

# Preserving and Disseminating Emerging Forms of Digital Scholarship in Academic and Research Libraries: The EDS Report

By Anne Morrow & Tallie Casucci

Version 01.0  
November 22, 2019

<b>Preserving and Disseminating Emerging Forms of Digital Scholarship in Academic and Research Libraries: The EDS Report</b>	1
Acknowledgments	1
Introduction	2
Collection Development	8
Curation	10
Metadata	12
Archiving	16
Preservation	19
Resources	24
Bibliography	25
Definitions	31
About the Authors and Editor	31

## Acknowledgments

We wish to thank Ashley Sands, Ambra Gagliardi, Leah Donaldson, AJ Dimick, Roger Altizer, Jose Zagal, Bob Kessler, Ryan Bown, Gabe Olsen, Ashley Brown, Topher

Nadauld, Clayton Mann, Allyson Mower, Nancy Lombardo, Mark Durham, Rebekah Cummings, Kinza Masood, David Roh, Alberta Comer, Rick Anderson, Alfred Mowdood, Peter Kraus, Greg Hatch, Tawnya Keller, Jeremy Myntti, Brain McBride, Daureen Nesdill, and Chris Erickson for their support and generously sharing their wisdom and insight.

This publication was made possible in part by the Institute of Museum and Library Services ([LG-74-18-0111-18](#)). The views, findings, conclusions or recommendations expressed in this report do not necessarily represent those of the Institute of Museum and Library Services.

Este proyecto ha sido posible en parte por el Instituto de Servicios de Museos y Bibliotecas LG-74-18-0111-18.

The Institute of Museum and Library Services is the primary source of federal support for the nation's libraries and museums. We advance, support, and empower America's museums, libraries, and related organizations through grantmaking, research, and policy development. Our vision is a nation where museums and libraries work together to transform the lives of individuals and communities. To learn more, visit [www.ims.gov](http://www.ims.gov) and follow us on [Facebook](#) and [Twitter](#).



This is an open access publication [hosted](#), archived, and maintained by J. Willard Marriott Library, University of Utah, Salt Lake City, Utah.

We welcome your feedback, comments, and suggestions.  
— Anne and Tallie

## Introduction

### Project background

Our report is based on an effort to develop an archival and preservation strategy for scholarship generated by students in the Entertainment Arts and Engineering (EAE) program at the University of Utah. EAE is an interdisciplinary game development program that draws students from visual arts, engineering, computer science, and business. Students in the program focus on Game Arts, Game Engineering, and Game Production. In 2019, the EAE program was ranked #4 for both its graduate and undergraduate programs by the [Princeton Review](#).

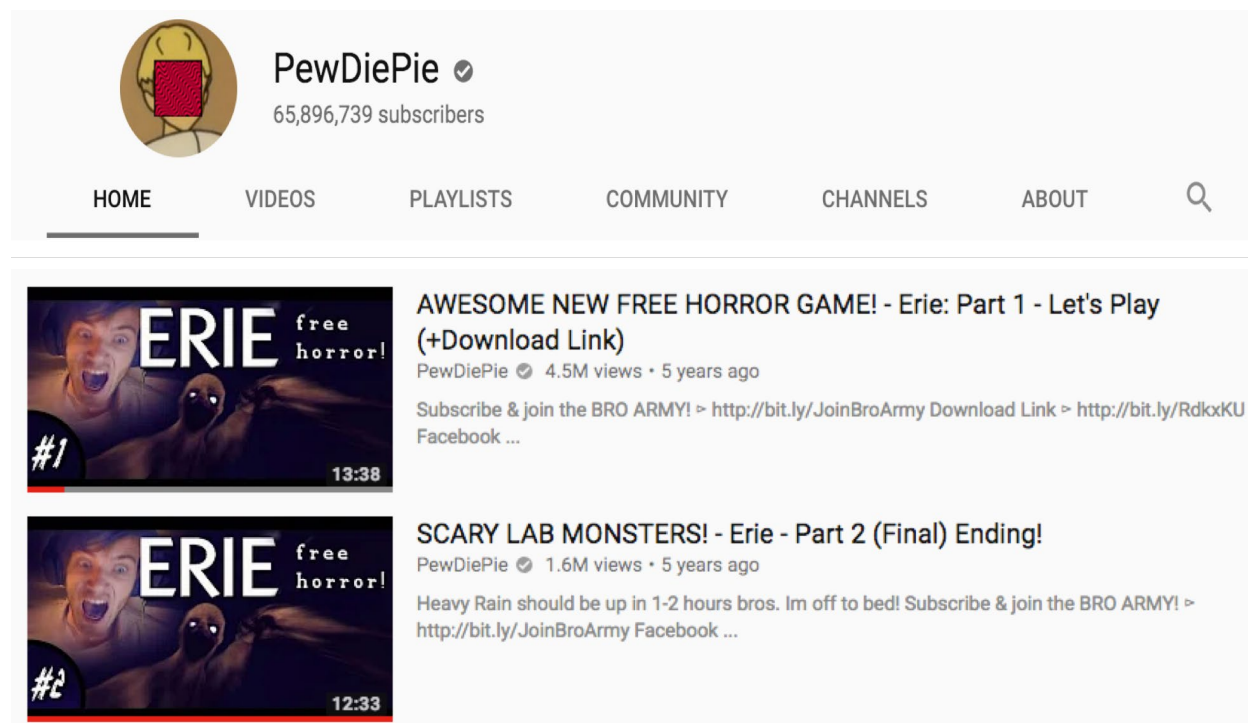
Despite EAE's success since the program launched in 2008, EAE is experiencing a preservation crisis. There is not an archival or preservation strategy for the video games produced by EAE students.

We first became aware of EAE's preservation crisis in 2015, when a group of librarians met with Jose Zagal, PhD, a faculty member in the EAE program. Zagal identified types of program support for us to explore, from developing collections of contemporary and legacy games to support their curriculum, to archiving and preserving video games produced by EAE students.

*We currently struggle with how to best archive, preserve, and disseminate the video game thesis projects our students develop. It is my understanding that similar programs across the nation face the same issues. The findings and results of this research project will be invaluable not only to us, but to our colleagues in game studies more broadly."*

*-- Jose Zagal*

To illustrate the archival crisis, Zagal told the story of Erie, one of the earliest games produced by EAE students. Today Erie cannot be played. The few remnants that remain are a handful of Youtube video recordings of Erie's gameplay. In 2012 the well-known vlogger, PewDiePie, posted two 'walkthrough' videos of himself playing Erie. PewDiePie's videos of Erie, [Part one](#) and [Part two](#), have been viewed over 6 million times.



The screenshot shows the YouTube channel page for PewDiePie, who has 65,896,739 subscribers. The navigation bar includes HOME, VIDEOS, PLAYLISTS, COMMUNITY, CHANNELS, ABOUT, and a search icon. Two videos are displayed:

- Video 1:** "AWESOME NEW FREE HORROR GAME! - Erie: Part 1 - Let's Play (+Download Link)". It has 4.5M views and was posted 5 years ago. The description includes links to join the BRO ARMY and a download link.
- Video 2:** "SCARY LAB MONSTERS! - Erie - Part 2 (Final) Ending!". It has 1.6M views and was posted 5 years ago. The description includes a message about heavy rain and a link to join the BRO ARMY.

Because Erie's dependent and executable files are no longer available, it is not possible to migrate Erie to today's platforms. As a result of being one of its earliest games, and due to the extraordinary popularity Erie enjoyed on Youtube, Erie is regarded as EAE's flagship game. Today Erie remains marooned on an obsolete operating platform.

The plight of Erie is representative of the preservation crisis facing higher education programs that are at the forefront of digital scholarship creation. Digital scholarship works have unique archival and preservation needs that frequently fall outside of the expertise of the content creators' program or department. In a recent scan of peer game programs at similar institutions,

we were unable to locate an archiving and preservation plan for game scholarship, nor was game scholarship represented in the institutional repositories or library collections of their institutions.

As for the authors of this report, one of us serves as a liaison to the EAE program, and the other author has responsibilities that involve maintaining the institutional repository, Uspace. It is our responsibility to examine how the library might be able to expand support for the EAE program to archive and preserve students' scholarship.

In 2016, we began by working with our grants officer to identify potential funding opportunities and sought out the expertise of librarians, specifically the Research Data librarian and Digital Preservation archivist. We also consulted with EAE faculty, staff, students, and alumni. Based on the information we'd gathered, we drafted a project proposal to use the scholarship of EAE as a basis for delivering recommendations to libraries and archives on how to integrate video game scholarship, and, by extension, emerging forms of digital scholarship, into libraries and archives. In the spring of 2018, we were awarded a year-long IMLS Sparks grant in the area of National Digital Platform to conduct this research. This report contains recommendations, based on the outcomes of our research.

## **Digital Preservation: A (very) brief history**

In their 1992 article, *Scholarly Communication and Information Technology: Exploring the impact of changes in the research process on archives*, Michelson and Rothenberg focused on the impact of information technology on scholarly communications, noting technology was "prompting transformations in scholarly practice" and "new scholarly methods will demand innovative services and responses from the archival community" (Michelson and Rothenberg, p.238). As technology became further interwoven both culturally and within academia, the dilemma over how to sustainably preserve digital works had become an area of increasing concern for scholars, archivists, librarians, and digital preservationists. Michelson and Rothenberg's article brought attention to the immediacy of the digital preservation problem at that tie: researchers were producing scholarly works that, due to their digital form, had unique preservation challenges.

