2020

Make Your Escape: Experiences with Gamified Library Programming

Tim Miller
Humboldt State University, tim.miller@humboldt.edu

Kimberly Stelter
Humboldt State University, Kimberly.Stelter@humboldt.edu

Garrett Purchio
Humboldt State University, garrett.purchio@humboldt.edu

Brianne N. Hagen
Humboldt State University, brianne.hagen@humboldt.edu

Recommended Citation

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Introduction

To increase student engagement, the Humboldt State University Library ventured into the realm of gamified programming, exploring several strategies with the goal of transforming library outreach and instruction. Our efforts range from simple outreach to highly structured information literacy instruction and workshops that use gamification to encourage students to engage with knowledge practices and dispositions outlined in the ACRL *Framework for Information Literacy for Higher Education*. Using gamified activities in library instruction led us to create lesson plans that are purely game-based, including escape room drop-in sessions where students race against the clock to solve a series of puzzles in order to "escape" the room. This model aimed to promote collaboration and problem-solving skills through inquiry-based learning.

As a team of librarians, we participated in a student-led Leadership Week escape room event where we saw a connection between the problem-solving skills required to "escape" and common information literacy concepts that Humboldt State University (HSU) students often use to complete their research assignments. This gamified learning experience inspired us to develop and offer an escape room for Open Access Week in which participants were required to solve a series of puzzles exploring creative commons, public domain, and open access databases. The escape room format requires students to perform various information literacy strategies and skills, including keyword searching, using filters, and understanding metadata and bibliographic information. For a group to succeed, participants must also apply critical thinking and collaboration skills relevant to real-world academic contexts.

We used inquiry-based instruction strategies to develop the game as a lesson that offered basic structure and scaffolding but focused primarily on encouraging exploration and inquiry. The game structure required students to explore and navigate the databases in order to solve the series of puzzles and experience the iterative nature of the research process. Studies examining the effectiveness of inquiry-based learning in different contexts suggest that students are able to learn complex tasks, such as research, while also learning soft skills, such as independent learning and group work.[1] Matching our escape room to the inquiry-based learning model seemed like a perfect fit.

The purpose of this chapter is to demonstrate how we designed this and other gamified lessons to engage students in the research process with an emphasis on the ACRL *Framework for Information Literacy for Higher Education* frames Research as Inquiry and Searching as Strategic Exploration. We also share lessons learned, observations, participant feedback, and our process for iterating and improving our gamified learning programs.

Origins and Planning for an Escape Room

Games to Enhance Learning

In order to increase student engagement and rethink our teaching strategies, the HSU Library began experimenting with the use of games in outreach and instruction. Early on, we provided games to enhance outreach programs, but the games were self-directed and not intentionally designed to engage in specific learning outcomes. An example is the LEGO Creation and Relaxation Station that is set up in the library lobby during finals week. This program was inspired by the Art Library LEGO Playing Station created by Megan Lotts of Rutgers University, presented at ACRL 2015 in Portland, Oregon.[2] Our LEGO station is a passive project, consisting of a set of building blocks left out during finals week to provide a fun and creative outlet during stressful exam periods. The station encouraged students to post their creations to social media. Students created bigger and/ or more elaborate constructions, often building on each other's work. The popularity and high level of engagement around this station led us to provide other similar stations during the semester with more of a focus on gameplay, including jigsaw puzzles, magnetic poetry, and wood block puzzles. Creative play stations and puzzles have remained a constant feature in the library, with revolving options every few weeks. These remain consistently popular among students, especially during midterms and finals. After considering the successes of these passive, creative games, we decided to experiment with integrating gamification into information literacy instruction.

We began by introducing gamified learning activities in librarian-led instruction both in course-aligned sessions and co-curricular programming sessions called SkillShops. SkillShops are free and open drop-in workshops facilitated by librarians, staff, and faculty from departments across campus that cover a variety of topics with the goal of developing skills for personal, academic, and professional growth. Librarians use SkillShops as a means of offering supplemental library instruction. The flexibility of SkillShops has

also allowed us the freedom to experiment with gamification in information literacy instruction.

Games in Instruction

One of our earliest efforts to add gamification into library instruction was after the library had acquired a large-format touchscreen computer, the InFocus Mondopad. This was part of the creation of a new, innovative, collaborative teaching space and offered the potential for interactive presentations. Librarians began designing workshops around the use of the touchscreen, incorporating interactive quizzes in the presentation. Students moved around the room to interact with the touchscreen presentation rather than passively sitting and watching the presenter scroll through the slides. This helped create a more open and active learning environment to prepare students for later group activities. The inclusion of these short gamified activities as part of information literacy instruction proved to be a successful method for increasing student engagement with the lesson content.

We began to incorporate other online quizzing tools during course-aligned information literacy instruction to add a competitive and interactive gaming experience. Kahoot! is a web-based quizzing app that helps keep students engaged. It is also useful for assessing learning with the use of downloadable reports to track response accuracy for the entire class or individual students. Kahoot! awards points for speed and accuracy, which fosters competition among the students. The student point standings are displayed after each round, which underscores the competitive aspect and affords an opportunity for the instructor to check student understanding and provide feedback before moving on to the next question. We have used Kahoot! quizzes to gamify learning about information literacy concepts, including Boolean operators, citation styles and formatting, and identifying scholarly sources as well as to explore other topics like Freedom of Information Act requests and time management. From this experience, we realized that gamification improves student participation and engagement.

Due to this increase in engagement, we began to build entire gamified lessons. In a Skill-Shop called Information Investigator, which focused on search strategies and background research, we created a storyline requiring students to use the library catalog to conduct an investigation to solve a mystery. The lesson addressed the ACRL frame Searching as Strategic Exploration, specifically helping students "realize that information sources vary greatly in content and format and have varying relevance and value, depending on the needs and nature of the search."[3] The mystery to be solved surrounded an escaped possum from a wildlife care center. Students were given the keyword "possum," a clue about eucalyptus leaves being left behind, and the name of an encyclopedia as a starting point. Other visual and narrative clues were provided to guide students in the right direction during their investigation. The plan was for students to start with a title search using the keyword to locate an encyclopedia entry which provided background information and more terms to use for further research.

