choice consumers made would dictate the trends of the next generations of games. We live in the post-choice space where graphics were chosen over text but, at the time, it was uncertain. For example, text-adventure games were the first to be networked (i.e., MUDs; Mud, Object Oriented (MOOs)). This delayed the choice for a time; however, hardware development was starting to allow for larger, more complex graphically-driven gameworlds.

One of the most poignant developments was the creation of *zones*, areas that are loaded only when the player goes to them. These allow a game to maximize memory usage and would become a feature when games became three-dimensional and networked [6]. These could be dungeons, towns, or special areas. The development of zones allowed for game worlds to gain more space and thus more complexity. The game that seems to have united the concepts of zones for dungeons and towns is first game in the *Ultima* series (see Figure 6) [100, 117].

Maps typically comprise a dynamic and constantly shifting scale and abstraction. This abstraction could be the transition from an overworld map to one for a particular town or dungeon. These multiple layers of mapped spaces developed over time and much of that development is fuzzy at best. The game that seems to have united the concepts of "other" screens (i.e.,

⁹While text adventure games have struggled to maintain an audience, they have also seen continual development and experimentation over the years. This includes dating sims, interactive fiction, even visual novels, and queer design [5, 46]. For more information about this space, we suggest exploring the Twine game engine or any of of the programs like it (e.g., Inform7, Quest, Ren'py).

gameworld interfaces) for maps, dungeons, and towns is first game in the *Ultima* series [100, 117].

In *Ultima*, players are given an overworld map and a series of maps for towns, dungeons, and castles to explore. Each one of these maps was a 2D, top-down view of a town. In essence, play occurred *on* the map. Play inside of dungeons was often done through a first-person, 3D perspective and players were meant to draw maps of the area as they walked around inside of them [86,88]. As this style of game proliferated, Japanese developers distilled the growing complexity of early RPGs in an attempt to widen their appeal.

The moment of choice ended with consumers choosing to play on the map directly (e.g., Figure 6). This has tremendous implications for future game developments. The surge in home-console video gaming paired with the creation of new franchises like *Final Fantasy* [G108], *Dragon Quest* [G107], *Wizardry* [G103], and *Ultima* [G81] quickly overwhelmed the Infocom-led text-adventure video game lines. The increase in available computation led to a concomitant increase in the complexity of gameworlds, driving a need for players to have alternative representations for orienting, wayfinding, etc.

Decreasing Complexity, JRPGs, & Automaps (1986-...)

The genres that defined how a map should be used in games were early war games and RPGs. The moment of choice resolved with graphics-based RPGs stabilizing their feature set. These computer-based games were well-received. Throughout the 1970's and early 1980's, other types of computation began to appear – video game consoles.

The makers video game consoles and the games for them targeted families in an effort to expand marketshare [10, 97, 107]. This translated to making games easier and filled with more features. Several features from the video game console market have changed the nature of the game map interfaces.

The most notable development was that Japanese game developers began to provide new interpretations of RPGs [10]. The game *Dragon Quest* [G107] was created using what the designers felt were the most important elements of RPGs: encountering random monsters, a virtual world that was explorable, and gaining power in the form of levels [83]. These games from Japan, often called JRPGs or light RPGs, established new life for a declining RPG market.

These streamlined features and wider appeal fostered a wider market. Other games followed suit, improving the UI and capabilities of game cartography interfaces along the way. The *automap* was one such improvement [86]. *Bard's Tale III* [G55] is often considered to be the first game with this feature (Figure 7). In games with auto-mapping, a small screen shows a player's current position and as the player walks around, a map would be created for the player to use as needed [86].

Automapping would be expanded to other types of maps over time. For example, in large-scale games like *World of Warcraft* [G20] or *The Elder Scrolls: Skyrim* [G15], the map of the



Figure 7. First instance of the automap from *Bard's Tale III* [G55]. Screenshot shows the upper portion of the UI with the first-person view on the left and the automap on the right. (Screenshot taken ©) the authors.)

world would automatically extend as players reached new parts of the world. Automaps freed players from needing to map space by hand, providing them with a map of the virtual space, generally filled as they explored the gameworld. Further, automaps removed the need to keep gameworlds grid-constrained – players would not need map by hand with graph paper. The combination of the wide appeal of video game consoles and led to more powerful computational technologies resulting in a new space to explore: 3D virtual spaces.

3D Gameworlds (1996-...)

The addition of the Z-axis in video games started the trend of three-dimensional play. Early attempts to map 3D gameworlds took the same path that many 2D gameworlds did: through the use of pen and paper to map out areas. Massively multiplayer online role-playing games (MMORPGs) have been a driving force in the creation of game map interfaces. These games often present their players with multiple towns, dungeons, dimensions, and continents to explore.