In 1999, Rothenberg published a second article on digital scholarship, this time focusing on the preservation of born-digital scholarship. Rothenberg suggested that any proposed solution "not require continual heroic effort or repeated invention of new approaches every time formats, software, or hardware paradigms, document types, or record keeping practices change" (Rothenberg, p. v). In contrast to Rothenberg's recommendations, the preservation of digital content opened up an ever-expanding market of opportunities for developers and vendors. As far as digital preservation has come since emerging as a topic of research focus some thirty-plus years ago, we are in some sense very much in the same position. In Cain's 2003 article, *Being a Library of Record in a Digital Age*, Cain recounts attending a meeting of the Council on Library Resources in the 1990s. One of the participants, Jim Haas, had brought up the emerging digital preservation crises libraries faced, Cain observed: "Even back then, the

members were well aware of the rapid obsolescence of information technologies... eighteen years have past and we have realized that the issues are more complex.”

In 2009, Lowood et al. published a white paper that focused on preserving video games. Lowood et al. presented an argument, directed at the industry of commercial game production, that advocated for the preservation of commercial games based on their cultural significance. The preservation risks for video games are formidable; they include media decay, or, bit rot, and the obsolescence of media formats that were employed within the development and production of a video game. Lowood et al. argued the cultural, historical, intellectual property, design form, artform, and entertainment forms video games represented were essential for us to archive to understand and interpret video games in the future.

The 2010 report *Preserving Virtual Worlds (PVW)*, is a nearly 200-page report introducing challenges that arise in preserving and archiving digital works. PVW's authors comprehensively examined the digital preservation landscape at that time and set forth recommendations for how to archive and preserve digital works. PVW's authors included video games among the types of digital objects to preserve. Video game preservation should by necessity include preservation of the game experience, to the extent possible, through emulation, migration, visualization, and other forms of re-enactment. The entire point of preserving the object's files and complex file relationships was to preserve access to the gameplay. While PVW has shed light on technical, legal, and logistical challenges of preserving video games, they were constrained by the fact that there were legal limitations on what preservation interventions could be taken on a commercial game without violating trademark and copyrights.

*There are all kinds of layers to (video game) software, relating to other kinds of software. It's a very complex multimedia object. So, one argument can be made for tackling digital game preservation is - to put it bluntly - if you can solve that problem, you can probably solve any other digital preservation problem. It's that complex. - Henry Lowood (Enis, p.44)*

While PVW and others have helped us to understand the technical, legal, and logistical challenges of preserving video games, they were constrained from taking action in part because they were focusing on commercial video games. The legal limitations on commercial games make it impossible to preserve and archive a video game and elements which Lowood et al. would regard as essential to the archival record. In a 2013 article, *Saving Games*, Enis wrote about the challenges of preserving video games. For the article, Enis interviewed experts in video game archiving, among them Jon-Paul Dyson, founder of the [Strong National Museum of Play](#). Dyson described video games as digital preservation's “canary in a coal mine,” because the challenges faced in preserving video games would better-illuminate the challenge of preserving a range of digital objects of lesser complexity. Video games, as an example of a complex digital object, are exactly managed by an executable file. For the video game to function as intended, the relationship between its dependent and executable files must be maintained; in addition to maintaining the video game's reliance on software, hardware, and peripherals. Enis also interviewed Henry Lowood, a curator with Stanford University Libraries, who described video games as “a form of multimedia, and almost every other digital media you

can imagine is embedded in [video] games... [there are also] all kinds of layers to the software, relating to other kinds of software..." (Enis, p.44).

Game producers have not shown much interest in developing a preservation strategy for their games. In an article on the record-keeping and archiving practices of indie game developers in the UK, the authors found there was little interest in proactively addressing video game preservation (Bachell and Barr, 2014). The role of librarians, archivists, and preservationists in this context is archiving the video game and its supporting documentation in a manner in which "archival documentation reveals, among many other elements of humanity, the thought, time, innovation, toil, and inspiration that go into the making of [video] games" (Lowood, p.5). Preserving a game, to Lowood et al., meant collecting and curating design documents, artwork, versions (from prototype to patches, sequels, and mods), source code, assets, tools, binary executables, gameplay recordings, development documentation, marketing materials, press kits, demos, and source materials.

Researchers continue to grapple with long-term preservation of digital content, particularly digital content that is multi-faceted, composed of multiple file types, and reliant on native operating environments in order to function as intended. Over the nearly thirty-year investment of research and development effort to preserve digital content, the remedies which currently exist do not adequately address complex digital objects like video games. In this report we focus on actionable methods of supporting complex digital object preservation; to that end, we've strived to develop recommendations that are broadly relevant to the established practices in most libraries.

## **Our Recommendations**

The recommendations we offer in this report are based on conversations and consultations with faculty and staff in both the EAE program and libraries. Additionally, we conducted a sweeping literature review that spanned over three decades' worth of publications on digital preservation in general and video game preservation in particular.

The recommendations are divided into five chapters: collection development, curation, metadata, archiving, and preservation. Our goal for the recommendations was, first and foremost, that they address known preservation and archiving barriers and that they represent realistic, achievable, and implementable guidelines for libraries.

The chapter on collection development suggests additional ways in which library services and the EAE program can more fully support student-authored video games.

The chapter on curation examines the significance of ephemera in creating an archival record for a video game.

The chapter on metadata focuses on the student community and the importance of including gaming terminology in the keywords and descriptions of EAE video games.

In the chapter on archiving we suggest modifications to the Open Archival Information System (OAIS) framework to more practically address video game archiving.

In the chapter on preservation, we focus on decentralizing the preservation of video games, seeking to explore community-driven solutions for their preservation.

## Recommended Readings

- Bachell, A., & Barr, M. (2014). Video game preservation in the UK: a survey of records management practices. *International Journal of Digital Curation*, 9(2). doi:<https://doi.org/10.2218/ijdc.v9i2.294>
- Barwick, J., Dearnley, J. A., & Muir, A. (2008). *The barriers to the preservation of digital games: questions on cultural significance*. Paper presented at the DOCAM. <https://dspace.lboro.ac.uk/2134/4988>
- Cain, M. (2003). Being a library of record in a digital age. *Journal of Academic Librarianship*, 29(6), 405-410. doi:10.1016/j.jal.2003.08.007
- Enis, M. (2013). Saving games. *Library Journal*, 138(17), 44-47.
- Lowood, H., Armstrong, A., Monnens, D., Vowell, Z., Ruggill, J., McAllister, K., . . . Pinchbeck, D. (2009). *Before it's too late: Preserving games across the industry /academia divide*. Paper presented at the Breaking New Ground: Innovation in Games, Play, Practice and Theory - Proceedings of DiGRA 2009.
- McDonough, J. P., Olendorf, R., Kirschenbaum, M., Kraus, K., Reside, D., Donahue, R., . . . Rojo, S. (2010). *Preserving virtual worlds final report*. Retrieved from <http://hdl.handle.net/2142/17097>
- Michelson, A. & Rothenberg, J. (1992) Scholarly Communication and Information Technology: Exploring the impact of changes in the research process on archives. *The American Archivist*, 55(2), 236-315.
- Neal, J. G. (2015). Preserving the Born-Digital Record. *American Libraries*, 46, 30-33.
- Pinchbeck, D. (2014). Standing on the shoulders of heavily armed giants -- why history matters for game development. In J. Delve (Ed.), *Preserving Complex Digital Objects* (pp. 3-12): Facet Publishing.
- Rothenberg, J. (1999). *Avoiding Technological Quicksand: Finding a Viable Technical Foundation for Digital Preservation. A Report to the Council on Library and Information Resources*. Retrieved from <https://eric.ed.gov/?id=ED426715>

Ruan, J., & McDonough, J. P. (2009). *Preserving born-digital cultural heritage in virtual world*. Paper presented at the ITME2009 - Proceedings 2009 IEEE International Symposium on IT in Medicine and Education.

## Collection Development

### Recommendations

- Provide authors customizable options in the archival agreement form concerning their archival plan, copyright, and access
- Develop educational modules to support authors' decision-making
- Work with the program to integrate the archival agreement form into an assignment

### Practical Reasoning

#### Archival Agreement

EAE students own their intellectual property and they decide what the library collects and archives. The thesis game collection is completely student-driven. By offering a comprehensive archiving agreement ingest form, we present options concerning what the library records, archives, preserves, and communicates. The EAE faculty recommended and supported this tiered system of customization. This form can be found at:

<http://campusguides.lib.utah.edu/eae/archive>.

To facilitate the decision-making process, and align a video game to the appropriate archival and preservation services, we modified the standard publishing permission form into tiers of access the library is able to support. Students have the choice to opt out of allowing the library to archive and preserve their game, and we would retain a record of their decision (which they may reverse in the future, if they choose).

Tiers of access, archiving, and preservation are delineated by degrees. Starting from the option "do nothing", student-authors may choose to make only some video game materials available. They would be responsible for gathering those materials and handing them off to the library using the campus cloud-hosting service, UBox. Institutional repository staff will create a record for the contributed materials that includes contributed metadata, descriptive and technical metadata, a copyright statement, and relevant keywords.