Students left with an introduction to basic research strategies and hands-on practice using databases, but the gamification aspect didn't work as desired. It became clear that

the game scenario did not provide enough guidance or direction for students, resulting in a step-by-step tutorial rather than a game. Even though this workshop did not work out as expected, what we learned about game and lesson design helped inform later gamification efforts. This experience led to an awareness that we needed to be more thoughtful in the construction of our clues and more deliberate in clarifying how the game operated. We also needed to provide more time for clarifying questions to gauge student experience before starting gameplay with the escape room.

We developed a *Family Feud*-style game show to teach students how to find peer-reviewed journal articles using library databases, the library catalog, and Google Scholar. Students were given a brief introduction to database searching, including an overview of library research guides and database search strategies. Following this short presentation, students were given time to explore the databases on their own and compile a list of ways they can narrow or expand their search results. Once their lists were made, the students were placed into teams to compete against each other. Librarians incorporated important search strategies into the game board and awarded points to teams that matched these answers. Engagement in these sessions has been remarkable and has allowed the librarians to act as facilitators while the students teach their peers by sharing their own search strategies.[4] Many students shared with the librarians that this interactive learning format provided them with a firm understanding of search strategies and clarified material they may have received in previous sessions.

We also modeled a lesson on *Match Game*, focused on promoting library services and resources available to HSU students, faculty, and staff. In this game format, two contestants respond to a fill-in-the-blank statement with a word or phrase that they think will get the most matches. Before sharing their responses, a panel of participants come up with their own answers. In our version, the workshop participants made up the panel and two librarians served as the main contestants. This incentivized the panel participants to come up with the best answers to demonstrate their library knowledge. This model also exposed a variety of answers and allowed the attendees to share their favorite resources. The game demonstrated the range of knowledge people across campus had about how the library helps them and how they use library resources. We found this format to be a fun and engaging way for participants to share their knowledge and learn from their peers about what the library has to offer. It also was informative for the librarians to hear how others perceive library services and resources.

The game Trivia for Cheaters focused on thinking critically about keyword searching using Google and subscription databases. The game was designed to disrupt the idea of traditional trivia gameplay that limits players to their current bank of knowledge. As an information literacy workshop, this model was designed to help illustrate how to find information resources to solve a given problem as well as how to expand their knowledge. The host of the game presented questions that require deeper searching than a typical Google keyword search, including critically reading and understanding sources. Participants were given ten minutes to work in groups and formulate their answers and provide their sources and search strategies. The game encouraged collaboration, creative thinking, and sharing alternative strategies for finding the same information. We were surprised to

learn that the participants had more fun solving the most complex questions. We noticed with several different gamification approaches that the instructor needs to strike a balance between creating a challenging experience and allowing for success.

A similar game called Defeat the Tweet required participants to explore misleading, inaccurate, and false information shared via a fictional Twitter account run by @Dishonest_Abe. Participants in this game were asked to debunk the tweets by researching the topics to identify errors and provide corrections. We found that the scoring system was difficult to establish because there was some ambiguity in what exactly constituted an error. Given that the game encouraged competition, the ambiguity of the scoring system proved to be a major distraction. Despite the messiness of the scoring, the format worked well for learning about ways to evaluate and research information on the open web.

Our transition into creating these types of lessons that are primarily based on game formats sprung out of our experience participating in a student-led escape room. We saw the game format as an engaging way to create an inquiry-based lesson that offers students the chance to learn by exploration while also supporting and scaffolding their learning through the use of clues. Additionally, this format encourages students to use their prior knowledge and experience to develop problem-solving and teamwork skills organically instead of through a prescribed and formulaic set of instructions. Shortly after participating in the escape room, we began designing our own, with the goal of teaching information literacy.

Setting the Stage

In designing our lesson, we adapted the escape room model so that instead of unlocking a door to get out of a room, students had to unlock a database in time to discover and prevent a mysterious catastrophe. The goal was for students to learn about and search for free and open resources in order to highlight Open Access Week. We hoped to increase awareness of open resources and to encourage students to use them, particularly after college when they will lose access to the HSU Library subscription databases. The game format would also encourage exploration and inquiry-based problem-solving. In order to allow all participants the opportunity to engage with at least one puzzle, each session was limited to eight to ten participants. This relatively small capacity meant that we had to offer the workshop several times in order to reach more students. The following year, we offered the escape room workshops again using the same model but changing the clues and solutions. We found it fairly easy to update our game with new clues, puzzles, and databases since we already had the structure of the game in place and the password interface designed.

Our Setup

The escape room was staged in the library's Collaboration Lab, a small classroom space with four computers with large monitors set up at large tables to facilitate collaborative group work. Before guiding the participants into the room, we provided a basic overview

of the escape room format and rules for the game (see Appendix 12A: Escape Room Rules). This gave us an opportunity to gauge how many participants had previously attempted an escape room and allowed them to ask questions. Upon entering the room, the storyline role-play began. Participants were told about a suspicious mad scientist, named Dr. Ne'er-do-well, who left a trail of clues they needed to decipher in order to uncover his nefarious dealings and stop his evil plans.

Each puzzle was set up at one of the group work stations. At the front of the room, a seventy-inch touch-screen was open to an online interactive website we created that included information about the scenario, instructions for completing the activity, and was the interface for them to submit their answers for each of the four puzzles. Each puzzle provided clues to discover the passwords that, when entered into the site, would unlock the database and provide the rest of the role play narrative. We created the site using Glitch.com, a free and open coding tool for creating simple web applications. All Glitch.com projects, including our project, can be remixed and customized by anyone. (To view and remix a clone of our site, visit https://glitch.com/~open-access-escape.) Our project is a basic website, including HTML, CSS, and JavaScript files that are used to create an interactive storyline narrative as well as the password simulator and puzzle solution reveal. The platform allows for synchronous editing by collaborators, including an easy-to-use version control tool. Glitch.com supports media uploads as well as more advanced app functionality, with Node.js servers and SQLite databases. Glitch.com projects can also be synced to GitHub repositories for further sharing and collaboration.