Each of these continents is split into multiple zones for each geographic region [6], which may be further subdivided into sub-zones. Zones serve to reduce the computational power necessary to maintain the persistent 3D world for so many players in the same gameworld. As these games have become so large as to allow players to get lost, the need for a game map interface has increased significantly.

Early 3D games used 2D representations of their gameworlds. On a 2D surface, elevation changes are difficult to display. Instead, walls and objects that looked like they would be on a higher elevation often served as complete barriers, rather than differences in elevation, that needed to be navigated around. To give these objects a facade of depth, players would change floors by moving up and down virtual stairs to evoke the appearance of elevation shifts.

With 3D gameworlds, elevation shifts became real-time and represented directly in the gameworld being explored. The use of 2D maps of 3D gameworlds has remained constant since the appearance of 3D games (with a few notable exceptions, e.g., *Elite: Dangerous* [G45], the *Descent* series [G83], the *Metroid Prime* series [G89–G91]). This freed the map up to become a separate object from the surface it is being played on. Despite being separate from the main play-related interface, maps of 3D gameworlds have mostly remained two-dimensional.

¹⁰Wizardry is often connected with the PLATO game *Oubliette* along with the words "plagiarized" or "stolen" [29]. The controversy surrounding this game is deserving of more research.



Figure 8. Map of Legend of Zelda: Breath of the Wild [G78] with markers in unexplored and explored areas. (Screenshot taken (©)) the authors.)

Smart Devices & Game Map Interfaces Converge (2004-...)

In tandem with the development of 3D gameworlds has been the proliferation of smartphones and the growing ubiquity of the internet. The smartphone has become so ubiquitous in the game-playing world that it is often difficult for players to think of a human without a smartphone or tablet in their hand.

The constant companionship of these devices is so pervasive that it does not seem out-of-place to see a smartphone, tablet, or similar device in nearly every type of setting. As a result, designers seem to be using skeumorphisms of existing mapping interfaces to migrate [55] users to the game map interfaces of their gameworlds. The additional features of these game map interfaces form an essential part of learning to understand the game world. This connection is what designers can take advantage of when trying to move the features of game map interfaces back to the outside world. The most direct example of this growing trend is *Legend of Zelda: Breath of the Wild* [G78] (Figure 8).

In *Breath of the Wild* [G78], the avatar is given a magic fantasy "slate" (effectively a modern tablet computer). On the tablet's map, the player sees a vast outline of a world map that is not filled in. Throughout the game's initial tutorial area, the player learns that there are many climbable towers¹¹ throughout the gameworld. Accessing the top of each of these towers will download a file that contains the map topology of a region (but not points of interest). In addition, from anywhere in the gameworld, the player can use the tablet as a scope with which to mark far-off locations shows this in action). By mimicking things like favorites on Google Maps and inserting these affordances into a system that include the existing mapping norms of 3D video games, *Breath of the Wild* serves as an example of what is possible.

Other recent games also incorporate smartphone or tablet skeuomorphs. In *Grand Theft Auto V* [G97] (Figure 9), as well as the *Watch Dogs* series [G118], players could use their smartphones to map paths automatically by plugging in a destination. Like current mapping software, these paths would reroute depending on player behavior. With the interfaces that

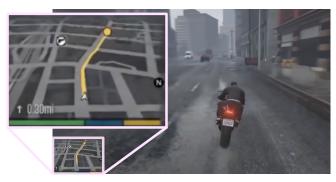


Figure 9. Automatic routing map in *Grand Theft Auto V* [G97] (main view with corner map blown up in inset). As the player drives, the map in the lower-left corner automatically updates the street route. (Screenshot taken $\textcircled{\bullet}$) the authors.)

these games offer, the map serves as an abstract object on which players point to destinations. In *Breath of the Wild*, the map served as more of a game mechanic than passive tool: the map, itself, is becoming a play space within a gameworld.

DISCUSSION

This section discusses numerous observations we made while gathering our data. The first observation focuses on the overarching thread of how maps simplify complexity and improve quality of play at a cost to a particular type of player creativity. There is further discussion about the emergence of collaborative cartography in communities devoted to specific games to develop their own resources. In those communities, players work together to develop their own game cartography interfaces. We next consider how certain games subvert the sanctity and accuracy of maps to create new forms of play.

Simplifying Complexity and Improving Quality of Play...

Early digital games were limited by small storage media and relied on players using pen and paper to make maps and take notes. Sometimes games would come with paper [G15,G80] or cloth maps [G81,G105] in the game box [41,86]. Many of the notes taken and maps made were rudimentary mazes with relatively small iconographies of dungeon furnishings (e.g., traps, treasures, monsters, exits).