Copyright has been a major obstacle for the preservation of commercial video games. In a campus setting, however, there is the opportunity to work with the student-authors to craft an access, archiving, and preservation plan for their video game. Because students retain the rights to their intellectual property, student-authors of video games collectively hold the rights to their game. Providing copyright support to the students is an important activity for embedded librarians.

Students also have the option to embargo some or all of the components of their video game, or to limit access to some or all of their video game to campus IP address. Provided there is some level of approved access to the video game, or content related to the work, we'll provide the corresponding level of archival and digital preservation measures. Where no level of access is permitted, the library will not perform archival or digital preservation measures, retaining only a record of the student-authors' signed permission form.

Within this archival agreement form, we list the archival significance and what exactly the library does for each tier. This is important because it shows how the library plans to present and connect the various materials. For example, the institutional repository will include, among its collections, a collection for EAE student-created video games. The display record in the institutional repository will be a multipage PDF of still images, author-created documentation and other text and image-based materials submitted by the authors. Media will be archived separately and linked to in the metadata record. Where provided by authors, institutional repository metadata will include link(s) to sites and queries relevant to the video game. Also, students frequently put their video games on Steam (<https://store.steampowered.com/>), so the library will include links to the video game on Steam, or similar services.

## **Education**

To support student education about crucial elements of the archival agreement form, we created on-demand, self-paced, asynchronous modules in Canvas, our learning management system. Fortunately, Educopia Institute created the Electronic Theses and Dissertation (ETD) Plus. This ETDplus toolkit includes instructor notes, PowerPoints, YouTube videos, and guidance briefs. Leveraging this existing resource, we created 7 modules:

- Module 1: Background
- Module 2: Copyright
- Module 3: Data organization
- Module 4: File Formats
- Module 5: Metadata
- Module 6: Storage
- Module 7: Version Control

Each module includes learning objectives, an introduction (generally brief text followed by an embedded Educopia ETDplus video), and a final knowledge check. The knowledge check included questions about the module's content and a reflection. These modules are licensed under CC Attribution Non Commercial Share Alike.

## **Securing Items**

The EAE faculty posted the archival agreement form as an assignment in the Capstone class' Canvas course. We provided the faculty with a brief introduction to the new "assignment" and offered special drop-in office hours during the last week of school to help the student-authors.

Since the students create thesis games, the thesis office does not work with the program since there's "nothing" to collect, from the thesis office's viewpoint. (Most ETDs are directed to the

library from the thesis office.) By working with the capstone faculty, we can ensure the students are introduced to the archival form. Next year, we hope to briefly present in the capstone class, so we can review the project and form with the students.

### **Recommended Readings:**

Educopia Institute. (2017). Electronic Theses and Dissertation (ETD) Plus. Retrieved from <https://educopia.org/electronic-theses-and-dissertation-etd-plus/>

Nilson, L. (2016). Teaching at its Best: A research-based resource for college instructors (Fourth edition). San Francisco, California: Jossey-Bass.

## **Curation**

### **Recommendations**

- Representative content in the form of walkthroughs, let's plays, still images, and marketing materials (i.e. ephemera) have high archival value
- Seek to widely-curate the footprint of a video game from its development through to its launch

### **Practical Reasoning**

Representations can never fully express the many trajectories that any one player could experience in playing a video game. When we envision reaching the goal of having digitally preserved a video game, it is that the video game, above all else, is capable of being played.

A video game is a cohesive object, with a host of operational and environmental dependencies, an activity, and an immersive individualized experience. There is an inherent duality to video games, they are both an object and an activity. Nylund describes video games as "complex things... made of information that will not last" and asks "Are we supposed to save playable games or the act and context of playing these games?" (Nylund, p.55).

In Abbott, Jones, and Ross' 2009 article on digital performing arts, they highlight the importance of curating representations of performance despite the fact they "are often discounted as inadequate and unfaithful...[and] offer a very narrow perspective" (Abbott, Jones, & Ross, 2009). They argue it is important to "multiply rather than close down the points of access...by creating and curating records of different kinds" (ibid). The more representations that can be gathered, the richer and more nuanced a representation of the original emerges.

Nylund encourages us to consider gathering recordings of gameplay, known as 'walkthroughs' and 'Let's Plays', as an "intrinsically gamist" method of video game curation. While the value of representative images of gameplay, and footage of walkthroughs, and Let's Plays, are no match for the actual gameplay experience, they do provide valuable contextual information about the gameplay.

Curating images of a video game, as well as walkthroughs and Let's plays of gameplay, are part of a proactive preservation strategy to memorialize, if not one day more fully support any rebuilding effort. The representations of a video game serve a role in characterizing, defining, and describing the video game. To overlook the archival value of representations of gameplay would be a disservice both to potential and actual communities of video game content users.

Each semester EAE hosts an Open House to showcase the students' games. Thesis games are shown at multiple Open Houses, which provides us the opportunity to collect development footage (i.e. photos or videos of gameplay at the Open House). Additionally, the capstone faculty will play thesis games throughout their development and stream them on Twitch (if the students allow them). The recordings of the faculty playing and providing feedback about the thesis game can be another venue of portraying the development process of a thesis game. This development-related scholarship may be useful for future students and researchers.

## Value of Curation

The value proposition for curating, archiving, and preserving EAE's video games varies, depending on the stakeholder:

- For student authors it is having their original works recorded, catalogued, archived, and preserved; discoverable to the extent they wish it to be shared.
- For the EAE program, the value is in having the output of the program integrated into library collections and archives, that it may not only attract future students, but memorialize the work of past students.
- For our library and institutional repository, the value is in having scholarship produced on campus represented in library collections, archives, and repositories.
- For the University, the value lies in the evidence of scholarship generated within the university is cataloged, organized, accessible, and disseminated.
- For future researchers, the value is in providing a multitude of opportunities to access and examine video game materials critically and analytically.
- For the public and Public Good, it is access to what was deemed worth saving, especially content that is rare, unique, and of cultural and historical value.

## Recommended Readings

Abbott, D., Jones, S., & Ross, S. (2008). Theoretical Discussions on Digital Representations of Performance. *Capturing the Essence of Performance: The Challenges of Intangible Heritage*, 81-88.

Boss, K., & Broussard, M. (2017). Challenges of archiving and preserving born-digital news applications. *IFLA Journal*, 43(2), 150-157. doi:10.1177/0340035216686355

Boutard, G. (2015). Towards mixed methods digital curation: facing specific adaptation in the artistic domain. *Archival Science*, 15(2), 1769-1189.

- Broussard, M. (2015). Preserving news apps present huge challenges. *Newspaper Research Journal*, 36(3), 299-313. doi:10.1177/0739532915600742
- Chassanoff, A. (2017). Building a model for software curation: an introductory post. Retrieved from <https://informatics.mit.edu/blog/guest-post-alex-chassanoff-software-curation>
- Nylund, N. (2015). *Walkthrough and Let's play: Evaluating preservation methods for digital games*. Paper presented at the ACADEMICMINDTREK 2015 - Proceedings of the 19th International Academic Mindtrek Conference.
- Rinehart, R. (2007). The Media Art Notation System: Documenting and Preserving Digital/Media Art. *Leonardo*, 40(2), 181-187. doi:10.1162/leon.2007.40.2.181
- Sköld, O. (2018). Understanding the “expanded notion” of videogames as archival objects: A review of priorities, methods, and conceptions. *Journal of the Association for Information Science and Technology*, 69(1), 134-145. doi:10.1002/asi.23875

## Metadata

### Recommendations

- Metadata Is Not Done In Isolation. The Student-Authors Can And Should Provide The Library With Information About Their Work, Which Can Be The Basis For The Metadata.
- Ask student-authors for keywords concerning specific game elements, technical information, etc.

*Disclaimer: I am not a metadata librarian. I approach metadata from a patron's perspective: Can I find the thing I'm looking for? Is there a useful description?*

### Practical Reasoning

Before beginning this project, we knew that we wanted the student-authors to contribute to the metadata. Practically, this would: 1.) give the cataloger a starting point, 2.) “decolonize” our collections, 3.) educate students about metadata and give them time to reflect on their game, and 4.) recognize that video games are constantly changing.

First, author-provided metadata would give the cataloger a starting point. We did not want to further burden the library's cataloger at this time. Without the author-provided metadata, the cataloger would need to play the game, which may require game engines and/or specific software to actually run the game. Additionally, a library cataloger may not have video game experience or knowledge to accurately describe the video game within the greater field's context and the games' influences. Right now, we want to secure the materials and some descriptions for them. The technology and time hurdles would drastically slow the process for the cataloger. In the future, we hope that the cataloger and metadata librarians could use this as a research

opportunity: How accurate is the author-provided metadata? What standardize metadata can and should be applied? Does this method of collecting author-provided metadata produce accurate descriptions for future users? Existing studies have demonstrated that author-provided keywords complement subject headings; however, STEM students tend to provide fewer keywords (Maurer and Shakeri 2016). By providing a very specific framework for requesting metadata, can we increase STEM author keywords?