Figure 12.1
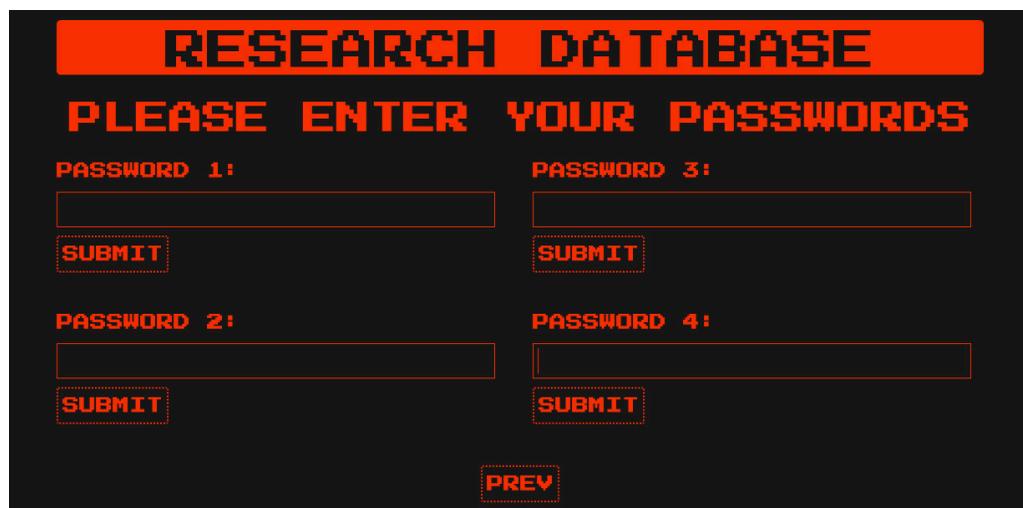Screenshot of locked "research database" for the open access escape room.

Once we finished designing the game, we hosted a pilot session prior to the Open Access Week workshop sessions. We invited library student assistants, staff, and librarians to help us test the design of the escape room. The feedback they provided helped us determine how difficult it would be to make the puzzles. Following the pilot, we had to

adjust the puzzles in order to make them solvable within the given thirty-five-minute time limit. The pilot was very valuable in helping us create puzzles that were challenging enough to be interesting, yet easy enough to be solved.

During the sessions, the participants had the opportunity to ask for three hints to aid them in solving the puzzles. Most groups tried to avoid using the hints until they felt that they couldn't solve the puzzle without help. Several students expressed that their ego or pride would not allow them to ask for hints, with a few also expressing that they were stubborn people. This reluctance to ask for help often resulted in the groups following false leads and wasting a lot of time. This prompted us to change our opening instructions in order to promote and destigmatize the use of hints. We based the hints on the progress each group had made and tailored them to the specific challenges that we perceived to be obstacles for that group. This sometimes proved difficult, given that each puzzle was developed by a different librarian and not all librarians were able to attend every session. However, most groups only needed basic search strategy guidance or help recognizing red herrings and other incorrect assumptions.

Following each session, the librarians debriefed participants and solicited feedback. This included an overview of open access, public domain, and creative commons with a brief discussion on what each of the resources offers, the different materials they contain, and how participants might find them useful. We found, however, that by the end of the experience, students were much more focused on the gameplay and were more interested in talking about their problem-solving. We realized that covering the scope and nature of the resources would be better placed at the beginning of the session along with the storyline setup. We also solicited feedback about the puzzles and game setup to improve subsequent sessions.

Open Access Week

Established in 2008, Open Access Week is a global initiative aimed at increasing free access to research.[5] The HSU Library is a leader in the California State University System's Affordable Learning Solutions program and has been a partner in the HSU Sustainable Learning Program, a campus-wide initiative that promotes the use of Open Education Resources (OER) and supports faculty in incorporating OER in their courses.[6] We encourage our faculty to participate in open access research dissemination and were looking for ways to promote it to our students. Open Access Week, combined with our escape room concept, offered such an opportunity.

Many research publications disseminate their content through subscription-based services. This includes online databases that libraries across the globe pay for in order to access this content. Once students graduate, they lose this access to subscription databases and the associated peer-reviewed research articles that many librarians focus on in information literacy instruction sessions. With the open access theme, we conveyed that a student's ability to conduct research does not end once they are no longer enrolled in college. Nor should students assume that the end of their formal education marks an end to being able to conduct academic research. Exposing students to open access resources

demonstrates that the research process can continue in whatever context is needed to support their lifelong learning. With the escape room, we wanted to expand awareness of open sources in a way that was fun and accessible for students and allowed them to explore various openly licensed resources.

The Puzzles

The mechanism of the escape room requires exploring resources and multiple ways to augment a search. Since different formats (e.g., photos, books, articles, music) have different types of metadata and therefore different search interfaces, they all require different search strategies. The escape room experience allowed us to provide ways for students to engage with these differences, explore and experiment in a limited amount of time, and learn about open access resources available to everyone.

Puzzle 1: Public Library of Science (PLoS)[7]

Given the importance of access to information for people entering the workforce and preparing for graduate degrees, we felt it was crucial to incorporate a peer-reviewed open access database into our escape room. We chose to use the Public Library of Science (PLoS) database, a leading open access publisher that focuses on scholarly content in the sciences. We incorporated this resource into a puzzle that required critical-thinking and information literacy skills. Playing cards were hidden around the room, with many being laid on top of a collaboration station.

Figure 12.2
Using a deck of playing cards and hidden clues, participants must find and enter four search terms into the PloS database to retrieve the article containing the correct password.