Increases in memory and processor speed fostered the creation of new sub-systems to keep track of objects like resource nodes, types of treasure, types of monsters, hidden walls, and areas where special monsters could appear. This allowed designers to enable different levels of choice through game map interfaces, inventory interfaces, and complex algorithms that mediate the consequences of player choice.

As the number of objects and detail goes up in games, there is a need for sub-systems to simplify a player's interaction with them. Game map interfaces offer that opportunity for designers to create rich engagements with gameworlds. As a result, they are largely ubiquitous in digital games, but are seemingly invisible in academic discourse.

The largest digital games, typically flagship 3D open gameworlds, such as the newer *Fallout* games [G14,G16], *Grand Theft Auto 5* [G97], and *Legend of Zelda: Breath of the*

¹¹Due to their prevalence in games by the developer Ubisoft, this game mechanic is pejoratively referred to as an "Ubisoft tower" [118].

Wild [G78], are complex, with a multitude of activities to which players are invited. Such complex gameworlds include large expanses of space to traverse and detailed areas in which graphical complexity can make it hard to distinguish game elements. The complexity of such worlds is at odds with human situation awareness [35]. Game map interfaces foster exploration and aid navigation of virtual worlds, much like their physical counterparts [19,75]. However, the way these systems foster these player behaviors has consequences.

... at the Cost of Creativity

Quality-of-play improvements to mapping systems, like automapping [86], eliminated much of the need for players to engage in their own cartography enterprises. This moved the space of interaction to just one media – the video game itself. By removing the need to use other media to keep notes or reference, game map interfaces inadvertently removed an outlet for creativity surrounding digital gameplay.

The intimate connection between a game, player, and map they create is no longer a design space. The impact of this loss can be seen in the resurgence of "old school" RPGs and the current board game renaissance [73]. Similarly, the *Etrian Odyssey* series [G7–G12] traces the lineage of its game cartography interface to recapturing the experience of paper maps [93].

It is for this reason that we must reconnect scholarship to old ways of mapping. There are multiple archives of players' work in building up their own maps, which identifies them as valuable artifacts:

- the Hand Drawn Maps Association¹²;
- the Strong Museum of Play's Play Generated Map and Document Archive [18] containing 40 years of player-created paper maps; and
- the Atlas of Cyberspace [62] offers maps of virtual space.

Such hand-drawn maps offer a way to engage with nostalgia.¹³

The consequences of moving mapping into the game itself, by offering automated map experiences, is as such that players are restricted to the points of view on the game that designers enabled, instead of being encouraged to make their own. This results in a loss of creative play.

Recent digital games have begun to remove read-only maps and are advancing *game cartography interfaces* [112]. This opens the game map for player-created annotations and notes in-game. Game cartography interfaces allow players to manipulate the map, make choices about what information a given map carries, and afford additional opportunities for play that are different from those afforded by a read-only map interface.

This subset of games with game cartography interfaces enables rich engagement with the breadth of a gameworld. They also provide implications for the design of games as well as the design of physical-world mapping systems. However, players' creativity is reduced to using and appropriating the annotation scheme designers intend for them.



Figure 10. The iZurvive community created web-based map for DayZ [G24]. The map is annotated with loot locations and allows players to mark their locations. (Screenshot taken - the authors.)

Collaborative Cartography of Game Maps

Across many of the game map interface trends, we observed a common thread of collaborative creation and sharing of game maps. Shared maps go beyond the individual player, incorporating knowledge and creative effort from small player groups and larger game communities. Early hand-drawn and later digital maps for D&D, text-adventures, and MUDs were often shared. In the case of D&D, shared maps help distribute the effort of creating new game worlds. Collaboratively created maps also serve as shared information resources for player communities. The creation of a map is not only an individual or group activity, but one that forms and sustains a community.

The collaborative cartography practices of EverQuest (EQ) [G105] players is an early exemplary case of web-based collaborative cartography. Early EQ maps were hand-drawn or digitally created images that were shared on the web to help other players navigate and explore the various locations in the EQ gameworld [91,92]. Later, the developers of EQ added an in-game map feature, which enabled the authoring and installing of custom digital maps in game. Members of the EQ player community began to create, disseminate, and archive custom EQ map files for other players to use [92].

We have recently observed the emergence of player-created maps, for games like *DayZ* [22, G24] (see Figure 10) and *Player Unknown's Battle Grounds* [30, G86]. Other maps, such as those found in IGN's archive of interactive maps [37], are created through wiki-style [90] editing processes. These maps are often created to help players navigate, loot, and plan strategies. Some of these maps (e.g., iZurvie [22], Tachnet.io [34]) incorporate collaborative map annotation tools to help teams coordinate play in real-time [67, 111].

These collaborative cartography practices extend the play experience outside of the context a game. There is a clear need to further investigate collaborative game cartography tools and practices in order to inform the design of both in-game and external tools for collaborative cartography.

