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# **Crowdsourcing cultural heritage metadata through social media gaming**

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## Abstract

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Crowdsourcing has been used in the cultural heritage domain for a variety of tasks. One of them is generation of descriptive metadata for digital archives. Gamification offers citizens a more entertaining way to interact with digital collections and generate useful metadata as a side effect of gameplay. The rise of social gaming on Facebook in recent years opens new horizons for cultural heritage institutions to leverage the capabilities of social networking platforms and to gain immediate access to millions of potential contributors. In this work, we explore the integration of social networks with crowdsourcing games for generating archival metadata. We studied crowdsourcing, gamification and social dynamics from the perspective of cultural heritage and combine their features in a metadata game prototype on the Facebook platform. We tested our prototype and evaluate its results by analysing participation, contribution and player feedback. The two-week testing phase showed promising results in terms of user engagement and produced metadata: almost 3000 tags were added, 90% of which were valid dictionary terms. We conclude that deploying metadata games on social networking platforms is a feasible method for digital archives to harness human intelligence from large shared spaces.

**Keywords:** crowdsourcing, gamification, cultural heritage, digital archives, metadata, tagging, social games, social networks, Facebook, games with a purpose, casual games

## Popular science summary

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Modern practices of archiving cultural heritage embrace technology for preserving archival content and making it accessible to general public in digital format. The availability of open data makes it possible to interact with digital archives by means of software applications. This approach allows citizens not only to consume content but also to execute useful tasks that require human intelligence, such as providing descriptive annotations – or “metadata” - for archival objects. Offering these activities as games has been a popular practice to motivate public participation and sustained contribution. Nowadays, games on social networks have grown into an industry that attracts more players than any other class of online games. Facebook demonstrates the phenomena when a social networking website is becoming just another place for people to play games, with more than 1 million of monthly active players. However, there seems to be little or no presence of social media games for cultural heritage.

In our research we attempted to fill this gap by investigating possible ways of deploying “metadata games” for digital archives on social media platforms. Our study of game design for digital archives and social networks resulted in the set of features and design guidelines to enable such integration. We applied some of these principles and functionalities in a Facebook game prototype called Art Collector. In this game, players compete with each other for “art pieces” from the game’s photo collection. The gameplay is centered around two main activities: annotating images with keywords (“tags”) and guessing tags of other players. As a side effect of gameplay, user-generated metadata are gathered. In addition, automatic validation of metadata takes place when two or more players agree on a tag for the same image.

To evaluate the prototype, we used various metrics of participation and contribution, as well as a survey to get players’ feedback. Promotion of the game on Facebook groups showed steady growth in participation and the players’ interest was also supported by their feedback. Over two weeks of testing, the game was played by 103 users and more than a half of them were returning players. The manual inspections of contributed metadata revealed that nearly 95% of contributed tags were meaningful one-word keywords or two-word phrases correctly spelled in English language.

The prototype showed good potential of using games on Facebook for gathering user-generated data for digital archives. Some of the possible advantages include huge social graph of potential contributors, mechanisms of viral promotion, personalized gameplay, lack of registration barrier, use of micro-transactions for raising funds, and so on. Among possible caveats we identified privacy issues, misuse of notifications, platform instability and potentially high maintenance and marketing costs.

Metadata games for mobile space and multiple social networks, as well as ecosystems of social games for cultural heritage collections are proposed for future work.

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## List of Acronyms

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GLAM	Galleries, Libraries, Archives, Museums
GWAP	Games With A Purpose
MVC	Model – View - Controller
OCLC	Online Computer Library Center
OCR	Optical Character Recognition
OSN	Online Social Network
SCG	Social Change Games
SDK	Software Development Kit
SOCH	Swedish Open Cultural Heritage

# 1. Introduction

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*“Archiving is not just located in the past, it occurs in the present, and it impacts the future”[1]*

## 1.1. Project idea

This master thesis is inspired by the Living Archives project<sup>1</sup>, which studies the phenomena and the modern practices of archiving public cultural heritage with the aim of making it accessible to everyone. The “openness” of digital archives has an interactive nature: citizens are given the opportunity to become active contributors rather than passive consumers of archival content. Games with a purpose of generating useful data or performing certain tasks for digital archives have been a subject of recent studies. Our work continues the research of Ridge [7], who studied the design of “crowdsourcing games” in the cultural heritage sector. As an extension of this research, we explore how and why to deliver this type of games on social networks on the example of Facebook.

## 1.2. Background and motivation

Nowadays, many cultural heritage organizations such as Galleries, Libraries, Archives and Museums (GLAMs) turn to massive digitization of information to secure the long-term preservation of valuable archived material [3]. However, for opening up cultural heritage collections the digitization itself is not sufficient. A key factor for the discoverability of objects in digital archives is the availability of metadata [30]. The metadata are descriptive annotations that accompany collection items and allow them to be found via searching and browsing tools. Over the years, GLAMs themselves were responsible for providing metadata for the collection objects with the aid of professional cataloguers [3,30]. This way, the produced metadata are often limited by the vocabulary and the perspective of a particular institution. Therefore, it is important to fill the semantic gap between experts and general public. One way to address this problem is to create a platform of collaborative metadata generation using such methods as crowdsourcing and gamification [1].

Crowdsourcing is a form of outsourcing, where tasks are directed to the crowd by means of an open call mostly via the Internet platform [2]. The concept of crowdsourcing has been applied on a wide range of projects across the globe, which demonstrated the power of public participation in strengthening cultural heritage. In particular, social tagging has become a popular way for institutions to explore the potentially positive implications of presenting their collections online [3]. Since 2005, the Steve.Museum<sup>2</sup> social tagging project managed to gather 551,947 user-generated

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<sup>1</sup> <http://medea.mah.se/2012/11/living-archives/>

<sup>2</sup> <http://www.steve.museum/>

terms for 96,896 objects in its collection [29]. Perhaps a better known example is Flickr Commons<sup>3</sup>, which was launched in 2008 as a photo-sharing platform for cultural heritage collections. In a five-year period, over 165 thousands of comments and nearly 2 million tags have been added by the Flickr community [5]. The potential of crowdsourcing in social media is observed from statistics: 72 hours of videos and 2500 photos are uploaded to YouTube and Flickr every minute, and in total 35% of Internet users have contributed a piece of user-generated content at least once [3,31,32].

Certain cultural heritage organizations have taken the direction towards gamification of crowdsourcing in attempt to seamlessly integrate computation and gameplay. Gamification is defined as “the use of game design elements in non-game contexts” [19]. The concept of bringing game mechanics into crowdsourcing applications appeared in 2008 under the name “Games With A Purpose” (GWAP) [9]. The authors of GWAP believe that the gamification approach to crowdsourcing is motivated by three factors: a) an increasing proportion of the world’s population has access to the internet; b) certain tasks are impossible for machines but easy for humans; c) people spend lots of time playing games on computers. Ridge [7] calls games “participation engines”, which attract people who wish to have fun with creating valuable content. A number of GLAMs adopted this approach by offering metadata games for their audiences, i.e. games that play with words to produce better data for their collections. These projects have demonstrated that gamification in many cases can be a better alternative to other crowdsourcing interfaces.

Apparently, the success of metadata games is not accidental. Nielsen [6] reports that online games have become the second most heavily used online activity behind social networks, holding the biggest share of U.S. Internet time. Moreover, social gaming continues to grow in terms of frequency and hours per week played, with 71% increase or nearly 120 million people playing social games in 2011 compared to the preceding year [4]. In this respect, Facebook remains the top attraction of social gamers, 91% of whom regularly visit this platform to play games [4]. From her research, Ridge [7] concludes that “Facebook seems to be a good place to promote games”. Furthermore, in one of her interviews she noted: “I’d also love to explore social game dynamics more” [10], pointing at the fact that existing metadata games still lack strong social layer in gameplay, which is prominent in social games. While game content is obviously an important part of a game, in today’s settings the social side of what happens to the players, their friends, family members and communities matters no less [21]. At the time of writing, search on Facebook did not reveal any crowdsourcing game for cultural heritage. All the above indicate that the integration of social networks and crowdsourcing games remains largely overlooked area worth exploring.

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<sup>3</sup> <http://www.flickr.com/commons>

### **1.3. Living Archives at Medea**

Living Archives is a project funded by Vetenskapsrådet (The Swedish Research Council) and carried out at the Medea research center. The project aims to revitalize dormant public archives with the aid of contemporary practices associated with open data, social networking, mobile media, storytelling, gaming, and performing arts [1]. The goal of the project is to turn the digitized cultural heritage material into a significant social resource that could raise cultural awareness and pave the way for a shared future of a society. The project addresses the problem of bridging official archival material and public participation by building a platform of collaborative content generation. The project is comprised of two concurrent research strands: Performing Memory and Open Data. This master thesis is related to the Open Data strand led by Gustafsson Friberger, which explores opening the content of archives from the technological perspective.

### **1.4. Goal and research question**

The goal of this master thesis is to explore the integration of social networks with crowdsourcing games for generating archival metadata. This is examined by building a functioning crowdsourcing game prototype on top of a social media platform.

In this work we will seek to answer the following research question:

RQ: How can gamification on social networks contribute to crowdsourcing metadata for digital archives of cultural heritage?

### **1.5. Hypothesis and contribution**

Based on the aforementioned facts and figures, the hypothesis of this master thesis is that by building metadata games on social networks we can produce a class of more productive, personalised and participative crowdsourcing games for cultural heritage institutions.

By developing a metadata game for Facebook, we expect to demonstrate how certain native features of social networks can be used to diversify gameplay, attract more contributors and generate useful metadata for digital collections.

### **1.6. Outline**

The report is structured in six chapters. It starts with an introductory chapter that gives insight into the problem area and motivates the particular direction of the research. The second chapter describes the methodology that we used to conduct a research. The third chapter is a theoretical exploration of the key areas of interest of our research. It also reflects our study of existing applications relevant to our prototype. The design of the prototype is described in details in Chapter 4 and its evaluation is

presented in Chapter 5. Based on our findings, Chapter 6 concludes the study and expresses our considerations for further research.

## 2. Methodology

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This chapter describes the three methods used to conduct the research: literature review, design and creation, and a survey. It also describes the process of evaluation.

### 2.1. Literature review

The purpose of the literature review is to form the conceptual framework for the research [27]. In this work the conceptual framework is built around three areas of interest in the context of cultural heritage: crowdsourcing, gamification and social dynamics (Figure 1). The theoretical exploration of these concepts and bringing them together are essential steps to answering the formulated research question. Moreover, this part of the research aims to examine existing works and applications, identify gaps in previous research works, and build the ground for the design of the prototype.

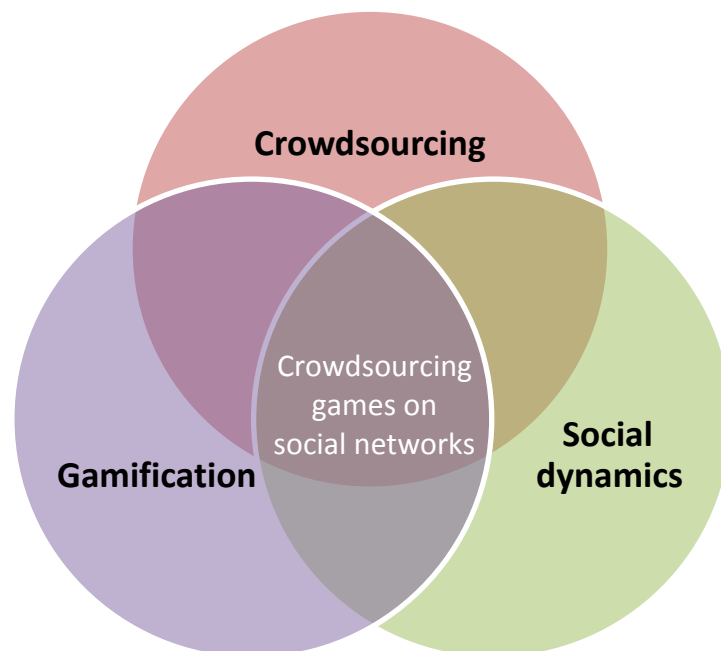


Figure 1. Conceptual framework

Another type of the literature study used in this research is aimed at consulting the technical documentation required for the development process. This includes reference manuals, tutorials, Facebook developer's documentation, specialised forums and other sources of technical information. This type of literature study is performed during the prototype development phase.

For the most part, the sources for the literature review were found via the Internet, which is considered as a very important resource for researchers [27]. Online search was performed on Google and Google Scholar using keywords *crowdsourcing*, *gamification*, *casual games*, *social gaming*, *cultural heritage on social media*, *facebook development*, *facebook social features*, etc. Certain sources were obtained

directly from the references section of publications cited in this thesis. Literature sources that we use in this research include journal articles, books, conference, symposium, and workshop proceedings, dissertations, reports, white papers and technical documentation mentioned above.

## **2.2. Design and Creation**

This master thesis follows a design science paradigm, which is characterized by two main activities: build and evaluate [28]. The method of building a new IT product, or “artefact”, is called design and creation [27]. The particular research method was chosen because it allows to demonstrate the solution to the research problem in practice. In this work, the output of design and creation is an “instantiation”, i.e. working artefact realised in its environment [28]. In particular case, game prototype serves as an artefact, whereas the social network constitutes its environment. The process of design and creation of the game prototype is divided in three stages: design, implementation and testing.

### **2.2.1. Prototype design**

The product of this stage is the prototype of a crowdsourcing game deployed on the social networking platform. To achieve this goal, we studied existing crowdsourcing games for cultural heritage, design principles for creating such games, as well as the design of social media games. Finally, we combined our findings to produce and test the resulting output, which is the game prototype called “Art Collector”. The game design is discussed in detail in Chapter 4.

### **2.2.2. Prototype implementation**

This stage has the purpose to develop a browser-based application and integrate it with a social network. The initial phase of the game implementation included determining the set of tools necessary to build the application as well as the content provider offering access via API. The implementation entails both server-side and client-side programming with the use of platform-specific SDKs. This phase also entails the implementation of the survey, which is incorporated into the gameplay. The working game prototype is produced as the output of this stage. The game build is described in more detail in Chapter 4.

### **2.2.3. Prototype testing**

As soon as the game prototype was ready, it entered the testing phase lasting two weeks. During this period, the prototype was tested in real conditions to produce the data for analysis of user participation and contribution. The process of analysis is described in Section 2.4. The results of the performed analysis are discussed in Chapter 5.

### **2.3. Survey**

Surveys are used to systematically collect the same type of data from a large group of people and draw generalized conclusions based on the data analysis [27]. In this work, the purpose of the survey is to obtain players' impressions of the game and their suggestions for its further improvements. Thus, application users are asked to complete a short questionnaire about their playing experience.

The particular data collection method was preferred over other methods because it offers the possibility to obtain brief, uncontroversial, and standardized data from a large and geographically dispersed population [27]. It helps to answer the research question by assessing the playfulness of the game from the players' perspective.