Within the library and information science field, there's been a recent trend to "decolonize" collections and give voice to the creators and subjects presented in collections. Author-provided metadata is a simple way to give voice to the authors. EAE is one of the most diverse programs on-campus. Furthermore, by allowing the actual authors to describe the game, it would make the collection extremely unique. Libraries must cultivate unique collections, that would otherwise be inaccessible. In the future, researchers could analyze the changes in language, terms, etc. that the students use to describe their works.

Our third reason was that the students will learn about the basics of metadata. The student-authors must self-reflect and think critically about their game. By completing the archival form's metadata section, the students consider how their game fits within the existing games fields, but is also unique. What words describe it best?

Finally, we can't capture future games in what we know now. Author-provided metadata would allow for flexibility for this growing field.

## **Development of the Metadata**

First, we reviewed existing literature on video game collections, metadata, and controlled vocabularies. While reading these articles, we considered their relationship to the EAE students' thesis games and other final game projects. Jin Ha Lee and colleagues created and tested several schemas and controlled vocabulary terms for commercial video games. The OLAC working group created a best practices document for cataloging video game metadata and genre vocabulary. Finally, the IMLS-supported GAMECIP project presented controlled vocabularies for computer games. Combining the work of these three groups, we created our author-provided metadata table in part 4 of the archival agreement form.

Our project was different compared to the existing video game metadata and controlled vocabulary work because all our content was student-created video games. Unlike many commercial games, thesis games tend to break across genres, themes, and aesthetics. We did not want to be restrictive to future development that may not be represented in current schemas. For example, one thesis team made a 4D game last year and an entire cohort of EAE students created games using alternative controllers. These student-created video games are unique and not necessarily represented in large commercial games. Due to the uniqueness and novelty of student-created video games, we did not propose a controlled vocabulary of keywords for students. Instead of providing indexing options for the students, we left the sections blank for the students to decide their genres, visual styles, etc. Most of these metadata fields are not part of the cataloging records, but we still wanted to ask for the information. For

example, the type of game-ending could be added to the description of the game. By requesting a lot of information from the students, the catalogers would have more information about the game.

Second, we shared the archival form with the EAE Library Advisory Taskforce for their review. For the metadata section, we asked them:

- The fields listed are common metadata fields for video games and other digital content. As game experts and creators, are we missing anything?
- Do the fields make sense? Are more definitions needed?

We received feedback from three members and only one mentioned the metadata section. They suggested combining the basic and technical metadata sections into one large table. We agreed with their suggestion and requested all metadata from the student-authors.

## Metadata Fields on the Archival Agreement Form

We requested the following information in our archival form from the student-authors. The information in the square brackets is just information for readers of this report.

- Title
- Alternative Title [Teams frequently change the name of their game or have an abbreviated title.]
- Edition
- Format – Distribution medium or method
- Platform
- Developer [Student teams usually form LLCs.]
- Distributer
- Release Date
- Official Website
- Game Engine
- Programming Language
- Special Hardware
- Online Capabilities
- System Requirements
- Number of Players
- Target Audience
- Awards/Recognition
- Genre
- Summary/Purpose
- Setting – Location, time-frame, cultural context, etc.
- Point of View – Perspective from which player experiences gameplay: first-person, third-person, etc.
- Dimension – Intended perception of the depth: 2D, 3D, etc.
- Pacing – Methods by which time passes or events take place: real-time, turn-based, etc.
- Estimated time of completion – Average time to complete game
- Visual Style – Predominant and recognizable visual appearance
- Artistic Techniques – Tools used to create the “look”

- Mood – Pervading atmosphere or tone the game evokes or recalls a certain mood or state of mind
- Type of Ending – Characteristics describing how the game ends and/or postgame content

## Recommended Readings

- Clarke, R. I., Lee, J. H., & Clark, N. (2017). Why Video Game Genres Fail: A Classificatory Analysis. *Games and Culture*, 12(5), 445–465.
- Donovan, A., Cho, H., Magnifico, C., & Lee, J. H. (2013). Pretty as a pixel: Issues and challenges in developing a controlled vocabulary for video game visual styles. Paper presented at the Proceedings of the 13th ACM/IEEE-CS joint conference on Digital libraries.
- Game Metadata and Citation Project (GAMECIP). (2019). GAMECIP. Retrieved from <https://gamecip.soe.ucsc.edu/>
- Lee, J. H., Cho, H., Fox, V., & Perti, A. (2013). User-centered approach in creating a metadata schema for video games and interactive media. Paper presented at the Proceedings of the 13th ACM/IEEE-CS joint conference on Digital libraries, Indianapolis, Indiana, USA.
- Lee, J. H., Clarke, R. I., & Perti, A. (2015). Empirical evaluation of metadata for video games and interactive media. *Journal of the Association for Information Science and Technology*, 66(12), 2609-2625.
- Lee, J. H., Tennis, J. T., Clarke, R. I., & Carpenter, M. (2013). Developing a video game metadata schema for the Seattle Interactive Media Museum. *International journal on digital libraries*, 13(2), 105-117.
- Maurer, M. B., & Shakeri, S. (2016). Disciplinary differences: LCSH and keyword assignment for ETDs from different disciplines. *Cataloging & Classification Quarterly*, 54(4), 213-243.
- Online Audiovisual Catalogers, Inc. (2019). OLAC Video Game Vocabulary. Retrieved from <https://olacinc.org/olac-video-game-vocabulary>
- Online Audiovisual Catalogers, Inc., Cataloging Policy Committee, Video Game RDA Best Practices Task Force. (April 2018). Best Practices for Cataloging Video Games Using RDA and MARC21, version 1.1. [PDF File]. Retrieved from: <https://olacinc.org/sites/default/files/Video%20Game%20Best%20Practices-April-2018%20Revision-a.pdf>
- Schwing, T., McCutcheon, S., & Maurer, M. B. (2012). Uniqueness matters: Author-supplied keywords and LCSH in the library catalog. *Cataloging & Classification Quarterly*, 50(8), 903-928.
- Strader, C. R. (2009). Author-assigned keywords versus library of congress subject headings: Implications for the cataloging of electronic theses and dissertations. *Library Resources & Technical Services*, 53(4), 243-250.

# Archiving

## Recommendations

- Use OAIS as a framework for video game archiving
- Cultivate a Designated Community specific to local video games
- Create a closed repository for Significant Properties

## Practical Reasoning

Establishing a resilient framework to guide the archiving and preservation of digital objects continues to challenge librarians; moreover, applying that framework to video games introduces additional challenges.

### Open Archival Information System (OAIS)

Introduced in 1997 as a framework for archival processes of collecting, archiving, and preserving digital objects, Open Archival Information System, or OAIS, was developed by the Consultative Committee for Space Data Systems (CCSDS) to serve as an abstract model for the stakeholder interactions with digital content. The logic of the OAIS structure brings together the primary stakeholders for digital content: producers, archivists, preservationists, librarians, and the community making use of the content, to serve in specific roles designed to distribute the archival and preservation responsibilities across a broader community of users and information professionals. Digital content is contributed by producers, placed in an *archival information package*, or AIP, by library professionals. Each of the stakeholders have a clearly defined role in OAIS, related to submitting materials, collecting content, packaging information, and providing support to the user community of today and tomorrow.

The OAIS structure functions to bring content producers, information archivists, and preservationists, and content users together in forming a concept of what the contents of an AIP ought to contain. The required conditions and characteristics of the collection are re-evaluated on an on-going basis as a means of ensuring relevance and continuity of access to the digital object and supporting materials. Librarians work with producer and user communities to define the characteristics, qualities, and properties of an AIP that will preserve future access to the content.

For the content to be useful in the future, there needs to be information about its properties, specifications, operating systems, etc. An AIP needs to contain all of the information necessary to access and use the content it holds. For video games and other multi-file multi-format works, the amount of documentation that would be required to satisfy this expectation is enormous.

While OAIS provides a solid structure for stakeholders to interact, OAIS is not without issues. Chiefly, those issues have to do with the designated community and significant properties elements of OAIS.

Designated Communities, as defined in the OAIS framework, are communities of current, future, and potential content users. Designated Communities serve an important role in determining what content has archival value, who the primary audience is (both currently and in the future), and the tools, skill-sets, and materials that are needed to use the content. Bettivia has suggested Designated Communities address a single type of digital collection or type of digital object rather than addressing a group of collections or variety of objects, as “different people want to save different things” (Bettiva, 2016, p.4). The most effective Designated Communities are those where “significance is situational [and] depends on the audience and their relationship to the digital object” (Bettiva, 2016, p.3).

Designated communities are frequently mistaken as representing actual users, when instead they “might encompass... some actual users, it by no means pretends to be a stand-in for all users more generally.” Designated Communities, writes Bettivia, “are bound together with the assumption of preservation for someone rather than preservation of something” (Bettiva, 2016, p.1). We need EAE students, staff, and faculty to help us develop policies that answer the question: “Who will be using the content in the future, and what will they need to use it?”

The Designated Community dictates the relevant properties of an AIP. Called *Significant Properties*, these documents (technical specifications, user manuals, etc.) are deemed vital to ensuring access and utility to the primary audience for the content. The volume of documentation for programs, platforms, peripherals, and more, that would be required of a video game AIP to satisfy the significant properties requirement is extensive. Significant properties can instead be collected, cataloged, and maintained in a closed repository.