Four cards were missing from the deck, each of which corresponded to search terms. To discover the terms, participants had to first find a hidden poem that instructed them to eliminate keywords from a fifty-two-term list, which was hidden underneath the computer's keyboard. Each term corresponded to a specific card, so by matching cards, they found with terms on the list they would be left with four remaining terms. Entering these four terms into PLoS would guide them to an article that contained a word they would enter

into the puzzle board. The participants had to follow the clues to a specific point in the article to retrieve the word needed to solve this puzzle.

The PLoS puzzle simulated a common assignment scenario and was designed to reflect the inquiry process students utilize to find peer-reviewed research articles. Choosing keywords that are appropriate to a given search and reading strategically to find relevant information are two skills that both faculty and students recognize as important in being able to complete their course assignments.

Puzzle 2: Free Music Archive[8]

Free Music Archive is a platform for posting and sharing creative commons licensed audio files. Artists can upload their music and assign any creative commons license to their work. Creating a puzzle for the Free Music Archive was a bit different from the text-based resources incorporated in some of the other puzzles. Finding known music by artist or title is simple and can be done with a keyword search. However, serendipitous discovery of unknown music or artists is done by filtering to genres and subgenres, such as rock, garage, and surf. Serendipitous search strategies are quite different from keyword search strategies. To nudge participants into using the genre filters, the puzzle included clues pointing to the various genres and subgenres that would lead to the exact song that would provide the clue for discovering the password. The clues were in the form of other tabs in the browser open to websites about terms like "rock," "garage," and "surf."
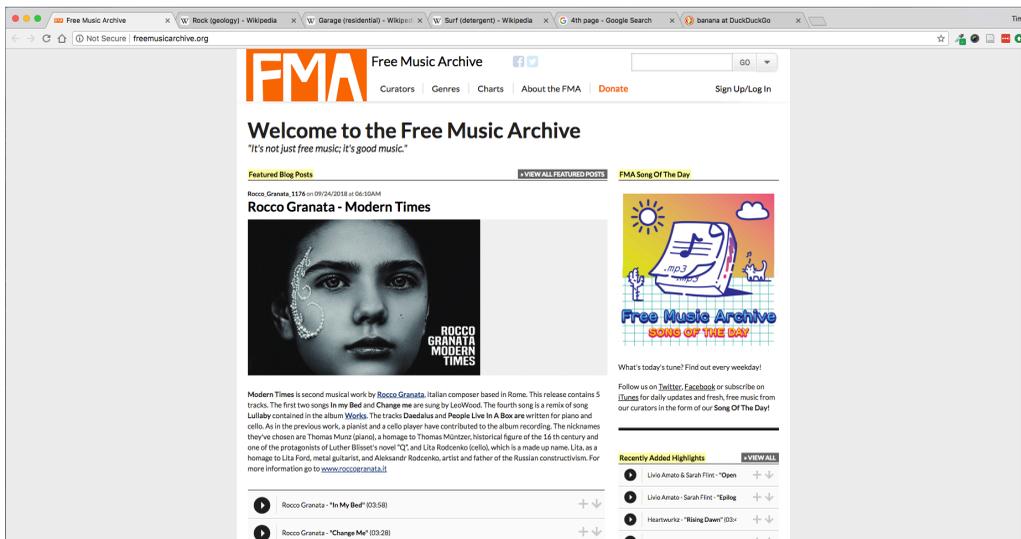

Figure 12.3
Screenshot of Free Music Archive | freemusicarchive.org

The hint for this station, therefore, was a simple prompt to use these terms as genre filters instead of keywords.

The intended learning goal from solving this puzzle was that participants would engage in adapting their search strategies from more typical directed searching to serendipitous searching. This required that they adapt the typical search strategies they use on the web or in research databases. This, in turn, meant that the puzzle had to be created in a way that both allowed for serendipitous searching and yet was directed enough to be clear and solvable. During the pilot, we discovered that the concept of searching by genre instead of keyword searching was so unexpected that the original clues were too difficult and led to confusion. Participants spent too much time trying keyword searches for the terms that were associated with the genre filters. For this reason, the final version included simplified clues that provided a clearer path to the genre filters.

During the rest of the sessions, participants were able to solve the puzzle and seemed to enjoy the process. However, serendipitous searching for audio and using the genre filters seemed to be a new experience for most participants. Even though students solved the puzzles, it is hard to assess how well they internalized the search strategies and whether they would be able to reproduce the strategies they employed in a real-world context. Therefore, the main success of this puzzle seemed to be that students were introduced to a new way of searching for a format that is more frequently a known-item search.

Puzzle 3: Project Gutenberg[9]

Project Gutenberg is a database for public domain ebooks. At the time of publication, the platform boasted over 57,000 free ebooks available in epub or Kindle formats, accessible for online viewing or download. Everything about the platform is simple; a straightforward search bar allows for keyword searching across several indices. This was the catalyst for the ebook puzzle. The clues consisted of a "diary" containing fill-in-the-blank squares. Usually, one letter or number was given in advance to help the players. At the beginning of the diary was an entry by our villain, Dr. Ne'er-do-well, giving clues as to what word needed to be searched for in Project Gutenberg and what piece of metadata would need to be chosen to unlock the program (see Appendix 12C). Following the diary entry, players encountered a series of logic puzzles they would need to solve in order to decipher the final clue to be used as the search term for Project Gutenberg. Once the players typed the final search term into the search engine, they would find one result that would be able to answer the question Dr. Ne'er-do-well needed in order to unlock the puzzle.