The design of the questionnaire was conducted with the aid of the evaluation guide for surveys by Oates [27]. On the one hand, the questionnaire should be kept as short as possible so as to avoid users skipping on it; on the other hand, it should provide sufficient and meaningful feedback to ensure proper evaluation. For this reason, we designed a short 4-page survey comprised of two open questions, two closed questions, and five scale questions. The complete questionnaire with screenshots is presented in Appendix B.

The survey was designed to be an integral part of the game. The important step during its implementation was to determine at which stage of the game players should be asked to complete a survey. The solution that we found most reasonable is to show the invitation to answer the questionnaire after a player completes the full cycle of the game, i.e. its both rounds (the gameplay is described in Chapter 4). The "Survey" button is shown on the message window that pops up to congratulate a player on their winning (see Figure A10). As an incentive to participate, a player is rewarded with points upon completing the survey.

### **2.4. Evaluation**

As mentioned in Chapter 2.2, this master thesis follows the design science paradigm. The next step after building an IT artefact is evaluation, whose purpose is to define metrics and then assess the performance of the artefact against those metrics [28]. In the design and creation research method, three types of artefact evaluation are possible: proof of concept, proof by demonstration, and real-world evaluation [27]. The nature of this research allowed us to perform the real-world empirical evaluation of the prototype, which operated in real-life social networking environment and without any constraints in regard to the target group. The evaluation is undertaken by analysing data gathered during the testing phase. To recruit game testers, we promoted the game on Facebook groups. Game promotion is described in more detail in Section 5.1.1.

We measure and analyse player participation and contribution as well as survey results using quantitative and qualitative methods.

### **2.4.1. Quantitative analysis**

The majority of game's statistical data (player retention, number of inactive players, number of participants in the survey, etc.) were obtained by querying the database at the end of the testing period.

For monitoring daily dynamics of user participation and contribution, we created a statistics table in the database. At the end of each day of the testing period, sums for monitored parameters (e.g. number of users, number of tags, etc.) were automatically calculated and added as a separate record in this table. On the last day, we visualized data from the statistics table and used that day's measurement for each parameter as our final results.

For platform-specific statistics such as published stories and user demographics we used Facebook analytical tool called Insights.

Ordinal data from the scale questions in the survey were calculated as percentages and visualized as pie charts.

### **2.4.2. Qualitative analysis**

Qualitative data that we analyse are user-generated tags and players' responses to the open questions in the survey.

The analysis of user-generated tags was done by manual checking each tag in the database at the end of the testing phase. First, identification of various categories of user input was done (e.g. single-worded tags, two-word phrases, misspelled words, etc.). After that, we used numerical analysis of these data to find the number of tags in each category (see results in Section 5.2.2).

Similar procedure was followed for the analysis of player responses to open questions. First, we looked for patterns in the data to derive concepts related to various aspects of the game. Then, we categorized user feedback by positive and negative in relation to these concepts. Finally, we counted responses in each of the identified categories. Some creative responses of general nature were grouped together as suggestions for future improvements of the game. The results of this analysis are presented in Section 5.3.4.

## 3. Literature review

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This chapter gives insight into the concepts and sample applications that form the theoretical framework described in Section 2.1 from the perspective of cultural heritage. In Section 3.1 we describe crowdsourcing starting from its roots and follow its expansion on the cultural heritage sector. In Section 3.2 we define gamification and introduce concepts of social gaming and games with a purpose, supported by examples. In Section 3.3 we outline the role of social media in cultural heritage, introduce social gaming and pinpoint some important features of social networks relevant to the purpose of our research.

### 3.1. Crowdsourcing in the cultural heritage domain

#### 3.1.1. Introduction to crowdsourcing

The term “crowdsourcing” is a technical neologism derived from words “crowd” and “outsourcing”. The term was popularized by Howe [11] in his 2006 article “The rise of crowdsourcing” of the Wired magazine. Outlining the trend of harnessing distributed intellectual resources of the Internet after the example of open source movement and projects such as Wikipedia, eBay and MySpace, Howe concludes: “It’s not outsourcing; it’s crowdsourcing.”.

The wide adoption of the term by the online community has led to numerous and often contradictory variations of its definition. To reduce the semantic confusion among researchers, Estellés-arolas & González-ladrón-de-guevara [14] performed an exhaustive literature study to produce a definition of the term covering all aspects of crowdsourcing. The study resulted in the following definition:

*Crowdsourcing is a type of participative online activity in which an individual, an institution, a non-profit organization, or company proposes to a group of individuals of varying knowledge, heterogeneity, and number, via a flexible open call, the voluntary undertaking of a task. The undertaking of the task, of variable complexity and modularity, and in which the crowd should participate bringing their work, money, knowledge and/or experience, always entails mutual benefit. The user will receive the satisfaction of a given type of need, be it economic, social recognition, self-esteem, or the development of individual skills, while the crowdsourcer will obtain and utilize to their advantage that what the user has brought to the venture, whose form will depend on the type of activity undertaken.*

Despite that the term first appeared in 2006, crowdsourcing-like activities in the form of various contests were successfully practiced by institutions long before the Internet era [2]. The first online crowdsourcing platform called InnoCentive was built as early as 1998 by the pharmaceutical company Eli Lilly [2]. The platform specializes in crowdsourcing innovation problems to its 270,000 registered solvers from nearly 200 countries as of 2012 [13]. During the last decade, a great variety of other crowdsourcing projects have emerged in a wide range of domains, such as science

(Fold it, Galaxy Zoo), industry (Velvet Brigade, FashionStake, Threadless), healthcare (PatientsLikeMe, Webicina, Medting), law (LawPivot, LawDingo), and more.

### **3.1.2. Crowdsourcing initiatives of GLAMs**

This raises the question: what is in it for cultural heritage? In fact, cultural heritage is probably one of those domains to which the model of crowdsourcing is a perfect fit. Unlike other projects seeking to source the labour from the crowd, cultural heritage organizations put a different meaning in crowdsourcing: they offer citizens the opportunity to deeply engage in production, development and enhancement of their digitized memories of the past [16]. This is best described by Owens [17]:

*What crowdsourcing does, that most digital collection platforms fail to do, is offers an opportunity for someone to do something more than consume information. When done well, crowdsourcing offers us an opportunity to provide meaningful ways for individuals to engage with and contribute to public memory. Far from being an instrument which enables us to ultimately better deliver content to end users, crowdsourcing is the best way to actually engage our users in the fundamental reason that these digital collections exist in the first place.*

Thus, numerous crowdsourcing projects succeeded to attract masses of “engaged enthusiast volunteers” eager to help organize and contribute to public memory [16].

A lot of archival material that has been digitized is often of poor quality and remains virtually inaccessible due to the lack of semantic annotations. As mentioned earlier, manually enhancing digital archives with the help of professional cataloguers is too costly, time-consuming and often results in specialized content that is incomprehensible hence undiscoverable for a casual visitor [7]. So why not ask visitors to provide corrections or meaningful annotations in their own words? Interestingly, the analysis of 36,981 user-generated terms contributed to *steve.museum* – a social tagging research project for museum collections - showed that 86% of these terms were totally different from the vocabulary used by museum experts [15]. Nevertheless, 88.2% of these terms were deemed useful for locating collection items via online search, according to museum staff [15].

Public participation in digital archiving is not restricted by metadata generation. Oomen & Aroyo [3] identify 6 types of crowdsourcing in the cultural heritage domain, summarized and exemplified in Table 1.

Table 1. Types of crowdsourcing in cultural heritage [3]

Activity	Example
Correction and Transcription	<i>Australian Newspaper initiative</i> <sup>4</sup> : correcting OCR'ed text of digitized newspaper pages. <i>Transcribe Bentham project</i> <sup>5</sup> : transcribing the manuscripts of the philosopher and jurist J. Bentham
Contextualization (wiki-style platforms)	<i>The Netherland Institute for Sound and Vision</i> <sup>6</sup> : a wiki platform to gather contextual information on television programmes, broadcasters, presenters, etc. <i>Wikipedian in residence</i> <sup>7</sup> : detailed curation of Wikipedia pages on masterpieces from the collection of the British Museum
Complementing Collections	<i>UK SoundMap project</i> <sup>8</sup> : recording and uploading sounds accompanied with contextual metadata via a smartphone. <i>Wir Waren So Frei</i> <sup>9</sup> : contribution of content and stories related to the fall of the Berlin Wall.
Classification (social tagging)	<i>Flickr: The Commons</i> <sup>10</sup> : adding tags to photography collections of cultural heritage institutions <i>steve.museum</i> : adding tags to artworks from participating museums
Co-curation	<i>Kröller-Müller Museum</i> <sup>11</sup> : inviting children to select their favourite landscape from the museum's collection. <i>DR Bonanza project</i> <sup>12</sup> : inviting the audience to vote for their favourite show from the archive collections to be digitised and made available on-demand first.
Crowdfunding	<i>The Louvre</i> <sup>13</sup> : recruiting online donors to buy a Renaissance painting by Lucas Cranach the Elder.

Thus, the “crowd” in the cultural heritage domain is comprised of passionate volunteers of all kinds: hobbyists, collectors and even children, each of whom can engage in meaningful activities for social good. The most popular of these activities, according to the survey by OCLC [18], are commenting and annotating, followed by tagging. The next chapter will explore how metadata generation methods can be facilitated through the use of gamification techniques.

<sup>4</sup> <http://www.nla.gov.au/australian-newspaper-plan>

<sup>5</sup> <http://blogs.ucl.ac.uk/transcribe-bentham/>

<sup>6</sup> <http://www.neutelings-riedijk.com>

<sup>7</sup> [http://outreach.wikimedia.org/wiki/Wikipedian\\_in\\_Residence](http://outreach.wikimedia.org/wiki/Wikipedian_in_Residence)

<sup>8</sup> <http://sounds.bl.uk/>

<sup>9</sup> <https://www.wir-waren-so-frei.de>

<sup>10</sup> <http://www.flickr.com/commons>

<sup>11</sup> <http://www.kmm.nl/>

<sup>12</sup> <http://www.dr.dk/Bonanza/index.htm>

<sup>13</sup> <http://www.louvre.fr/en/acquisition-three-graces-lucas-cranach>

## 3.2. Gamification in the cultural heritage domain

### 3.2.1. Definition

The term “gamification” appeared in 2008 and is defined by the Oxford Dictionary [12] as:

*the application of typical elements of game playing (e.g. point scoring, competition with others, rules of play) to other areas of activity, typically as an online marketing technique to encourage engagement with a product or service.*

“Gamification” should not be confused with “serious games”, although the line between them can sometimes be very thin. The product of the latter is a full-fledged game serving a non-entertainment purpose, while the product of the former is a “gamified” application featuring certain game elements [19].

### 3.2.2. Games with a purpose

The concept of “Games with a purpose” (GWAP) was designed in 2008 by von Ahn & Dabbish [9] in attempt to apply gaming practices to crowdsourcing tasks that cannot be automated by computers. In this work authors provided a set of general guidelines for designing games aimed at harnessing collective human intelligence, wherein valuable output is produced as a side effect of enjoyable gameplay.

A classic example of a GWAP is the ESP Game<sup>14</sup>, which pioneered the metadata tagging games genre and served as a prototype for its many successors later developed by GLAMs. In this game, two players are shown the same image and asked to describe it with keywords. Players cannot see each other’s input. When two players come up with the same keyword, they are rewarded with bonus points and the matched keyword is added as a descriptive label for the image.

After the example of ESP Game, the GWAP approach entails the following set of features [9]:

- *Score keeping*, which increases player motivation by establishing a link between effort, performance (winning condition), and outcomes (points). In ESP Game, players are given points when they agree on a keyword;
- *Taboo words*, i.e. words that players are not allowed to enter. They help increase tagging coverage and avoid the input of overused words [8]. In ESP Game, these are labels that were added through agreement and therefore cannot be used again for the same image in the future;
- *Time limit*, which adds more challenge to the gameplay. In ESP Game, tagging a series of 15 images has to be completed in 2.5 minutes;

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<sup>14</sup> <http://www.gwap.com/gwap/gamesPreview/espgame/>

- *Randomness*, which ensures varied difficulty and keeps the gameplay interesting and engaging. In ESP Game, random player selection is used;
- *Player skill levels*, which a player advances through by gathering points. Skill levels help create competitive spirit among players. ESP game presents 5 skill levels starting from “newbie”;
- *High score lists*, which provide extra motivation for extended gameplay. Time-based high score lists provide varied levels of difficulty.

### **3.2.3. Casual gaming**

In cultural heritage, gamification elements of GWAP are usually used in the context of casual games. This is a popular class of games that are aimed at general public who do not naturally consider themselves as gamers [20]. Casual games are lightweight, “sticky” online games with simplified controls and straightforward gameplay, which do not require either previous video gaming skills or fundamental time investment to engage in play [20,21]. Remarkably, casual games are played by 200 million online users each month, with an average of 20-40 minutes per game session [20,22]. In turn, repeated game sessions often last for hours of continuous gameplay [20]. Casual games are designed to be platform-agnostic and target all genders and ages [22]. This is what makes them ideal “crowdsourcing games” [8].

The main design principle of casual games is to “eliminate any possible barrier to someone enjoying the game” [22]. These games are designed to offer rapid progress by using short instructions, short rounds and immediate gratification [8].

### **3.2.4. Gamification initiatives of GLAMs**

In her research, Ridge [8] explores the design of metadata games for improving museum collections. The research yielded the list of possible activities, outputs and validation methods for metadata games in GLAMs, presented in Table 2.

Table 2. Types of activities in metadata games [8]

Activity	Output	Validation
Tagging	Tags, folksonomies, multilingual term equivalents	Validation through agreement; automated validation on common terms
Debunking (e.g. providing corrections, flagging content for review)	Corrected data	Flagging tags, links, facts for review Not suitable for subjective personal stories
Storytelling	Personal stories; contextualising detail; eyewitness accounts	Careful moderation
Linking (e.g. objects with other objects, objects to subject authorities, objects to related media or websites)	Relationship data; contextualising detail; information on history, workings and use of objects; illustrative examples	Validation through repetition; preference selection, debunking, recording followed links
Stating preferences (e.g. choosing between two objects; voting; 'liking')	Preference data, selecting subsets of 'highlight' objects or 'interestingness' values for different audiences; providing information on reason for choice	Can help validate most forms of data based on predefined value
Categorization (e.g. applying structured labels to a group of objects, collecting sets of objects or guessing label or relationship between presented set of objects)	Relationship data; preference data; insight into audience mental models; set labels	Validation through agreement (e.g. repeated labels or overlapping sets)
Metadata guessing games (e.g. guess which object in a group is being described)	Tags; structured tags (e.g. 'looks like', 'is used for', 'is a type of')	Successful clues provide validation through agreement
Creative responses (e.g. description of object's purpose)	Relevance, interestingness, ability to act as a social object; common misconceptions	Criticism from other players

Ridge's empirical study of crowdsourcing games design revealed that [7]:

*A well-designed crowdsourcing game can be more fun and more productive than other crowdsourcing interfaces. Not only does good game design entice more people to make their first contribution, but games are also designed to motivate on-going participation. Just as games have been called 'happiness engines', crowdsourcing games could be called 'participation engines'.*

Several GLAMs have successfully implemented crowdsourcing games to offer visitors a more enjoyable and engaging way to interact with their digital collections. Some of the well-known examples include:

- “Tag! You’re it!”<sup>15</sup> by Brooklyn Museum, for tagging objects in collections;
- “DigiTalkoot”<sup>16</sup> by the National Library of Finland, for word fixing tasks;
- “Alum Tag”<sup>17</sup> by Rauner Rauner Special Collections Library at Dartmouth College, for tagging photograph collections donated by Dartmouth alumni to the college’s archives;
- “Waisda?”<sup>18</sup> by the Netherlands Institute for Sound and Vision, for annotating TV Shows

Some activities presented in Table 2 are not so much “fun” on their own, tagging included. However, when offered as casual games with well-thought game mechanics, they can become compelling and entertaining experiences. It is worth noting that gamification approach received criticism for enticing people into doing work via “gaming tricks” instead of letting them be a part of something bigger, which is a deep interaction with their past through digital collections [17]. To address this problem, we believe that crowdsourcing games should provide players with a clear picture of what they are playing with, what they generate and how it will be used.

