Impact of Gamification and Shared Situated Displays on Smartphone Application Engagement

Juan Mejia
Grand Valley State University

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Impact of Gamification and Shared Situated Displays on Smartphone Application Engagement

Juan Fernando Mejia Velez

A Thesis Submitted to the Graduate Faculty of

GRAND VALLEY STATE UNIVERSITY

In

Partial Fulfillment of the Requirements

For the Degree of

Master of Science in Computer Information Systems

School of Computing and Information Systems

April 2013
Dedication

This thesis project is dedicated to my parents. They always supported me during every stage of my career, motivating me to go on and reach new goals.

To Hye Soon. She has played a key role during my master’s degree, injecting me energy and inspiration to make out of my work achievements a product I feel proud about.
Acknowledgments

My deep thanks to Professor Jonathan Engelsma for his constant commitment to this project and my career. It has been a tremendous honor to meet him. Also the GVSU Art Department, especially to Nathan Kemler for his willingness to cooperate when it was necessary to the project either with time or resources.

To my thesis committee. Professors Christian Trefftz and Yonglei Tao for being open to help and provide their valuable input into the project.

To Sam Serpoosh. For his unconditional dedication to contribute with his time implementing the Android version of the game.

To all the players that I hope enjoyed the game while it lasted. I know that there were lots of improvements to be made but due to time constrains the game features were kept under a tight scheduled implementation.
Abstract

Planning the development of a smartphone application with user engagement in mind is a creative process that involves the incorporation of elements that encourage a sustainable longitudinal connection with its users. As more and more smartphone applications are introduced in the various application ecosystems, sustained user engagement has become very challenging and unpredictable.

Incorporating game elements into applications is one technique that appears particularly promising with regard to increased engagement. This process is referred to as gamification. The availability of inexpensive high quality flat panel displays has increased the use of digital signage in public places, and raises another interesting question: can the integration of smartphone app experiences with shared situated displays be used to encourage sustained engagement with users? This project investigates both of these opportunities as a way to encourage smartphone engagement. An existing campus app (that lacked an engaged user base) was enhanced with game features, and integrated into a series of situated displays. By comparing analytics data collected during the experiment, we can conclude that gamification encouraged engagement, but the impact of the shared displays was not conclusive.
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Introduction

The current market for smartphone applications (referred to as “apps” in the remainder of this thesis) has grown dramatically since the first version of Apple’s iPhone made its debut back in 2007. The rapid proliferation of apps has created a new challenge for app developers: visibility. Many apps have been written, but only a few apps had managed to become widely popular. Most apps experience very small user bases, and an overall lack of engagement. As reported by Canalys [1], 25 US development companies are accounted for the 50% revenue at the leading app stores.

Consistently achieving user engagement from the first use remains an elusive goal. Apps that have succeeded combine many different elements, going from a simple but addictive game (Angry Birds) up to a camera filter and photo sharing service (Instagram). Repeating these successes, even on a very small scale has proven to be very elusive.

Today’s smartphone user differs from the traditional PC user. The latter was submissive to what the market had to offer while the former is more discerning and demands better quality. Errors are punished by abandoning the app and bashing it in reviews, public forums and blogs, leaving developers and companies with little room to recover from a bad experience.

This brings an additional aspect to the already existing complexities of creating an app. It is not about features to solve a need anymore—sometimes only an initial need—or offering a delightful design or managing to provide good performance. Some apps become so popular that the companies behind the mobile platforms ask their creators to port a version for them. But going from unknown to viral is something that cannot be totally controlled or planned. Some companies in addition to well thought ideas require to advertise them via different media to attract users.
Additional elements are incorporated to apps or websites with the goal to increase user attention. These strategies need some special care due to their volatile effects around the contributed user engagement. Determine how effective the techniques of added elements are the foundation of this research project. Where an existing app is enhanced but its existing functionality is not altered.

Gamification is one way to make a mobile app more engaging. The possible scenarios offered could go from loyalty programs to keep users frequently using the app, to contests that will run for a period of time allowing users to get more familiar and dependent on the app, to collaboration experiences based on typical game mechanics such as levels, points, leaderboards, etc. to entice users to compete amongst themselves.

The goal of this research was to evaluate a couple of different ways to make a mobile app more engaging: gamification plus shared situated displays. It is clear that only a few apps will be considered essential for most users, while the other apps—including the one under study—are just non-essential apps in the mobile ecosystem. The classification as non-essential captures the intended meaning of pleasant to use but not absolutely fundamental. For this reason these non-essential or second level apps should provide a certain level of enjoyment to the users through a good experience allowing them to socialize the app among their friends. Usually viral apps get to that point by building upon large existing social network platforms.

