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In the past decade, archives have utilized emulation to preserve older pieces of software including video games and make them accessible to patrons. However, recent literature neglects user needs for emulated software in archives. Using web content analysis, this study examines the text of nearly 1,200 online comments, threads, and forum posts about software emulation from four different websites. The findings suggest that audiences are keenly aware of software emulation but not of emulation as a way to preserve video games. It also found that user needs are often unique or even contradictory, and much user attention is paid to the visual quality of emulation systems as well as the quality of the emulated experience. The author suggests a number of policy proposals for libraries and archives that argue greater public input is necessary in the creation and development of systems that preserve software through the process of emulation.

#### Headings:

Information needs

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SOFTWARE EMULATION AND THE VIDEO GAME COMMUNITY: A WEB  
CONTENT ANALYSIS OF USER NEEDS

by  
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**Part 1: Introduction**

As a popular entertainment medium, video games are a cultural powerhouse. Game consoles are present in 65% of American households, and gaming is an industry that generated \$21 billion in 2014 alone (Winget, 2011, p. 1869; Cassidy and McEniry, 2014, p. 17). However, despite those successes, games are left increasingly unpreserved in archival settings. This is in part due to their at-risk physical states and their digital manifestations. For example, floppy disks containing games that were produced before 1985 are already showing signs of bit rot, and plastic cartridges that house older games will eventually become physically unusable (Monnens, 2009, p.141; Newman & Simons, 2009, p. 2). These factors mean the playability and function of video games are in a precarious position long-term.

One solution to this problem is found through the process of emulation, where games are run through independent software that is programmed to behave as an original game console would. This process programs the game to act as if it is being run on its original system even though it may not be. Currently, emulation is the most effective method of game preservation, as only one piece of software - the emulator - has to be written for the library of games on a given console to be considered playable (Guttenbrunner et al., 2010, p. 78). Nevertheless, it has sparked debate between archivists and game players. Archivists assume that users will want to play the original games, advocates of emulation argue that emulation will better preserve the “look and feel” of the originals, and surveyed audiences believe that emulated versions are superior to the original because of ameliorative improvements in computing speed (Hedstrom et al., 2006, p. 168-169, 171).

Archivists' assumptions for what users will want out of video game preservation largely stem from their own expectations and one user study that was based on research conducted nearly two decades ago (Hedstrom et al., 2006, p. 159, 185-187). There has been a noticeable lack of consideration into user experience or user impressions since this publication. Indeed, much of the research into emulation has been based on theoretical discussion or the author's personal impressions. Even in the original article by Hedstrom et al. that discussed user impressions of emulated play, the conclusions suggested that emulation may not be the best solution for preserving the experience of playing a video game, because certain aspects of the experience will be lost over time (Hedstrom et al., 2006, p. 171, 186).

Nevertheless, in the years since, there have been several well-known and well-publicized case studies of archives using emulation in real-world applications. The first notable case of computer software and electronic files being preserved through emulation was when Emory University acquired the papers of Salman Rushdie. These papers were hosted online both through a database of PDF files, and were also made available inside of an emulated environment that replicated the interface of Rushdie's computer, so users could view them "just as he saw them" (Carroll et al., 2011, p. 80-85). Several years later, the New York Public Library made a number of video games from the 1980s and 1990s found in the Timothy Leary Papers available through emulation (Dietrich et al., 2016). In addition, the video game industry itself has used emulation to resell and repackage older games to consumers (Cifaldi, 2016).

Given these real-world examples of emulation being used to preserve software in archival settings, including the preservation of video games, it is time to revisit how user needs and user attitudes should play a part in archival emulation methods. Because it is no longer wistful thinking that archivists could use emulation to preserve

materials, it is necessary for researchers and interested parties to understand how users interpret emulative play, and what their needs are for preservation through emulation. It is not enough to rely on older research when the state of video games, emulation, and technology more broadly have all greatly progressed in the past two decades. If archivists consider emulation the key to preserving video games, they must consider what the needs and expectations of their end users are in order to present these games in a properly contextualized way.

This paper represents a necessary first step in addressing that research gap. First, I will review the literature on the state of video game preservation and the conceptual issues associated with emulation as a method of preservation. Second, I will describe the research methodology used in this study. Third, I will discuss the findings of my study, a web content analysis designed to examine user information needs of those who are interested in emulation and use it to play video games. Finally, I will recommend a series of policy proposals for libraries and archives given the information found in this study, as well as other areas where future research may be conducted.

## **Part 2: Literature Review**

### **I. Playing Games with Preservation**

Until very recently, there was little systematic archiving of video games, beyond consumers keeping games in their cases on a shelf, in a closet, or hidden out of harm's way. An uninterested video game industry has neglected formalizing archival preservation practices, leaving them as low priority (Bachell & Barr, 2014, p. 154). For gamers who attempted to take matters into their own hands, collecting physical copies of games and placing them in storage simply will not do for long-term playability. The plastics that make up physical media are materially unstable, and cartridges will eventually crumble into dust (Newman & Simons, 2009, p. 2). This

“museum approach” for video games is unsustainable, as the hardware parts necessary to run cartridges or the discs that games come on are fragile and will not be produced indefinitely (Guttenbrunner et al., 2010, p. 76).

The types of formats that games come on are at risk. According to established guidelines for digital preservation, any digital object’s data can be threatened in any number of ways, and games are no exception (UNESCO, 2003, p. 35). Thousands of games’ data are affected by bit rot, the “natural decay of digital information and storage media over time” and general format obsolescence. As a result, games have a “shockingly short-lifespan” (Monnens, 2009, p. 140-141). There are no disc, magnetic, or cartridge media formats that are immune to bit rot, with the highest estimates for life-spans around thirty years (Monnens, 2009, p. 141-142). The memory on cartridges themselves are likely to become compromised as well, as data with internal batteries has sometimes become unusable after as little as ten years (Farrand, 2012, p. 12).

These issues have sparked debate over how best to preserve games in the meantime. Some archivists have recommended creating a video of the game in order to create a rough representation of what it is like to play a certain game. While this method loses interactivity, it does give a good visual and aural representation of what the game is like - points of data that could be used to recreate the game later. For games that are multiplayer-only, for example, it may be the only way to preserve the central experiences of playing a game with others (Guttenbrunner et al., 2010, p. 77). However, academics have always deemed these video approaches inadequate at best - they can serve as good reference points for research, but in their tests, a “lack of interactivity was...defined as a knock-out criterion in the object characteristics” (Guttenbrunner et al., 2010, p. 84-87).

Therefore, most archivists, librarians, and game enthusiasts have emphasized preserving the digital code and workings of the game itself, beyond the physical CD or cartridge copy. If video representations of the game and its elements are unsatisfactory, preserving the game itself must become a priority. But video games are unique in that, unlike books, movies, music, or art, as digital code, any organized plans for their preservation have been incomplete and ineffective (Cassidy & McEniry, 2014, p. 17). Because digital objects are vulnerable to loss in ways that traditional library documents are not, they require innovative solutions to recover the object and its software environment.

## **II. Emulation**

One solution, emulation, was first proposed in 1995 by Jeff Rothenberg as a possible method of long-term digital preservation (Hedstrom et al., 2006, p. 160-161). Emulation is the act or process of replicating the behavior of one device or software on a different hardware device or piece of software. Even at the expense of the actual product, format, and cartridge, it is likely the most efficient and cost-effective way there is right now to document and preserve video games (Guttenbrunner et al., 2010, p. 78). To use an emulator, the video game data from a disc or cartridge has to be extracted and dumped into a file, which are known as ROM files (Farrand, 2012, p. 7). At that point, only one piece of software - the emulator, has to be created for those ROM files to be considered playable (Guttenbrunner et al., 2010, p. 78).

The first free, downloadable, consumer-grade emulators appeared online around the time of Rothenberg's publication, as the children and adolescents that had grown up on the video games of the 1980s found themselves using the personal computers of the 1990s ("iNES: Portable Nintendo Emulator", 2018). As the decade progressed, those developers began work on standardized ROM file formats, made games easier to share, and added tools that made it easier for mass audiences to emulate games.

These emulators opted for “usability over accuracy,” encouraging gamers to relive their youths rather than utilize a preservation-caliber gameplay experience (“The Story of NESTicle...”, 2017).

By emulating digital objects, like a video game’s source code, Rothenberg believed that it would be possible to “recreate a digital document’s original functionality, look, and feel” accurately (Rothenberg, 1999, p. vi). This goal has largely become the focus for digital preservationists and archivists - preserving a game means preserving all of the elements that make up a game. In the years since, as emulation became more popular among retro game players and more feasible for academics to test, this discussion of preserving the “look and feel” of a video game has become part of a wider debate among those interested parties about what the “significant properties” of a video game really are.

### **III. Significant Properties of a Video Game**

First defined in 2002, the significant properties of a digital object are any elements of said object that “affect [its] quality, usability, rendering, and behaviour” (Hedstrom & Lee, 2002, p. 218). While video game preservation is undoubtedly important for the medium and for future research, and it is easy to say that all of a game’s elements need to be preserved, it can be difficult to determine what exactly should be preserved in order to adequately represent a video game. For a static object like a photo, it may be easy to create a finite list of its important elements, but it is more difficult to define, list, and categorize what is important for a video game to run in a suitable way with regards to archival preservation.

Indeed, no one can agree on what makes up the significant properties of a video game, and the concept itself has been criticized as impractical and simplistic.

Adrienne Decker, et al., argue that the significant properties of a game are not just the object itself, but also include the surrounding environment in which it is played. In



addition, as the choice of what titles must be preserved is often socially constructed, this “leaves preservationists...on shifting ground” (Decker, et al., 2012, p. 1-2).

Indeed, what is significant with one game may not be significant in another, and significant content from one game may not even be significant in the context of the whole series (Carta, 2017, p. 195; Bettivia, 2016, p. 22). Finally, what one user may find significant may not be significant to another (Carta, 2017, p. 196).

Rhiannon Bettivia argues that this discussion of significant properties in games causes “discomfort in the realm of archival science” because it often focuses on nebulous, social elements that cannot be neatly defined inside the objects themselves. Some data suggests that preserving games is not about the “ability to play a particular game,” but the significance of that game in that place and time and the social nature of the game (Bettivia, 2016, p. 18). Indeed, this is why video game preservation is often seen as a balancing act - Zach Vowell suggests that archivists’ central priority should be the games themselves, but if we place too much emphasis on the games without their contextualized history, we lose what makes them important in the first place (Vowell, 2009, p. 151). For archivists, there can be a happy medium between sacrificing the game data in favor of representative videos, and rigid preservation focusing solely on the source code of the game and that loses why the game played a function at its critical point in time.

#### **IV. The Audience and the Original**

This brings the discussion to a crucial question - when video games are being preserved, who are they for, and who is the audience for video game preservation?

There are a number of different stakeholder groups present, including “players, historians, researchers...and industry partners” (Bettivia, 2016, p. 18). However, most strategies for digital preservation are based on the “needs and requirements” of the archivist, rather than the needs of the user or eventual researcher (Hedstrom et al.,

2006, p. 159). Megan Winget has argued that an operating definition for authenticity must become widely accepted - one based on user needs rather than traditional archival concepts. Users often play the same game in different ways, and some might want to change how the game is played or alter its source code (Winget, 2011, p. 1875).

Just as we have to define the audience for preserved games, we must also define the “original” in terms of the games themselves. For most gamers and in the popular discourse, the “original” refers to the experience of playing the game for the first time on the original console, in the time period in which it was developed. This is obviously problematic for game historians, preservationists, and those involved in curating game history - it is impossible to recapture the nostalgic feeling of experiencing something again for the first time. In addition, as established above, the video game industry will not always sell older software and hardware, and the original consoles, cartridges, and controllers will eventually cease to function.

For some gamers, play through emulators cannot hold a candle to the original play context - it has been deemed “always decent but never the same as the real thing” (Swalwell, 2013, p. 2). There has been somewhat of a backlash to this concept of the original experience among academics as a result. Melanie Swalwell has written that the concept of the original experience is often more valued than capturing gameplay through an emulator - a dangerous attitude to have considering that most games will not continue to work well into the future and that eventually the original experience will be impossible to replicate (Swalwell, 2013, p. 1-4). For those who are concerned about preservation and accuracy in presentation, how do we determine what the original product is - the experience or the game itself?

Even the developers of emulators are aware of the debate amongst users and gamers over emulator accuracy and whether emulative play can compare to the original. As mentioned above, the first emulators written in the 1990s were designed for popular consumption, preferring easy availability to perfect reproduction (“The Story of NESTicle...”, 2017). A 2011 essay written by the pseudonymous “byuu”, the creator of the BSNES emulator, noted the complexity of ensuring proper timing and accurate emulation, writing that truly perfect reproduction would require much more powerful computers than the ones that are currently available. Their ultimate recommendation was for users to run slower emulators on more powerful machines, arguing that by adopting more power-intensive emulators, communities of gamers could collectively find more numbers of bugs, ensuring greater accuracy in the quality of emulation (“byuu”, quoted in Takhteyev & DuPont, 360).