### **Using OAIS for EAE games**

OAIS, as McDonough had put it, is “an awkward fit” for digital objects like video games. Creating an OAIS-compliant AIP for a video game easily gets hamstrung on the mechanics, it becomes a systems, vendors, and products question. An ideal system for archiving video games using AIPs was an open question in 2011 and remains an open question today. Just as a Designated Community is in some important ways an amorphous and open-ended body, so too is how we can think of an AIP’s container. Working with the resources available to us today and within current practices, archival content will be dispersed across several sectors of the library.

The container for the AIP will be its record in the institutional repository (IR). The IR record will link to and redirect searchers to elements of archival content both internal and external to the library. The IR record will display or link to shareable content, descriptive metadata, significant properties metadata, and provide avenues to access a copy of circulating game files.

OAIS has been widely discussed and frequently criticized for promoting standards that are ambiguous and difficult to translate into practice. This is partly because OAIS was not meant to be a rigid framework. OAIS, as Schumann and Recker put it, is "an abstract and highly generic conceptualization of a preservation and dissemination environment" (Schumann and Recker, p.7). Creating the environment envisioned in an OAIS model requires the interaction of an archive, the management of that archive, the content producers, and the consumers of that content.

Librarians and archivists structure an AIP based on what the designated community has agreed is necessary. Student-authors seeking to have their video game archived and preserved submit their wrap kit, metadata, and other content related to the game. Using the metadata provided by the student-authors, librarians can help with the completion of the AIP by collecting technical information and specifications in the form of user manuals and product literature. We propose, rather than adding this large volume of literature to the AIP, to instead create a Significant Properties Archive that contains technical documentation. Repository managers can distribute the content it contains upon request.

## Recommended Readings

Bettivia, R. S. (2015). Mapping significance properties in OAIS: A case study with video games extended poster abstract. *Proceedings of the Association for Information Science and Technology*, 52(1), 1-4. doi:10.1002/pr2.2015.1450520100136

Bettivia, R. S. (2016). The power of imaginary users: Designated communities in the OAIS reference model. *Proceedings of the Association for Information Science and Technology*, 53(1), 1-9. doi:10.1002/pr2.2016.14505301038

Decker, A., Egert, C., Phelps, A., & McDonough, J. P. (2012). *Technical properties of play a technical analysis of significant properties for video game preservation*. Paper presented at the 4th International IEEE Consumer Electronic Society - Games Innovation Conference, IGiC 2012.

McDonough, J. P. (2011). Packaging videogames for long-term preservation: Integrating FRBR and the OAIS reference model. *Journal of the American Society for Information Science and Technology*, 62(1), 171-184. doi:10.1002/asi.21412

McDonough, J. P. (2012). *'Knee-deep in the data': Practical problems in applying the OAIS Reference Model to the preservation of computer games*. Paper presented at the Proceedings of the Annual Hawaii International Conference on System Sciences.

Schumann, N., & Recker, A. (2013) De-mystifying OAIS compliance: Benefits and challenges of mapping the OAIS reference model to the GESIS Data Archive. *Iassist Quarterly*, 2013.

Sköld, O. (2018). Understanding the “expanded notion” of videogames as archival objects: A review of priorities, methods, and conceptions. *Journal of the Association for Information Science and Technology*, 69(1), 134-145. doi:10.1002/asi.23875

## Preservation

### Recommendations

- Where possible, collect two copies of a video game's wrap kit; one will become an archival copy, the other will circulate to the extent permitted by its authors
- Support, foster, and cultivate replication, variation, and emulation communities

### Practical Reasoning

Any effort to preserve video games is fraught with technical challenges; and, in the case of commercial video games, there are legal hurdles to overcome as well. We still struggle with how best to implement inclusive and sustainable long-term preservation for digital content. The standard preservation practices that have developed within the past two decades, chiefly file migration, are upended when applied to video games. The best technological solutions bring their own vulnerabilities and are essentially short-mid term solutions, not long-term preservation solutions.

As scholarship continues to take shape in new and varied forms, the gap between what is integrated into university libraries and archives and what is not will continue to widen. There is not currently a preservation solution that is achievable and sustainable. There is, however, the opportunity to re-evaluate complex digital objects and their footprint. There is the opportunity to collect and preserve emerging forms of digital scholarship even if the work isn't entirely accessible. The materials representing video games and other complex digital scholarship works contain significant value and are easily managed within most current library processes. Proactively preparing for a future that will enable the use of the scholarship is our role as librarians.

### Imperfect Solutions

The proposed solutions for mid-term and long-term preservation are imperfect and frankly impractical for libraries at this time.

### Migration

Preserving digital objects by migrating them to new platforms is the default preservation strategy at our library. Migration as a preservation strategy is less a solution than a stop-gap measure; for most digital content, migration is a sufficient mid-range preservation strategy, especially for common file types.

Conditions which lend to migration being considered a 'mid-term' solution as opposed to a long-term solution include the slight changes to an original file that occurs during migration. Baker and Anderson note, of the over 6000 known file types, "some of these [are] so intimately bound up with the particularities of their originally intended hardware that the conversion process becomes more tricky... [and] even when a great deal of care has been exercised, it is not uncommon for files originally written on one computer system to appear slightly differently on a new system" (Baker and Anderson, p.93). Baker and Anderson state conversion errors will "gradually accumulate as a file moves from one system to the next."

A video game employs an array of file types, if we were to migrate only the common files we would inevitably be changing the relationships between the files. If we were to migrate the lesser known file types as well, we cannot be sure that they will be able to function as intended in the operating environment they are migrated to, much less maintain the integrity of file to file interactions. Additionally, we can expect for the slight shifts Baker and Anderson wrote of, which further compromise the authenticity of the migrated files, and by extension, the video game.

## **Emulation**

The strides made in emulation development cannot undo the fact that emulation itself is a software, sharing all the same vulnerabilities as the softwares it emulates. Boss and Broussard write of the 'false dichotomy' of emulators; emulation is more a stop-gap, relatively short-term preservation solution (Boss and Broussard, 2017). Emulation can help in early preservation efforts, but ultimately emulators will require the same preservation interventions as the video games they emulate. Pinchbeck in an article on emulation as a preservation strategy wrote, "the biggest problem... with all current emulators is their own obsolescence" (Pinchbeck, p. 3).

Institutional commitment and fiscal concerns (which are in lockstep with each other) aside, were we to pursue emulation as a solution to video game preservation we would not be solving a digital preservation problem but instead compounding it. Emulation is software. A video game is software. With a technologically-myopic approach to video game preservation, we are not solving video game preservation, we are squaring it. Producing emulations as they are needed is not a feasible or sustainable venture for our library, and, we imagine, many libraries.

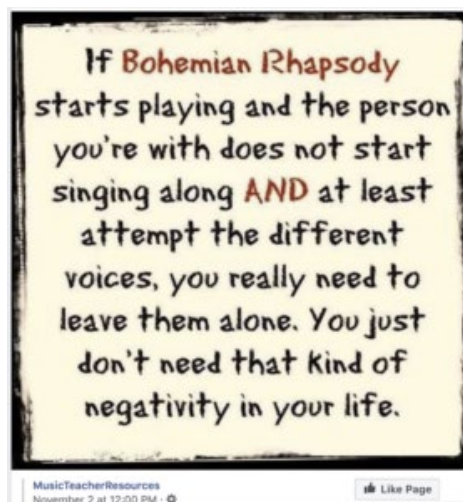
Hypothetically, the way an emulation program would play out for us is that we would need to obtain or create an emulator to encase a video game in its original operating environment. An emulator would function just fine in the operating environment it is hosted in, but, not when the operating environment changes; at this point, the emulator must be migrated or re-built. We would be assuming responsibility for managing not only emulators for individual video games, but endlessly producing emulation solutions for the emulators that have already been deployed by us. At the current rate, EAE students produce anywhere from 8-15 video game theses a

year; games that may operate in very different environments. Pursuing emulation on an institutionally-resourced level is beyond our capacity and that of libraries and archives in general.

### Versioning, replicating, and rebuilding

Examining a video game from a performative aspect, in the same way we would a recital, play, or dance performance, highlights how variations can play a role in preservation. For example, originally released on Queen's 1975 album *A Night at the Opera*, the song *Bohemian Rhapsody* is six minutes long, so long that the record label feared no radio station would be willing to play the song in its entirety. Instead the song became a fan favorite. Years later Queen performed a portion of it at [LiveAid](#). *Bohemian Rhapsody* has become so well-known that thousands of attendees at a [Green Day concert](#) participated in a massive group sing-along.

These celebrated versions of *Bohemian Rhapsody* memorably pay homage to the original recording while at the same time serving as examples of transformative iterations of the song. Recreations and emulations of video games will similarly result in transformative versions of the original game; the quality of each version judged by the degree to which it authentically and faithfully recreates the original in a new and different environment.