There were several other clues given around the table to help aid students in a search. The most obvious solution was to solve the logic puzzles, but this was also the most time-consuming method. Other clues were scattered throughout the table that would have been difficult to interpret, albeit quicker. No one actually attempted any other method than the obvious one. Students had to take part in the frustration of trial and error with this puzzle. The learning goals were designed around building upon critical-thinking skills and adapting mental flexibility to iterative search strategies. This includes awareness of using the right keywords to retrieve the best search results. Several groups attempted to search

the database using words they seemingly found at random but were quickly overwhelmed with too many search results. After one or two attempts, they adapted their strategy and eventually solved the puzzle. The puzzle was initially too hard; the pilot group failed to finish because of too many red herrings. As a result, we changed the puzzle to make it easier, but the next group solved the puzzle almost too quickly. We eventually struck a balance on difficulty and the time to solution averaged itself out between the groups. This puzzle became the easiest to solve among the four, with the quickest average turnaround. We decided to keep the difficulty level where it was so that participants might be motivated by the reward of solving a relatively easy puzzle in the beginning.

Puzzle 4: Flickr[10]

For this puzzle, the participants were required to solve a word jumble and interpret clues that would guide their strategic searching and application of the appropriate search limiters. This would help them find an image containing one of the four correct "passwords" to unlock the database and reveal what their professor was hiding.

Flickr, an online photo-hosting platform, offered a way to engage students with visual resources and explore Open Access content through creative commons licensed media. Participants used some unique filters in Flickr that helped them refine their searches, including color, style, size, date, license, content (photo or video), people (the content creator), and social tagging filters/limiters. These limiters are all in the advanced search options, which required the user to move beyond a simple keyword search for success with this puzzle.
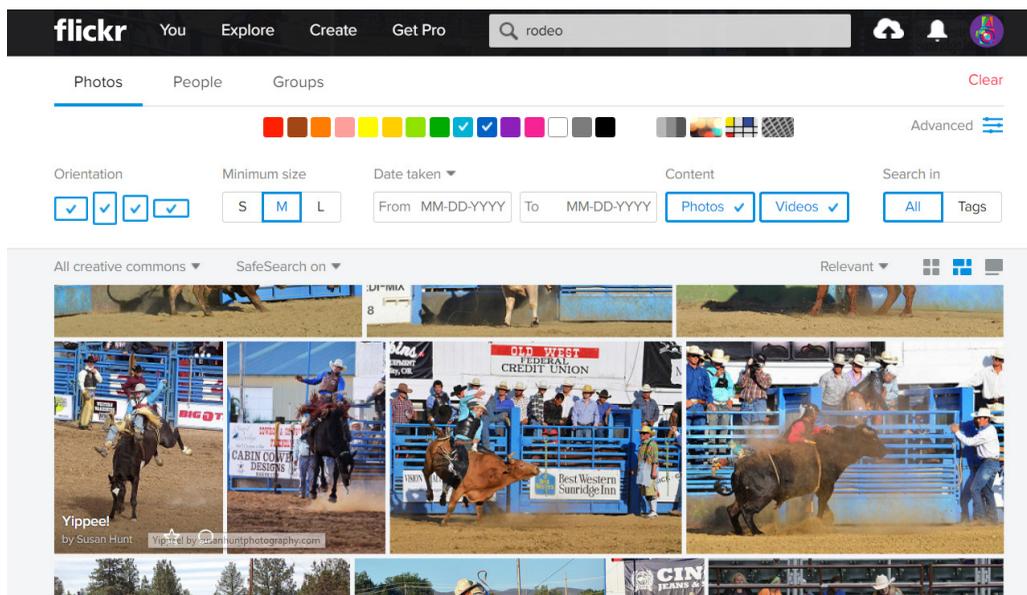

Figure 12.4
Screenshot of Flickr demonstrating filters used to solve the puzzle

Participants navigated the challenges of searching in a database using natural language descriptors and metadata without the aid of standardized subject headings found in traditional library catalogs and subject databases.

The design of this puzzle required participants to experience the iterative process of research and practice using alternative terms or synonyms before identifying the correct solution. In this case, the solution was the password "yippee," which was also the title of the photo. The limiters and other filters that were required to solve this puzzle included the blue and cyan color filters, which were marked on the puzzle envelope, and the creative commons license filter. The title of the photo also had an exclamation mark that needed to be excluded for the password to be correct and was indicated in a clue on the envelope that also included the first name of the photo creator. The word jumble revealed the keyword they would need to use to search in Flickr before applying additional search limiters. To solve this puzzle, participants needed to use both context clues found on the envelope and metadata revealed by hovering the mouse over an image.

Figure 12.5
Physical clues to the keywords used to solve the Flickr puzzle.

This prompted the need to practice visual analysis, use browsing as a search strategy, and to assess metadata.

ACRL Frames

With each of the four puzzles, we attempted to engage students in developing information literacy skills and dispositions. Below are a few examples of how the puzzles were designed to develop dispositions related to the frames Searching as Strategic Exploration and Research as Inquiry. (See Appendix 12B: Learning Goals.)

Searching as Strategic Exploration

Dispositions:
- Exhibit mental flexibility and creativity.
- Recognize the value of browsing and other serendipitous methods of information gathering.

- Understand that first attempts at searching do not always produce adequate results.
- Exhibit mental flexibility and creativity.
- Persist in the face of search challenges and know when they have enough information to complete the information task.[11]

Locating peer-reviewed journal articles, books, images, audio recordings, or any other information source requires knowledge and skills to navigate the appropriate catalog or database. The PLoS database, for example, required participants to enter keywords derived from a list into the database to retrieve the desired article needed to solve the puzzle. Each of these information sources offered its own unique ways for retrieving the needed item. Through the trial-and-error process, participants would come to understand that initial guesses and strategies would require reevaluation and modification until the desired outcome was achieved. In the same way, research requires open-ended exploration across platforms and necessitates that researchers modify their actions based on what their initial attempts yield.