#### **V. Effective Emulators and the Users That Play Them**

If emulation is to be the ultimate tool of video game preservation, how are archivists supposed to test emulators for their effectiveness? Much of the existing literature is theoretical or philosophical in nature, but beyond casual use of emulation to play older games, there have only been limited academic tests for emulation as a tool for video game preservation. For digital objects as complicated as games, judging the effectiveness of emulators can be somewhat hampered. Most tests so far have been based on individuals manually reviewing emulation results, a process which is time-consuming, and would have to be infinitely repeated every time a new emulator is developed or a new computer is used (Guttenbrunner & Rauber, 2012, p. 6-7).

What these tests have shown is that emulators can be genuinely successful at running games, albeit with several significant qualifiers based on criterion established by archivists. While popular systems have workable emulators, those systems that held smaller market shares or those that were not well-known in their lifetime receive

less development support, yielding “considerably lower” results. In addition, the more recent the system, the lower the degree of accuracy in emulating a game, on top of distracted developers who program the software as a hobby or personal interest (Guttenbrunner et al., 2010, p. 84). This is concerning for the use of emulators as a tool of preservation - it shows the need for a fully realized effort to make emulation a legitimate and long-term tool of preservation, one that would likely require complete industry support.

While there have been a handful of tests on the accuracy and scalability of software emulators, I have found only one that was concerned for the needs and attitudes of emulation users. The CAMiLEON Project, conducted from 1999-2003, tested user reactions to an obsolete computer game as played on an older computer from the 1980s, an emulated version of the game on a contemporary computer, and a version of the game that was ported to a contemporary software environment. While archivists assumed that users would want to work with the original game “rather than copies or surrogates,” the experiment had shown that audiences preferred the emulated version to the original - specifically noting the improved speed and ease of use. In addition, there was not a demonstrable difference in how emulation presented the object to audiences compared to the original being run. Finally, audiences noted aesthetic and technical differences that were not present in the archivists’ assumptive model of significant properties (Hedstrom et al., 2006, p. 166-171).

While this CAMiLEON Project study represents the extent of user-centric research studies focusing on game emulation and their significant properties, there has been other, more anecdotal evidence suggesting that user needs will greatly depart from archivist needs in other ways. In one example, highlighting the change in how games are played, one player became frustrated by a game’s mechanics that forced him to

run away from the very first enemy encounter rather than defeat it. As this type of behavior is foreign to modern players, one academic blogger lamented that the game may not be able to “make its case for greatness all by itself” (cited in Winget, 2011, p. 1875). While archivists may focus on the presentation and preservation of a given game, users may find their needs focusing on how the game plays and how successful they are at progressing.

### **Part 3: Research Question**

This anecdotal evidence along with the results of the CAMiLEON Project shine a light on the differences in which archivists and users view emulated material, and the need for more modern data in how users interpret emulated video games. Given that computers and game systems have gotten significantly better at emulating older consoles, the number of emulators released has increased exponentially, and the numerous console generations that have passed since the CAMiLEON Project, it is appropriate to ask: what are the needs of emulation users, given the use of emulation to preserve video games in archival settings?

### **Part 4: Methodology**

#### **I. Web Content Analysis**

A staple of the social sciences for many decades, content analysis has recently risen in popularity among researchers in the fields of library and information science. By collecting passages of text, qualitatively coding them, and supplementing them with quantitative measurements, researchers learn about what is being said, by whom, in what terminology, and how frequently (Chu, 2015, p. 39). The same principles apply to web content analysis, including data and text gathered through blogs and their associated comment sections. Although it is a relatively new methodological way to gather information, there is precedent for web content analysis of comment

sections - it has been an established method for conducting research that has gradually grown in popularity over the last two decades (Herring, 2009, p. 241-244). In addition, scholars have previously conducted studies in which online posts centering on video games were content analyzed for insight into attitudes about social phenomena (Rubin & Camm, 2013, p. 369, 374).

The research question being asked is most immediately answered through web content analysis. As I needed to find what thoughts, attitudes, and needs are naturally present and common among groups of video game players, emulation enthusiasts, and software emulator developers, web content analysis is an immediately accessible and efficient method. Through collecting and analyzing their natural conversations on different types of web forums, I was able to find out what is being said about a certain topic, as well as a rough estimate as to who is speaking, how it is being phrased, and in what context, as well as a rough estimate of how frequently a certain topic is being discussed.

## **II. Collection Choice**

Over the course of two months in late 2018, I harvested online posts and forum comments from video game players, emulation software developers, video game emulation enthusiasts and video game collectors. I gathered and documented posts from four different websites and several of their subforums related to video game emulation or software emulator development: Internet Archive Forums, EmuTalk.net, Quora, and Reddit. I collected these posts to study the feelings, attitudes, and information needs that are present among the above user groups who are actively invested in video game emulation, seeking to fill a gap in recent literature regarding the information needs of video game players and software emulation users as it relates to emulation as a way of archiving and preserving video games.

The first website, the Internet Archive, is dedicated to building a digital library of software, video, audio, web pages, and more. Created in 1996, it is the oldest website in this list and is the only website included that specifically hosts software that can be emulated. Currently, the Internet Archive advertises over 200,000 software programs available to the public as a part of its digital library. Its forums contain questions or concerns about the dozens of collections found on the site, often posed by preservation enthusiasts or by the individuals who donated materials to be preserved in the Internet Archive's collections. The most popular forum on the Internet Archive contains over 290,000 posts ("Internet Archive: About IA", 2019).

The second website, EmuTalk.net, is a traditional web forum dedicated to discussing software, hardware, and video game emulation. Created in 2001, it is the second oldest website in this list. It is a discussion space for those who are interested in emulator creation, emulator development and progress, or even those who want to create emulators themselves, with some posters from 2001 still involved in forum discussions to this day. While EmuTalk.net does not host materials or software on its website, it does link to partnered websites that contain legal emulators available to download. Crucially, its terms of service forbid any discussion of piracy and forbid the encouragement of illegal downloading ("EmuTalk.net Rules", 2004).

The third website, Quora, is a website primarily built upon asking questions on any number of topics, encouraging fellow users to answer them. First unveiled in 2010, it is the most recently created website in this list. In contrast to the Internet Archive and EmuTalk.net, it is aimed at a general audience of all ages and all interests, not necessarily focusing on software or video game emulation. However, users can choose to follow certain topics, and several topics related to video games and

emulation have gathered anywhere from between several thousand to over 100,000 followers each (“About Quora”, 2019).

Finally, Reddit, created in 2005, is an aggregator website consisting of over a million smaller communities (called “subreddits”) where individuals can discuss specific topics around which the community is based. While Reddit is considered a social media site that is aimed at general audiences not necessarily interested in video game emulation, 7 of the top 100 subreddits are related to video gaming, with the most popular containing over 17 million subscribers (“New subreddits by date...”, 2019).

These websites represent varying methods in which users can comment, the different groups which they target, as well as their wildly differing size and popularity. For example, while the front page of EmuTalk.net advertises that there were once nearly 7,000 browsing the forum at once, Reddit averages 330 million average active users a month and is the fifth most visited website in the United States (“Homepage - Reddit”, 2019).

Due to the anonymous nature of the majority of these posts, one of the limitations of this study is that there is not exact demographic information about the authors of individual posts. However, there are rough data estimations about the typical audience that comments on Reddit posts and answers questions on Quora. In 2010, one report from Experian Hitwise estimated a “large share” of Quora’s user base to be college-educated professionals, primarily consisting of students or young adults under the age of 35 (“Report: Quora’s User Demographics...”, 2011). In a 2016 poll conducted by Pew Research Center, Reddit’s user base was found to be similar - 56% of Reddit users were aged 18-29 and 82% acknowledged having at least “some college” experience (Barthel, et al., 2016, p. 7). As a result, while the information gathered



here is useful for those interested in information needs among emulation enthusiasts, any results found or recommendations made in this report are not necessarily indicative of larger communal feelings, but based on the information needs of those who are invested enough to comment and engage with content within a small community of a small group of highly educated users on a few given websites.

These four websites contain and highlight different types and coalitions of video game players, software enthusiasts, or emulation users. Many of the posts found in the Internet Archive Forums are created by users who are actively invested in software preservation, and care deeply about how software is categorized online and how metadata is presented in library software collections. EmuTalk.net targets a different audience - that of video game players who regularly use emulators in their time spent gaming. Quora and Reddit both target mass audiences that may include software preservationists, emulation users, video game players, or all of the above and more. The websites themselves also represent a broad range of website presentation - the Internet Archive Forums and EmuTalk.net represent older, more traditional forum structures that are built around individual responses without necessarily encouraging engagement from outside readers. Quora and Reddit, on the other hand, are newer websites that are presented as open discussion hubs that encourage mass engagement.

### **III. Data Collection**

On the Internet Archive Forums, all posts since January 1, 2018 on the “Software” board were cataloged. These posts were filtered by date to retain a sense of modern emulator users’ interests, affect, and needs.

On EmuTalk.net, I cataloged all posts created since January 1, 2017 found in eight subforums chosen at random. This method of filtering by date ensured that the posts mentioned emulators that are still being updated or are still in use, and would contain information needs found in a modern audience. The eight subforums were, as follows:

- “PSX/PS1 Emulation”
- “ePSXe”
- “PCSX2”
- “Sega Saturn Emulation”
- “SNES Emulation”
- “Other Emulation Discussion”
- “General Nintendo 64 Emulation Discussion”
- “General Nintendo Gamecube Emulation Discussion”

These subforums represent a diverse spread of discussion about several video game platforms that range in popularity and influence. This also allowed me to collect information from different users - while there are users whose posts were found across multiple subforums on this list, others only posted on one subforum. Finally, these subforums include discussion that ranges from generalized emulation to more focused discussion about specific emulators.

On Quora, I cataloged all posts created since January 1, 2017 found on the “Emulation (video games)” tag. Quora allows users to ask questions either anonymously or through registering and logging in. Every question is tagged with certain, automatically generated keywords based on the language used in the question. “Emulation (video games)” is the most relevant Quora tag, so it was used. As Quora encourages users to comment and answer proposed questions, I cataloged only posts that contained comments with at least 1 “upvoter” (a sign of approval by someone who found the answer credible, useful, or legitimate) or greater than 1,000 views. I used these filters to ensure that these posts had some sort of engagement or general agreement among the Quora community.

On Reddit, I conducted filtered searches for all posts from October 6, 2018 through December 20, 2018 found across 7 subforums (called “subreddits”) relating to video game emulation. The seven subreddits were, as follows:

- **r/retrogaming**, a forum related to gaming on consoles no longer in production;

- **r/emulation**, a forum related to software emulation, emulator development, etc.;
- **r/Games**, the 2nd largest forum on Reddit related to general video game discussion, designed to “provide a place for informative and interesting gaming content and discussions”;
- **r/truegaming**, a smaller forum about video games designed for long-form discussion;
- **r/patientgamers**, a forum for gamers who “wait at least 6 months after release to play a game” that encourages discussion of older games;
- **r/pcgaming**, a forum dedicated to playing video games on one’s computer;
- **r/gamecollecting**, a forum dedicated to amassing personal collections of video games or subsets of games.

Like Quora, Reddit also encourages engagement with the initial post itself and with the comments from other users. Reddit users can “upvote” or “downvote” both content and individual comments as they see fit, depending on whether they approve or disapprove of the content, respectively. Much as I had with Quora, I filtered posts from these subreddits by their engagement, primarily depending on the level of subscribers to the subreddit - those individuals who want to stay updated on activity found within the community. For ease of use, I have included the table below to illustrate these filters.