### 3.3. Social dynamics

#### 3.3.1. Role of social media in cultural heritage

The vast popularity of online social networks (OSN) found a keen and timely response among cultural heritage organizations for their role of a central platform that enables closer interaction with their patrons and facilitates the creation, use, and sharing of information [23]. Small GLAM organizations with limited resources can take advantage of social networks to make their digital collections available to wider audience, whereas large organizations can benefit from the increased exposure of their collections, since their own user communities often socialize with each other on social media [18]. Deeper engagement with online community is achieved via OSN’s communication channels, which include posts, news feeds, comments, status updates, private messages, synchronous chat features, and so forth [23]. According to Dimaraki *et al.* [26], the investment of cultural heritage institutions in social media practices aims to:

- *make the cultural heritage institution attractive to broader and more diverse audiences*
- *encourage active exploration of physical exhibits and online collections*

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<sup>15</sup> [http://www.brooklynmuseum.org/opencollection/tag\\_game/start.php](http://www.brooklynmuseum.org/opencollection/tag_game/start.php)

<sup>16</sup> <http://www.digitalkoot.fi/>

<sup>17</sup> <http://metadatagames.dartmouth.edu/alum/www/index.php/games/ZenTag/>

<sup>18</sup> <http://woordentikkertje.manbijthond.nl/>

- *collect valuable audience generated content (ratings, recommendations, crowdsourcing)*
- *engage audiences in meaningful dialog around the content shared by the cultural heritage institution*
- *build and sustain an active online community of interest for the cultural heritage institution*
- *enrich the curatorial narratives with local knowledge and popular memory*
- *claim and define the relevance of the cultural heritage institution to the activities and concerns of its community*

In addition, authors outline two approaches to engaging in social media practices:

1. Building a custom platform for social participation around digital collections
2. Participatory activities that use existing functionalities of popular social media

An example of the first approach is the Posse Community<sup>19</sup> created by the Brooklyn Museum on their web portal. The social platform supports tagging, commenting and saving favourite objects.

Far more common is the second approach that allows GLAMs to leverage the potential of social media. For instance, the Flickr Commons project<sup>20</sup> launched in 2008 provided a specialized environment for cultural heritage institutions where they could merge their content to achieve a greater level of interaction with a large online community [24]. Flickr's in-built social features such as tags, notes and comments result in social dialog that helps institutions learn more about their audiences [24]. In addition, user comments and annotations have proven invaluable for some organizations, which incorporated them back to their own records [25]. In January 2013, Flickr Commons celebrated its 5-year anniversary with astonishing figures: more than 250,000 images have been uploaded from 56 different archives, libraries and museums, which produced more than 165,000 user comments and 2 million tags [5].

Naturally, hosting content on social networks is not without its trade-offs. These are summarized in Table 3 [18].

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<sup>19</sup> <http://www.brooklynmuseum.org/community/posse/>

<sup>20</sup> <http://www.flickr.com/commons>

Table 3. Trade-offs in hosting content on social networking sites [18]

Pros	Cons
Increased visibility of your collections on sites where your communities are already active	Relying on a third-party for long-term access to user-generated content can be risky
Aggregate your content with content of other organizations. Provides economies of scale	Cannot control how your resources are presented
Take advantage of social media features already offered	Host site's functionality and policies may change without notice. If you stopped using it, will you still have access to the user- contributed content?
Users are already familiar with third-party software	Need to determine how to transfer user-generated content to your own institution's website or catalog
Implement quickly	Be careful about copyright and privacy concerns regarding the content you expose
Incur little to no programming or software development costs	

### 3.3.2. Introduction to social gaming

Just as many GLAMs move their digital collections from private portals to larger shared spaces [24], their crowdsourcing applications can follow the same path thanks to the provided functionality of some OSN to build social applications. Games layered on top of social networks – hereby referred to as social media games – have demonstrated an explosive rise in popularity since the genre appeared in 2007 and constitute the latest innovation in the history of game design [38]. Today, social media games have matured from the state of “social toys” to the products of big business, gaining more players than any other class of games [38]. In this respect, Facebook remains on top of other OSN platforms, with its staggering 1 billion audience and 10 million integrated applications. Unsurprisingly, Facebook is also the platform where social gaming applications have had the biggest impact [21]. For instance, “Farmville” and “Mafia Wars” attract more than 83 million and 25 million active users per month, respectively [21]. To estimate game dynamics on social networks, the following facts are provided by PopCap [4]:

- *Nearly 120 million people play social games*
- *Fun and excitement (57%), competitive spirit (43%) and stress relief (42%) continue to be the top three reasons people play social games*

- *At 91%, Facebook is the social networking website where most social gamers go to play social games, followed by Google+ (17%), MySpace (15%) and Bebo (7%)*
- *81 million people play at least once a day, while 49 million people play multiple times a day*
- *56% said social gaming makes them feel more connected with members of their social network, and that they have made new friends while playing social games (52%)*

Social media games take advantage of the “ready-made” community and encourage deep social engagement and interaction by leveraging the functionalities of the underlying OSN platform. This provides unprecedented possibilities for viral growth by exposing application usage to user’s social network serving as an implicit recommendation for the application [37]. Although the exhaustive study of these functionalities is beyond the scope of this work, the next section presents the outlook at some characteristic features of social networks that are found useful for the deployment of crowdsourcing games.

### 3.3.3. Design of crowdsourcing games for social networks

The main design principle for social games is to create compelling interaction between players by means of communication and self-expression [35,36]. This interaction is also perceived as the key to successful data acquisition from an online community [39]. Therefore, the major design challenge for crowdsourcing games is to enable social interaction and retain players for sustained contribution [39]. To tackle this challenge, we study common design principles and important characteristic features of social media gaming in the context of our research.

Jarvinen [35] formulated a set of design drivers that enable “playfulness” as a characteristic of social media games (see Table 4).

Table 4. Design drivers for playfulness in social games [35]

Design principle	Meaning
Symbolic physicality	Adding physical depth to games (e.g. poking)
Spontaneity	Sense of familiarity with various conventions and behavioural schemas of a game (e.g. giving gifts)
Inherent sociability	Relying heavily on social context as a starting point for concept creation and design
Narrativity	Using narrative rhetoric and propagating it across the network through platforms’ social channels
Asynchronicity	Multi-player game mode, where players play in sequence, not in tandem (turn-based gameplay)

### ***(Meta)data collection***

The commonsense data collection through social games that was studied by Kuo *et al.* [39] has proved that “the emergence of online community presents further opportunity to enrich human computation games”. According to authors’ empirical findings, design elements that enable a community-based game to become successful and sustainable in terms of data collection include:

- *strong affective bonds between members in the communities, e.g. friend-invitation on Facebook*
- *quality-verification mechanism by taking advantage of the communities*
- *behaviour of players affected by their goals*
- *interaction with the responsive players in communities*
- *community-selection according to the features of data to be collected*

### ***GWAP framework for social networks***

Rafelsberger & Scharl [40] studied the design of GWAP for social networks through Sentiment Quiz<sup>21</sup> – a browser-based social verification game for sentiment detection. In a 3-month period, the application received more than 1000 Facebook users who evaluated 30,000 quotes on the US presidential candidates. Based on the results of this game, the authors proposed an application framework for implementation of GWAP on social networks. The framework has the following features:

- Multi-platform support, providing consistency across platforms, generic data repository, caching and plug-in architecture
- Two types of user activity: general and task-specific, allowing developers to focus on handling tasks without having to deal with standard web processing
- Lifestream and notification services through mini-feeds and profile pages, to foster viral growth
- Visualization services, for tracking social network activity using graphs

The authors believe that the integration of various types of games into a common gaming platform can enhance game’s appeal, mitigate cheating, harvest public contribution in a more effective manner by prioritizing tasks across games, and offer players the diversity of challenges.

### ***Social change games for social networks***

The research of Whitson & Dormann [36] focused on how Facebook platform can enrich social change games (SCG) – a specific class of games that aim to cultivate awareness and foster public participation in advancing positive social change. In our view, this category is particularly applicable to crowdsourcing games in the cultural heritage sector. As outlined by the authors of Living Archives [1], participative contribution to public digital archives is “capable of creating social change, providing

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<sup>21</sup> <https://apps.facebook.com/sentiment-quiz/>

inclusion to the excluded and bringing forth a broader perspective on our history and the diversity of society.”

The authors advocate deploying SCG on OSN platforms for two reasons: a) to reap the benefits of the platform to enhance a game’s reach, and b) to promote social engagement and commitment that these games try to achieve. The ways of enriching SCG by leveraging OSN features are summarized below [36]:

- Social graph

Utilizing social graph in games and enabling players to interact with members of their social network is one of the most powerful features of OSN platforms.

The opportunity to play with one’s real friends, colleagues, neighbors and family members is important for SCG since social change is a collective effort. We also believe that real-world identity and relationships in social media games encourage fair play, which positively affects the quality of crowdsourced (meta)data.

- Virality

The platform’s built-in viral notification systems allow games to be shared with friends and recruit new players from the social graph. The “snowballing effect” [38] caused by sharing game activity is highly beneficial for SCG because it allows to disseminate them across the community and attract more followers.

- Micro-transactions

Micro-transactions in social games have grown to be a popular way for developers to monetize games by offering players in-game purchases of virtual goods. OSN platforms incorporate secure payment mechanisms and give players the ability to use virtual wallets. For non-profit organizations, micro-transactions in games offer the opportunity of raising funds and soliciting donations for social good.

- Metrics

Rich analytical tools offered by OSN platforms are used to collect wide range of statistical data that help assessing game’s success in terms of growth and social interaction among players. The analysis of this data gives developers the ability to adjust games “on the fly” in order to raise the effectiveness of crowdsourcing or any other goal that a SCG attempts to achieve.

- Asynchronous gameplay

Asynchronicity (see Table 4) is one of the characteristic features of modern games on OSN platforms. It enables indirect social interaction while creating the feel of playing together. Asynchronicity allows players to play at their own pace and interact with other players through status updates, which in turn positively affects retention.

- Social infrastructure

Social infrastructure of OSN platforms is comprised of various in-built functionalities, such as instant messaging, content sharing, notifications, liking, gift exchanging, etc., which enable players to socialize in games in a variety of ways. When used in proper context, these tools foster cooperative behavior, mutual aid, reciprocity, and community development. For instance, grouping in teams for completing a mission is a common phenomenon in social media games. Leveraging such social mechanics is important to cultivate public engagement and contribution in SCG.

- Challenges

In addition to the above, we consider challenges as another prominent feature of modern social games. Loreto & Gouaich [21] point out that “aggression is the primary power need satisfied by most games”, while Whitson & Dormann [36] believe that “conflict can be an important learning element in SCG”. Therefore, competition between players is a driving power of many social media games.

### ***Facebook features for motivating social interaction***

As outlined earlier in this section, social interaction is the main reinforcer for sustained contribution in community-based games. In terms of social interaction, features that characterize social games on Facebook can be grouped in 3 categories: a) communication features, b) collaboration features, and c) competition features [21]. The summary of these features is shown in Table 5.

Table 5. Classification of Facebook features for social games [21]

Stimulus	Features
Communication	Chat / Instant messaging
	Mailbox
	Online / offline state of player's friends
	History of last friend's actions
	Requests to install the game
	List of friends already using the game
	Showing off player's avatar
	Notifications
Competition	Posting game activity to player's news feed
	Challenging friends (in game)
	Request for challenge (outside the game)
	Leaderboard (global and among friends)
Collaboration	Achievements
	Visiting / helping friends
	Sending gifts
	Recruiting friends as helpers
	Collective quest
	Exchanging objects (i.e. for collections)
	Sharing objects or requests (e.g. I am looking for...)
	Voting for friends (e.g. best of...)
Sharing wealth (when winning a trophy, etc.)	

### 3.3.4. Possible caveats with games on Facebook

In this section we present some of the possible pitfalls associated with games on social networks, which must be taken into account.

Considering the ever-changing nature of Facebook in terms of its rules and API, the reliance of the game on the underlying platform may cause unstable behaviour and limit game functionality. Limitations in the platform may impact the game's capability for social scaling and create sudden barriers for players to use the application the way they intended to [37].

The use of micro-transactions and advertising in social media games imposes risks of identity breach or misuse of personal information. Past cases of scam and privacy violations through fraudulent marketing practices had an impact on the reputation of Facebook, which in turn influenced negatively the trust of gamers [36].

Despite that social media games can be developed at low cost, the maintenance and marketing costs required for sustainable player engagement can be disproportionately high [36]. This could pose a barrier for cultural heritage institutions with limited financial resources.

Finally, the overuse or misuse of certain in-build social features in games should be avoided. The so-called “mini-feed spam” caused by sending inappropriate, irrelevant or too many notifications to user’s feed may easily reverse the effect of viral distribution [40].

### **3.4. Summary**

From existing literature sources we identified the types of activities that can be crowdsourced for the purposes of cultural heritage institutions. It became evident that many tasks can be wrapped in the context of casual games, offering an alternative way to allocate human resources. The GWAP concept defines a set of guidelines for designing such kind of games. We found a number of examples of how gamification was used to generate data for GLAM collections.

Following the direction of our research, we investigated how cultural heritage institutions make use of social networks to reach larger audiences. Our study showed that the presence of GLAMs on social networks can significantly enhance their public outreach and even elicit data collection by hosting content on large shared spaces such as Flickr. However, there seems to be a gap between GLAMs and social networks in terms of deploying integrated applications on OSN platforms. Although little research exists in this field, we identified some successful examples of using social media games for crowdsourcing purposes. The works by Kuo *et al.*[39] and Rafelsberger & Scharl [40] outlined the main design principles for community-based games aimed at harvesting user-generated data. Playfulness and interaction between players were found to be the main drivers for user engagement. Furthermore, we identified a set of Facebook features that enable social interaction, as well as some of the platform core functionalities particularly useful for the design of “social change games”.