### Developing a local video game preservation strategy

At our library, [J. Willard Marriott Library](#), ExLibris's [Rosetta Digital Asset Management and Preservation](#) is used for much of the content in Marriott's [Digital Library](#). Rosetta is used for comparatively simple digital objects, for example, images, text files, and other, generally common, archival media file-types. We plan to deposit a zip file containing the operating files for an EAE video game in Rosetta. Digital preservationists managing the library's digital preservation processes in Rosetta will migrate the zip file as needed, but its individual operating files won't be migrated separately. The reason for migrating only the zip file lay with the issues that arise if we were to individually deposit the operating files in Rosetta. Obscure filetypes may not migrate, and the essential relationships between the files may be lost if some files are migrated and others are not.

We are fortunate that challenges that apply to commercial games, do not apply in the same manner or to the same degree as with EAE's student-created video games. EAE video games could be collected immediately after they have been launched at the annual unveiling of new games during EAE's bi-annual Open Houses. New EAE games are launched with a limited number of versions, chiefly prototypes that informed the final game design. Documentation and

representation information for a video game can be collected in forms submitted by the students to EAE as part of their final project submission. Copyright, access, preservation, and use are explicitly asked on the form that students submit. The tiered form offers a range of archival preservation treatments available which must be approved by the video game's creators. The more openly-available students chose to make their video game, the better the chance of prolonging and preserving its playability. The students willing to allow community users to migrate, emulate, and replicate their game, open avenues of distribution of the game, and in turn, the possibility of community users playing a role in preservation of a video game through using approaches that include replication, variation, and emulation.

EAE's bi-annual Open Houses are the public debut of a cohort's team-produced video games. At the events, it is expected that each video game will be functioning as intended by its engineers, artists, designers, developers, and producers. Open to the public, visitors are encouraged to play the newly-launched games. For our purposes, the Open Houses presents an opportunity to collaborate with video game creators and the Open House visitors to capture archival recordings of gameplay. Gameplay recordings, as archival content, are essential elements we would want to make available for rebuilding, migrating, and emulation efforts. In some cases, a video game's creators will decide not to deposit a copy of the game's operating files in the library's archives. For these games, we are hopeful the creators will permit static representations of gameplay in the form of walkthroughs, still images, and other ephemera with which we can create an enhanced archival record for the game, and, in turn, catalog it with the same logic as we would an exhibition, performance, or recital.

Where commercial video games have a distinct advantage over student-created video games is in the fan communities that have formed around a beloved game. The archival value of community-contributed content for a commercially successful video game cannot be understated. That there is relatively little opportunity to gather community-contributed content for EAE video games makes the annual Open House a significant opportunity to represent EAE video games in library collections and archives, whether as a single performance with still images, footage of video game gameplay, the wrap kit for a video game, or some combination of these.

We are going to explore the method of prolonging the longevity of EAE's video games by supporting and facilitating the emergence of EAE-focused communities of replication, emulation, and variation. Where community members are allowed access to the original operating files of a video game, there is the opportunity for them to replicate the video game for use on their personal devices. As librarians, we can assist in this community in its rebuilding efforts by developing strong curation and archival practices for video game-related materials and ephemera. By developing a community-focused preservation strategies for EAE's video games that are focused on potential permutations of video game scholarship in library collections, we are then able to regard a video game more expansively. Curatorial and archival treatment of the video game is according to content its authors submit, allow, describe, and choose to share.

Versioning, replicating, and rebuilding video games as methods of preservation invites comparisons to the established practice in item treatment for a performance, musical recording,

choreographed dance, or event. Viewing EAE's video game theses as scholarly works that include operating files, code, and representations of gameplay, allows an expanded approach from which we can archive a video game and proactively implement preservation-focused practices for EAE's video games and other complex digital scholarship works.

## Recommended Readings

Abbott, D. (2014). Preserving interaction. In J. Delve (Ed.), *Preserving Complex Digital Objects* (pp. 297-308): Facet Publishing.

Abbott, D., Jones, S., & Ross, S. (2008). Theoretical Discussions on Digital Representations of Performance. *Capturing the Essence of Performance: The Challenges of Intangible Heritage*, 81-88.

Bartle, R. A. (2014). Archaeology versus anthropology: what can truly be preserved? In J. Delve (Ed.), *Preserving Complex Digital Objects* (pp. 13-17): Facet Publishing.

Barwick, J., Dearnley, J. A., & Muir, A. (2008). *The barriers to the preservation of digital games: questions on cultural significance*. Paper presented at the DOCAM.  
<https://dspace.lboro.ac.uk/2134/4988>

Cain, M. (2003). Being a library of record in a digital age. *Journal of Academic Librarianship*, 29(6), 405-410. doi:10.1016/j.jal.2003.08.007

Dyson, J.-P. C. (2017) *Collecting, preserving, and interpreting the history of electronic games: An interview with Jon-Paul C. Dyson./Interviewer: A. J. o. Play*. (Vol 1), The Strong.

Enis, M. (2013). Saving games. *Library Journal*, 138(17), 44-47.

Lowood, H., Armstrong, A., Monnens, D., Vowell, Z., Ruggill, J., McAllister, K., . . . Pinchbeck, D. (2009). *Before it's too late: Preserving games across the industry /academia divide*. Paper presented at the Breaking New Ground: Innovation in Games, Play, Practice and Theory - Proceedings of DiGRA 2009.

McDonough, J. P., Olendorf, R., Kirschenbaum, M., Kraus, K., Reside, D., Donahue, R., . . . Rojo, S. (2010). *Preserving virtual worlds final report*. Retrieved from <http://hdl.handle.net/2142/17097>

Neal, J. G. (2015). Preserving the Born-Digital Record. *American Libraries*, 46, 30-33.

Pinchbeck, D. (2014). Standing on the shoulders of heavily armed giants -- why history matters for game development. In J. Delve (Ed.), *Preserving Complex Digital Objects* (pp. 3-12): Facet Publishing.

- Rothenberg, J. (1999). *Avoiding Technological Quicksand: Finding a Viable Technical Foundation for Digital Preservation. A Report to the Council on Library and Information Resources*. Retrieved from <https://eric.ed.gov/?id=ED426715>
- Ruan, J., & McDonough, J. P. (2009). *Preserving born-digital cultural heritage in virtual world*. Paper presented at the ITME2009 - Proceedings 2009 IEEE International Symposium on IT in Medicine and Education.

## Resources

During a literature review we conducted of publications in the field, we discovered seminal works that, while published several decades ago (in some cases), remain highly-relevant to developing a fuller understanding of the digital preservation challenge. In addition, our review revealed resources and tools available that address various aspects of digital preservation. Below is a non-comprehensive list of what we found to be particularly significant works, tools, and resources.

Cain, M. (2003). Being a library of record in a digital age. *The Journal of Academic Librarianship*, 6(29), 405-410.

Creative Commons <https://creativecommons.org/>

Educopia Institute's Preservation and Curation of ETD Research Data and Complex Digital Objects: Overview of the ETD+ Workshop Series  
[https://docs.google.com/presentation/d/1XGK1qEklewqZX6SjXX3grgRAXSF5ln\\_balCLEdBfz1l](https://docs.google.com/presentation/d/1XGK1qEklewqZX6SjXX3grgRAXSF5ln_balCLEdBfz1l) and <https://educopia.org/etd-plus-guidance-briefs/>

Lowood, H., Monnens, D., Vowell, Z., Ruggill, J. E., McAllister, K. S., & Armstrong, A. (2009). Before It's Too Late: A Digital Game Preservation White Paper. *American Journal of Play*, 2(2), 139. Retrieved Oct. 8, 2019  
[https://digitalcommons.calpoly.edu/cgi/viewcontent.cgi?referer=https://scholar.google.com/&httpsredir=1&article=1118&context=lib\\_fac](https://digitalcommons.calpoly.edu/cgi/viewcontent.cgi?referer=https://scholar.google.com/&httpsredir=1&article=1118&context=lib_fac)

McDonough, J. P. (2012, January). 'Knee-Deep in the Data': Practical Problems in Applying the OAIS Reference Model to the Preservation of Computer Games. In 2012 45th Hawaii International Conference on System Sciences (pp. 1625-1634). IEEE.

McDonough, J. P., Olendorf, R., Kirschenbaum, M., Kraus, K., Reside, D., Donahue, R., ... & Rojo, S. (2010). *Preserving virtual worlds final report*. Retrieved Oct. 8, 2019  
<http://www.ideals.illinois.edu/bitstream/handle/2142/17097/PVW.FinalReport.pdf>

McHenry, K., Kooper, R., Marini, L., & Ondrejcek, M. (2011). The ISDA Tools: Preserving 3D Digital Content. *The Preservation of Complex Objects*, 66.

Moulaison Sandy, H., & Corrado, E. M. (2018). Bringing content into the picture: Proposing a tripartite model for digital preservation. *Journal of Library Administration*, 58(1), 1-17.

Mountain West Digital Library Education Toolkit <https://mwdl-epublishing.org/education-toolkit/>

National Digital Stewardship Alliance <https://ndsa.org/>

OAIS Reference Model <https://www.impactzone.co/portfolio/oais-reference-model/>

Rothenberg, J. (1999). Avoiding Technological Quicksand: Finding a Viable Technical Foundation for Digital Preservation. A Report to the Council on Library and Information Resources. Council on Library and Information Resources, 1755 Massachusetts Ave, NW, Washington, DC 20036. Retrieved Oct. 8, 2019  
<https://files.eric.ed.gov/fulltext/ED426715.pdf>

Software Preservation Network <https://www.softwarepreservationnetwork.org/>

Software Sustainability Institute <https://software.ac.uk/>

## Bibliography

Abbott, D. (2014). Preserving interaction. In J. Delve (Ed.), *Preserving Complex Digital Objects* (pp. 297-308): Facet Publishing.