<b>Subreddit</b>	<b>Number of Subscribers</b>	<b>Minimum Post Point Threshold</b>	<b>Minimum Comment Threshold</b>	<b>Minimum Comment Point Threshold</b>
r/retrogaming	Fewer than 75,000	N/A	At least 5	At least 2
r/gamecollecting	Between 75,000 and 100,000	N/A	At least 10	At least 2
r/emulation	More than 100,000	50	At least 10	At least 20
r/Games	More than 100,000	50	At least 10	At least 20
r/truegaming	More than 100,000	50	At least 10	At least 20
r/patientgamers	More than 100,000	50	At least 10	At least 20
r/pcgaming	More than 100,000	50	At least 10	At least 20

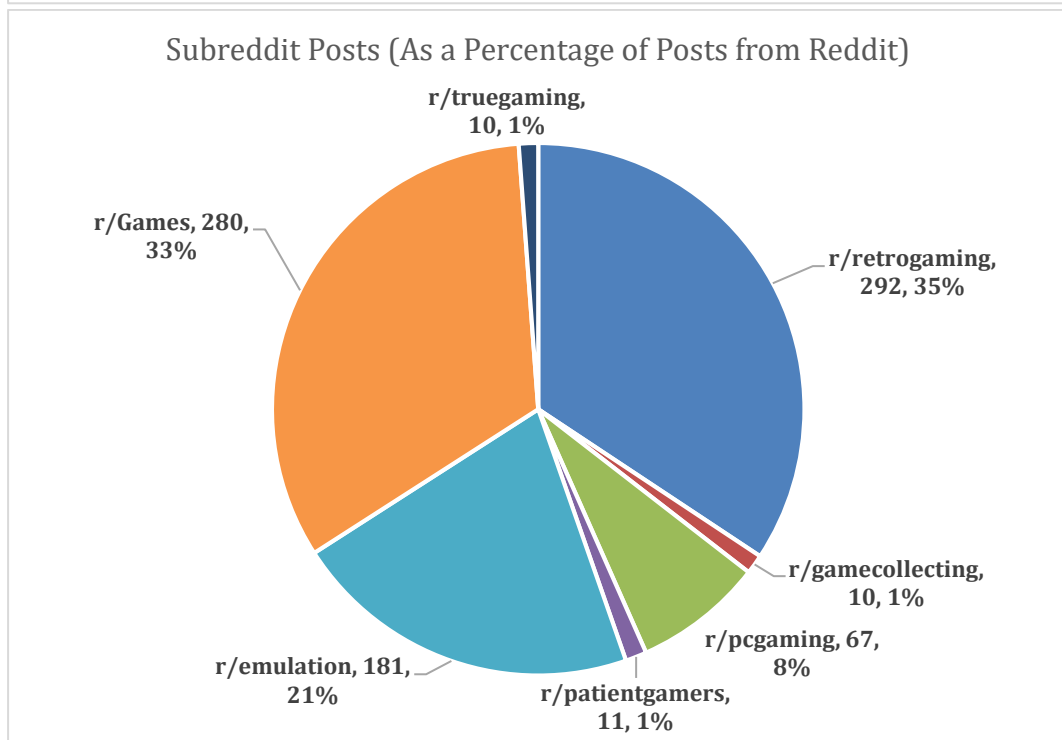
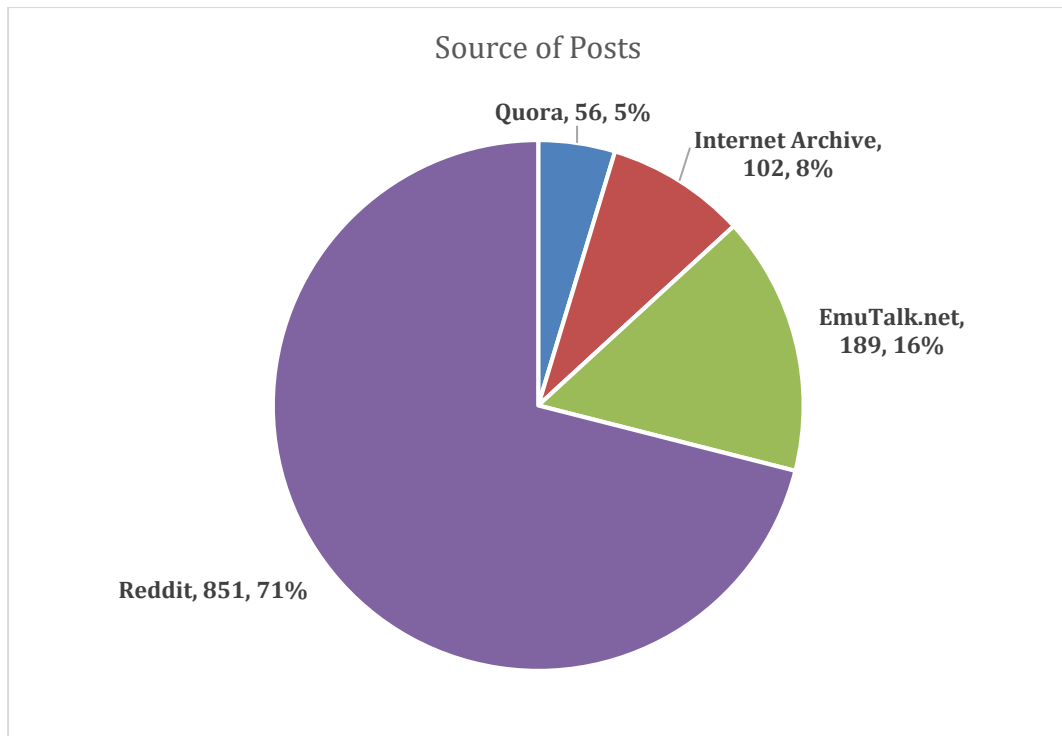
For r/retrogaming, as it had less than 75,000 subscribers at the time I began cataloging its posts, the cataloged posts were those with at least five comments, and comments containing at least two points each. Due to the comparably small size of the subreddit, there was no minimum threshold for points (upvotes) given to the original post. For r/gamecollecting, as it had more than 75,000 but less than 100,000 subscribers at the beginning of cataloging, posts were limited to those with at least ten comments, and comments containing at least two points each. I also did not include a minimum threshold for points (upvotes) given to the original post. For the remaining five subforums, all of which had greater than 100,000 subscribers at the beginning of cataloging, posts were limited to those with at least ten comments, at least 50 points given to the original post, and comments containing at least 20 points each. I chose these thresholds to ensure that there was some baseline of engagement with the original topic at hand, and that any collected posts were engaged with and reviewed positively by their community.

To streamline navigation and the cataloging of posts from the aforementioned Reddit subforums, specific searches were conducted using keywords that were slightly altered for grammar in order to pull a larger range of posts. The search terms and their corresponding subreddits are as follows:

- **r/retrogaming**: “emulation”, “emulator”, and “emulated”;
- **r/emulation**: “games”, “emulator”, and “emulation”;
- **r/Games**: “emulate”, “emulator”, “emulation”, and “emulated”;
- **r/truегaming**: “emulator” and “emulation”;
- **r/patientgamers**: “emulation”, “emulator”, and “emulate”;
- **r/pcgaming**: “emulator” and “emulation”;
- **r/gamecollecting**: “emulate”, “emulator” and “emulation”.

## **Part 5: Findings**

### **I. Statistics**



Source of Posts	Number of Posts	Percentage of Total
Quora	56	4.67%
Internet Archive	102	8.51%
EmuTalk.net	189	15.78%

r/retrogaming	292	24.37%
r/gamecollecting	10	0.83%
r/pcgaming	67	5.59%
r/patientgamers	11	0.92%
r/emulation	181	15.11%
r/Games	280	23.37%
r/truegaming	10	0.83%
<b>Total</b>	<b>1198</b>	<b>100.00%</b>

Every cataloged post was also coded with at least one tag, allowing for a maximum of three tags.

## II. Tags and Thematic Supersets

I assembled 32 tags in total and compiled them into eight thematic supersets for ease of use. These supersets all contain between two and six tags and are structured around one overarching theme, issue, or topic of discussion contained within. These tags were developed around the text found within the individual posts, as well as the theme of the originating thread or surrounding conversation.

The eight supersets are, in order, as follows:

- “Emulator Creation and Development”
- “Games and Emulation”
- “Benefits of Emulation”
- “Microconsoles”
- “Legal Issues”
- “Video Game Preservation”
- “Questions Posed Online”
- “Collection-Based Concerns”

The first superset, Emulator Creation and Development, is comprised of the five tags (Emulator Creation; Emulator Development; Emulator Release Update; Finances of Emulation; How Emulation Works) relating to how emulators are created, their development cycles, and their eventual releases and updates. Posts that centered

around how emulators function, how they are built, and how they render games, for example, were also included in this superset. Finally, posts that focused on how emulation funding (either done for free, created for profit, or funded in part through crowdfunding ventures) were also included.

The individual tags were developed because a number of posts centered around the creation, progression, and development of the emulators themselves. Announcements of new emulators were greeted with excitement, as were the updates to existing emulators, and these announcements were made often enough that they warranted their own tags. Users were also curious about how emulators function and how they are funded, and these discussion points gave forth to fruitful discussion, warranting their own tags, as well. This superset was built as a container for these tags, as they focus on the actual inner workings of the emulators themselves.

The second superset, Games and Emulation, is comprised of the four tags (Emulation in the News; Nostalgia in Emulation; Presentation of Emulation; Significant Properties) given to posts that centered around how the emulative experience was presented to players, along with gamers' nostalgia found in the act of emulating games. Posts in this superset also included discussion of the significant properties of emulated games, even if the term "significant properties" was never articulated as such. Finally, discussions of emulation in popular news outlets were also included in this superset.

One of the recurring themes around discussion of emulation was how it presents and renders the games that are to be emulated. These conversations of how emulation is presented to its audience were very common and warranted its own tag. In addition, as one of the staples of the existing literature is discussion of significant properties in emulation, a tag that discussed significant properties to users was necessary as well.

Nostalgia was another recurring talking point found among user conversations, both as a selling point in emulators and as a presence in the act of gameplay, warranting its own tag. Finally, a general tag of emulators being announced in a public sphere was warranted. This superset was developed as a container for these conversations, as they primarily centered around the games themselves act when emulated and how the experience of emulation affects gameplay.

The third superset, Benefits of Emulation, is comprised of the four tags (Benefits of Emulation; Emulator for Online Play; Emulator to Mod a Game; Emulator to Use Special Controller) relating to the concrete benefits to the user of using emulation over playing games on their native system or console. Although the list of all benefits possible is potentially infinite, there were overarching themes found in these posts that were mentioned often enough to warrant their own tags. As a result, posts in this superset also included three specifically cited and recurring reasons why users chose to use emulation. These include using emulators to modify or change elements in gameplay, using emulators to artificially play multiplayer games online, or using emulators to accommodate a special or unusual controller.

Many users viewed emulation as a personal activity, and one that yielded personal benefits of their own – it warranted its own general tag. The other tags found in this superset are more commonly cited benefits that were more often mentioned by name – in fact, the remaining three tags were spoken of often enough that they all warranted their own individual tags. The superset was designed to encompass these tags that represent both generalized and specific ways that emulation provides benefits to the users.

The fourth superset, Microconsoles, is comprised of the four tags (Microconsoles (General); Microconsoles (NES Classic); Microconsoles (SNES Classic);



Microconsoles (PlayStation Classic)) that relate to microconsoles - smaller devices containing a predetermined set of games that are sold in stores based on older consoles that are no longer in production. This market craze began in earnest with the release of the Nintendo NES Classic in 2016, the Nintendo SNES Classic in 2017, and the Sony PlayStation Classic in 2018, the latter of which was released in the time period in which these posts were collected (“PlayStation Classic review...”, 2018). Most relevant is the fact that these systems use emulation to replicate or enhance the experience of playing these older consoles. The tags included in this superset reflect these three devices, while also capturing posts that centered around more general discussion of microconsoles. As microconsoles have exploded in popularity over the last few years, discussions of them were common enough to warrant their own specific and general tags, depending on what system was discussed. This superset acts as a tightly organized container for those corresponding tags.

The fifth superset, Legal Issues, is comprised of the three tags (Emulation and Piracy; Legality of Emulation; Litigation) given to posters’ various legal concerns with regards to the usage of software emulation and the legality of emulative play. Given that the history and use of video game emulation is often intertwined with software piracy, it is natural that emulation users would still be concerned with being able to legally use emulators today (Farrand, 2012, p. 8-11). As a result, discussions of emulation and piracy warranted their own tag. Posts and discussions of personal and corporate litigation were also cited as their own individual tags under this superset, as they represented a legitimate and important concern that was often referred to when even discussing emulators. This superset acts as a container for these posts that observe and comment on the legality of emulation, as it is a central part of how emulators have been used in the past, and inform who uses them now.

The sixth superset, Video Game Preservation, is comprised of the two tags (Video Game Preservation (General); Video Game Preservation Through Emulation) that relate to how video games preservation takes place in general, or how video games may be preserved through the act of emulation. Posts in this subset centered around issues relating to how video games were currently being preserved, issues that may prevent video games from being run or operating in the far future, the curation of video games to present a historically-accurate image, and more. As video game preservation and the use of emulation to preserve video games are central topics for answering my research question, they both warranted their own tags. This superset was created in response, as a container for these posts that directly relate to how video games are or may be preserved.