Recognizing the value of browsing and serendipitous searching was a major focus of the Free Music Archive puzzle. The database itself requires this type of searching, which is in contrast to the Project Gutenberg and PLoS databases. However, the design of the puzzle was directed in such a way that it isn't clear that participants actually were engaging in serendipitous searching. It is more likely that they used the directions provided by the clues as a step-by-step set of directions to navigate the database in a way that mimicked serendipitous searching but did not require that mindset. The following year, when we used a similar puzzle design for finding openly licensed video, participants seemed to engage with the search functionality, using visual video preview options to get a sense of the content of the titles. One of the databases, Pexels.com, offers hover previews, which allowed for the participants to visually find more information about the video. In contrast, with the audio files in Free Music Archive, this type of preview was more time-consuming (no hover functionality and no ability to quickly scan or skip through the audio files), and almost no participants chose to try to play music clips. This suggests that the nature of searching for non-visual materials has significant differences that might require more direction or support. One option would be to include instructions to listen to specific tracks to find clues and supply headphones or external speakers to highlight and facilitate listening sessions. The modality of audio has different requirements for creating successful gameplay, just as it has different requirements for searching.

The puzzles gave players an opportunity to demonstrate multiple dispositions of the Searching as Strategic Exploration frame. (See Appendix 12B: Learning Goals.) Each of the dispositions works in conjunction with the others, making library instruction gamification particularly suited for this frame. When gamified, the desire to persist in order to find an answer becomes an end in itself, rather than just a means to that end. The attitudes of the players demonstrated the mental flexibility necessary to complete each of the puzzles. Players demonstrated the iterative nature of research, brainstorming, and keyword searching in each of the databases.

Research as Inquiry

Dispositions:

- Consider research as open-ended exploration and engagement with information.
- Value persistence, adaptability, and flexibility and recognize that ambiguity can benefit the research process.
- Seek multiple perspectives during information gathering and assessment.
- Seek appropriate help when needed.[12]

The participants demonstrated persistence by exploring many creative iterations and combinations of searches and filters before asking for assistance when they recognized that there was not enough information to solve the puzzle or that they needed a new way of thinking about the information already shared with them.

While not limited to this frame, Project Gutenberg lends itself well to promoting the development of dispositions outlined in Research as Inquiry. The participation of multiple partners helped participants work through the simple logic puzzles more easily and forced them to adapt to others' learning styles. This flexibility could be seen with each iterative attempt that they made working through the queries. Working with multiple perspectives gave them the tools they needed to unlock the puzzle more quickly. This became true of all the stations, but noticeable problem-solving took place as participants puzzled through Project Gutenberg in particular. As noted earlier, the easier solvability of this puzzle contributed to the persistence of participants in the other puzzles, perhaps by giving them a sense of confidence and satisfaction.

Persistence, adaptability, and flexibility were particularly evident with the Flickr puzzle, as both the design and some technical issues that occurred required students to practice these dispositions. For each round of the escape room, three hints were available to participants. The participants rarely took advantage of expert assistance when they could have used clarification or guidance in interpreting the puzzle to complete their task until they had exhausted their own strategies. Once they accepted hints, participants solved puzzles quickly because they had already explored the puzzle thoroughly, modifying and adapting approaches as they learned more information or failed at their attempt. In one case with Flickr, where, due to a technical error, the participants could not locate the needed image even with the correct application of limiters, our assistance was the only way for them to solve the puzzle. The participants recognized that even after their many creative attempts and alternative ways of approaching searching for the image, they needed to seek out help when they needed more information or a new perspective, which also connects to the Searching as Strategic Exploration frame and disposition.

Observations

Each session offered a unique glimpse into the workings of group dynamics. The mixture of people dictated the type of learning environment during the session. Some groups were very competitive and worked toward solving the puzzles in the allotted time. For them, finishing was the only acceptable outcome. Others gravitated toward finishing the puzzles

with a less serious approach. For them, having fun was the goal as opposed to finishing at any cost. For both of these types of participants, being able to solve the puzzles was a key factor in satisfaction.

Determining the appropriate level of difficulty proved to be one of our biggest challenges. The participants in the trial run expressed that some of the puzzles they faced were very difficult, which led us to make the puzzles easier for the opening session. In contrast, the participants in the opening session said that they would have liked to see more difficult puzzles. We may have eased the difficulty too much to offset concerns about the puzzles being too hard. One other factor that may have influenced these differences is the participants' previous experience with escape rooms. Our informal pre-session surveys indicated that many of the participants in the trial run had no prior experience with escape rooms. Some had heard of them, but for many, the library's escape room would be the first opportunity they had to participate in one. During the other sessions, some of the students told us that they already had participated in escape rooms. This led us to think that their knowledge of escape room strategy and gameplay helped them solve the puzzles more easily.

We noted different levels of collaboration and strategies during the sessions. In some sessions, groups worked cohesively to solve the puzzles. They would divide themselves into small groups and have each group work on a specific puzzle. Once a puzzle was solved, the participants would join other groups working on the remaining puzzles. This was evident in sessions where friends signed up together, therefore working with people they previously knew. We also found that if we instructed the participants to introduce themselves at the beginning of the session, they were more communicative during the game. For the sessions in which participants were unfamiliar with each other or didn't introduce themselves, we observed less collaboration and communication. This was most evident when the group was a mix of students and staff. These mixed groups had much less communication, likely due to age differences and/or comfort with challenging or questioning people outside of their peer group.

Staff participants seemed to take a more serious approach to the game, likely either feeling more pressure to perform or feeling more of an expectation of success. Some staff members expressed that they felt that they "should have known" the answers because they are already familiar with the library and are seen as experts. Other staff noted that since they already had familiarity with some of the content, they made assumptions based on previous knowledge that caused problems with solving the puzzles and following the provided clues. Staff often finished the game feeling anxious and frustrated by the difficulty of the puzzles, and though they enjoyed the game, they also stated that they felt disappointed with their mistakes.

Even though students experienced varying degrees of frustration and anxiety during the game, they finished with a greater sense of fun and accomplishment. The students were able to see their struggle and persistence as a part of the fun of the gameplay and the success of the solution, rather than as a disappointing experience. This was evident when they were asked about their favorite puzzle: students invariably chose the most difficult puzzle as their favorite, even when they were unable to solve it.