The second element that was part of the research experiment is the use of shared situated displays; where information pulled from each individual device was presented in a dashboard/slide show experience. Creating a collocated shared environment among the users to compete. This shared displays presented different user’s actions with the app serving two purposes: a hub of user interaction with the game and a way to dynamically advertise the app among the people around the area where the displays were situated.
Hypothesis

This research project looked to answer the following questions:

▪ Does gamification increase user engagement on an existing smartphone application?

▪ Does incorporating a shared situated display in the game increase the engagement in an existing smartphone application?

▪ Will users engage with the app’s main content as part of the experience, or will they just use the game-related content?
Literature Review

The research project involves a series of topic areas including gamification, situated displays and the use of smartphones in art galleries and museums. From different sources reviewed some literature is closer to the goal of this research, while others provide some guidelines to discern right decisions and how to interpret results gathered during the deployment of the experiments.

Gamification

Gamification is “an umbrella term for the use of video game elements (rather than full-fledged games) to improve user experience and user engagement in non-game services and applications” [2]. Applying such elements to other contexts provides the benefit from the experience of the game industry where a lot of research has been invested on areas like behavioral psychology, HCI, and others. This approach has been applied for years in other fields not directly related to computers. Marketing for instance, was one of the first fields to fully understand the potential of game dynamics in human persuasion [3]. It can be found in multiple different experiences in everyday life, from loyalty programs on frequent flyer subscriptions offered by almost every airline—Programs that keeps the customers linked with the promise of a rewarded free ticket to their dreamt destination—to small contests organized by companies to promote their products. It is clear when any lottery starts accumulating significant digits as their big prize, people become almost frenetic to participate, even though, it has been demonstrated that the possibility of hitting the jackpot is almost zero. The notion of “free” or “prizes” results in a tremendous motivation to attract people’s interest.

Ian Bogost [4] has decomposed the elements of video games and explains why they become a persuasive power that keeps an audience attached to the goals consciously created by its designers.
He introduces the current issues that the game industry still faces with regard to cultural acceptance of games, especially in the case when they are still deemed for youth audiences. To fully absorb the potential of gamification it is required to understand how game mechanics are applied on the games itself. The concept of games has been perceived by many as an activity that involves entertainment. In a board game, illustrations and the atmosphere surrounding its use requires that people be on predisposition to play. The time invested on such play activities is clearly identified as “leisure time” where it could be “used” for more productive tasks. But games exists in many different ways that could even involve production time. As Bogost posits when he mentions a game called “Tenure” created in 1975 by Owen Gaede. This game is a simulation activity to evaluate high school teachers and helps to determine if a contract renewal should be offered. It is a simple game of responses to multiple-choice questions, which are interconnected and will take the player to different paths based on their answers.

The future will likely see the propagation of more game-based activities and tasks in our lives. What once was considered as a recreational side activity is gaining more of our time. As Zichermann and Cunningham [5] express it, games are being applied to daily activities vacation planning to marathon trainings to learning a new language or managing finances. Today’s generation of children have grown up surrounded by video games, and although they act more as distraction elements, there has been research around ways to incorporate them into the classroom. For example, QuestAtlantis is a game that uses multiuser and virtual environments to immerse children in educational tasks. [6]

**Shared Display**

In addition to game elements, information sharing techniques will be combined using a series of semi-interactive situated displays supporting the contest to motivate and attract the attention of users towards the application.
Nacenta and others have observed that shared displays provide benefits of usability when involving groups of people [7]. And although convenient to access information anywhere/anytime, smartphone displays possess limitations regarding sharing information due to the nature of privacy and individualism involved on the form factors of these devices. Furthermore being able to integrate a larger display with the experience of the smartphone has been studied and some use cases have been shown to increase interaction among people. Much can be done in this area where information can be “extracted” from the different devices and shared on a large display for people to start interacting. Using that display as a magnified version of the phone or a combination of multiple phones as the case of LunchTable [7]. LunchTable is an application that looks for centralizing the attention on a dashboard-like display from content fed out of the smartphone from the people around the lunchtime in a closed environment.

Human-Computer Interaction literature consists of a significant body of knowledge around the understanding of display based interaction. Situated displays cannot be studied with the same principles as the normal PC displays. They share some common elements but they also hold many unique characteristics regarding collaboration, group interaction and engagement that present particular design considerations and challenges [8]. All around New York a series of displays can be found being used as advertising means where space can be optimized to present products and messages to passing by pedestrians of the subway system. In this case as O’Hara notes, this type of public displays are situated to “attract public notice” [9] but they are not designed in terms of location and content presented, to engage with any specific audience. O’Hara also highlights “the impact on the behavior context within which displays are immersed by virtue of their spatial location, the relationship between space and meaning of information, zones of influence and activity around these displays and the way that spatial arrangement of displayed information can structure collaborative computation.”
Technology in Museums

The application under study in this research is a local campus app known as Art@GVSU. Art@GVSU is ultimately a mobile art gallery. It is an app that complements the physical art collection that GVSU maintains for the university community. Therefore, taking into account the impact of technology in art and museums is also part of this research. However, it is not the goal of this research to focus narrowly on how technology affects art or museums. Rather, our goal is more broadly to find ways to boost user engagement on the app under study.