The seventh superset, Questions Posed Online, refers to the six tags (Assistance; Game Recommendation; Emulator Recommendation; Specific Emulator; Specific Game; Miscellaneous) coded to posts that posed questions online seeking answers or guidance, or those posts that answered said questions. This often resulted in questions looking for recommendations on games to play or emulators to use, or questions about a specific game and issues with a specific emulator. Finally, a miscellaneous tag that served as a catch-all for everything else (posts either too short to be useful, posts that argued with or targeted other users, or were otherwise unhelpful) was included in this superset.

Many of the posts found in this dataset asked for help with specific tasks; although the tasks and questions were often different and unique, the mere act of asking and receiving assistance occurred often enough to warrant its own tag. Likewise, the act of asking for recommendations about games to be emulated and emulators to be used were also common reasons for creating posts or being involved in conversations –

thus, they received their own tags. Likewise, questions (beyond general assistance) also appeared for specific emulators and specific games in such numbers as to warrant their own tags. Finally, a miscellaneous tag had to be assigned to posts that did not clearly fit with any other tag. As having conversations with others is a central part of the online experience, it is a natural umbrella term in which to host these tags.

The eighth and final superset, Collection-Based Concerns, refers to the four remaining tags (Collection Arrangement; Collection Addition/Request; Collection Deletion; Collection Metadata) used exclusively for posts associated with the Internet Archive Forums. As the Internet Archive is the only website in this list that actually contains software collections and functions as a digital library, its posters' thoughts and needs are often unique to the rest of the posts that were captured and cataloged. This resulted in posts that were concerned with how software was improperly represented in the Internet Archive's library, how metadata was displayed, and requests for software to either be moved to the correct subsection or to be deleted entirely.

The posts found on the Internet Archive Forums largely fit neatly into these four corresponding categories. Posters either asked to have collection arrangement altered or modified, they were curious about or requested to have materials added to certain digital collections, they wanted to have certain collections or objects in collections deleted, or they wanted collection metadata altered. These posts often so rigidly conformed to other, similar posts that these tags encompassed nearly every post taken from the Internet Archive Forums. These tags chosen were natural fits. Finally, this superset was developed as a way to distinguish these tags from those from the other websites, as they were designed solely for a parent website that held material in a digital library setting.

For ease of use, I have included the table below to illustrate these supersets and the tags included therein, along with their rate of occurrence, separated by semicolons and sorted alphabetically:

<b>Superset Title</b>	<b>List of Tags Included</b>
Emulator Creation and Development (428 tags / 23%)	Emulator Creation; Emulator Development; Emulator Release Update; Finances of Emulation; How Emulation Works
Games and Emulation (382 tags / 20%)	Emulation in the News; Nostalgia in Emulation; Presentation of Emulation; Significant Properties
Benefits of Emulation (96 tags / 5%)	Benefits of Emulation; Emulator for Online Play; Emulator to Mod a Game; Emulator to Use Special Controller
Microconsoles (352 tags / 19%)	Microconsoles (General); Microconsoles (NES Classic); Microconsoles (SNES Classic); Microconsoles (PlayStation Classic)
Legal Issues (104 tags / 6%)	Emulation and Piracy; Legality of Emulation; Litigation
Video Game Preservation (41 tags / 2%)	Video Game Preservation (General); Video Game Preservation Through Emulation
Questions Posed Online (404 tags / 22%)	Assistance; Game Recommendation; Emulator Recommendation; Specific Emulator; Specific Game; Miscellaneous
Collection-Based Concerns (63 tags / 3%)	Collection Arrangement; Collection Addition/Request; Collection Deletion; Collection Metadata

### **III. Discussion**

In quoting the various posts featured below, I have made no attempt to censor the language originally used. While some posts have been abridged for length, the original vocabulary, spelling and capitalization used are preserved to retain authenticity (Rubin & Camm, 2013, p. 384).

#### **A. Emulator Creation and Development**

This superset is taken from post tags about how emulators are created, how they are developed, how they are built and how they work; and the finances behind their development. Also included in this superset are tags from the posts that announced

and commented on release updates for existing emulators. As emulation does not exist without the emulators behind them, this is a central superset to understanding the needs of those people who use emulators. Put simply, without the emulators, there are no emulator users, and without the users, there is no data.

It is first important to note that for several of these posts, it was not always simply emulation users represented in the data set. In some instances, the developers themselves joined the topic or forum post to add their input or opinions into the discussions, or simply to address issues that users had with their emulators:

Example 1

I hope the developer is aware about input lag in PPSSPP and improve it someday.  
(Post 717)

Example 2

I'm aware and I plan to make some attempts to improve it in the near future.  
(Post 718)

One developer goes so far as to explain why they created an emulator in a specific programming language - simply because they like the language and wanted to experiment with it. Having this type of input in discussions of emulation development is an unambiguously good thing - it shows there is a sense of community between game players, emulation enthusiasts, and emulator developers. All three groups have to peacefully coexist for the whole system to work. Having a cordial back-and-forth like the examples above is illustrative of a positive online environment in which fruitful discussion can occur.

Between the five tags listed, this superset contains 22.89% of all posts. By collecting such a large amount of posts about how emulators are created or their place in the development lifecycle, it illustrates a concern on the part of game players for how certain emulators are coming along, as well as how effective they are at emulating a game, and what that means for them. Like the conversational input

between developers and their users, this is also a bright spot in the community, as it shows regular and continuing concern, along with a desire to see the emulators succeed. This also sends a good signal for using emulators to preserve video games - it is very possible the institutions that use emulation as a method of preservation will have the support of the overarching community behind them given the emotional support for emulators in general.

There is considerable interest in the technical aspects of emulator development, as well as how one emulator compares to another emulator in the same console generation. Topics discussed included how emulators will progress and develop as the most current generation of consoles become more powerful over time. Posters also discuss at length how and why certain emulators are farther along in their development than others, and not many of these questions are left unanswered. This shows that many of the people involved or interested in emulator development have a sophisticated understanding of how emulators work and function - both the software and hardware alike. Many Quora answers cite specific material aspects of the consoles that emulators have to compensate for - like the original machine's architecture, the size of given discs, and graphical unit clock speeds.

Legal issues were briefly discussed as they relate to how emulators are created. A few of the Quora answers recognize that creating emulators is legally sanctioned but is still considered dicey. The creators of emulators have to do so without access to the original system's architecture, as it is considered a legally protected entity - this can present a major hurdle in the emulator's development lifecycle. There is also discussion as to why Sony did not use an in-house emulator in the PlayStation Classic product, but I will discuss that in much greater detail in Superset D (Microconsoles).

Just as posters discussed the technical requirements of an emulator, many posts, especially on EmuTalk.net, centered around specific elements of a game being rendered properly in an emulator. For example, there is a lengthy discussion about how the 2000 game *Hey You, Pikachu!* commands its' controller's Z button:

Example 3

first how is this going to even work? My plan (my knowledge about the VRU is limited)

Using player one on an emulator connect a n64 controller.

Using player 2 connect the VRU (assuming this is how it was done)

When the user presses Z on player one send a custom FFB command

My adapter will receive this unique command and wait for speech (x seconds)

Then using the HID buttons, display the code or codes. (I could read up to 4)<- is that enough?

The emulator then can read the button data.

If more codes are needed, and if Z is still pressed send a continuation command and read 4 more.... (Post 331)

While the original game was not warmly received at the time of its release, it is seen as warranting detailed discussion by the gamers who seek to emulate it. What may seem like small (or even insignificant) parts of a larger game yielded long, often productive and even collaborative discussions. Having these smaller elements examined in microscopic detail is healthy for emulation development, but it is also useful to know that different players will pick up on different aspects of how emulators are performing, or if they are failing at a given task. This is a phenomenon I will discuss in much greater detail in Superset B (Games and Emulation).

In topics and threads where updates to emulators are announced, response is almost uniformly positive across the board. There are a number of comments and inquiries about how fast certain emulators are progressing. Many marvel at the fact that we have emulators at all for what were once considered top-of-the-line machines:

Example 4

I remember just like 2 years ago when people said 360 and PS3 emulation would likely never be possible (Post 714)

Example 5

Wow. That looks impressively playable. Is a beefy rig needed for running it this well? (Post 813)

In many of these comments, there is palpable excitement at the possibility about being able to play certain games again. Many players named a wide variety of games they hoped would become playable in emulation, hardly ever mentioning the same game twice.

Because it is not traditionally discussed in longform platforms, the finances of emulation development also yielded much in the way of fruitful discussions. Historically, before the internet provided an avenue for creators and developers to reliably crowdfund money on a recurring basis (e.g., through websites like Patreon), most emulators had to rely on individual one-off donations. This is still considered the norm. A few of the posts seem to reluctantly acknowledge that it takes a lot to create a reliably stable emulator because they are created for free, without pay, and later released as freeware. By comparison, larger companies, such as Nintendo with their Virtual Console, have the ability to pay for emulation development, and charged for its use in the past. These instances remain the large, corporate exception.

One of the largest threads I cataloged from EmuTalk.net was one that advertised a 2017 crowdfunding campaign to implement a specific emulation technique into the Nintendo 64 version of the 1998 game *Star Wars: Rogue Squadron*. Reactions were uniformly positive from the forum's posters, and financiers backed their support. In due time, the developers issued updates, and it provided concrete motivation for other projects from the same development team. There was later a second campaign advertised to fund the same type of implementation into other games because of the success of this first effort. Both crowdfunding campaigns were apparently funded beyond the creators' initial goals, which lends quantifiable credence to the idea that



gamers and emulation enthusiasts are invested (both emotionally and financially) in seeing these projects succeed.

**Takeaways:**

- Past and present conversations between developers and emulator users help establish community between the two parties.
- Developers have a sense of responsibility toward the user in these conversations.
- Users often have a lasting concern for continued emulator development.
- Users are highly interested and knowledgeable about the technical progression of emulators over time.
- Users are highly knowledgeable about the legal issues involving emulator development.
- Users will find shortcomings in emulator technology, even if they are esoteric or unnoticed by others.
- Users are knowledgeable about how emulators are funded, if they are funded at all.

**B. Games and Emulation**

This is the superset taken from post tags about the presentation of emulation, significant properties in emulated games, nostalgia found in emulation, and emulation as it appears in the news. While the posts in the above superset often focused on how users interpreted emulation development, the ones featured in this superset focus on how users interpreted the games themselves. As mentioned in the above superset, because gamers and emulation enthusiasts often focus on different material aspects of the emulative experience, at times these attitudes can seem contradictory and even at

odds with themselves. Nevertheless, finding the list of elements they consider to be significant is crucial, as is determining how they feel about how emulation is presented - as a tool, as a way of experiencing content, and as a sold product. These posts matter because, like the superset “Benefits of Emulation” which I will discuss later, they are direct and often unfiltered thoughts into how users feel about emulation, how they interpret emulation as it is presented to them, along with what they find important about the endeavor.

One of the frustrating semantic difficulties in creating this superset is that I deliberately chose to include the “Nostalgia in Emulation” tag here, and not in the “Benefits of Emulation” superset. A person could easily define nostalgia as a direct benefit of emulation, and they would not be wrong to do so. There is some overlap between posts with these tags as well - a nonzero number of posts write that the appeal to nostalgia is one of the selling points of all emulators. However, I made the choice to separate the two entities as there are a number of posts that talk about nostalgia as a general concept, not simply as an underlying benefit to emulation. Nostalgia is also noted as a market selling point in products such as Sony’s PlayStation Classic, and not always in a positive light:

Example 6

These ""classic"" consoles are the most cynical exploitation of nostalgia I've ever seen. Happy to hear this one's getting awful reviews tbh. (Post 1012)

Nostalgia found in microconsoles is a concept I will discuss in further detail in Superset D (Microconsoles). Yet still other posters want to remove any rose-colored glasses entirely, and often make the point that nostalgia for older games is simply nostalgia for their younger days, especially as flaws in certain games are revealed in the morning light of emulation:

Example 7

As someone who loved the fuck out of that game when it came out, I can say

you are absolutely correct - it's fucking unplayable today. Thankfully at least a few remakes have come out that have been decent enough. (Post 994)

Like creating a complete list of benefits that emulation yields, to assemble a full list of significant properties in video games would almost be impossible.

Nevertheless, there is some information we can glean from these posts regarding what people consider important about their games - and their emulators. As discussed earlier, many commenters are especially upfront about the important technical aspects of an effective emulator - it needs to render graphics and sound elements properly, but also be capable of interpreting device inputs such as controllers, memory cards, CD-ROMs, and a continuing laundry list of additional technical specifications.

Also, as discussed earlier, some posters were more concerned with how certain emulators render minute aspects of the games. One common element brought up on several occasions was input lag, the delay between the television receiving a video signal and the signal being displayed, and how that affects their gaming experience. As input lag can create a noticeable difference in how certain games function, a number of players wanted it reduced to an imperceptible minimum, so that even the idea that they are playing on an emulator may disappear.