Escape Rooms 2.0

After our success with the escape room, we developed a new set of puzzles over the summer and again for Open Access Week the following year. In the second iteration, we added an element of embedded role-play where participants engaged with a librarian directly. This game asked participants to search for a hidden treasure using primary sources in the HSU Special Collections & Archives. Prior to beginning the game, participants were instructed to utilize the librarian on duty in the event that they needed assistance locating an item. Instead of providing hints, as we did in the Open Access Week version, the librarian provided research assistance. This element was designed to mimic the experience of seeking assistance from a librarian in a real-life research context. The librarian guided the participants in their quest to complete the game but also familiarized them with a foundational library service that any researcher can use to meet their academic, professional, or personal information needs. Additionally, the librarian provided guidance for learners as they developed and carried out their problem-solving strategies, helping to ensure that learning outcomes were met.[13]

For the following year's Open Access Week escape room, each of the puzzles was adjusted to reflect the new theme, which centered around Dr. Ne'er-do-well's new research interests. Overall participation in the sessions increased. Additionally, two campus groups requested to have their own private escape room sessions while a group from the HSU Marketing & Communications Department utilized one of the sessions as a team-building exercise. We made changes to our puzzle, which was fairly easy to do by using the formats from the previous year.

Conclusions, Recommendations, Tips, and Lessons Learned

To help us guarantee and manage attendance for the escape room workshops, we marketed and promoted the events for several weeks. This allowed participants to register in advance for the session they preferred. We wanted to scale the workshops for small groups of no more than eight participants in order to make the experience manageable and to ensure that the participants who signed up were guaranteed their spots. Pre-registration was essential to make this possible. In one session, a pre-registered group did not arrive but we were able to fill the time slot with students who had shown up expecting to drop-in. However, in most cases, having the advance registration prevented the disappointment of showing up and not being able to participate. More importantly, this helped us prevent overcrowded sessions, allowing everyone to participate more fully with the different puzzles.

Improving Gameplay

Escape rooms are often sequential, requiring that one puzzle needs to be solved before the next. For our escape room, we opted to have a non-sequential series of four puzzles in

order for eight to ten participants to engage simultaneously in smaller groups, each focusing on different puzzles. Our rationale for this decision was two-fold. Giving participants a selection of puzzles to choose from would allow for greater involvement. The participants would need to split up into small teams to solve the puzzles in the allotted time. Having every group focus on one puzzle would cause stronger voices and personalities to take the lead while others would not be as involved. Additionally, by having to solve the puzzles in sequential order, there would be a risk that the teams could get stuck on one puzzle and limit their overall progress toward finishing the game in the allotted time. Participants were also able to switch and mix groups when a puzzle was solved or when a group got stuck. The downside to non-sequential puzzles was that each participant was not able to engage with every puzzle.

Overall, we observed many different collaborative and team-oriented strategies that led to the participants engaging with at least two of the puzzles. Other less cooperative approaches appeared when participants were less familiar with each other or were from different social groups. Sessions with staff and student participants that had no previous relationship left some individuals to engage with only one puzzle. To address this, we changed our introduction to encourage participants to think about possible strategies and methods of collaboration that would empower them to feel comfortable moving from puzzle to puzzle.

During our first pilot, we found that it was important not to use too many red herrings, which can be too much of a distraction from the actual clues and thus a barrier to learning. Our test group was distracted by pursuing irrelevant props and clues and were unable to solve all of the puzzles in the limited time frame. For the rest of the sessions, we removed a number of the items meant to mislead. This made the puzzle clues less obscure, focused student attention on the search strategies, and resulted in more of the puzzles being solved within the time limit. That is not to say that the puzzles were made explicitly less challenging, but the challenge now rested on the puzzle complexity. It was also important to scaffold the difficulty of puzzles. Participants often struggled for the first ten to fifteen minutes. However, once they had success solving a puzzle, they appeared encouraged, confident, and motivated to persist in their efforts. Finding the right balance of difficulty depends not only on the perceived ability of the students but also on what goals you are trying to achieve with the puzzle. When creating puzzles for escape rooms, you may ask yourself, "Is the goal of the puzzle to stump them, or is the learning outcome more important than the difficulty level?"

Technology Considerations

With any database or online tool, it is important to recognize that you have limited control over content and your participants may encounter technical or user errors. Changes can occur between sessions and individual participants can cause errors that will directly impact your puzzles and user experience. In order to avoid too many errors, consider your options. In some cases, it may be necessary to log in to an account, if possible. In other cases, using a private tab may be beneficial. With the example from Flickr, we used it as

a teachable moment about why the participants should connect with a librarian if they are struggling to find information that they need. There was also a user error that caused the puzzle interface we created to reset when they pressed an incorrect key. In this case, providing clarity about how the users should interact with the interface for entering the answers and providing extra time to solve their puzzle can assuage frustrations with the technology.

We also had difficulty with the PLoS database in one of the sessions. Again, the participants used the correct search strategy, entered the four keywords into the PLoS database, but the correct article did not show up in the search results. After looking into this issue, we found that the browser cookies prevented the database from displaying the correct article. As a workaround, students in the following sessions searched in the PLoS One Journal, a subset of the PLoS Database. A trial run was conducted prior to the next session, with the required article successfully retrieved. There were no further errors in the remaining sessions. Other possible solutions would be to use a private or incognito browser tab or to clear the browser cache before each session.

Students surprised us with the myriad ways they used available technology to find solutions to puzzles. Even when explicitly told the tabs or browser windows open were all that were needed to solve puzzles, many often tried to find answers through a Google search. This behavior led to time-wasting and distractions that didn't really serve the participants or advance the learning outcomes and goals of the puzzles. To combat this, we offered free hints and guidance as well as better explanations of rules and expectations at the beginning of each session. Overall, students were able to work through technology challenges and ultimately got back on track with help from librarians when their thinking led them astray.