Thus, we attempt to fill the gap in research by combining the features of casual GWAP games with those of an OSN platform to create a community-based metadata game for digital archives. This is done in the next chapter.

## 4. Game prototype: Art Collector

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The three concepts studied through the literature review are brought together in a practical application, which is the game prototype called Art Collector<sup>22</sup>. Our objective was to build a simple (due to time constraints) but functional casual game that could demonstrate the findings of the theoretical study and draw a parallel with existing crowdsourcing games.

The process of game design involves determining game genre, content provider, social features, gameplay & rules, user interface and technology used to build it. These steps are described in the next sections.

### 4.1. Choice of genre and content provider

Following the example of the ESP Game and its successors, we chose to build a metadata tagging game, which belongs to the “word games” genre. This choice is supported by the following facts:

- Word games are relatively easy to build because they do not rely on heavy graphics or fancy animations
- Tagging is familiar to most internet users and does not require a lot of effort, hence it fits perfectly to the context of a casual game
- Tagging allows for automatic “validation through agreement” of produced metadata
- The adoption of this genre by many GLAMs makes it easier to compare our prototype with similar crowdsourcing games

In fact, our approach entails taking an existing tagging game as a basis and improving its logic by adding extra functionality to it, including the elements of social gaming (more on this in the following chapters). Being a tagging game, its goal is to gather user-generated tags for collection items presented to players in the game.

Metadata tagging in crowdsourcing games can be used to annotate image, audio or video content. Like the majority of tagging games, we use images as the content of our game due to the wide availability of archived photo collections that have been digitized and opened up for public access by many GLAMs. One such source of digital imagery is the web service of the Swedish Open Cultural Heritage (SOCH), which aggregates pictures from multiple content providers of open data related to the Swedish cultural heritage [33]. For our game we chose to work with an image database of the Swedish National Heritage Board (Riksantikvarieämbetet<sup>23</sup>), which is one among twenty four other SOCH member institutions. The particular organization offers nearly 100.000 digitized images that have to do with heritage and historic

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<sup>22</sup> <https://apps.facebook.com/art-collector>

<sup>23</sup> <http://www.raa.se/>

environment issues. These images mostly depict historic buildings and locations, which in our belief is an interesting and relatively easy-to-annotate material. All image sets provided by the Swedish National Heritage Board have been released under the Creative Commons License<sup>24</sup> (CC0 1.0), which means that they hold no copyright and hence can be used freely in our game.

## 4.2. Choice of social features

Our goal was to determine a subset of social features representing each of the three categories listed in Table 5. The set of features that we found reasonable to demonstrate in the context of our game included:

- Leaderboard (competition feature)
- Friend requests (communication feature)
- List of friends (communication feature)
- Achievements (competition feature)
- Posting notifications to news feed (communication feature)
- Challenging friends (competition feature)
- Sharing a trophy (collaboration feature)

The way we use these features in Art Collector is described in Section 4.4.

## 4.3. Game rules

As the name suggests, players of the game become art collectors – they compete with each other for art pieces (i.e. images) in order to build the richest private art gallery. Being the richest means having the highest value, calculated as the total value of all pieces in a gallery. The value of a piece is determined by the total amount of tags associated with it, multiplied by 10. For example, an image with 5 tags has a value of 50.

There are two types of galleries in Art Collector where art pieces are stored:

- private galleries, where each player keeps art pieces that they won;
- public gallery, containing art pieces that have not yet been won by anyone;

Players start with an empty private gallery and can challenge art pieces from either public gallery or from private galleries of other players. To win an art piece, a player must guess the half of tags associated with it.

The top 3 art collectors are awarded with gold, silver or bronze medal, which is indicated by a special icon in the leaderboard.

The gameplay is described in details in the next section.

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<sup>24</sup> <http://creativecommons.org/publicdomain/zero/1.0/>

## **4.4. Gameplay**

The game consists of two rounds and is played iteratively. The Main Menu screen serves as the home page, which displays important information and provides navigation options. The structure of the Main Menu, Round 1 and Round 2 is described in the following sections.

The game's messaging system guides the player at every stage of the game, providing useful information such as game rules or outcome of the performed actions. Message windows also contain navigation buttons for quicker access to other game screens.

The screenshots of the game are given in Appendix A.

### **4.4.1. Main Menu**

When a player enters the game they are transferred to the Main Menu, preceding an information message explaining the purpose of the game and its rules (see Figure A1). The snapshot of the Main Menu screen is depicted in Figure A2.

The topmost part of the screen shows the game title and two information boxes, where player's tokens and the amount of art pieces in the personal gallery are displayed.

The personal gallery is shown at the bottom of the screen. This is where all collected art pieces are stored, sorted by their value. The total value of the collection is shown on the right of the gallery title.

The total value is what determines the winner, as it was stated in game rules. The "Top 10" column on the left displays the leaderboard, where the top 10 art collectors are placed in the ranked order.

The "Friends" column shows the list of friends. This column implements the friend request feature of Facebook. Pressing the "+" icon next to friend's avatar issues an invitation to play the game. A player earns 40 points for each friend who accepted an invitation.

Finally, two large buttons in the centre of the screen are used to navigate the player to either of the two rounds. The button of the second round is disabled if a player does not have enough tokens. In this case the small text in red informs a player of how many tokens need to be earned in order to enter the second round.

### **4.4.2. Round 1 "Tag It!"**

The first round is based on the Alum Tag game and offers the same functionality and a similar interface. The screenshot of the first round is shown in Figure A4.

The purpose of the first round is to earn tokens. The round consists of 4 turns. In each turn the player is asked to describe an image presented on the screen. Comma-

separated tags are entered in the text field under the image. A limit of 10 tags was set to discourage keyword spamming.

Under the text field, a sample tag input is demonstrated along with the reminder to add only meaningful and accurate tags.

When the “Done” button is pressed, tags get added to the image and the player is rewarded with tokens. The current score is indicated in the top-right information box. The calculation of tokens is based on the uniqueness of contributed tags: 4 tokens are credited for each new tag and 2 tokens are given for each matched (pre-existing) tag. Images that have received at least 4 tags are automatically added to the public gallery from where they can be challenged in the second round.

Images are loaded in a random order from the remote database of the Swedish National Heritage Board. The priority is given to images that have already received 1 to 3 tags from other players. This is done to speed up the process of moving them to the public gallery. Like in many image tagging games, players can skip difficult or uninteresting images by pressing the “Skip” button.

Upon the round’s completion, a summary window pops up with statistics regarding contributed tags (see Figure A5).

To reward the most active players, two types of achievements are used: “Power Tagger” for adding a total of 50 tags, and “Super Tagger” for adding a total of 100 tags. Achievements are triggered automatically by the Facebook platform, which posts a special notification with an accompanying badge to the user’s timeline, as shown in Figure A11.

#### **4.4.3. Round 2 “Challenge!”**

The second round gives a player the chance to win an art piece to their private collection. To do so, a player must guess correctly the half of the tags assigned to the challenged art piece (if the total number of tags is odd, the amount of tags to be guessed is rounded down, e.g. 4 out of 9). Each guessing attempt costs a player 20 tokens per tag. That is why the player is allowed to enter Round 2 only if they have sufficient tokens for at least the “easiest” challenge.

The Round 2 is completed in two steps:

##### ***Step 1: Choosing an art piece***

The first screen of the second round is shown in Figure A7. At this stage a player has to choose an art piece for challenge either from the public gallery (on the left) or from private galleries of other players (on the right). Art pieces in galleries are sorted by their value. In the private gallery the priority is given to art pieces of player’s Facebook friends to encourage the competition between the player and the members of their social network.

When a player rolls over an image, it is previewed in the central frame. At the same time, the information bar under the frame indicates the criteria for challenging the current art piece, namely: Tags to guess, Tokens needed, and Attempts. Images that satisfy these criteria display the yellow shield icon on mouse over, indicating that they can be challenged. When the player selects an image, they are transferred to the second screen where the challenge takes place.

### ***Step 2: Guessing tags***

Challenge means guessing tags that were added by other players. A player needs to provide tags in the text fields presented on the screen (see Figure A8). The number of text fields corresponds to the amount of tags that need to be guessed. This amount is shown on the information box in the top-right corner of the screen. If a challenged piece contains tags that were added by the same player before, they are highlighted as taboo words and cannot be used for guessing.

After all tags have been entered, a player presses the “Done” button to check the result of their attempt. Fields containing correct tags are highlighted with green border whereas those with incorrect tags are indicated with red border.

If all tags were guessed successfully, the player receives a congratulations message (see Figure A10) and the art piece is added to player’s private gallery. Winning also triggers the Facebook dialog window that welcomes a player to brag about the victory and share the acquired image on their timeline. The resulting post is illustrated in Figure A12.

In other cases, the player receives a summary window showing how many tags were guessed correctly and how many attempts are left (see Figure A9). In total, 3 guessing attempts are given for each art piece per game session. During the subsequent attempts, a player is only asked to guess the remaining tags for the piece. Thus, any tags that were matched during the previous attempts are saved and converted to taboo words.

Any tag that was not guessed correctly is added to the art piece and therefore raises its value by 10 units. This way, if somebody’s art piece is challenged, the risk of losing it is countervailed by the likelihood that its value will be increased. This is called a “risk reward principle” [35].

Similarly to the first round, the second round triggers two achievements: “Power Guesser” for winning a total of 5 art pieces, and “Super Guesser” for winning a total of 10 art pieces (see Figure A11).

## **4.5. Game build**

Art Collector is a browser-based game that targets modern browsers. Due to the limited time frame allocated for the project, full compatibility with older browsers and mobile version of the game were not considered during the development.

The game interface was created using HTML and CSS3 and the graphics were designed in Adobe Photoshop. We chose to use a wooden background for the game to match the environmental theme of the Riksantikvarieämbetet's photo collection. The access to this collection is done via SOCH RESTful API requests.

The game logic was implemented using MVC pattern (Model – View – Controller) and web technologies Javascript, JQuery, Ajax, PHP. We used MySQL database to store game's data.

The integration with the Facebook platform was done using Facebook SDKs for PHP and Javascript. According to the Facebook terminology, Art Collector is a game built “on Canvas”, which means that the application is loaded into an iframe and presented from within the app.facebook.com domain, so that it appears to users as an integral part of the social network [34]. The game can be found on Facebook under the following URL: <https://apps.facebook.com/art-collector>.

## 4.6. Summary

Although all tagging games serve the same purpose that is to generate useful metadata, their game logic can follow different scenarios. The simplest and the most common is a single-player scenario, when a player is rewarded for describing an image with a series of keywords. Other games such as the ESP Game feature more social, multi-player gameplay where players are rewarded for matching inputs of their opponents.

In Art Collector, we took a complex approach that combined two methods of metadata generation. The first method is the traditional “tagging for points” logic that we used in Round 1. For this method we borrowed the logic from Alum Tag - a casual tagging game that offers a turn-based structure and a scoring system based on whether contributed tags are unique or not. Despite that this tagging strategy has been widely used in similar games, we found that it did not provide much space for the integration of Facebook's social features, which was our primary goal. We needed more sophisticated scenario that could produce metadata by means of social interaction.

Thus, in Round 2 we implemented another type of metadata generation which is based on matching user inputs. Contrary to the ESP Game, in Art Collector tag matching is used to trigger the winning condition instead of accumulating points. In fact, points are spent rather than collected. Moreover, tags generated through failed guessing attempts get added to the challenged image. We adhere to the logic that players are motivated to provide only the most relevant and accurate tags to be able to guess other players' input correctly. Finally, Art Collector features asynchronous play, which increases players' retention in direct proportion to the activity of their friends. Thus, tag matching in Art Collector was used in a different manner and in different context, when compared to the ESP Game. Finding a proper balance between various game

parameters such as guessing attempts, value of an art piece, score and amount of tags to be guessed was a challenging task.

The important step of the game design was to combine the two methods of metadata generation into a meaningful and interesting game scenario. Our efforts yielded Art Collector as a resulting idea for the game prototype. In this game we tied the two methods together by the single scoring system, wherein tokens accumulated in the first round are spent for guessing attempts in the second round. The spirit of competition that we tried to foster was needed to keep players interested and willing to play. In their pursuit for art pieces players are motivated to play both rounds iteratively, generating metadata as a result of their actions.

Due to increased complexity of the game logic, explaining game rules and giving instructions to players presented a challenge. According to the casual games concept dictating that “learning = work, playing = fun”, instructions should be kept as short as possible, with game skill learning integrated into the game flow [22,8]. That is why we divided the information in three parts: a welcome message shown before the Main Menu screen and two information messages shown before each round. To keep these messages concise, only the absolutely necessary bits of information are given for each stage. The rest of gameplay specifics are left to be discovered intuitively through the user interface. As noted in Sub-section 3.2.4., in crowdsourcing games it is important that a player clearly understands the purpose of the game and their role in it. That is why the welcome message begins with a statement that informs a player about their contribution to the Swedish cultural heritage, while the message in the first round informs a player how their tags will be used.

Our main goal during the game design was to combine features and design principles of casual gaming, social gaming, and games with a purpose that we learned from the literature review. In terms of casual behaviour, we designed a game that offers rapid progress through both rounds, varied game difficulty (depending on challenged pieces' value), step-by-step instructions and immediate gratification (tokens in the first round and a “trophy” in the second round). In addition to the selected social features listed in Section 4.2, we implemented the majority of GWAP features described in Sub-section 3.2.2, namely: score keeping, randomness (when loading images from the photo collection), taboo words, player skill levels (in Facebook terminology - achievements), high score list (in Facebook terminology – leaderboard).

The disadvantage of the Alum Tag scoring system that we used in the first round is that it does not encourage players to add correct tags. In the context of Art Collector, one of the possible playing strategies could be to add erroneous tags on purpose so as to make it difficult for other players to guess tags in the second round. The problem can be addressed by reversing the logic of the scoring system and increasing the difference between points awarded for unique or matched tags (for example, awarding 2 points for a unique tag and 6 points for a matched tag). This would motivate a player to enter accurate tags in hope that some of them will be matched and points

will be accumulated faster. As an additional measure for securing data quality, tags produced in the first round could be checked for validity before getting tied to images. One of the possible validation models would be a two-step semi-automatic validation based on dictionary. In such a model, user input is first undergone spell checking through automated tools to filter out words that do not exist in English dictionary. Any tags that do not pass the spell checker control are marked for manual review that is performed by either a game moderator or other players. In the second case, validation of metadata may take place in the context of another game similar to the Brooklyn Museum's Freeze Tag!<sup>25</sup>, where players vote for tags added by other players and decide whether to keep or discard them.