As far as the act of playing a game on an emulator itself, the thought appears to be much the same: many players do not want to be reminded that they are playing on an emulator, and they want the same experience (or as close to the same experience as possible) on emulated software and hardware that they had on the original console. This is an overly simplified expectation for complex emulation, but it is the singular through-line of what many of the posts in this content analysis desire from their emulated games:

Example 8

Some titles work fine emulated - but some just don't "feel" or "sound" right without being on their original hardware. (Post 402)

This comment goes back to the original debate of what emulating the “look and feel” means for a video game, and for any emulated software, really. There will never be a perfect emulator because try as one might, many of these posters recognize that something is always different about an emulated experience, even if it is developed by the same creators as the original hardware.

The significant elements cited are often subjective, and many are contradictory in nature. Some gamers simply want the perfect experience of playing the game itself. Others need more minute technical requirements to be met. Yet others still disagree about these requirements at all:

Example 9

i know this is against popular thought regarding retro games but i seriously dislike scanlines and the like. if it's on a CRT, fine, obviously, but i don't like artifacting a digital image on purpose trying to emulate authenticity. (Post 629)

Example 10

I don't much care for the scan lines either, but emulating the CRT blur and softness is pretty necessary to me. For SNES games you can use BSNES to do it without scanlines. (Post 630)

This discussion of significant properties goes hand in hand with how games are presented to the people who play them. By “presentation of emulation,” I am not just referring to how a game is visually presented to players (although that is part of it). I refer to the whole larger package of how emulation software is displayed, delivered, and exhibited to its users. One good example of this is in discussions of Sony’s PlayStation Classic. As the machine is designed to look like the original PlayStation of the 1990’s, that part of the microconsole’s physical presentation was warmly received.

However, European (PAL) versions of several notable games were included on the microconsole. This is important because European territories have traditionally used

televisions that operate at 50Hz instead of the American (NTSC) 60Hz standard. This results in PAL versions of games running at 83.3% of the full speed that NTSC versions do - both in terms of gameplay speed and frame rate (PlayStation Classic mixes...”, 2018). To the American end user, this means that those PAL games are a full 1/6 slower on the PlayStation Classic than they would be if the American version was played on an original American PlayStation. To many gamers, especially those who wanted to replay the 1998 fighting game *Tekken 3*, this was considered a baffling dealbreaker:

Example 11

Games can be subjective but emulation problems and having a fighting game like Tekken 3 be pal version is unacceptable. At least at this price point. USB controllers and a good quality mini console case are the good things everyone can agree about it. (Post 480)

Example 12

Don't reward Sony for producing this half-arsed piece of junk. If you like the games and want to play them, do yourself a favour and get something that can actually do them justice. A PSP, a cheap PC, or a real PlayStation of some kind. (Post 481)

I will go into greater detail on this subject in Superset D (Microconsoles). For many gamers whose comments were included in this collection process, despite the pleasing exterior of the PlayStation Classic, this visual and experiential difference was considered anathema to how games are meant to be played. This was also viewed as a major fault on the part of the developer, who delivered what they viewed as a subpar emulator.

One of the limitations of this study is a real lack of posts coded with the “Emulation in the News” tag - almost always because there were more relevant tags to code posts with. For example, almost of all the posts related to the PlayStation Classic would have eventually been tagged with “Emulation in the News”, as it was announced, released, reviewed, etc. during the course of data collection. The posts

that were tagged with “Emulation in the News” were often about another, much smaller-profile microconsole based around the Sega Mega Drive being announced. Reception was near uniformly positive, with posters mentioning different aspects of the machine that they found exciting:

**Example 13**

Being able to play Master System games and Sega CD games on the same machine is a nice bonus. Plus, I have a decent amount of Japanese games that are a pain in the ass to play so this is very attractive. The only downside is the lack of 32x support, but that is not a deal breaker. (Post 736)

**Takeaways:**

- Users may view appeal to nostalgia as predatory if the emulator’s performance is unsatisfactory.
- Users are highly interested in the technical capabilities of an emulator and what it can do to render aspects of a game.
- Players do not want to be reminded they are using an emulator.
- Many elements that users list as significant are unique to their person, and may contradict another’s choices.
- The visual, aesthetic, and experiential presentation of an emulator are key to its audience reception.
- Users view emulator announcements positively and as aspirational.

**C. Benefits of Emulation**

Posts like the one quoted above are indicative of this superset, containing the four tags taken from the posts about the direct benefits that emulation and emulators provide. In this superset, I include posts that list the general benefits that come with emulation, as well as discussions of how emulators are used to modify a game, how they are used for online play in games where it was previously unavailable, and how they are used to allow for special or unusual controllers.

As this paper is about examining the attitudes and information needs of gamers and emulation users, why they use emulation software and what they get out of it is crucially important. Even if they never classify these posts as “information needs” per se, these posts still contain relevant data about why these posters behave in certain ways and use what they use. This superset also contains some of the most relevant information of all, as the benefits of emulation directly correlate to why players use emulation. This directly addresses my research gap and my research question - this is how users feel.

These tags factor into the generalized benefits that emulation provides to players, and they are plentiful indeed. A complete list of all of the reasons why people play emulators would be too long for consumption, but it is worth examining in future research. First, I will list a few minor examples that were cited, before I delve into the more common and specifically named benefits afforded to game players.

Various posters noted that there are several technical reasons as to why they use emulation. As I discussed above, certain emulators allow for artificially reducing input lag so that a game functionally behaves the same way as they did on its original system, an aspect that was found attractive because it retains the integrity of gameplay. In another instance, one poster mentioned they use emulation because of frustration at features found in modern games that are not present in older, emulated games:

Example 14

after 6 months without a single game I got into (emulated) retro gaming and I am now having a blast! An Odroid Go and Pokémon are giving me more than the latest Nintendo masterpiece. These games are finished, nobody wants to squeeze my wallet or get my personal data... I feel free and the games feel honest. (Post 404)

This poster mentions 3 reasons why they opt to play older emulated games instead of newer ones: an emulated game is a finite and completed package, likely in refutation

of downloadable content packages found in modern games. Second, an emulated game is a fixed price, likely referring to modern microtransactions that individually charge the player money for additional benefits not found in the original title. Finally, the emulated game does not collect data on the user's personal habits, referring to the practice conducted by games or systems that require a constant internet connection, for example. No other poster in the entire dataset directly wrote of emulation and the practice of playing games through emulation as a form of economic boycott against modern industry practices. This is an important, unnoticed angle that warrants further research.

There are real-world benefits to emulation that are occasionally discussed. One person mentioned they do not have enough physical room in their residence to display their cartridges or systems, so they use an emulator to save on space:

Example 15

I have carts but not enough room to display or even put all my consoles up. So I like to use my android game box to play them. (Post 399)

Others echoed the sentiment about physical space, and noted that emulating games often saves money as well. Because buying physical copies of retro games is a potentially expensive proposition, acquiring emulated copies through legal means like Nintendo's Virtual Console presents a cheaper alternative by comparison:

Example 16

I realized while I like having the games, I'm not necessarily using them, and that's a lot of money sitting around (and still spending when I saw them in the wild) plus have limited space (we are downsizing house for a better location, so have been getting rid of stuff like 100s of games, books, dvds, etc etc). I recently sold or still in process of selling of most of my collection, I kept a few key games and memorabilia though for display though. I did something similar with Nintendo Powers... I had a big stack, and added to that, then thought...why am I doing this..they are gone, again, except a few key issues. While I love the stuff (like crack to me) I realize emulation is just better for me and fine with that. (Post 400)



There were other, more common reasons cited as to why someone would use emulation. 2.19% of all collected posts were about using emulators to modify (mod) a game - to artificially enhance the gaming experience or change how it was played from the original system. Common posts about elements users wanted to change were graphical layers, changing the frame rate at which the game runs, translating games into English that were previously Japanese-only, accessing debugging modes, adding in cheats, and more.

Interestingly, though perhaps not surprisingly, players who were frustrated with Sony's PlayStation Classic wanted to hack the system to mod more games into the emulator:

Example 17

Hopefully it's only a matter of time until this thing is hacked - maybe the scene will fix it. (Post 567)

This poster saw the omission of certain games to be particularly offensive, and they wanted to use its function as an emulator to mod in and play additional games not sanctioned by the developers. The most telling word is "fix", as if the editorial choice to omit certain games was an issue that required repair. I will go into greater detail on this subject in Superset D (Microconsoles).

0.64% of all posts (12 posts) were about using an emulator for online play, which means often modding in online multiplayer into games that did not feature it to begin with. Online play (also called netplay) is sometimes used to create online multiplayer in games that were originally found in offline consoles, connecting players over the internet through emulators. As a result, there was some overlap between this tag and those posts that wanted to mod a game. One poster argued that the advent of modding netplay into older games was a godsend for certain gaming microcommunities:

Example 18

The Melee competitive community wouldn't be as good as they are or as

popular without netplay. It works amazingly well, when you both have good connection it's genuinely better than even some fighting games designed to be played online. (Post 744)

Others replied in marvel at how far netplay had progressed over the course of the decade - much as those posters in the first superset had with emulation development in general.

Another finite advantage that emulation provides is that it allows people to use a different controller than the one that the system originally came with. This is something that game players immediately pick up on - often advocating for specific devices and emulation software solely because they accommodate the use of custom controllers. Sometimes this is just because it improves their skills in a game to use a controller rather than a mouse and keyboard for certain titles. Other examples listed were because their choice of custom controller is more comfortable or has a longer physical reach than the original controller.

One often overlooked reason why players may want to use a special controller is if they are disabled or do not have full dexterous use of their hands that prevents use of a traditional controller that requires both. I will highlight one post in particular:

Example 19

I only have use of one hand so I can't play console and need a custom OSK to play using my mouse. Sadly I'm stuck with only playing turn-based RPG's, I do actually own a PS2 and the games i mentioned. (Post 9)

Emulation, despite its historically questioned status as an avenue for piracy, delivers a way to play video games for those who are not able to traditionally use controllers that require both hands. This poster requires a custom setup so that they can play emulated games, but they obviously care about emulation and video games enough to contribute to online discussions about it, even wishing that there was a way they could play additional titles. Emulation provides one way for these players to remain involved in gaming discourse, gaming circles, and in their gaming communities of

choice. This is a crucially underrepresented target market to examine for future research into emulation and video game theory in general.

**Takeaways:**

- Users often have individual, idiosyncratic reasons for why they emulate games.
- Users find there are real-world benefits to emulation (e.g., saving on money spent or physical space).
- Users want to emulate so they can modify games, including adding in online multiplayer.
- Emulation may accommodate physically disabled gamers in ways that traditional consoles cannot.

**D. Microconsoles**

One of the most high-profile examples of emulation as a regular part of the gaming discourse has been through the advent and explosive popularity of microconsoles - small devices that are designed to look like older consoles that are no longer in production, featuring a limited selection of popular games from that system. Most recently released was the Sony PlayStation Classic, a device meant to resemble a more compact version of the Sony PlayStation, originally released in the 1990s. At a fraction of the original's size, featuring a predetermined set of 20 games, and including one controller that all faithfully harken back to the original system, it took cues from the successful releases of Nintendo's NES Classic and SNES Classic in the years prior ("PlayStation Classic review...", 2018). Nevertheless, the PlayStation Classic was released to mixed reception, the reasons for which I will also discuss in this section.

As the promotional cycle and release of the PlayStation Classic was in full swing during the time in which I cataloged these posts, it is natural that most of the posts in

this superset are about it. However, there are a number of posts about Nintendo's two microconsoles in this superset, as well as posts about the little devices in general. It is worthwhile to reiterate that the reason why these microconsoles are significant is that it is not just another way for companies to re-release games, but that these machines often use emulation to run the games in a legally sanctioned way that is both profitable for the company and cost-effective for the consumer. In addition, they are also marketed as a nostalgic item, meant to faithfully recreate the experience of playing a game for the first time two decades ago. As a result, there was a lot of crossover with tags from the "Games and Emulation" superset. Many of the posts about the PlayStation Classic were tagged in tandem with "Presentation of Emulation" and "Significant Properties" because there was visible frustration with how the PlayStation Classic presented its emulated games. Many of the posts also cited missing elements that they found important, even if the phrase "significant properties" is an academic invention and was never articulated as such in the collected posts.