¹²http://www.handmaps.org/location.php?ID=fictional

¹³ e.g., http://mapstalgia.tumblr.com

Subverting Patterns

Hand-drawn maps were largely effective due to the grid-like design of early games – serious cartographic skill was not necessary to construct a functional map. However, some skill was needed to maintain an accurate map and was reflected in which player took on the role of map-maker in early editions of D&D. When player maps are not accurate, play can become subverted. At times, this subversion is due to players misunderstanding descriptions, getting lost, or by games *purposefully misinforming* players. It is worth noting how some games subvert maps and move gameplay to a meta level.

Some games have played with making maps that do not accurately capture their gameworlds. For example, there could be secret doors where a map otherwise indicates a wall. Secret doors are a common trope originating in the physical world and propagated to RPGs (including D&D) and the digital realm (e.g. *The Legend of Zelda* [G80]). Other games rely on psychologically-derived game mechanics. Games like the tabletop game *Call of Cthulhu* [G99] or the digital game *Eternal Darkness* [G60] manipulate the player's character's perception of the world. This can result in a form of an unreliable narrator which, as a result, can manipulate cartographic enterprises.

Other games play with the idea of a map entirely. In Zork's [G53] [in]famous maze, rooms are described as "a maze of twisty little passages, all alike." ("Maze" part of Figure 3). This description breaks the assumption that each room connects directly to the next. That is, the game, up until this point, connects each room's north exit to the next room's south exit, each room's east exit connects to the next's west, etc. The "twisty little passages" diegetically do twist: an east connection goes to a room's south connection, some connections lead back into the same room.

The identical room descriptions foster a sense of becoming lost and make it difficult to make sense of their layout. This foils the player's ability to map the space. Mapping is essential to success in the rest of the game and so the inability to map a space present a multi-media tension for the player. As a result, players are forced to rely on other clues and strategies to triage the issue, such as dropping items in rooms to change the room description, so that they can work out which spaces connect.

This tension also appears later in the hall of fame nominated [95] game *Myst* [G33]. The game looks as though a series of grid-patterned spaces; however, the transitions begin to twist. This puzzle requires a player to learn to read how various sounds indicate which direction to take, rather than to rely on mapping the space.

While these are just two examples, they are indicative of ways in which designers can subvert maps and the spaces they are meant to represent to create interesting, albeit occasionally frustrating [60], play experiences.

Broader Context

Game map interfaces offer a way to lower the complexity of game experience. Unfortunately, this is often done at a cost of player creativity. The loss of player creativity has had implications in MMORPGs like *World of Warcraft* [G20] wherein

addons like the Azeroth Autopilot¹⁴ optimize a player's experience to the point of making it more like an idle game by attacking enemies, gathering materials, and completing quests without player input [2]. Addons like this call to the need to move games back into the past by reconnecting to old ways of doing things with new perspectives.

Any call to the past is simultaneously remembering and reimagining it, seeking to undo certain frustrations while highlighting others. Alternative pasts, new waves, and revisions given present-day knowledge help us not only to make sense of where we have been but alternative directions that things could have gone or might still be open for investigation. Video game maps are a unique aspect of that past.

CONCLUSION

The present research has developed a chronicle of design trends in game map interfaces over time. The chronicle began with published and hand-drawn maps that exist as a manifestation of the game itself. It then moved into text adventures and early graphic-based RPGs upon which play occurred on the map. These early games became very complex and difficult.

New developers from Japan distilled RPGs into a new, more family-friendly experience, expanding the audience for video games. In doing so, they also expanded the usefulness and potential of maps. That usefulness became critical as 2D games became 3D. When the Z-axis began to be used in games, designers began to rely on outside technologies and their respective user behaviors to help players orient themselves inside of vast 3D worlds.

As we developed our chronicle, we provided insights and context about how and why these map systems were needed. We intend these insights to be useful for game designers and researchers who build mapping sub-systems and gameworld interfaces. Those insights also carry from inside gameworlds to the physical world. We expect that some of the insights here may be of use to building physical-world digital map interfaces.

The map connects the invisible culture of humanity with its physical representation. Buildings, cities, roads, states, countries, and other political realities are displayed and made manifest by this ancient technology. Inside of video games, there have been strides toward a different type of use for maps—game cartography interfaces. These interfaces afford designers a separate space of interaction with the player, a third object in a conversation about a virtual world. This third object creates a culture. More work is needed to understand how that third body manifests, maintains, and mediates that culture.

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¹⁴This addon is designed to optimize the player's path between quest-givers and automate quest completion and acceptance. It is constantly re-optimized to decrease total time to maximum level. https://wow.curseforge.com/projects/azeroth-auto-pilot.

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