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<sup>25</sup> [http://www.brooklynmuseum.org/opencollection/freeze\\_tag/](http://www.brooklynmuseum.org/opencollection/freeze_tag/)

## 5. Evaluation

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In this chapter we analyse the results of the survey and measure various game parameters to assess players' participation and contribution.

### 5.1. Participation

#### 5.1.1. Game promotion

The recruitment of game testers was done through Facebook groups. From the day of its launch, Art Collector was submitted for review to be listed in the App Center, which is the primary way for users of Facebook to find games. However, during the testing phase the application was still pending a review and was discoverable only by its name in search. For this reason, the initial gameplay testing was done among Facebook users from the personal circle of friends, colleagues and fellow students. The invitation to take part in the game was sent via Facebook and Twitter. At a later stage, we promoted the game on Facebook groups related to the subjects of our research. For locating these groups we used keywords *Sweden, Swedish history, cultural heritage, crowdsourcing, open data, metadata, gamification, games, game development*, and so on. The promotion in groups was done by sharing an application fan page<sup>26</sup>, which was created as an extra entry point for the game (see Figure A13). Targeting diverse groups was needed to evaluate our prototype from different perspectives.

Before the game launch, we pre-loaded the public gallery with 10 images of 4 tags each to make sure that even the first player will have enough pieces to challenge.

#### 5.1.2. Quantitative analysis

Over the two-week period, the application received a total of 103 users. The application fan page received 20 likes. Sharing the fan page on Facebook groups caused a relatively steady growth in participation, as illustrated in Figure 2.

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<sup>26</sup> <https://www.facebook.com/pages/Art-Collector/627350493946321>

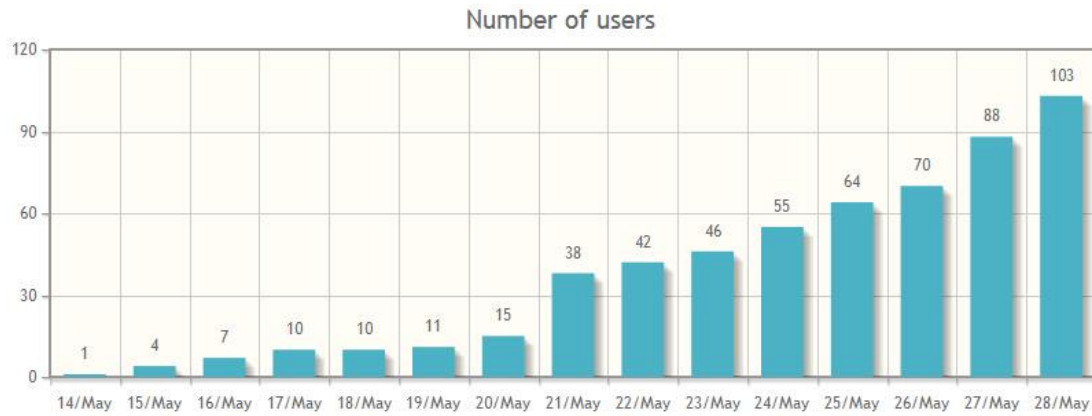


Figure 2. User participation

13.6% of participants were recruited via friend requests issued from the game, as illustrated in Figure 3.

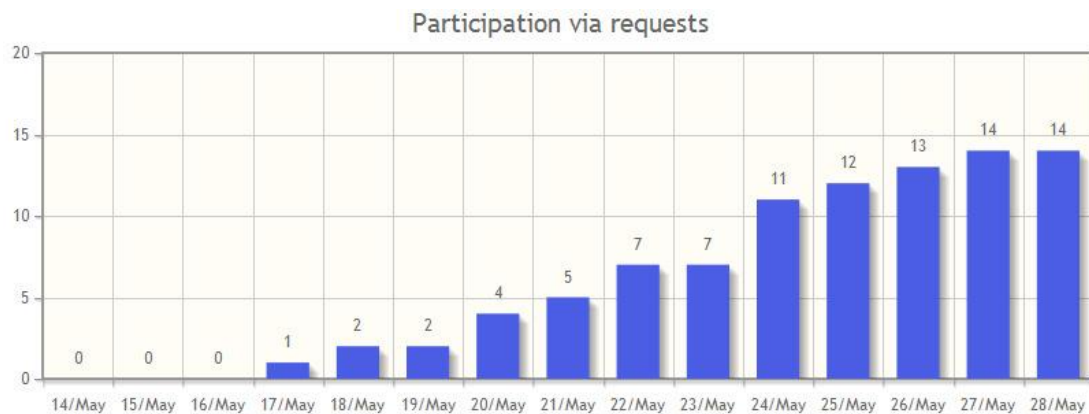


Figure 3. Participation via friend requests

Player retention was found equal to 56.3%, which indicates that more than a half of players returned to the game at least once. However, 35% of visitors were not active in the game and did not generate tags. 36 stories were published from the application, which were clicked 10 times.

Demographic data provided through Facebook Insights indicates that male players outnumbered female players by 10%, while the biggest age group of players was between 25 and 34 years. More detailed information on demographics is given in Figure 4.

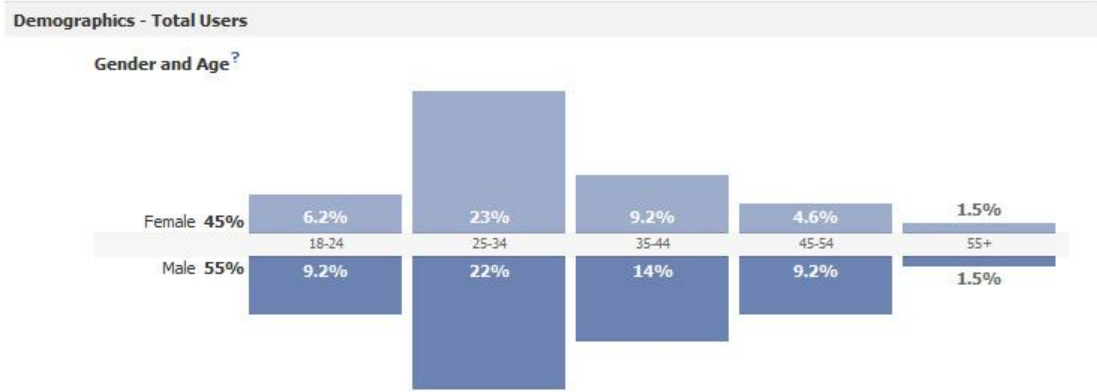


Figure 4. Player demographics

## 5.2. Contribution

### 5.2.1. Quantitative analysis

The overall playing activity after two weeks yielded 2841 tags for 431 images, with an average of 5.33 tags per image. Dynamics of user activity are presented in Figures 5 and 6.

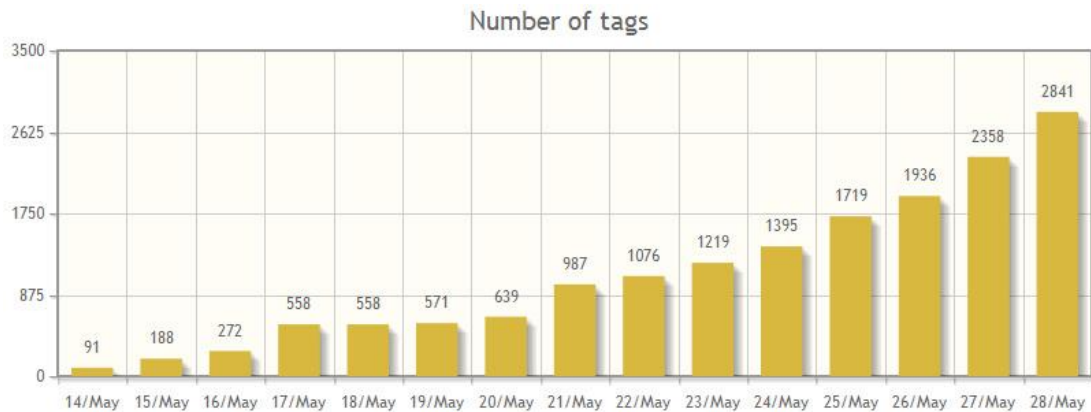


Figure 5. Total number of tags

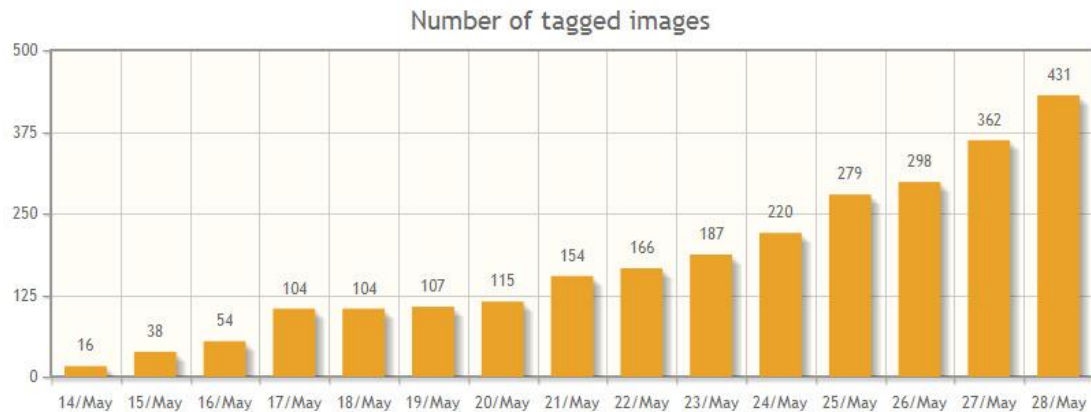


Figure 6. Total number of tagged images

The number of most productive players identified by earned achievements is presented below:

- 12 Power Taggers with 50 or more contributed tags
- 6 Super Taggers with 100 or more contributed tags
- 4 Power Guessers with 5 or more art pieces in the gallery
- 2 Super Guessers with 10 or more art pieces in the gallery

Tag matching in both rounds produced 383 non-unique tags, which means that 13.5% of the total amount of tags were automatically validated through agreement.

### **5.2.2. Qualitative analysis**

Manual inspection of contributed metadata revealed that the vast majority of tags (more than 90%) were single dictionary words correctly spelled in English language (with some valid non-dictionary exceptions such as “1856“, “Volvo”).

User input that falls outside this category is presented below:

- 115 tags or 4.0% were two-word phrases (e.g. “royal family”, “old man”, etc.)
- 32 tags or 1.1% were comprised of three or more words. Some of them were short phrases such as “forest in spring” or “man with a dog”, while others were complete sentences like “Foot ball court. Preparing the ground for the match”
- 70 tags or 2.4% were added in Swedish language
- 12 tags or 0.4% were identified as spam
- 35 tags or 1.2% were misspelled or bad quality tags (e.g. “b/w”, “rockface”)
- 8 tags or 0.3% were added in a wrong manner, separated by space or dot characters instead of comma as it was required and exemplified in the instructions
- 31 tags or 1.0% contained names of various locations of Sweden, meaning that some players were able to identify them on images

An example of user-generated metadata is presented in Figure 7. The complete list of tags contributed by users of Art Collector is available at the URL:

<http://www.art-collector.me/statistics/showTags>

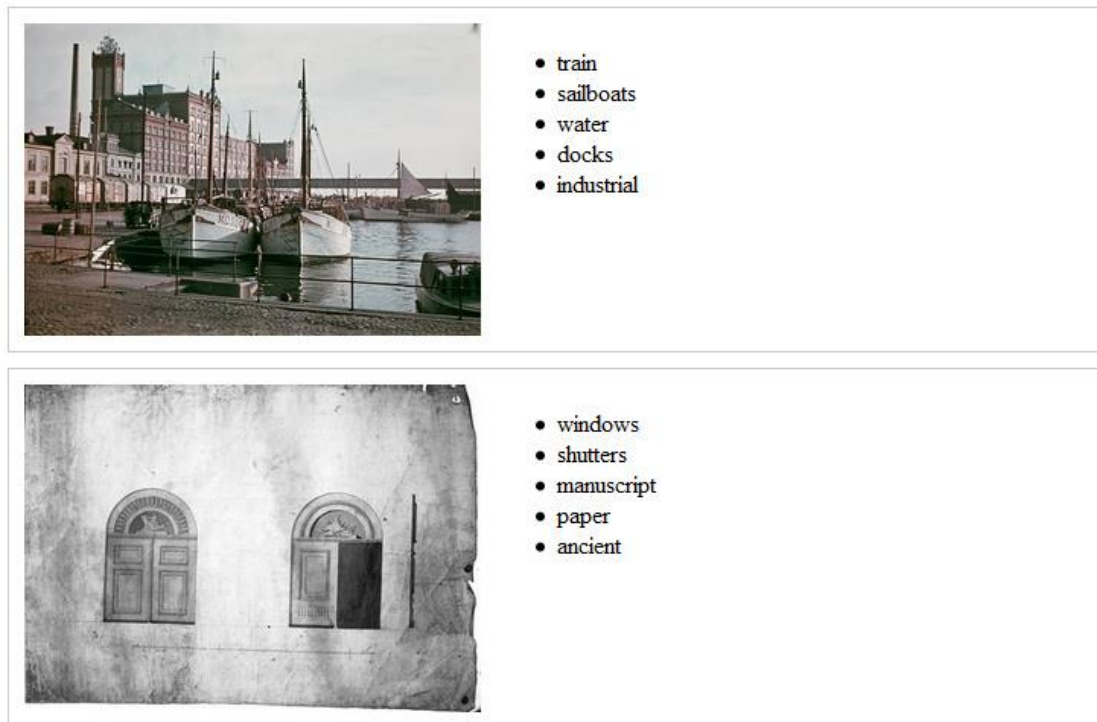


Figure 7. Example of user-generated tags

### 5.3. Survey results

As stated earlier in Section 2.3, the option to complete the survey and earn tokens was offered to players only upon the completion of the second round. This was done to ensure that only committed players provide their feedback, based on actual playing experience of the entire game.

#### 5.3.1. Participants

Over the two-week period, 31 players provided their feedback via the survey. According to the provided data, participants in the survey were:

- 12 students
- 6 cultural heritage / open data experts
- 1 gamer
- 2 game developers
- 10 players who identified themselves as “just a visitor”

Diverse backgrounds of players were a positive factor that showed different perceptions that players have of the game.

#### 5.3.2. Player motivation

Analysis of motivational factors for players showed that:

- 18 players participated out of curiosity
- 5 players were looking for fun / entertainment
- 4 players wanted to make a contribution to the photo collection
- 3 fellow students were eager to help the research
- 1 student had a “professional interest of interaction designer, curiosity and interest in Swedish culture”

### **5.3.3. Game assessment**

The results of player assessment of Art Collector in terms of gameplay, difficulty, graphics, instructions, and images are illustrated in Figure 8.