To refer to an earlier example I discussed in Superset B (Games and Emulation), the worldwide use of PAL versions of certain games instead of their NTSC versions made them run noticeably slower than their original incarnations in certain regions. Many posters saw this as a centrally significant property - one that directly affected their choice of whether or not to purchase the PlayStation Classic. Also highlighted was a lack of a DualShock controller first popularized on the original PlayStation, which featured vibration capabilities and twin analog sticks, as opposed to simply a directional pad. The PlayStation Classic only features a standard controller without these features. The choice of games found in the PlayStation Classic itself was also often framed as a significant property, something that was crucial to how a given

gamer received the product. This predetermined set of games was either cited as a dealbreaker due to the omission of certain games, or something that could be fixed later through hacking, as an individual corrective to Sony's choices. These were some of the recurring reasons for its poor reception:

Example 20

They botched this thing on all fronts though. While I'm personally ok with the classic controller, I completely understand people wanting the DualShocks. The game lineup was a huge disappointment, with baffling additions/omissions. And to add one last unbelievable screw up, they include inferior PAL versions to almost half the lineup. (Post 498)

There was also interesting crossover with the "Legal Issues" superset found in a number of these posts. There was some speculation that the reason why some notable games were omitted was because of licensing, both in terms of material found inside the games, and in instances of third-party developers who sanctioned their intellectual property to appear on the PlayStation Classic:

Example 21

Nintendo has a huge advantage in this regard because of how many games they make themselves. Start thinking of some of the biggest Sony franchises and who owns the IP. Things like crash, Spyro, metal gear, and final fantasy. On top of that the PlayStation is one of the first systems to utilize licensed music so that makes porting games like Tony hawk and gran Turismo difficult. (Post 1008)

More notable was the fact that the PlayStation Classic uses a version of the open-source PlayStation emulator PCSX ReARMed ("PlayStation Classic Plays Fine...", 2018). As this emulator was created under the GPLv2 legal license, Sony is legally able to modify, distribute, and even sell this emulator commercially, but they must abide by several conditions, including stating and documenting any changes made to the source code of PCSX ReARMed ("pcsx\_rearmed...", 2019). It was this final point that frustrated some gamers, who believed that Sony would not legally abide by the license and post any updates that may benefit the emulation community. There was mostly apprehension that Sony would continue to adhere to it going forward, but

others still were more hostile towards the idea at all, given that Sony had been litigious towards emulation software that was commercially sold for profit in the past:

Example 22

It's under the GPL liscence, so there's nothing legally wrong with this. Just a bit of a sour taste here when you consider that Sony has been hostile to emulators before and are now making use of those products they attack for their own profit. (Post 904)

One element worth exploring is the comparison between the comments from detractors of the PlayStation Classic and those who take umbrage with free emulators available online. It is possible that such bitterness in the former is because it was sold to consumers at a not-insignificant price of \$100 in the United States, or because it was aimed at a popular market that has capitalized on a wave of nostalgia for the 1990's. This could also be because of the nature of web content analysis itself, which lends itself well to capturing angry posts online from purchasers with buyer's remorse, who have gone the extra mile to warn other potential consumers of their perceived mistakes. There are veritable complaints and issues with free emulators, but as stated above, most of the comments on updates to free emulators were uniformly supportive or positive. Even complaints or concerns about freely developed emulators were phrased less bitterly than complaints about the PlayStation Classic. In addition, there are posts that acknowledge issues present in Nintendo's NES Classic, but as far as the cataloged posts found here, there was just not the same type of fervor against that system as there was for the PlayStation Classic:

Example 23

Remember when people moaned that the NES and SNES classics were bad, overpriced ROM boxes? I don't agree with it there, but I definitely agree with it here. (Post 927)

Perhaps such bitterness is brought on because microconsoles directly try to profit from the concept of recreating the experience of childhood gaming. The concept of playing emulators as if they were the original game is best articulated with

microconsoles as well. Melanie Swalwell wrote that the concept of the original experience is often viewed as more important than capturing gameplay through an emulator. It is very possible to read the massive success of the NES Classic and SNES Classic, and the lukewarm success of the PlayStation Classic as her vindication (Swalwell, 2013, p. 1-4). That is their main selling point, after all - to be aesthetically pleasing reminders of the games that audiences played in their childhood or adolescence.

Many of the posters acknowledge that - even if the emulation is not perfect across any of those three microconsoles, and even if the presentation in all three examples left something to be desired, the point is to be a visually pleasing, quick way to pick up and play old games they recognize. However, even that nostalgic image in the mind's eye of what it was like to play those games is broken by actually playing the emulated versions. Much of the frustration with the PlayStation Classic is that games were not perfect recreations of the experiences they remember from the original console (once again, refer to the differences in frame rate and gameplay speed because of the region differences in the ROM file).

#### Example 24

Thats pretty savage, but honestly i think a lot of these games have aged pretty poorly. the SNES mini works because the SNES was the pinnacle of 2D gaming, the original playstation was the first step into the way we still play games today, meaning we're going to compare them to todays games much faster. (Post 1017)

It is also worth noting that, to consumers, some of the games on the PlayStation Classic, simply have not “aged well” when compared to games from the NES or SNES era, due to the PlayStation’s use of compressed textures and often jagged three-dimensional polygons. Unique to video games and software as a medium, this concept of something poorly aging in the public consciousness due to technological progress (through no fault of its own) is worth studying in the future.

**Takeaways:**

- The worldwide use of PAL games instead of their NTSC versions in the PlayStation Classic was a fatal error in its reception, as it affected gameplay speed and thus, audience perception.
- Users are highly aware of licensing restrictions and open-source licensing in emulation software.
- Users may interpret paid emulators more harshly than free ones.
- Users may find their positive opinions on older games are solely due to nostalgia and not perceived quality – microconsoles break the illusion.

**E. Legal Issues**

The unspoken rule about online discussions of emulation is that it has historically only been used to play pirated games, and as such, exists in a legally uncomfortable area - while emulators themselves are legal to use, downloading playing pirated games on them is not. This superset is taken from the post tags about the legality of emulation, past instances of litigation leveled against emulators or emulation users, and discussions of emulation as it relates to piracy. It is important to note that in none of these posts do any posters claim to have legal qualifications. Much of the discussion about what is and is not legal likely comes to them secondhand from other online sources. As mentioned above, I specifically did not catalog posts from websites related to piracy or ROM downloading to try to keep posts discussion-related, and to prevent linking to content that infringes upon copyright.

The legally gray history of emulation is not lost upon posters in these online venues. The terms of service of EmuTalk.net explicitly acknowledge this - they forbid users from posting links to ROM files or from even discussing how to pirate materials. Because of my choices in which websites to consult, very few posts also directly discuss piracy itself; the ones that are coded as discussing piracy are also



coded with the more general “Legality of Emulation” tag. As a result, the online discussions surrounding emulation also reveal that most posters who inquire about it also realize there is an element to it that skirts legality and risks personal litigation.

This history of emulation in association with skirting copyright protection law informs the type of audience who chooses to engage in emulation. As a result, at least for the websites chosen here, the different types of discussions revolve around how to either emulate legally, whether emulation is morally acceptable if it is illegal, or whether someone can be sued for the act of emulating. No one wants to be sued for copyright infringement, and the gamers featured here especially don’t want to be involved in personal litigation. There are several Quora questions asking about how they can personally avoid being sued if they download and emulate ROM files.

Taken as a whole, these posts show that there is a faction of emulation users online who wish to do so in a legally sound way and want to avoid the act of piracy altogether. Instead of pirating games, some posters instead suggest legal ways to emulate games - buying emulated games through the Nintendo Virtual Console, for example. When one company announced a streaming service for retro gaming powered by emulation, one poster announced:

Example 25

I'm more than happy to pay a subscription fee if it means I'm legally playing 2000+ ROMs, and supporting rights holders and the industry. It's a good feeling. (Post 584)

There is a market for emulation when it can be conducted legally. Given the continued success of the Virtual Console, and microconsoles, as mentioned above, the gaming industry is aware of this.

**Takeaways:**

- Users are aware that while emulator use is legal, they have historically only been used to play illegally pirated games.

- Users who post about emulation in public spaces do not want to be involved in litigation over emulation usage.
- Users want to avoid piracy and emulate games if the process has been legally sanctioned.

### **F. Video Game Preservation**

Somewhat disappointingly, the number of cataloged posts that dealt directly with video game preservation was only around 2% of all posts. Nevertheless, because this paper is about users' needs for how emulation is used to preserve video games, this is one of the most important supersets. Taken from post tags about video game preservation and how video game preservation is made possible through emulation, this superset is a valuable guide into the mind of the average gamer and emulation user. This relative lack of interest in posting about video game preservation achieved through emulation could be from a variety of factors. It is possible that discussion about video game preservation was actually filtered out given my choice in searching on certain websites and subreddits. It is also possible that video game preservation was being discussed using other, less academic terminology. Finally, it is very possible that it is just not on people's minds.

To that last point, anecdotally, video game preservation is often something that is discussed only in the wake of a large event that ripples throughout the gaming community - an event that forces people to discuss its implications. In August 2018, Nintendo sued the owner of two ROM file sharing sites for copyright infringement, which set off a wave of discussion about how ROMs are sometimes used as the only way to obtain certain games and play them ("All that's wrong with Nintendo's...", 2018). In January 2019, Nintendo also closed the Wii Shop Channel, the online digital marketplace for the Wii console, preventing anyone from purchasing or downloading

the games that were exclusively available on that system (“12 years in...”, 2019).

Besides these two events, however, it is entirely possible that video game preservation is still only being studied and discussed by academics, at a scale far more than it is being discussed in popular venues.

Despite any lack of enthusiasm, it is crucial that people take video game preservation seriously at a mass level. As the medium of video games ages, and as gaming audiences take note of this through nostalgic endeavors like microconsoles, there will be more pressure to preserve them as time goes by, just as there was with the growing medium of film in the early 20th century. For now, there are certain, specific threads in the collected data that I can use as points of discussion. Consoles aging, fading, and falling into disuse is noted in one Reddit thread, where the topic creator acknowledges that even the most popular consoles will eventually cease to be usable until there are none left. This is also known as general format obsolescence, often accompanied by bit rot that will eventually come to affect most technical equipment and current media formats (Monnens, 2009, p. 140-141). Oddly enough, this thought is resoundingly shut down, often condescendingly so:

Example 26

This is what I always say to people who get worried about disc rot. Your PS2/3 will die way before your discs go (Post 645)

Example 27

By the time that happens...Emulation. (Post 643)

These comments are poor ways of looking at issues of video game preservation, as if the buck will eventually be passed to some emulator developer who will magically fix everything. They also assume that those same developers will create flawless pieces of software that are successful beyond our wildest expectations. Most oddly, they also assume that every single piece of media will be recovered and preserved by some unknown entity and that emulators will be able to handle them perfectly.

A second thread on Reddit asked for examples of known games or systems that we have “failed” to preserve:

Example 28

What are some known games/systems that we have “failed” to preserve? (Post 1035)

This is an articulation I had expected to see more of - an acknowledgement that the video game industry, its players, and third-party nonprofits like libraries or archives have failed to preserve certain video game material. There are interesting examples offered - often digital games that were only available on console-exclusive marketplaces (e.g., those found only in the Wii Shop Channel shutting down, as mentioned above). More unusual examples were proposed - mods for games and other material that was only available on websites like Megaupload, which was shut down in 2012; VHS-based consoles that don't output a video signal to a television that is not cathode ray-based; multiplayer games that do not have private, fan-created servers; and web games hosted through fading technologies like Flash or Shockwave. This list is not altogether bad and warrants further academic research and discussion.

One Quora thread asks if video game emulation is the best method there is to preserve video games, but the discussion then gravitates to debating the merits of emulation as opposed to porting or migration. This is a debate academics largely solved at the beginning of the decade, but the points made are the same: porting and migration are complicated, impractical, and cost effective. One commenter wisely notes that, as mentioned above, while emulation as a concept has been proven to work, emulation software is often created for free by developers who do not have access to the architecture of the original system, unless they put themselves under threat of possible lawsuits.

Related legal issues were also briefly acknowledged in these posts. One discussion targeted digital rights management (DRM) technology as a problem within the video game industry. Although DRM serves to protect copyright by often requiring greater forms of online authentication from the game's purchaser, it complicates preservation efforts by doing so.

Example 29

It's far easier to preserve to stuff while it's still around. The only issue is copyright. (Post 1038)

Example 30

So DRM hinders preservation, not piracy. (Post 1039)

This is an interesting perspective on what usually prevents preservation from occurring. In the past, some academics have advocated for more legal loopholes allowing for libraries and archives to preserve games (Barwick, et al., 2011, p. 382, 385). Fewer directly attack DRM, and thus, copyright protection and industry profit in turn. However, various authors have fundamentally agreed with the sentiment, writing that DRM is an issue for game preservation and prevent community members from independently preserving video games themselves (McEniry & Cassidy, 2015, p. 11; Bachell & Barr, 2014, p. 155). DRM is often viewed as a net negative among gaming communities due to methods like always-online authentication, but it is interesting nonetheless that the gamers mentioned above arrived at the same conclusion as academics and archivists, albeit from a different direction.