Abbott, D., Jones, S., & Ross, S. (2008). Theoretical Discussions on Digital Representations of Performance. *Capturing the Essence of Performance: The Challenges of Intangible Heritage*, 81-88.

Bachell, A., & Barr, M. (2014). Video game preservation in the UK: a survey of records management practices. *International Journal of Digital Curation*, 9(2).  
doi:<https://doi.org/10.2218/ijdc.v9i2.294>

Baker, D., & Anderson, D. (2014). Laying a trail of breadcrumbs — preparing the path for preservation. In J. Delve (Ed.), *Preserving Complex Digital Objects*: Facet Publishing.

Barwick, J., Dearnley, J. A., & Muir, A. (2008). *The barriers to the preservation of digital games: questions on cultural significance*. Paper presented at the DOCAM.  
<https://dspace.lboro.ac.uk/2134/4988>

Bettavia, R. S. (2015). Mapping significance properties in OAIS: A case study with video games extended poster abstract. *Proceedings of the Association for Information Science and Technology*, 52(1), 1-4. doi:10.1002/pra2.2015.1450520100136

Bettavia, R. S. (2016). The power of imaginary users: Designated communities in the OAIS reference model. *Proceedings of the Association for Information Science and Technology*, 53(1), 1-9. doi:10.1002/pra2.2016.14505301038

- Boss, K., & Broussard, M. (2017). Challenges of archiving and preserving born-digital news applications. *IFLA Journal*, 43(2), 150-157. doi:10.1177/0340035216686355
- Boutard, G. (2015). Towards mixed methods digital curation: facing specific adaptation in the artistic domain. *Archival Science*, 15(2), 1769-1189.
- Broussard, M. (2015). Preserving news apps present huge challenges. *Newspaper Research Journal*, 36(3), 299-313. doi:10.1177/0739532915600742
- Cain, M. (2003). Being a library of record in a digital age. *Journal of Academic Librarianship*, 29(6), 405-410. doi:10.1016/j.jal.2003.08.007
- Carta, G. (2017). Metadata and video games emulation: an effective bond to achieve authentic preservation? *Records Management Journal*, 27(2), 192-204. doi:10.1108/RMJ-10-2016-0037
- Chassanoff, A. (2017). Building a model for software curation: an introductory post. Retrieved from <https://informatics.mit.edu/blog/guest-post-alex-chassanoff-software-curation>
- Cho, H., Donovan, A., & Lee, J. H. (2018). Art in an algorithm: A taxonomy for describing video game visual styles. *Journal of the Association for Information Science and Technology*, 69(5), 633-646. doi:10.1002/asi.23988
- Clarke, R. I., Lee, J. H., & Clark, N. (2017). Why video game genres fail: A classificatory analysis. *Games and Culture*, 12(5), 445-465.
- Corrado, E. M. (2019). Software Preservation: An Introduction to Issues and Challenges. *Technical Services Quarterly*, 36(2), 177-189. doi:10.1080/07317131.2019.1584983
- Dappert, A., Peyrard, S., Chou, C. C. H., & Delve, J. (2013). Describing and preserving digital object environments. *New Review of Information Networking*, 18(2), 106-173. doi:10.1080/13614576.2013.842494
- Dappert, A. (2014). Metadata for preserving computing environments. In J. Delve (Ed.), *Preserving Complex Digital Objects* (pp. 201-215): Facet Publishing.
- Decker, A., Egert, C., Phelps, A., & McDonough, J. P. (2012). *Technical properties of play a technical analysis of significant properties for video game preservation*. Paper presented at the 4th International IEEE Consumer Electronic Society – Games Innovation Conference, IGIC 2012.
- Delve, J., Denard, H., & Kilbride, W. (2014). Digital preservation strategies for visualizations and simulations. In J. Delve (Ed.), *Preserving complex digital objects* (pp. 143-153): Facet Publishing.
- Delve, J., & Anderson, D. (2014). Pathfinder conclusions. In *Preserving Complex Digital Objects* (pp. 337-358): Facet Publishing.

- Delve, J., Pinchbeck, D., & Bergmeyer, W. (2014). Preserving games environments via TOTEM, KEEP and Bletchley Park. In J. Delve (Ed.), *Preserving Complex Digital Objects* (pp. 217-231): Facet Publishing.
- Donovan, A., Cho, H., Magnifico, C., & Lee, J. H. (2013, July). Pretty as a pixel: Issues and challenges in developing a controlled vocabulary for video game visual styles. In *Proceedings of the 13th ACM/IEEE-CS joint conference on Digital libraries* (pp. 413-414). ACM.
- Doyle, J., Viktor, H., & Paquet, E. (2009). Long-term digital preservation: preserving authenticity and usability of 3-D data. *International Journal on Digital Libraries*, 10(1), 33-47. doi:10.1007/s00799-009-0051-7
- Dyson, J. C. (2017) *Collecting, preserving, and interpreting the history of electronic games: An interview with Jon-Paul C. Dyson./Interviewer: A. J. o. Play*. (Vol 1), The Strong.
- Educopia Institute (September 5, 2018). Electronic Theses and Dissertations (ETD)plus Toolkit. Retrieved from <https://educopia.org/etd-toolkit/>
- Enis, M. (2013). Saving games. *Library Journal*, 138(17), 44-47.
- Granger, S. (2000). Emulation as a Digital Preservation Strategy. *D-Lib Magazine*, 6(10). doi:10.1045/october2000-granger
- Guttenbrunner, M., & Rauber, A. (2012) Evaluating emulation and migration: Birds of a feather? In: *Vol. 7634 LNCS. Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)* (pp. 158-167).
- Hart, T. R., & de Vries, D. (2017). Metadata Provenance and Vulnerability. *Information Technology and Libraries*, 36(4), 24-34.
- Hong, N. C. (2014). Digital preservation and curation: the danger of overlooking software. In J. Delve (Ed.), *Preserving Complex Digital Objects* (pp. 111-123): Facet Publishing.
- Kaltman, E., Wardrip-Fruin, N., Lowood, H., & Caldwell, C. (2014). A Unified Approach to Preserving Cultural Software Objects and their Development Histories. In: *UC Santa Cruz: Center for Games & Playable Media*.
- Lee, J. H., Tennis, J. T., Clarke, R. I., & Carpenter, M. (2013). Developing a video game metadata schema for the Seattle Interactive Media Museum. *International journal on digital libraries*, 13(2), 105-117.
- Lee, J. H., Clarke, R. I., & Perti, A. (2015). Empirical evaluation of metadata for video games and interactive media. *Journal of the Association for Information Science and Technology*, 66(12), 2609-2625.
- Lee, J. H., Karlova, N., Clarke, R. I., Thornton, K., & Perti, A. (2014). Facet analysis of video game genres. *iConference 2014 Proceedings*.

- Lee, J. H., Clarke, R. I., & Rossi, S. (2016). A qualitative investigation of users' discovery, access, and organization of video games as information objects. *Journal of Information Science*, 42(6), 833-850.
- Lee, J. H., Cho, H., Fox, V., & Perti, A. (2013, July). User-centered approach in creating a metadata schema for video games and interactive media. In *Proceedings of the 13th ACM/IEEE-CS joint conference on Digital libraries* (pp. 229-238). ACM.
- Lowood, H., Armstrong, A., Monnens, D., Vowell, Z., Ruggill, J., McAllister, K., . . . Pinchbeck, D. (2009). *Before it's too late: Preserving games across the industry /academia divide*. Paper presented at the Breaking New Ground: Innovation in Games, Play, Practice and Theory – Proceedings of DiGRA 2009.
- Matthews, B., Shaon, A., Bicarregui, J., & Jones, C. (2010). A Framework for Software Preservation. *International Journal of Digital Curation*, 5(1), 91-105. doi:10.2218/ijdc.v5i1.145
- Matthews, B., McIlwrath, B., Giaretta, D., & Conway, E. (2008). The significant properties of software: A study. Retrieved July, 30, 2013. <https://www.semanticscholar.org/paper/The-Significant-Properties-of-Software%3A-A-Study-Matthews-McIlwrath/1e2ffd9437a2a7da14fdbaae8235174b5a169aa3>
- Matthews, B., Shaon, A., & Conway, E. (2014). How do I know that I have preserved software? In J. Delve (Ed.), *Preserving Complex Digital Objects*: Facet Publishing.
- Maurer, M. B., & Shakeri, S. (2016). Disciplinary differences: LCSH and keyword assignment for ETDs from different disciplines. *Cataloging & Classification Quarterly*, 54(4), 213-243.
- McDonough, J. P. (2011). Packaging videogames for long-term preservation: Integrating FRBR and the OAIS reference model. *Journal of the American Society for Information Science and Technology*, 62(1), 171-184. doi:10.1002/asi.21412
- McDonough, J. P. (2012). *'Knee-deep in the data': Practical problems in applying the OAIS Reference Model to the preservation of computer games*. Paper presented at the Proceedings of the Annual Hawaii International Conference on System Sciences.
- McDonough, J. P., Olendorf, R., Kirschenbaum, M., Kraus, K., Reside, D., Donahue, R., . . . Rojo, S. (2010). *Preserving virtual worlds final report*. Retrieved from <http://hdl.handle.net/2142/17097>
- McDonough, J. P. (2014). A tangled web: metadata and problems in game preservation. In J. Delve (Ed.), *Preserving Complex Digital Objects* (pp. 185-200): Facet Publishing.
- McHenry, K., Kooper, R., Marini, L., & Ondrejcek, M. (2014). The ISDA tools: preserving 3D content. In J. Delve (Ed.), *Preserving Complex Digital Objects*: Facet Publishing.