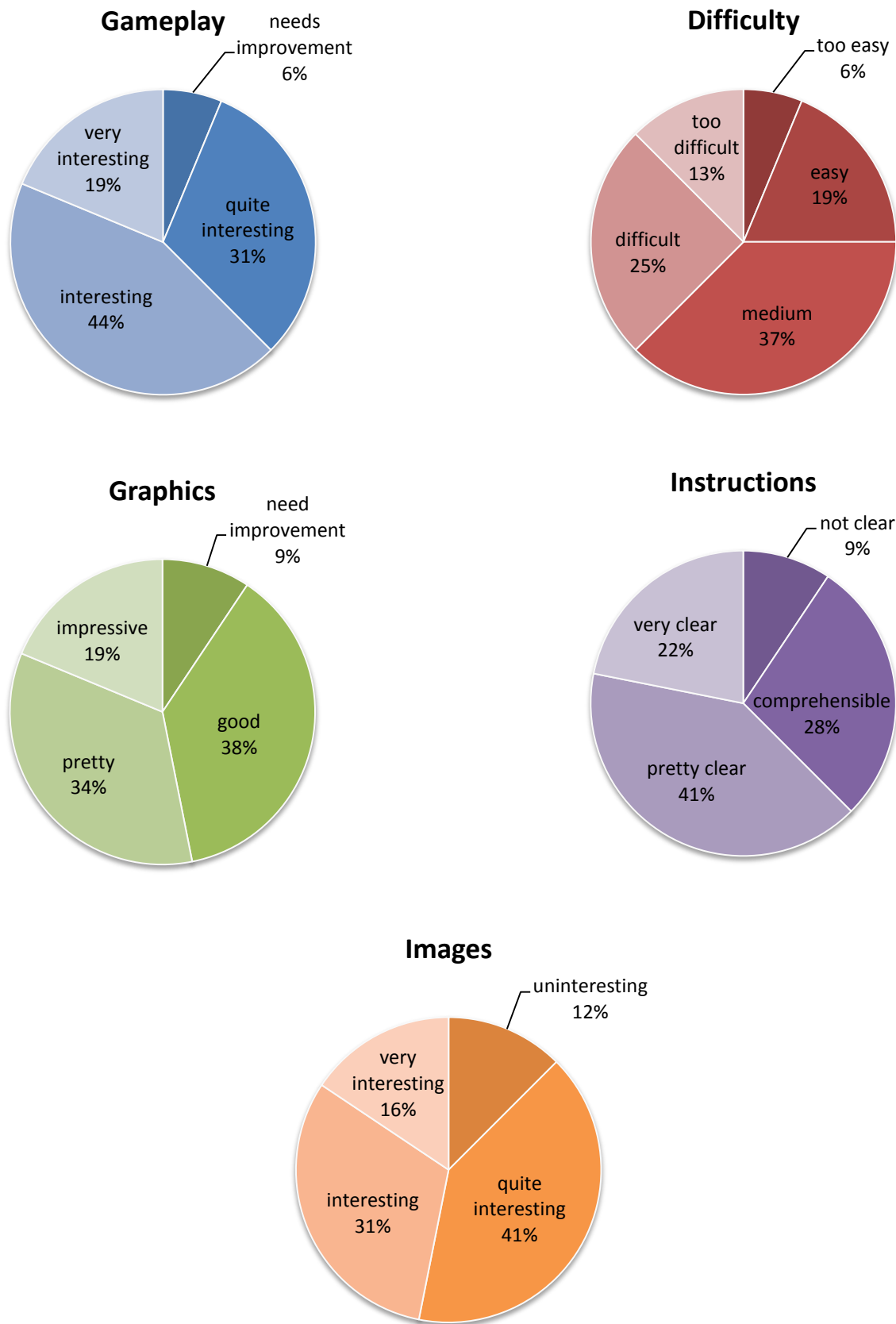


Figure 8. Game assessment

### 5.3.4. Player comments

Players were asked to express their overall playing experience by emphasizing the strong and the weak sides of the game and to give suggestions for its further improvements. Through qualitative analysis of user feedback we were able to categorize the answers by:

#### *Game idea*

Almost the half of all positive answers received from players (48.4%) was about the concept and the idea of the game. Many players thought the game was interesting and challenging. Some of the answers provided by players were:

*“Seems like it would be a fun game”*

*“Like the idea to give my tags to the collection”*

*“Intelligent game, really nice, smart and cute idea”*

The game was well received among all cultural heritage / open data experts, with answers like:

*“It seems like a really interesting way to add tags to images and add to collective knowledge”*

*“Love the idea of gamification as a means to contribute to a database of art tags”*

*“It's quick and challenging, has variety and unusual images”*

Feedback provided by game experts also complimented the idea of the game:

*“A good way to crowd source tags for the art pieces”*

*“Gamification at its best! Bravo”*

Several participants responded negatively:

*“I don't like playing games in facebook as a whole. I think that the game needs a story line”*

*“I am not attracted to annotate the pictures. It does not give me any fun, more of less like a test”*

*“Not sure, why I should play it again”*

One player liked the idea of the game but did not understand its purpose:

*“What's the overall point of collecting the pictures? What's in the end?”*

#### *Gameplay*

Some players gave answers with a focus on various elements of the gameplay.

Sound effects: 2 players commented that they liked them, while 2 other players commented that they would like to see the option to turn off the sound.

User interface: 5 players commented that they like the appearance and design of the game, its simplicity and user-friendliness. 2 players suggested to improve the user interface.

Instructions: 5 players thought that they were too lengthy or obscure. One of the players suggested to use graphic explanation of the interface and to add an option to check the rules while playing.

Other gameplay improvements that were proposed by players included:

- More rounds
- Improved navigation
- Seeing correct answers in the second round
- Showing additional information about pictures in the first round
- Timed challenge in the second round for more suspense and difficulty

In addition, one player commented that the game “takes a lot of hard earned tokens from the first part, in order to do the challenge part!”

### ***Images***

The photo collection used in the game was commented by many players, both positively and negatively.

8 players thought that images were among the strong aspects of the game and added comments like “nice pictures that make you curious” and “I liked viewing some of the photographs”.

11 players considered images as either obscure or monotonous or unfamiliar to non-Swedish visitors. One player also commented that “the images were photographs - I was expecting art in other forms”.

### ***Privacy***

Two users commented our posts on Facebook groups after an attempt to access the game and expressed concerns regarding their privacy:

*“Can you explain more what data are you gathering and what information will be contributed to public memory please?”*

*“I don’t play games that I don’t know well and which request my personal data for unknown reasons”*

## 5.4. Discussion

Taking into account the short period of game testing and the absence of Art Collector from the Facebook App Center, game promotion on Facebook groups attracted all kinds of participants that we targeted – students, cultural heritage experts, game developers and general public. The existence of various Facebook communities grouped by interests makes it possible to target specific audiences related to the topic of the game. We found that many members of such groups were enthusiastic and willing to accept new ideas in games. This interest was also supported by the players' feedback. Curiosity to try a new game was the main stimulus for most players.

In terms of generated data volume, the game demonstrated promising dynamics. User participation had a stable growth throughout the testing phase, with a good retention rate. To assess our results better, we compared them to those of Ridge's image tagging game called Dora, which produced 6039 tags over a three-month period of testing [7]. This means that on a bi-weekly scale, Art Collector generated about 2.8 times more tags than Dora did. The existence of the second round in Art Collector and leveraging Facebook social channels may be the reasons for the increased productivity.

On the downside, contribution was not evenly distributed between all players, with approximately one-third of players being unproductive. This is in line with the phenomena that only a small portion of people contribute most of user-generated content [3]. In Art Collector, the reason for this could lie in the photo collection itself, which was found to be too challenging or uninteresting by many players, according to the survey. Moreover, tagging "difficult" images requires the use of more complex vocabulary, which could pose a barrier for players who are non-native English speakers. Actually, two players commented that they were not sure in what language they should type tags, despite that the user interface, instructions and even the example were given in English. Apparently, that was also the reason why approximately 2.4% of tags were added in Swedish language. Some of other possible reasons for potential players abandoning the game after receiving the welcome message could lie in unwillingness to read through the game rules, insufficient knowledge of English language, lack of time, or simply visiting out of curiosity without having the intention to play.

When it comes to providing instructions, the balance between "short" and "informative" can be hard to achieve. The volume of instructions grows in direct proportion to the complexity of the game scenario. While the majority of players stated that the instructions were pretty clear, we faced some controversial demands from certain players who asked either for shorter instructions or more detailed explanations (as it was the case with specifying the input language). We partially solved this problem by integrating some of the instructions into the game flow, in accordance with the casual games concept. This was implemented through tooltips that highlight taboo words in the second round, explaining that the word has been

used already. In a similar manner, a short line specifying the input language could be placed under the tag input field in the first round. It is worth mentioning that the tagging example that clearly shows how to add tags to the input field was ignored by some players who added them in a wrong manner or produced phrases and sentences instead of keywords. However, these cases were very rare. The lesson learned from the game evaluation showed that instructions may directly affect the quality of produced metadata. As outlined by Oomen & Aroyo [3], “motivating not only for participation but also supporting quality contributions appears to be a major challenge”.

In terms of data quality, Art Collector performed exceptionally well. Around 95% of user-generated metadata were comprised of one-word tags or two-word phrases that were found valid and usable (even excluding those in Swedish). The relevance of tags to images was not considered as a factor of validity because it can be very subjective and should be judged by the staff of a collection owning institution. However, we marked a small subset of tags as “bad quality”, despite that subjectivity is also an issue in this case. This was done from the perspective of the game, since non-dictionary words are very hard to be guessed. Thus, validity of a tag can be interpreted differently depending on its purpose (e.g. “b/w” can be bad for the game but good for the search in the collection). We believe that instructions played an important role in assuring the quality of user input by passing the correct message to players about their contribution to cultural heritage.

Privacy concerns were identified as a possible barrier to participation, even though most players are used to Facebook application requests to access their personal data. However, removing access to user data would come at the expense of personalized gameplay. The inclusion of the game to the Facebook App Center might partially solve this problem by giving the game a better reputation.

Unsurprisingly, the quality of photo collection in an image tagging game seems to be the concern of most players. In a sense, Art Collector failed to meet the demands of many players in terms of image quality, or better say, interestingness. Skipping too many images comes in conflict with the casual games rule of fast progress through the game. There were also some minor issues with the access to the photo collection via API, resulting in some images being returned incorrectly. Furthermore, as one player noted, the context of Art Collector needs pictures with better relevance to “art”. Combining content from multiple sources could be a good way to bring variety to the in-game photo collection.

Results show that Art Collector was successful in providing varied levels of difficulty to its players, with relatively small difference in percentages of players who considered the game as easy (19%) or difficult (25%). Most players thought the game had a medium difficulty, which shows that a good balance was achieved. However, it is not clear if players were referring to the difficulty of the first or the second round, or both. The difficulty of play in the second round depends on the quality of user

input in the first round and cannot be controlled by the game developer. In the context of Art Collector, even short two-word phrases added in the first round can make the second round extremely hard, unless the winning condition is triggered by matching at least one word in a phrase. Nevertheless, other parameters such as number of guessing attempts or number of tags to be guessed can be adjusted in order to keep the game well balanced.

Despite that players were informed about the purpose of the game before entering it, the main drivers for their participation were not contribution to the collection, but curiosity and fun. We explain this by the fact that most people visit social networks to spend their free time, socialize and “have fun” – something that any community-based game must be able to offer, no matter how serious and noble its purpose is. As outlined by Jarvinen [35], focusing on playfulness in social games “should privilege emotional engagement rather than highly intricate and innovative gameplay – even if these two are not necessarily in contradiction”.

In this work, the contribution of the social network context can be seen through the lens of “collaboration - competition – communication” features of Facebook that were implemented in the prototype (see Section 4.2) in order to enable social interaction between Facebook community members. Bragging on the news feed (public wall) using textual notifications and images of acquired art pieces was a combination of collaboration and communication elements, which allowed players to share their winnings with the general public of the social network, generating extra entry points to the game (10 clicks were produced this way). A change to the game logic would allow for another collaborative feature prominent in many Facebook games, which is the call for help from friends. This could be implemented as a notification that welcomes friends to guess remaining tags for an art piece in case of several failed attempts in exchange for a reward. A list of friends with an option to invite a friend is a standard communication feature of Facebook games, which is used by developers to recruit more players. Players invite their friends either for a reward or out of sheer willingness to challenge a friend. In Art Collector, 14 players were recruited via issued friend requests. Challenging friends is a characteristic competition feature of Facebook that takes advantage of strong emotional ties between player and their friends and allows them to engage in a head to head competition. The ability to challenge a Facebook friend in the second round of Art Collector creates a spirit of competitiveness and gives a more personal feel to the game. Other features that were implemented to foster competition were leaderboard and achievements. The leaderboard is a ranked list of top players that displays their overall game score. It should be noted that the intention to beat friends’ scores is often stronger than getting other rewards offered by the game. Thus, in Art Collector a player might use the leaderboard to strategically target top players for challenge in order to take their place. This behaviour of frequent position changes in the leaderboard was noticed during the game testing phase. The Achievements API of Facebook provides mechanisms to automatically trigger certain pre-defined conditions met in the game and post them on

the wall as player achievements. Similarly to bragging on news feed using notifications, Facebook achievements offer increased exposure of game activity on the social network and serve as entry points to the game. Willingness to match a friend's achievement or to level up to the next achievement are considerable motivations for sustainable play. In total, 24 player achievements were triggered and posted by Art Collector. The set of the above features constitutes the core of the social network context in our game prototype.

### ***Towards Art Collector v.1***

The aforementioned findings and creative comments left by some players can be used to make a transition from the prototype to a full-fledged game, especially considering the keen interest towards the game that was shown by the owners of the photo collection. We believe that the inclusion of Art Collector to the Facebook App Center and monitoring its performance for a longer period of time should be the next step in this direction, which would allow us to make a more realistic estimation of the application's efficiency and viability.

## 6. Conclusions

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### 6.1. Answering the research question

The research question of this thesis was formulated as “How can gamification on social networks contribute to crowdsourcing metadata for digital archives of cultural heritage?”

To answer this question, we studied several concepts – crowdsourcing, gamification, and social networks – from the perspective of cultural heritage institutions. In parallel, we developed a crowdsourcing game prototype on the Facebook platform to test our hypothesis. The research methodology used in this thesis entailed literature study of related works and applications, design and creation of the game prototype, and survey of players.

Our study shows that gamification of crowdsourcing interfaces in the cultural heritage domain has established itself as an effective practice to harvest human intelligence in a pleasant and entertaining way. There is also evidence that crowdsourcing is becoming more prominent feature in social media games [35]. Deployed on social networking platforms such as Facebook, crowdsourcing games can serve as the gateway between GLAMs and OSN communities.

Exposure of archival content on large photo-sharing OSN such as Flickr has proven to be a powerful way to increase the outreach of digital archives and enrich them with user-generated metadata. Targeting even larger OSN audiences such as Facebook for metadata generation is possible by taking metadata games to the dimension of social networks that support the development of integrated applications. The immediate advantage of this migration is the availability of huge “ready-made” community of potential contributors. The fact that through Facebook groups we were able to recruit game testers ranging from students to professionals indicates that social network can serve as a platform of collaborative metadata generation for digital collections – something that projects like Living Archives attempt to create. To foster public participation, OSN platforms provide mechanisms of viral promotion through social channels, as well as powerful metrics that help to monitor user engagement, retention and many other parameters that are central to a crowdsourcing application.