Through our experiences with designing gamified library programming, we have learned lessons that will shape our future programs. It is important to scaffold the escape room experience and, when appropriate, encourage students to seek support in solving the puzzles, just as it is in other areas of information literacy instruction. If possible, have people outside of your team test what you have developed. They can provide insights on the user experience that help you adjust your activities to find the right balance of difficulty and ease, as well as discover potential issues that need to be addressed prior to public participation. While it is impossible to predict how each group will work toward solving the puzzles, do encourage the participants to collaborate and help each other, reminding them that they succeed or fail as a team.

Our classroom choice and setup afforded us the opportunity to observe the group successes and struggles with the puzzles as the game unfolded. Some groups achieved a correct answer within the first ten minutes of the game by following the clues and conducting the correct inquiries in our chosen databases. Other groups were led astray by our red herrings or skipped important steps that would have led to a correct answer sooner. We found each group's strategies and levels of collaboration to be unique. Each individual's strengths varied, but this was not a barrier to success. They each brought their own prior knowledge and experience, which we noted previously from the Information Investigator activity was important to foster creative problem-solving in this experience

and improve engagement. During gameplay, we encouraged them to use hints for help when they felt they needed it and to use their own prior knowledge and experience to solve problems creatively. We anticipated student failure and offered multiple attempts to solve each puzzle. The participants were generally competitive and they expressed an expectation to win the game. This competitiveness and expectation of success also led many groups to refuse hints despite consistent reminders from the librarians.

Our successes in delivering gamified learning programs reflect a team effort. We met—and still meet—often to share ideas and implement our visions for these activities. Collaboration is crucial in the delivery of active learning programs, as each activity requires a concerted effort to deliver an educational and positive experience for the participants. In addition to working together, we allowed each other to pursue our own visions in the creation of a puzzle. The people you collaborate with will have unique perspectives and ideas that can blend well with what you develop on your own. Engagement with the participants before and after each activity provides feedback that can help improve the learning experience. Learn from those who participate in your activities. Their input can inform your planning and implementation.

For future escape rooms, there are ways we have improved the experience for the participants. We now foster greater team collaboration by having the participants introduce themselves at the beginning of each session while also emphasizing that they succeed or fail as a team. Our continued use of pilot escape rooms will afford us opportunities to make adjustments in our clues and puzzles so as to be clear in our instructions to the participants. A deeper discussion about open access resources prior to each session will provide participants with additional context and a better understanding of the value of such resources. Such a discussion is needed to demonstrate how the research process is a lifelong endeavor that does not end with completing a degree, nor should it be assumed that research skills are only applicable in an academic context.

Designing gamified information literacy instruction can be a manageable and enjoyable endeavor that allows for effective team teaching and collaboration. The process of designing and hosting the games has also been a creative outlet for us. Given the success of this escape room, we intend to keep pursuing and experimenting with gamification, which we have found is an engaging way to teach information literacy and to improve library outreach and promotion.

Appendix 12A. Escape Room Rules

1. You have 35 minutes to unlock the computer program.

2. You are allowed to ask for 3 hints. To get a hint, knock on the Dutch Door (by the big screen).

3. The black keyboard on the cart is used to enter the passwords to unlock the computer program.

4. The hanging art does not have clues and is not part of the game. Please don't touch the artwork.

5. Leave the computer and screen cables in place. If they are pulled out or switched off, you will not be able to continue the game. Do not damage the computers, keyboards, monitors, etc.

6. Only access files that are on the desktop or in the web browser.

7. Keep all clues, puzzles, solutions, etc. to yourself/group so that groups after you can enjoy the experience.

8. Do not stand or climb on the furniture in the Co-Lab. All clues/puzzles will be reachable by standing on the floor.

Appendix 12B. Learning Goals

DISPOSITIONS	**Frame: Research as Inquiry**	
	Appreciate that a question may appear to be simple but still disruptive and important to research.	Puzzle 2
	Value intellectual curiosity in developing questions and learning new investigative methods.	Puzzle 1; Puzzle 4
	Maintain an open mind and a critical stance.	Puzzle 3
	Value persistence, adaptability, and flexibility and recognize that ambiguity can benefit the research process.	Puzzle 4; Puzzle 2
	Seek multiple perspectives during information gathering and assessment; seek appropriate help when needed.	Puzzle 4
	Demonstrate intellectual humility (i.e., recognize their own intellectual or experiential limitations).	Puzzle 3

DISPOSITIONS	**Frame: Searching as Strategic Exploration**	
	Exhibit mental flexibility and creativity.	Puzzle 3; Puzzle 2
	Understand that first attempts do not always produce adequate results.	Puzzle 1; Puzzle 3
	Realize that information sources vary greatly in content and format and have varying relevance and value, depending on the needs and nature of the search.	Puzzle 2; Puzzle 3
	Seek guidance from experts, such as librarians, researchers, and professionals.	Puzzle 1–4
	Recognize the value of browsing and other serendipitous methods of information gathering.	Puzzle 2
	Persist in the face of search challenges, and know when they have enough information to complete the information task.	Puzzle 1–4

Appendix 12C. Project Gutenberg Puzzle

Page 1
Dear Diary,
I saw the greatest show on Earth today! A man called Richard read from the funniest book about a cross-eyed cob roller. If only I could remember the author's **last name**. I need it to unlock my security code. Thankfully, I left myself clues. Maybe I can find it on Project Gutenberg?

LYLAS,
Dr. Ne'er-do-well

Page 2
Clue: Another word for silent.

		i		

[Answer: Quiet]
Clue: It began before this, and it'll continue forever. Make Fibonacci proud.

1	2			8

[Answer: 1, 2, 3, 5, 8]

Page 3
Clue: After leaving the beach, my feet are always

[Answer: Sandy]
Clue: The even progression between the beginning of this decade and next year.

		14		

[Answer: 10, 12, 14, 16, 18]
Page 4

*The layout of the clues on the page was important. On the final page two boxes, one blank and one containing random numbers with the words "Search for me" was shown, as follows:

10	1	2	3	14	8	18

[Answer: Squinty]

Endnotes

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