- Meyerson, J., Vowell, Z., Hagenmaier, W., Leventhal, A., Rios, F., Russey Roke, E., & Walsh, T. (2017). The Software Preservation Network (SPN): A community effort to ensure long term access to digital curatorial heritage. *D-Lib Magazine*, 23(5/6).
- Michelson, A. & Rothenberg, J. (1992) Scholarly Communication and Information Technology: Exploring the impact of changes in the research process on archives. *The American Archivist*, 55(2), 236-315.
- Moulaison, H., Corrado, S., & Corrado, E. M. (2018). Bringing content into the picture: proposing a tri-partite model for digital preservation. *Journal of Library Administration*, 58(1), 1-17.
- Neal, J. G. (2015). Preserving the Born-Digital Record. *American Libraries*, 46, 30-33.
- Newman, J. (2012). Ports and patches: Digital games as unstable objects. *Convergence*, 18(2), 135-142. doi:10.1177/1354856511433688
- Nilson, L. B. (2016). *Teaching at its best: A research-based resource for college instructors*. John Wiley & Sons.
- Nylund, N. (2015). *Walkthrough and Let's play: Evaluating preservation methods for digital games*. Paper presented at the ACADEMICMINDTREK 2015 – Proceedings of the 19th International Academic Mindtrek Conference.
- Pinchbeck, D., Anderson, D., Delve, J., Otemu, G., Ciuffreda, A., & Lange, A. (2009). *Emulation as a strategy for the preservation of games: The keep project*. Paper presented at the Breaking New Ground: Innovation in Games, Play, Practice and Theory – Proceedings of DiGRA 2009.
- Pinchbeck, D. (2014). Standing on the shoulders of heavily armed giants — why history matters for game development. In J. Delve (Ed.), *Preserving Complex Digital Objects* (pp. 3-12): Facet Publishing.
- Ribaudo, N. (2017). Youtube, Video Games, and Fair Use: Nintendo's Copyright Infringement Battle with Youtube's Let's Plays and Its Potential Chilling Effects. *Berkeley Journal of Entertainment and Sports Law*, 6, 114-138.
- Rinehart, R. (2007). The Media Art Notation System: Documenting and Preserving Digital/Media Art. *Leonardo*, 40(2), 181-187. doi:10.1162/leon.2007.40.2.181
- Rosenthal, D. S. (2015). Emulation & virtualization as preservation strategies. *Andrew W. Mellon Foundation*.
- Rothenberg, J. (1999). *Avoiding Technological Quicksand: Finding a Viable Technical Foundation for Digital Preservation. A Report to the Council on Library and Information Resources*. Retrieved from <https://eric.ed.gov/?id=ED426715>

- Ruan, J., & McDonough, J. P. (2009). *Preserving born-digital cultural heritage in virtual world*. Paper presented at the ITME2009 – Proceedings 2009 IEEE International Symposium on IT in Medicine and Education.
- Sköld, O. (2018). Understanding the “expanded notion” of videogames as archival objects: A review of priorities, methods, and conceptions. *Journal of the Association for Information Science and Technology*, 69(1), 134-145. doi:10.1002/asi.23875
- Schwing, T., McCutcheon, S., & Maurer, M. B. (2012). Uniqueness matters: Author-supplied keywords and LCSH in the library catalog. *Cataloging & Classification Quarterly*, 50(8), 903-928.
- Schumann, N., & Recker, A. (2013) De-mystifying OAIS compliance: Benefits and challenges of mapping the OAIS reference model to the GESIS Data Archive. *Iassist Quarterly*, 2013.
- Strader, C. R. (2009). Author-assigned keywords versus library of congress subject headings: Implications for the cataloging of electronic theses and dissertations. *Library Resources & Technical Services*, 53(4), 243-250.
- Steeves, V., Rampin, R., & Chirigati, F. (2018). Using ReproZip for Reproducibility and Library Services. *IASSIST Quarterly*, 42(1), 14. doi:10.29173/iq18
- Swalwell, M. (2009). Towards the preservation of local computer game software: challenges, strategies, reflections. *Convergence: the International Journal of Research into New Media Technologies*, 15(3), 263-279. doi:10.1177/1354856509105107
- UNESCO. Agreement on software preservation signed at UNESCO. Retrieved Oct. 8, 2019 from <https://en.unesco.org/news/agreement-software-preservation-signed-unesco>
- Wilson, T. C. (2017). Rethinking digital preservation: definitions, models, and requirements. *Digital Library Perspectives*, 33(2), 128-136. doi:10.1108/DLP-08-2016-0029
- Winget, M. A., & Sampson, W. W. (2011). *Game development documentation and institutional collection development policy*. Paper presented at the Proceedings of the ACM/IEEE Joint Conference on Digital Libraries.
- Winget, M. A. (2011). Videogame preservation and massively multiplayer online role-playing games: A review of the literature. *Journal of the American Society for Information Science and Technology*, 62(10), 1869-1883. doi:10.1002/asi.21530
- World Intellectual Property Organization. (2006). *Understanding copyright and related rights* (No. 909). Wipo. Retrieved Oct. 8, 2019 from [https://www.wipo.int/edocs/pubdocs/en/wipo\\_pub\\_909\\_2016.pdf](https://www.wipo.int/edocs/pubdocs/en/wipo_pub_909_2016.pdf)

## Definitions

**Archival Agreement Form** – The “Entertainment Arts and Engineering (EAE) Thesis Game Archiving Agreement” is the archiving document we created for the EAE thesis games. Student-authors decided the archival plan, copyright statement, access, and metadata for their game. This form was given to all the capstone students via the University’s learning management system and on the EAE Research Guide (<http://campusguides.lib.utah.edu/eae/archive>).

**Complex Born-Digital Scholarship or Complex Digital Scholarship** – Digital objects that are frequently born-digital and typically contain multiple file types; collectively the files support and represent a single cohesive scholarly work.

**EAE or Entertainment Arts and Engineering** – EAE is the game development program at the University of Utah. They offer undergraduate and graduate degrees. Learn more at: <https://games.utah.edu/>.

**Emulation** – The practice of creating a software that mirrors the original operating environment of a video game, or other form of platform-dependent software

**Preservation** – The act of maintaining a work in its original state.

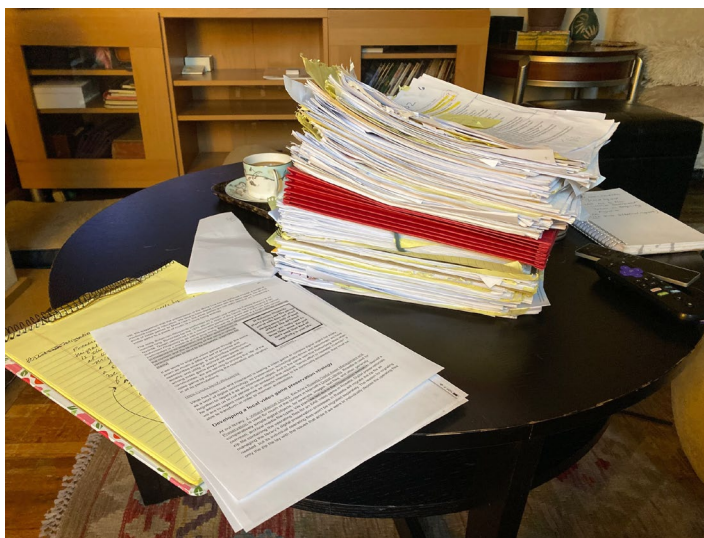
**Wrap Kit** – This term is used by EAE to describe the final deliverables for a game project. At the minimal it includes the game files and marketing materials. It can also include “readme” type files, production timelines, underlying research summaries, and recorded walkthroughs.

## About the Authors and Editor

Anne Morrow is an Associate Librarian and Head of Digital Scholarship Services at the University of Utah’s J. Willard Marriott Library. In this capacity, Anne manages the institutional repository, USpace, and facilitates UU community access to library-hosted publishing of research and scholarship. (View Anne’s faculty profile website [here](#).)

Tallie Casucci, MLIS, is an Assistant Librarian at the University of Utah’s J. Willard Marriott Library focusing on research, scholarship, and innovation support. Tallie is the liaison to the Entertainment Arts and Engineering program and co-teaches Serious Games for the EAE graduate student program. (View Tallie’s faculty profile website [here](#).)

Adriana Parker is an Associate Librarian at the University of Utah’s J. Willard Marriott Library. (View Adriana’s faculty profile website [here](#).)



<https://youtu.be/-yE8SYzZ6Eo>  
<https://youtu.be/Q2rG9joNzmE>