As a part of viral mechanism, content sharing can be a good way of exposing the content of archives from the application to the “outside environment” of social network – the way we did it in Art Collector. This could elicit interest towards the contents of the collection from non-players, and attract more contributors.

Micro-transactions as a way to monetize social media games could be utilized by GLAMs to raise funds for preservation of cultural heritage. This way, players voluntarily contribute not only their knowledge and efforts, but also their financial resources to digital archives – all as a side effect of playing a game. In such cases it is

important to balance ethical implications with the economic needs of an institution [36].

For existing crowdsourcing applications in the cultural heritage sector, requirement for registration is considered as the main barrier to participation [8]. For a game deployed on OSN platform, this barrier is eliminated due to the fact that users engage in play from the state in which they are already authenticated. The only requirement might be to authorize the game upon installation – something that users need to experience only once. However, we found that for some users authorization can create another barrier due to privacy concerns.

The fact that social media games “know” more about their players offers new opportunities for personalized gameplay, specifically adjusted to player’s persona. For instance, access to spoken languages could be used to offer the player a selection of translation tasks. Automatic pre-load of image content matching user’s personal interests or geographic location stated on the profile page is another option that comes to mind.

When designing community-based GWAP games, the emphasis should be made on rich interactions between players [39]. Art Collector was an example of how metadata games for cultural heritage can be adapted to a complex, multi-player social environment. The outcome of prototype testing provided evidence that “community-based games may be a feasible method for sustainable data collection” [39] for cultural heritage institutions. We conclude that the social enrichment of metadata games requires more sophisticated design when compared to traditional metadata games.

Collaborative metadata generation on social networks could be implemented as an ecosystem of mini-games that represent different tasks [7,40], capable of engaging both experts and general public. In such an ecosystem, user-generated data are passed between games for validation, linking, correction, translation or other activities. The ability to choose from tasks gives players the freedom of action and ways to define their own “fun” [38], making sure that committed players never run out of new challenges [40]. We believe that the social network infrastructure is ideal for such kind of multi-player asynchronous interaction.

Summing up, we believe that social media gaming is the next step in evolution of crowdsourcing games, allowing them to be personalized and socialized at greater extent than before. Since crowdsourcing is about “crowd”, huge online audiences of social networks should be a primary target for cultural heritage institutions that wish to leverage the wisdom of the crowds. Our work demonstrated how this can be done in theory and practice and pointed to the advantages and shortcomings of this approach.

## 6.2. Future work

Considering that more than a half of users today access Facebook via phones and tablets, developing cross-platform crowdsourcing games should be an absolute necessity in any future endeavours. Facebook platform capabilities enable games to run natively on both iOS and Android and take advantage of the same social channels that exist on the web. This offers serious advantages such as higher player retention and increased network of users. The simplicity and straightforwardness of most metadata games offered by GLAMs make them a good match for mobile phone users. Depending on the game, executing simple tasks or playing with tags and images can be as engaging as solving crosswords or Sudoku, but for a better cause.

Since this work's entire focus was set on Facebook, further research is needed to investigate how other OSN platforms that support social gaming, such as Google+, MySpace or Bebo could be used for crowdsourcing cultural heritage metadata. Analysing the API of a platform would help identify its "playability" [35] and define possible gamification strategies to engage audiences in crowdsourcing metadata for digital archives.

Creating a prototype of crowdsourcing games ecosystem based on a multi-OSN-platform GWAP framework similar to the one proposed by Rafelsberger & Scharl [40] (described in Section 3.3.3) would be an ambitious endeavour to allocate human resources from multiple social networks.

Although Art Collector demonstrated promising results when compared to similar prototype applications such as Dora, this comparison is not entirely reliable because of differences between prototypes. To make a more realistic comparison, the game could be launched in two experimental setups: stand-alone and OSN-based. The stand-alone version would be a separate web portal similar to GWAP games<sup>27</sup>, using a database of registered users as game opponents. The OSN-based version could be a Facebook game like the one presented in this work. The only difference between the two versions would be the absence of access to the Facebook community and platform's social features (listed in section 4.2) in the stand-alone version. In such a setup, two identical games would be launched at the same time and monitored for a certain time period. The side by side comparison of user participation and contribution in stand-alone and OSN-based versions after the testing period would allow for more trustworthy and accurate experimental evaluation of the prototype.

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<sup>27</sup> <http://www.gwap.com/>