GVSU art collection will become a digital playground [10] where from the point of view of visual design, objects in the collection can become the elements of games. Giving that those objects trigger emotional and imagined actions and motivate social interactions from users of the app. These elements are considered as part of the gamification and information sharing experiences under research, involving the player around art. When thinking to create or modify an app that involves experiences around art, design is a must. Being from a technical background, artistic elements are sometimes overlooked and details missed. For this reason research about design principles applied to museums [11] becomes an incredible contribution to be able to follow proven rules and avoid affecting what in the end continues to be an art gallery experience for users. Especially that most of this basic principles can be added to apps and look for similar goals as this research.

As a last element to consider in this research are the effects caused from the application on the context of the museum experience, research in the field [12] [13] regarding the impacts of smartphones in museum environments and statistics on mobile applications relating to them help understand how others are doing and what is there to improve.
Project Overview

The research experiment to support and help find answers to the presented hypotheses will be based on usage data collected from three different timeframes and two sources. An initial gathering of data from the existing usage statistics of the current version of the Art@GVSU app without being modified that starts from January 2012 to the end of February 2013 (collected via Google Analytics [14]). A second data set after a new updated version of the app with game elements incorporated is published. And the last data set when the shared displays are deployed in different areas of the campus. The last two data points expand from the end of February to April 15, where data is collected from Google Analytics and the game server.

The implementation products were deployed in time lapses of approximately one month to evenly distribute the available time of the project to have easier comparable data. Although the current data already collected from the application usage stats was from a wider time span.

The shared displays were positioned in public locations on campus where people walk by frequently during the day. The shared displays’ goal was to motivate people to participate in a game experience using the app Art@GVSU as well as presenting shared information to engage people in the game experience.

Evaluation process

The application tracks user activity and navigation behavior via Google Analytics. The data collected is going be analyzed to determine whether or not the proposed hypotheses are valid. The game server contains information regarding active users playing in the contest, but it is app usage and engagement that matters the most to the research, not focusing only on the game statistics but the entire application. Historical data is observed and conclusions are gathered by comparing the
lifespan of the app since its first publication. The first version of the app usage trend was going down. There was an initial burst of interest in the iPhone version motivated by a press release but those users were not totally engaged. For this reason the app resulted in a good study subject where a comparative analysis can be made.

The data considered into the analysis was collected until April 15, 2013.

These are the metrics to consider for the evaluation:

a) Visits before and during the project.

b) Navigation behavior before and during the project.

c) Voting behavior and registration trends collected from the game server.

It is natural that the game section of the app generates more attention, due to initial curiosity and further engagement, but part of the intention of integrating game mechanics on an existing application is to find out how engaged users are in the other sections of the app (e.g. the non-game content in the app).

While this research involves only a single app focused on art over a relatively short period of time, the lessons learned in this experiment is reasonably informative to others who are attempting to make their apps more engaging. Our goal was not to make the Art@GVSU app viral. The goal was to evaluate the effect that these two interventions—gamification and shared displays—have on user engagement levels.

**Contest**

Art@GVSU was gamified by adding a simple mini-game that allowed users to cast a vote for a favorite artwork selected from a set of nine choices. A new set of nine artworks was presented every
day and the user could vote for their favorite. The game server controls the amount of time a user has to wait to cast another vote. Players were allowed to vote once every 5 minutes, for the same artwork or another from the daily set.

The process to determine what artworks are shown for a particular day comes from a scheduled artwork list curated by GVSU Art Gallery staff members, with the option of having the game server randomly fill in any days in which artworks are not manually selected for play. Every time the user voted, the artworks are shuffled to encourage gameplay as a more conscious activity.

Every time users cast a vote, points were awarded to their account on the game server. Weekly prizes were given to the player who accumulated the most points during the week. At the end of the day, the most voted for artwork was identified by the game server, and the players who voted last during that particular day, for that artwork were awarded extra bonus points, and entered on a general drawing to win the grand prize at the end of the contest.