One final thread I want to highlight also delved into topics that were far more sophisticated than many of the other posts I collected. Its creator argued that, in the critical judgment of important games, people remove them from their historical context, viewing them as isolated objects thanks to emulation and how they are curated in popular mediums (presumably in box sets or package deals). This is one point that video game archivist Frank Cifaldi has made in the past - arguing that video

game preservation is “more than just a playable binary of a game,” but also “everything surrounding a game: the people, the stories, the history [and] the ephemera” (Cifaldi, 2016).

**Example 31**

Most gamers don't, I think, care very much about historical importance. That's not relevant to them or their lives. And I think we get confused about what's historically important, because we're narcissistic enough to think that if we spent a bunch of time on a game and loved it at the time, that makes it Meaningful...I suspect that, over the long haul, whether a game remains fun will become the definition of whether it's historically important. These were the games that got it right, and that's what makes them important. (Post 939)

**Example 32**

Historical context of games does not need to be linked to how good a game is. The wizardry game are iconic as being being the inspiration for RPGs, however, few play the original because they have control terribly. (Post 943)

These commenters debated the point of media curation as it relates to video games, as archivists and librarians often do in selecting and appraising media for their own institutions' collections - whether the most appropriate choice for appraisal and curation of video games is to leave the best or most memorable ones, or to look for the most historically important games regardless of quality. This belongs in a deeper discussion than can be written here, but it is an important one that is worth having.

**Takeaways:**

- Users often only discuss video game preservation in the aftermath of an event that forces preservation into public consciousness.
- Users are aware of general format obsolescence.
- Users are aware there has been a lack of past video game preservation.
- Users have targeted digital rights management (DRM) as an obstacle in the way of video game preservation.
- Users are curious about how video games will be historically viewed as other artforms are.

### G. Questions Posed Online

Though there is sometimes great and meaningful discussion found in online forums, and many of the posts found in this project were starting points for lengthy and valuable discourse, the truth of the matter is that on web forums, many participants are just asking questions, looking to find help online. This extends to video game related questions, which may sometimes teeter on the edge of asking about ROM files or pirated materials that infringe upon copyright. Therefore, this superset is about all of the questions that people asked in these cataloged posts - for example, what games are good to try out on emulators, what emulators are good, questions or concerns about specific games, questions or concerns about specific emulators, and assistance and answers for the above questions.

Finally, I also included in this superset any and all miscellaneous posts that could not be coded with a convenient or relevant tag. There will simply always be a signal to noise ratio in online discussions, and some posts were either unable to be categorized because they are too short, they involve infighting among forum members, they are not useful, or they are unrelated spam:

Example 33  
Sweet! (Post 291)

Thankfully the percentage of pure miscellanea is very low, at less than 3.5% of all posts cataloged. This is a much higher percentage than I would have preferred, but the vast majority of the cataloged posts were worthwhile data.

Before beginning data collection, I had incorrectly assumed that this superset would be the largest cross-section of posts online by far. Instead, this superset contains 21.60% of all cataloged posts - roughly on par with or surpassed by other supersets such as Superset A (Emulator Creation and Development). In truth, there *are* a number of technical support questions:

## Example 34

Which emulator can use anti aliasing? (Post 213)

And in return, there is a lot of assistance given to this type of question, and most posters seemed willing and eager to offer help, at least to the best of their ability. This implies a few things about the communities behind these online sources: they are invested in seeing the community succeed, they are welcoming to new members who share their hobby, and they are willing to help people out in accordance with the given website's terms of service (i.e., beyond telling people not to ask for illegal ROM files when forbidden). Just as I discussed with the positivity surrounding emulator development, I believe that this type of dynamic bodes well for the long-term health of these online communities in general.

Asking questions and receiving answers is an integral part of the online experience. Despite piracy sometimes serving as the backbone for some of these questions, this bodes well for the future of emulation as a part of online gaming discourse. If there are a number of posters asking about specific emulators, it shows they are quantifiably interested in using them, supporting them, and seeing them succeed as pieces of software. This concept applies to specific games as well. In seeing people ask about whether specific games can be emulated (the 2008 game *Metal Gear Solid 4* and the 2010 game *Red Dead Redemption* were mentioned by name several times), it proves at least two things. First, at least for game developers, there is still a market for games that were once exclusive to certain consoles. Second, for emulator developers, there is a solid contingent of gamers who will use their product if it can suitably run certain games.

## Example 35

I'll eventually dip my toe into this emulator once MGS 4 becomes playable at 4K! Then my life will be complete. (Post 892)



This is an interesting dichotomy; because of market forces at play, there will always be console-exclusive games, just as there will always be gamers who will look to emulation to circumvent that exclusivity, even if they are forced to wait the greater part of a decade or more.

When it comes to game and emulator recommendations, it becomes more complicated to discuss my findings, as there were so few posts tagged with the former (less than 0.25% of all posts). All of the tagged posts make reference to having an emulator standing by, just that they need games which they can play or experiment on. There were far more posts asking about this transaction in reverse - because they want to play a certain game, which emulator would be right for them? Among those questions, posters were often curious about how they could emulate games on a cheap computer, or how feasible it is to try to emulate games on a few different devices. Also common were questions asking how to build devices to perform emulation, such as a Raspberry Pi - a microcomputer that can be fitted to perform a variety of computational tasks, including to play emulated games.

#### Example 36

I would probably use retropi if your using Linux or you could use retroarch.

But I either use my raspberry pi to emulate game or I use individual emulators per console on Windows (Post 531)

There was also a limited overlap between discussions of which emulators were the best to use, and if official microconsoles like the NES Classic and SNES Classic fit these criteria. One consensus seemed to form that both examples were suitable representations of the original - though they did not hold a candle to playing on original hardware. However, they were viewed as very advantageous because they were legally sanctioned by their parent company. Future research may want to study how these official microconsoles stand in comparison to unofficial emulators that have been in development for several years.

**Takeaways:**

- Users are willing and eager to help with emulation-related questions.
- Users are interested in emulators that play games that were console-exclusive.
- Users are interested in how they can find the best emulator, especially if it can be used on a budget.
- Users view emulators that are legally sanctioned very positively.

**H. Collection-Based Concerns**

This final superset is taken exclusively from the Internet Archive, aimed at examining their concerns as they relate to how emulated software and software collections are presented on the parent website. As the Internet Archive is the only website on this list that contains and hosts software itself or acts as a digital library rather than just a hub for discussion, this is an unusual superset. As this superset represents the tags associated with posts from a group of software users that are invested enough to note the metadata and proper data cataloging, these posts are set apart from the regular gamers who, for example, simply want emulation to address a certain list of needs. In other words, the posts in this superset look at software differently, and their posts reflect those different needs.

For archives and libraries that insist on using software emulation as a part of their workflows, there is a determined group of users and contributors who care deeply about the way software is hosted, presented, and organized - both theirs, and others'. Many cataloged posts - the majority, in fact - are requests for website moderators or administrators to delete software that was either uploaded to the Internet Archive in error, or with one metadata element labeled incorrectly.

Example 37

Please remove this bad upload:

<https://archive.org/details/CFW25GOLD>

Thank you (Post 142)

It would be easy to look at these posts asking for materials to be deleted and interpret them as spam. However, questions of organization, arrangement, and removal or redaction are among commonly fielded questions that librarians and archivists encounter, even those who for a digital library.

Judging from these posts, software creators and those who choose to upload their materials into trusted digital repositories are often particularly concerned about how their work is presented, how it is organized online, and if it is up to date. Many of the posts display a sophisticated understanding of how metadata is displayed for digital objects and want to avoid any misinterpretation on the part of an eventual end-user.

**Example 38**

This item should have its mediatype changed to reflect that it is abandoned software (was being given away freely by the author prior to his passing away, and the website disappearing). Can someone change this or tell me how I can do it myself? (Post 122)

For users who want their software hosted in a library setting, they want it done in a professional manner. Given the Internet Archive's reputation as an effective archive and respected digital library with broad public reach, this may be the reason why these software creators chose them over another software hosting website like GitHub, for example. It is not hard to imagine that there is a reason why professional software developers have also chosen the Internet Archive as the place to host emulated copies of their work - over 200,000 software programs are there already ("Internet Archive: About IA", 2019).

**Takeaways:**

- Users of libraries are deeply knowledgeable about how software and associated are hosted and presented.

- Users of digital repositories trust that their software will be preserved and displayed correctly and professionally.

## **Part 6: Conclusions and Recommendations for Future Research**

Video game preservation lies at a critical junction, with much of the existing scholarly material focusing on theoretical assumptions from archivists and academics about how emulation should be approached. This paper represents a hopeful first step in addressing an issue that will only grow more relevant as a multi-billion-dollar industry ages and must grapple with preserving its legacy. For archives and libraries that may partner with industry professionals to act as preservationists through software emulation, it is of utmost importance to remember that, as emulation becomes more prevalent and necessary, gamers exist as key actors in the reception, use, and continuing success of emulation platforms.

### **I. Policy Proposals for Libraries and Archives**

What follows is a series of policy proposals for libraries and archives who seek to preserve software including video games through emulation.

This research study was partially inspired by a perceived lack of input on the part of the end user when it came to policy development for software emulation found in libraries and archives. Except for one user study, which took place nearly two decades ago, users have been largely neglected in the course of policy development (Hedstrom et al., 2006, p. 183-187). Instead, librarians and archivists have instead opted to focus on their own interpretation of emulated materials. Given the wide variety of opinions and attitudes found in the quoted examples above, I believe all policies about software emulation going forward will require extensive user input when it comes to how librarians develop systems that users will use, and many of my personal policy proposals involve having user input as a result.

### **A. Resources**

User posts found in Superset A (Emulator Creation and Development) displayed a great interest in the initial and long-term success in emulators, as well as a sophisticated understanding of how games are rendered in emulators (see: the discussion of *Hey You, Pikachu!*). Flaws in emulation software will inevitably be found and dissected by its users and use of subpar software will be discovered. Therefore, my first policy recommendation for libraries and archives is that resources must be invested into developing proper emulation systems - this will require time, money, and energy, as well as the hiring and use of programmers, testers, user studies and focus groups to test the systems' effectiveness. This would represent a paradigm shift in how emulators have traditionally been created - refer to the discussion in Superset A about how emulation software has traditionally been funded. By spearheading investment into emulation creation and development, libraries and archives would make themselves known as invested supporters of emulation and as a known quantity in the realm of video game preservation.

### **B. Community Outreach**

Another similar policy proposal is to involve and inform potential users during this development process and keep them abreast of in-house emulator development or emulation system choice. Other posts in Superset A noted the value in communicating with users how emulator development was progressing. Users found it valuable to personally see that their feedback was being read and were encouraged to stay updated on development as a result. This concept reads as being especially powerful in a library setting, where emphasis has traditionally been on user needs and user interaction with materials. As we can see in posts 714 and 813 above (Examples 4 and 5, respectively), reaction to emulator development is almost uniformly positive across the board. There is nothing to suggest that this would change in the shift from an

independent emulator being developed to one being developed by a non-profit institution like a library or archive.

Because of a lack of content in Superset F (Video Game Preservation) due to a lack of commentary about video game preservation, my second community-oriented policy proposal is for libraries and archives to step in as vocal representatives of video game preservation, as well as make known their abilities to do so. The concept of video game preservation itself sometimes seems to only exist as a pipe dream in popular gaming discourse, or as a wishful preventative measure, if it occurs at all. Libraries and archives have an opportunity to step in and make themselves known as institutions that prioritize video game and software preservation. Scholars themselves may benefit from popularizing the concept of video game preservation through emulation, as more and more online services are turned off as time goes by (refer to Nintendo shuttering its Wii Shop Channel and its exclusive games becoming lost).

Posts like Post 213 (Example 34) in Superset G (Questions Posed Online) revealed that gamers online still love to talk about and ask questions about emulators. My (noticeably lighter) third community policy proposal is for librarians and archivists to bulk up on knowledge about emulators, hire video game archivists and preservationists, and act as reference point people for questions about emulation. Libraries and archives are trusted civic institutions and can act as guiding lights for information about emulation - rather than leaving gamers to the proverbial wolves online or forcing inquirers to get their knowledge from uneducated online sources. By acting as reference figures, librarians and archivists can also provide information about their parent institution's own emulation resources that are trustworthy and work well. The burden of development and creation then shifts to the library or archival institution, rather than forcing the user, like the one in Post 531 (Example 36), to

purchase machines that have the potential to emulate (like a Raspberry Pi running RetroArch) but that may be difficult to set up and maintain.