## Appendix A: Game screenshots

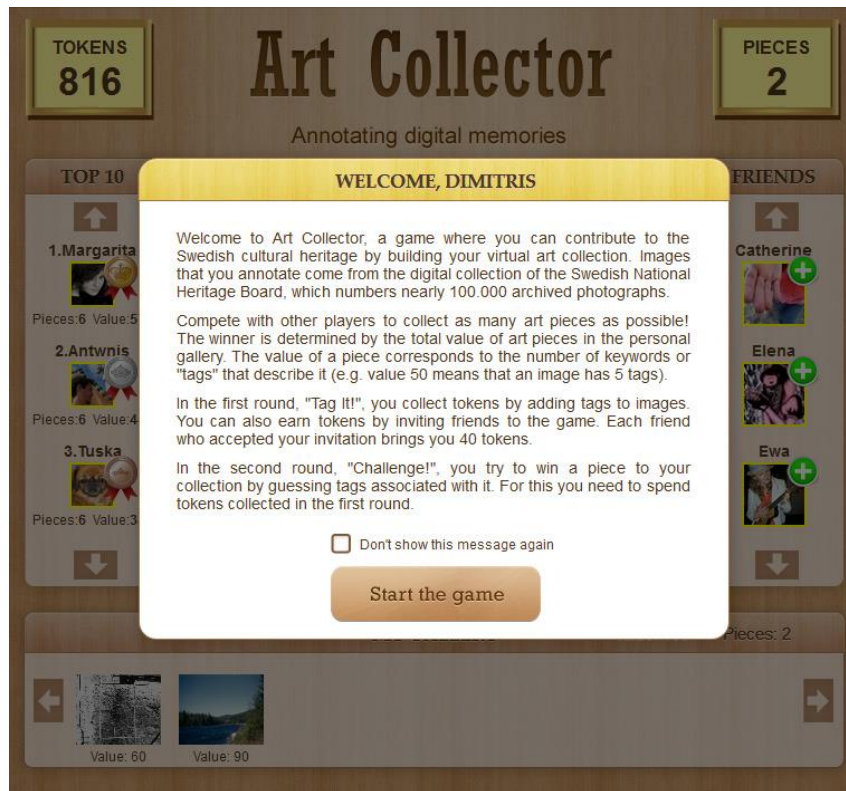


Figure A1. Main menu screen. Information window



Figure A2. Main menu screen

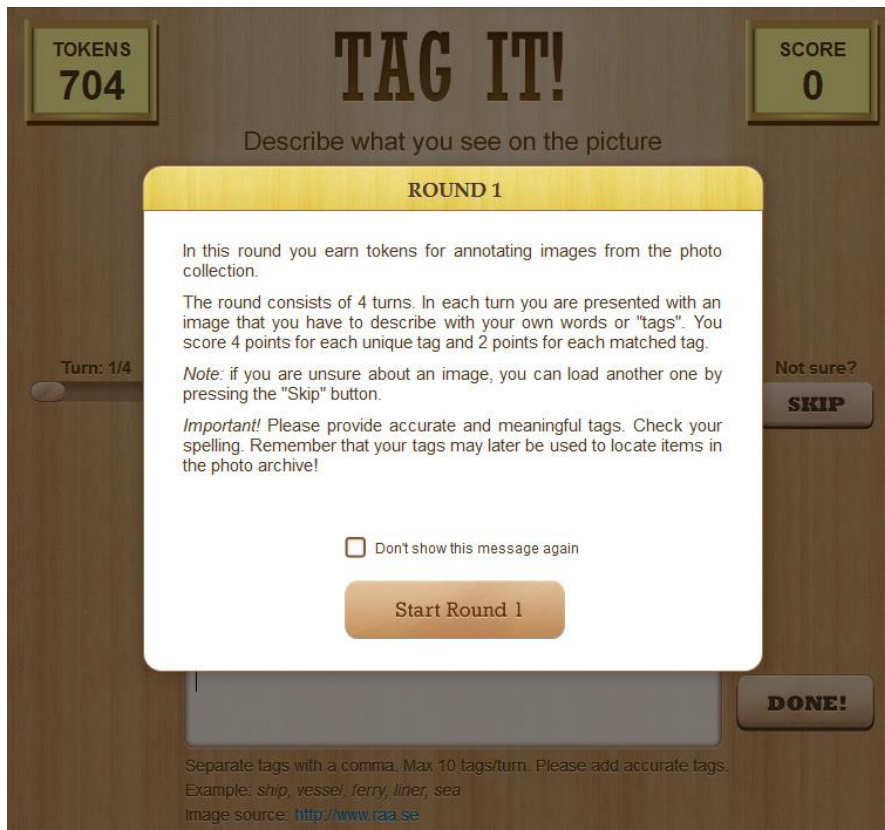


Figure A3. Round 1. Information window



Figure A4. Round 1. Main screen

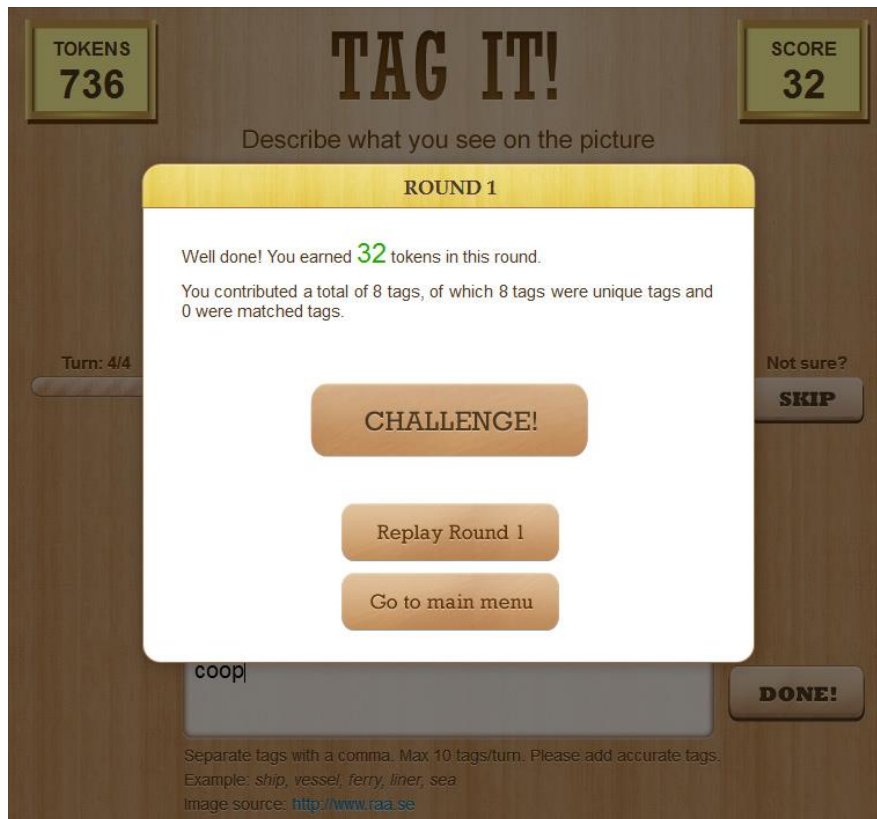


Figure A5. Round 1. Summary window

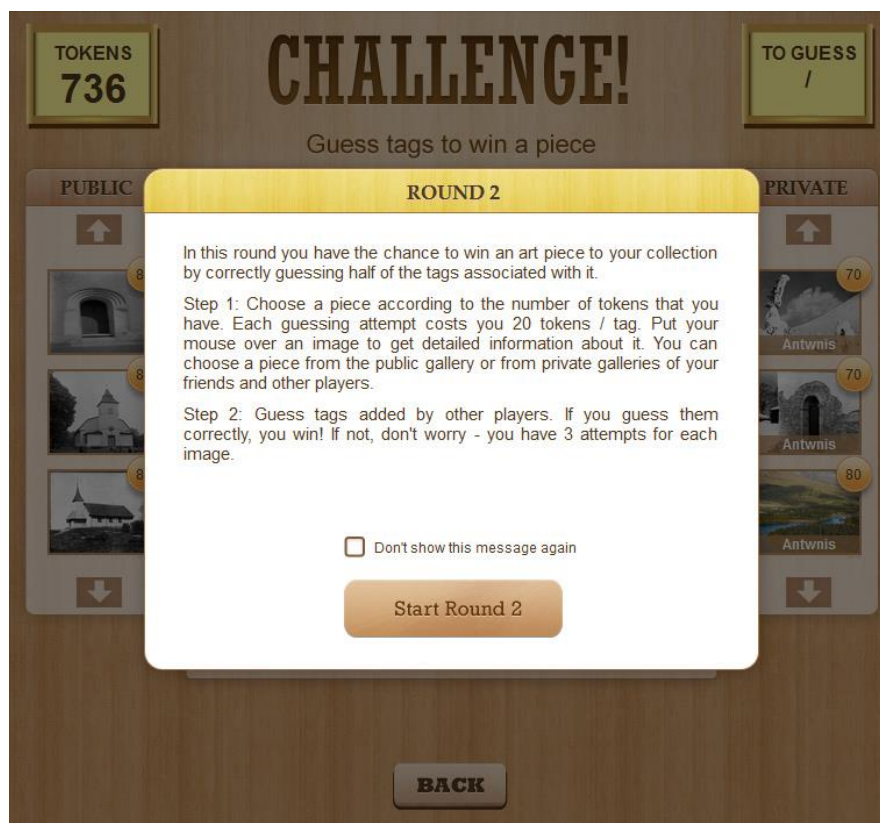


Figure A6. Round 2. Information window

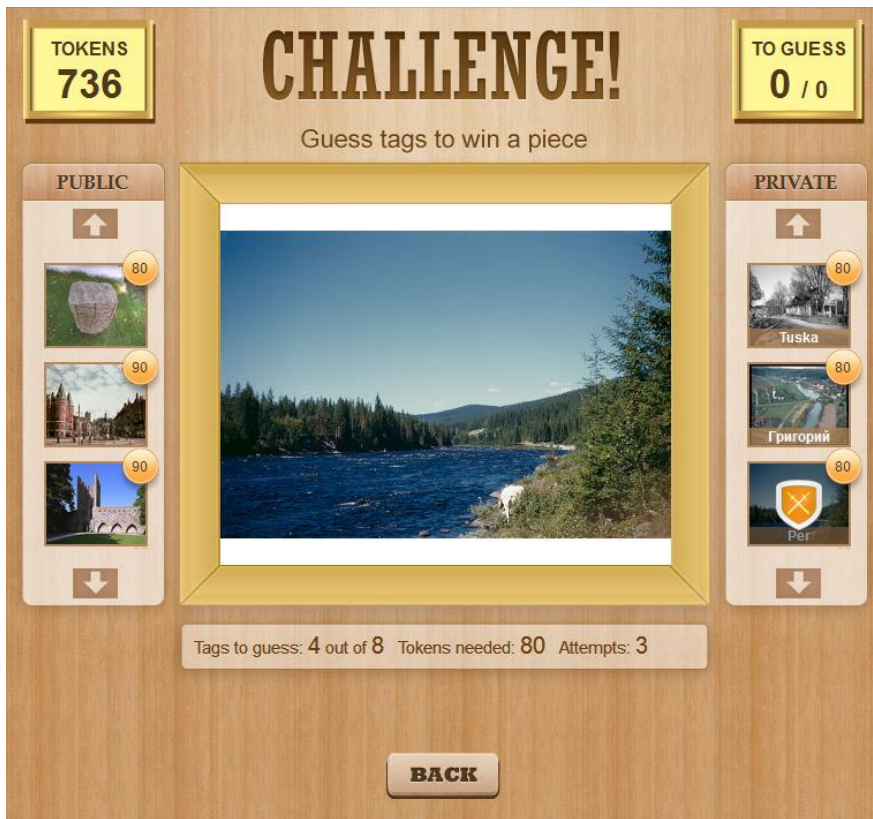


Figure A7. Round 2. Step 1: choosing a piece

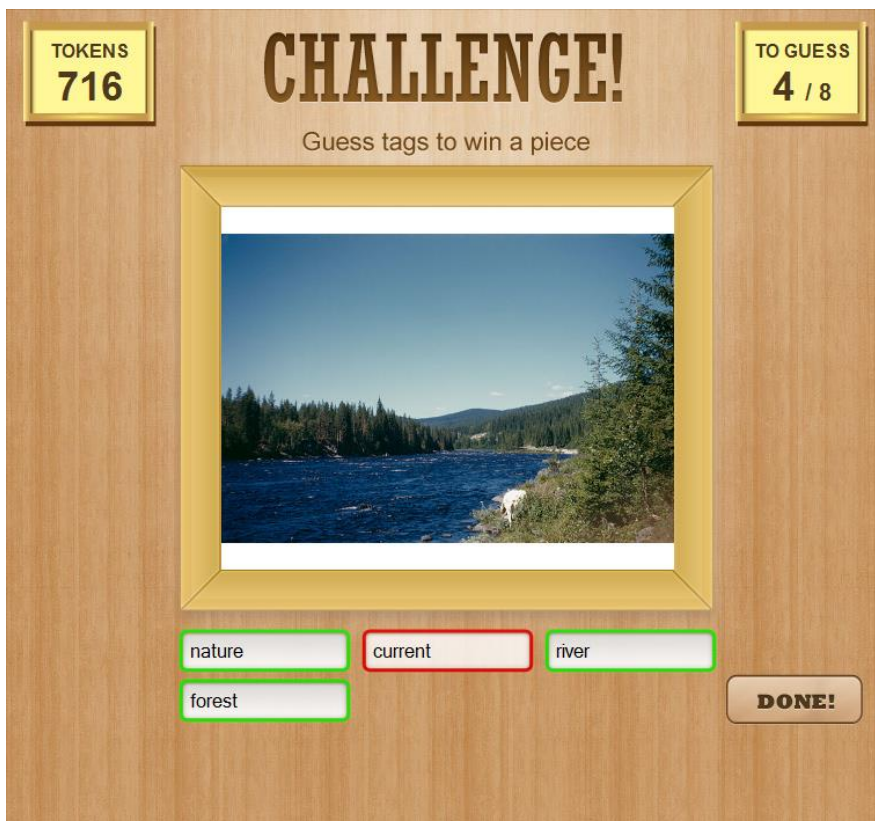


Figure A8. Round 2. Step 2: guessing tags

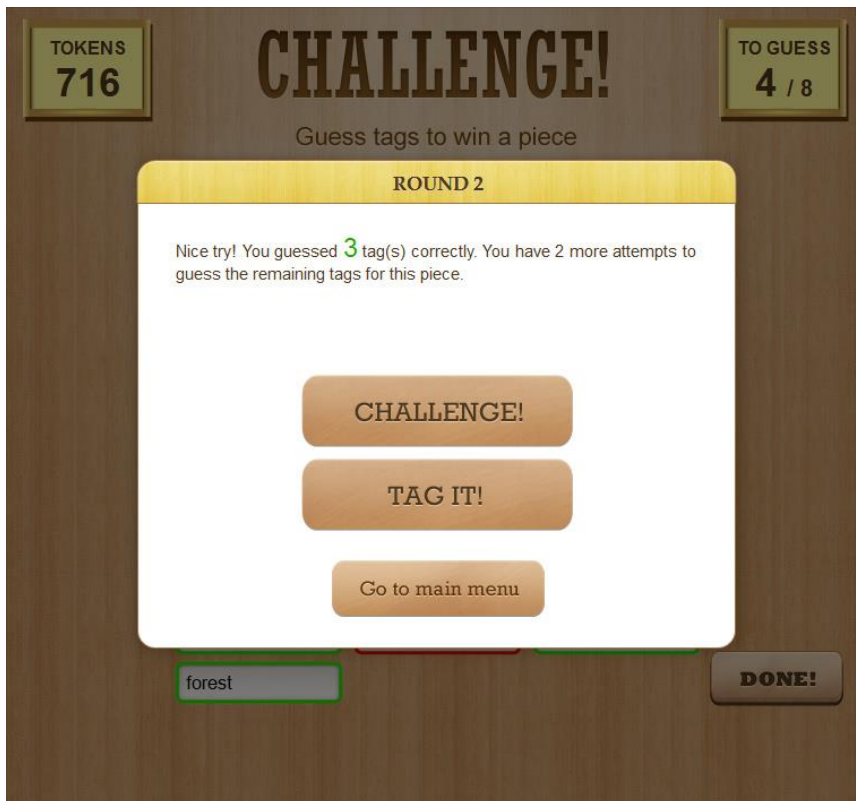


Figure A9. Round 2. Summary window: (partially) failed guessing attempt

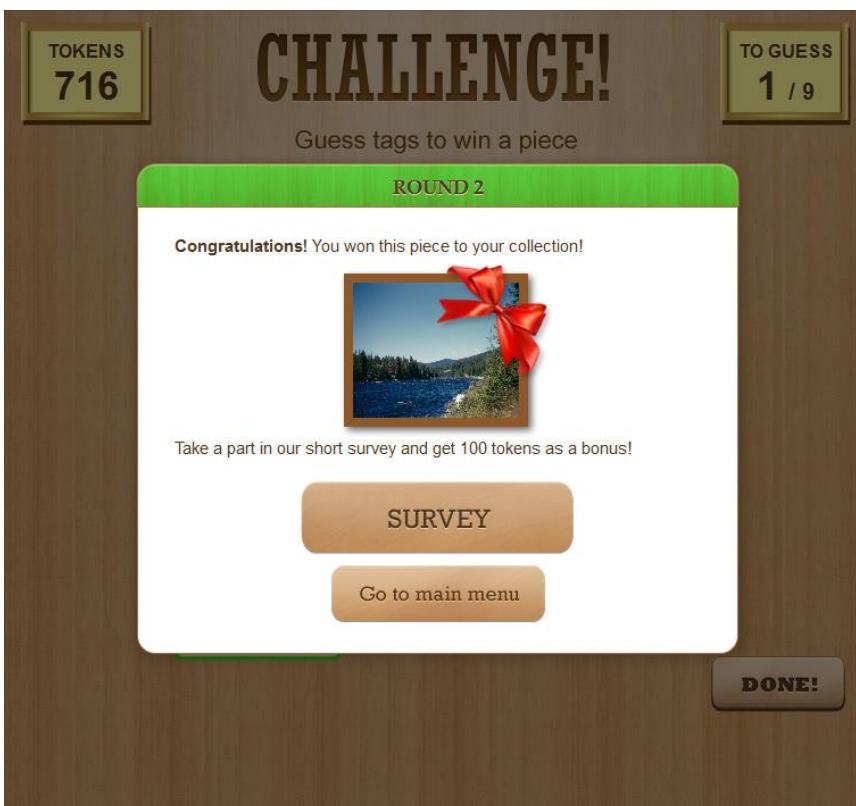


Figure A10. Round 2. Summary window: successful guessing attempt



Figure A11. Achievements

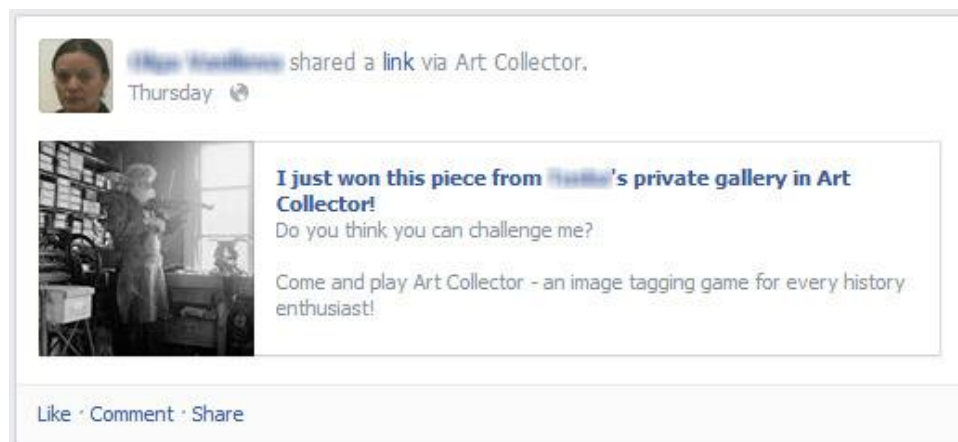


Figure A12. Bragging on news feed and sharing a trophy



Figure A13. Art Collector fan page

# Appendix B: Questionnaire

## Page 1: Assessment of various game elements (scale question)

*Question:* Please tell us what you think about Art Collector

*Responses:*

Gameplay				
unplayable / boring	needs improvement	quite interesting	interesting	very interesting
Difficulty				
too easy	easy	medium	difficult	too difficult
Graphics				
ugly	need improvement	good	pretty	impressive
Instructions				
confusing / obscure	not clear	comprehensible	pretty clear	very clear
Images				
bad quality / too difficult	uninteresting	quite uninteresting	interesting	very interesting

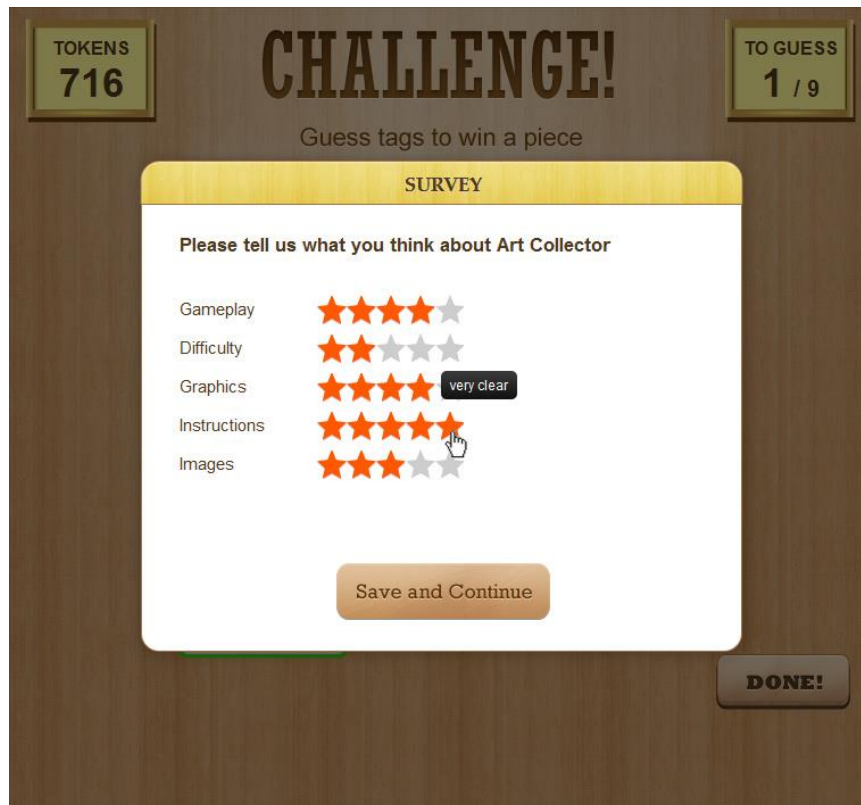


Figure B1. Survey. Page 1.

## Page 2: Motivation for playing (closed question)

*Question:* What was your main motivation for playing Art Collector?

*Responses:*

- Curiosity
- Contribution to museum collections
- Entertainment / Playing for fun
- Competing with friends
- Other (open question)

TOKENS  
716

# CHALLENGE!

Guess tags to win a piece

TO GUESS  
1 / 9

**SURVEY**

What was your main motivation for playing Art Collector?

Curiosity

Contribution to the photo collection

Entertainment / playing for fun

Competing with friends

Other

Save and Continue

**DONE!**

Figure B2. Survey. Page 2.

**Page 3: Assessment of negative / positive sides (open question)**

*Question 1:* What did you like about Art Collector?

*Question 2:* What did you NOT like about Art Collector? Suggestions?



The image shows a screenshot of a game interface titled "CHALLENGE!". At the top left, a box displays "TOKENS 716". At the top right, a box displays "TO GUESS 1 / 9". Below the title, the text "Guess tags to win a piece" is visible. The main content is a "SURVEY" form with a yellow header. The form contains two questions: "What did you like about Art Collector?" followed by a text input field, and "What did you NOT like about Art Collector? Suggestions?" followed by another text input field. At the bottom of the form is a "Save and Continue" button. In the bottom right corner of the game interface is a "DONE!" button.

Figure B3. Survey. Page 3.

#### Page 4: Participants (closed question)

*Question:* I am a...

*Responses:*

- Student
- Cultural heritage / Open data expert
- Gamer
- Game developer / tester
- Just a visitor

The image shows a game interface titled "CHALLENGE!". At the top left, a box displays "TOKENS 716". At the top right, a box displays "TO GUESS 1 / 9". Below the title, the text "Guess tags to win a piece" is visible. A central white box with a yellow header labeled "SURVEY" contains the question "I am a...". Below the question are five radio button options: "Student" (selected), "Cultural heritage / Open data expert", "Professional gamer", "Game developer / tester", and "Just a visitor". A yellow "Submit" button is located at the bottom of the survey box. In the bottom right corner of the interface, there is a grey button labeled "DONE!".

Figure B4. Survey. Page 4.

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