### **C. Collection Development**

Just as libraries and archives must develop systems to deliver emulated games and software, they must also assemble a collection of materials to be delivered to users. My policy proposal in this case is to develop a standardized procedural list of ROMs (files necessary to run each video game) to be included in the parent institution's collections. This comes primarily from the discussions seen in Superset B (Games and Emulation) about the PlayStation Classic holding both NTSC (American) and PAL (European) ROMs. This unusual choice created user frustration in the quality of game emulation and provoked highly negative reaction as a result. Therefore, libraries must create reliable collection rules about ROMs, collecting from one region as much as possible to maintain internal consistency and all-around quality. Libraries will need this sort of consistency in their collection's ROM acquisition, inasmuch as these collections can be consistent - after all, one game system's library may often consist both NTSC and PAL exclusive games.

Posts in Superset H (Collection-Based Concerns) like Posts 142 and 122 (Examples 37 and 38, respectively) show that there is a definite coalition of people that already pay close attention to how software is represented in a library and archival setting. The users therein want adequate metadata and adequate representation for the software they care about. In emphasizing how they wanted to see bad uploads and bad metadata removed and altered, they wanted to avoid any inadvertent misinterpretation on the part of the eventual end-user. This is a responsibility that librarians and archivists already handle in a traditional setting with institutional materials.

Therefore, my second collection-oriented policy proposal is for libraries and archivists to jointly create and develop a standardized metadata schema for video games and software as a part of their collections. This is worth immediately investing in and creating, especially for those archives and libraries who insist on using emulation to represent video games as a cornerstone of their collections. We have seen software emulation present in both university archives and public library settings, and in the Internet Archive (Dietrich, et al., 2016). There is a need for standardization and consistency while software emulation is still seen as a novel advancement in library collections.

#### **D. Aesthetics and Technology**

Discussions of the PlayStation Classic in Supersets B (Games and Emulation) and Superset D (Microconsoles) also revealed that libraries and archives need to be aware of how important visual and interactive presentation of emulation systems are. While Sony likely expected the PlayStation Classic to yield lively discussion about its merits, it was instead roundly rejected as many gamers found the way it presented its emulated games to be a failure. Posts 480 and 498 (Examples 11 and 20, respectively) revealed that while the PlayStation Classic may have been aesthetically pleasing, its emulation was viewed as inferior to the original product, sometimes rendering the games unplayable in the familiar ways that gamers recognized. If libraries and archives were to replicate something like this - pleasing upon first glance but ultimately failing in emulation quality - it would be unsatisfactory for the end user and it would make the institution look incompetent.

Therefore, my policy proposal in this instance is that if it is necessary to create an in-house emulator, it must be both visually and aesthetically pleasing, on top of being able to render games or software well. This is a tall order, but doable; there are existing emulators with a long history of public use, after all. For librarians and



software developers in charge of creating methods and avenues of software emulation, this data presents a compelling argument that its visual and all-around presentation is central to its success, perhaps second only to the quality of the emulation itself. Efficient presentation means life or death for emulation as a practical tool for preservation in an archival setting.

#### **E. Legal Issues**

Another policy proposal is that, for libraries and archives who use software emulation, they must abide by legal licenses, especially if they use, adapt, or modify existing emulators that are freely available. Superset D (Microconsoles) also highlighted this as a significant issue associated with the PlayStation Classic. Post 1008 (Example 21) revealed that gamers are often aware of the frustrations that come along with an emulative experience - there are real-world issues of rights and material clearances that must be addressed, often affecting the quality of the finished product. Post 904 (Example 22) also contained suspicion that Sony would not abide by existing legal licenses, as the PlayStation Classic was adapted from a freely available, open-source emulator. For libraries and archives that want to protect their reputation of quality, these legal frameworks must be abided by and publicly respected.

The discussion found in Superset E (Legal Issues) also pointed to the necessity for the development of a legal framework that would protect users, as well as librarians and archivists, in discussions of emulation and emulated materials. Much of the discussion in this superset circled around how emulation is illegal - largely uninformed or learned from other, possibly uninformed sources. My associated policy proposal is that libraries and archives can use this opportunity to inform game playing audiences about how to emulate software legally, as they have done in the past (Dietrich et al., 2016).

Gamers will require a legal framework in which they can safely discuss emulation as a concept and as a practical tool without fear of repercussion. Given the positive nature of several quoted posts above (Examples 4, 5, 13, 18, 25, and 35, specifically), it is easy to see that gamers want to use emulation and want to play emulated games. However, Superset E (Legal Issues) shows that they want to do so legally and will often require reassurance that it is officially sanctioned. It is not impossible to imagine libraries and archives stepping in to provide an outlet for those curious to discuss it, especially as the Internet Archive currently offers emulated games as one of their services to the public, for free.

Superset F (Video Game Preservation) also contained discussion of digital rights management (DRM) technology as a problem in video game preservation (see Examples 29 and 30). By attempting to protect intellectual property through measures like continually performing checks for online connectivity, developers have impeded progress into video game preservation. This has been noted in the past by scholars, revealing a certain continuity in the attitudes of gamers and academics alike (Bachell & Barr, 2014, p. 155). Therefore, my policy recommendation is for libraries and archives to jointly develop legal preservation strategies, and petition Congress or the United States Copyright Office to create legal loopholes for video games and software, so that they may be preserved by non-profit entities like libraries or archives without necessarily endangering intellectual property (Barwick, et al., 2011, p. 385-387).

## **II. User Groups to Study**

Existing literature does not address user need and expectations, and further research is required. Potential user groups and audiences for collecting institutions to study in the future include:

### **A. Emulator Users in General**

First and foremost, it is important to study who exactly uses emulation and why they do. Many of the recommendations that follow will naturally require speaking with or interviewing video game players, emulation users, or those who want to preserve software including video games. Focus grouping and interviewing certain audiences would be beneficial to research, especially as many of the attitudes found above can seem unusual or one-of-a-kind. Researchers will need to personally address the users as to how they feel about their attitudes towards emulation, so that the platforms libraries and archives develop will be user-friendly and accommodate a wide variety of needs. This is what I have attempted to do in this study, but it requires further in-depth research beyond one web content analysis.

It would be useful to study exactly how gamers personally interpret and pick up on various elements of the emulative experience. This includes how they discern major and minor elements of the gameplay itself, as well as how gamers interpret differences between the original game and having it played through an emulator. It may be worth interviewing game players who actively use emulators as to why it is preferable over playing on an original system. As seen in the discussion of the game *Hey You, Pikachu!* in post 331 (Example 3), different audiences of gamers will find different elements of a given game important. These discussions showed that those who play games will critically examine emulators in unique and often unexpected ways, especially as the games they are familiar with change as they are routed through emulation.

Given posts found in Superset B (Games and Emulation), it is important to study how nostalgia plays a central role in emulation, both in the success of microconsoles and in the practice in general. Other posts in Superset C (Benefits of Emulation) reveal that it is worth examining what exactly people get out of the experience of

emulation in general, and what benefits are afforded to them by emulating software. Researchers should consider the discussion on those who emulate because it saves them money or gives them more physical space in their residences in posts 399 and 400 (Examples 15 and 16, respectively). This is an interesting concept to explore in a world which libraries and archives could provide emulation services for free to researchers. Perhaps rates of emulation adoption or development would change or be reduced if emulation were to become a more pronounced part of local civic institutions.

### **B. Users Who Abstain From Certain Games**

It is important to study the user groups made up of those who have refrained from playing certain games and are finally able to enjoy them once they are available on an emulative platform. This can include those who want to play region-exclusive games or those who were unable to play certain games because of their age at the time. It can include those who are physically disabled and unable to play games with a traditional controller, as evidenced by post 9 (Example 19). Only one poster was represented in the entire dataset who identified themselves as having a disruptive physical disability, but they are likely far from the only person who is physically unable to play video games were it not for emulation. As libraries pride themselves on being accessible in presenting their collections, these emulation platforms should not disregard physically disabled patrons who may rely on an institution's use of emulators in order to enjoy the material in their collections.

### **C. Paid vs. Free Emulation Users**

Scholars may want to study the attitudes of those who play emulators for free versus those who pay for emulators - for example, the gamers who purchased PlayStation Classic. It may be worth asking what they find important about the experience of purchasing an emulator and how paying for emulated games impacts

their behavior, as evidenced by posts 904 and 927 (Examples 22 and 23). For example, does putting a price tag on an emulator directly impact how an audience will receive it? Would such reactions differ in a library or archive setting, where using such emulators would presumably be at a financial advantage for patrons or researchers? One may find that these questions are highly relevant in a library setting where the use and advertisement of emulation is not necessarily based around profit motivation.

#### **D. Emulation Users in a Library Context**

These changes in user perception if emulation were to be available in a library are worth considering. Superset E (Legal Issues) inspired several questions worth asking. For example, would gamers' attitudes change if emulation was made legally viable through trusted repositories or through their local civic institutions? If libraries and archives had legal loopholes to preserve video games, how would players interpret copyright protection violation with regards to emulation? Would rates of piracy go down if the video game industry partnered with libraries and archives to make their older or out-of-print video games legally available to the public?

Finally, as prompted by discussions found in Superset H (Collection-Based Concerns), it is useful to examine the user groups that already use existing library resources that utilize software emulation. We know that given this superset, they have their own specific demands regarding metadata quality and media representation that may be totally unlike other gamers' needs. It would not be inappropriate to focus group users that meet this criterion if a library or archive wanted to start using emulation software in their collections.

### **III. Future Research Areas**

What follows is a short list of potential future research areas that libraries, archivists, and academics may want to pursue in the study of software emulation, video game preservation, and the field of video game theory.

#### **A. Emulation Development Funding**

Much of the discussion in Superset A (Emulator Creation and Development) noted the finances of emulation development. This is worth engaging with on a critical level, given both its popularity among gaming audiences, and now that emulation is now theoretically independently profitable for its developers. It is worth examining the economic models behind emulation, especially in the late 2010s as many have become independently funded through crowdfunding ventures like Patreon. The other side of the transaction - individual user interpretation of the finances of emulation - would be equally valid. Consider post 404 (Example 14) - the one poster who uses emulation as a form of economic boycott against what they saw as consumer-unfriendly business practices. Perhaps these discussions belong as a larger part of game studies or as part of a larger examination as to how the Internet has influenced content creators independently earning income outside of traditional game development.

#### **B. Significant Properties in Video Games**

Given the posts in Superset B (Games and Emulation), it is worth examining and developing a list of significant properties in games as determined by players, in both their original incarnations and in emulated versions. This may be an impossible task because of a potentially infinite length and, as seen in posts 629 and 630 (Examples 9 and 10, respectively), user interpretations are often contradictory and unusual. This was noted in the original CAMiLEON Project experiment from nearly two decades ago, where it was written that users often proposed properties they found significant

that were not expected in the authors' assumptive models (Hedstrom et al., 2006, p. 171).

### **C. Games as Aging Media**

Finally, game theorists and game developers may want to study what it means for games to “[age] pretty poorly”, to quote post 1017 (Example 22). Noted as a problem with the PlayStation Classic's immersive experience, librarians and archivists may be interested in this concept, especially if they insist on keeping games and software titles as central pieces of their collections. This concept goes hand-in-hand with the discussion of media curation and video games as seen in Posts 939 and 943 (Examples 31 and 32, respectively).

Prompted by the discussion in post 1035 (Example 28), it is worth creating and developing a list of content, games, and systems that have failed to be preserved. Given the wide variety of responses, as well as the highly targeted answers, it is obviously on the mind of those who play games. The question itself is valuable given the fact that video games are an aging form of media and are now of consideration in libraries and archives.

One of the duties archivists and video game preservationists will encounter will be determining how to curate video games in an educational and academic context, even if certain portions of their gameplay may offend modern gamers' sensibilities. If archives intend on preserving video games and presenting them to modern gaming audiences as works of art and modern pieces of our media landscape, there must be a framework in which games can be critically discussed as historic milestones. These posts present a continuing need for video game curators and video game preservationists, just as there are art curators, film preservationists, etc.

Software emulation in an archival setting has typically only been considered a far-future, hypothetical method of preservation, and so the needs and concerns of gamers have been historically neglected. The last significant scholarly work to examine the needs of gaming audiences who use emulation in an archival setting was published based on data that was collected nearly twenty years ago. This paper represents a necessary first corrective to that research gap. In trying to address such needs, future scholars and emulation software developers will need to keep in mind what gamers find important. As the medium of video gaming ages, preservationists will be necessary, and the success of their efforts depends on how users view their methods. It requires not just theorizing by archivists, librarians, and academics, but instead, thoughtful involvement between archivists, developers, and video gamers alike.



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