Users used their own personal iOS and Android based devices to cast votes, check their point balance and get more information about the artworks in the game section of the app. The shared situated display presented the voting trend from the current hour and the trend of the day, so users could get a glimpse of the artworks that were trending as the most favorite. Users were able to observe the leaderboard of players and identify the top positions in the game. Advertisement about the game and the app was presented periodically to motivate new participants to download the app and join the contest. Late comers were able to catch up with the weekly voting and the final drawing because points are not the decisive factor to win the grand prize. Voting last on a given day for the winning artwork of the day gave users the opportunity to increase their chance at winning the grand prize.
Platform Architecture

Collective Access
The Collective Access [15] is an open source collections management web platform for museums, archives and digital collections. It is widely adopted by museums and galleries around the world. The Collective Access platform exposes a series of application programming interfaces (APIs) through which the database can be queried and collection data retrieved. The GVSU Art Gallery uses Collective Access to manage its art collection. All of the artwork specific information will be retrieved from this system.

Game Server
The game server was implemented using Microsoft ASP.NET MVC 4.0 with Web API to serve a RESTful web service that will provide the functionality to track votes and user points during the contest experiment. This adjunct server to Collective Access is the core component providing the game features in the app, linking the Collective Access database with the contest and providing smartphone players and the situated displays with the data services required.
**Shared Situated Display**

The shared display is a dashboard application running on Silverlight presenting information about the game, the application, leaderboard, and voting statistics.

**Smartphone Players**

The players will use the Art@GVSU app installed on their smartphones to vote for their favorite art and check their progress in the game.
Implementation

The project details were sketched while the proposal was being created, although many fine details were better clarified and established during implementation.

API Service

The server was the first element to be partially implemented because there were some missing pieces at the start. The development followed a short cycle iterative process where meetings were held every week and new features or improved ones were implemented.

The implementation process was a big learning experience. Even in the server side where Web development has been constantly evolving, New features that benefited the project needed to be learnt. Keeping things simple, without complexity and unnecessary decorations was the goal in mind. A clear and consistent API for the clients to consume was the final outcome.

The API provided services to three different client categories. The Management Console, the Smartphone app and the Shared Displays. The game server encapsulated the communication with the Collective Access database through a wrapper class making it easier to consume by the Management Console. The API exposed the following controllers:

<table>
<thead>
<tr>
<th>Controller</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Building</strong></td>
<td>Coordinates information about buildings where artworks are physically located from Collective Access.</td>
</tr>
<tr>
<td><strong>Campus</strong></td>
<td>Encompasses sets of buildings from Collective Access.</td>
</tr>
<tr>
<td><strong>Collection</strong></td>
<td>Provides access to the artwork data from Collective Access.</td>
</tr>
<tr>
<td><strong>Console</strong></td>
<td>Provides management services to schedule artworks and check trending data.</td>
</tr>
<tr>
<td><strong>Display</strong></td>
<td>Feeds the data into the Shared Displays regarding day and hourly trends as well as top 10 leaderboards and live activity.</td>
</tr>
<tr>
<td><strong>FavoriteGame</strong></td>
<td>Controls the voting procedures for the smartphone clients.</td>
</tr>
<tr>
<td><strong>Player</strong></td>
<td>Provides the registration and activation services for the game.</td>
</tr>
<tr>
<td>Controller</td>
<td>Description</td>
</tr>
<tr>
<td>------------</td>
<td>-------------</td>
</tr>
<tr>
<td><strong>Rewards</strong></td>
<td>Provides the Weekly point's data, leaderboard, and activity feed, as well as odds to win the big prize for those eligible to participate.</td>
</tr>
</tbody>
</table>

Table 1 API Controller List

Deploying the server to production created a big challenge at first. A premise based solution was the preferred approach, but due to IT security restrictions it was easier to host the service in an outside provider. Microsoft Windows Azure web services offer of 3-Month free trial and hence presented a very simple and cost-effective solution. Once that decision was made, the service was deployed in a matter of minutes. At the end of the contest a series of restrictions on quota usage negatively affected the game experience but being so near to the end of the research those issues were fortunately not a significant problem.

**Management Console**

The management console was created in two versions. An initial simple version to allow early management of data to be available for players, providing the functionality of artwork selection and schedule definition for the daily sets to be presented in the smartphones. Later when the client development was completed the management console was updated to include easier and simple navigation model and included additional functionality of granular control over the data.

The interface had simplicity in mind. Looking to create an intuitive experience to manage the information required by the game. Implemented using Silverlight 5 and C# as its coding language connects to the server via JSON.
The Artwork Selection allows the user to navigate in the hierarchy of Campus, Buildings and Artworks and select the artworks to be included in the game as well as schedule when those should appear in the daily set.
The Artwork Calendar section serves two goals. First, it allows the modification of upcoming sets by removing a particular scheduled artwork before it has been presented to the players. Secondly, to observe the statistics for a particular day in terms of number of votes and awards given to the artworks—Hourly Bonus and Daily Bonus—indicating how many times the hourly bonus has been achieved. This screen uses a similar visual design as applied in the game screen used on the smartphones.

Artwork Stats allows the viewing of the vote trending during the day, the last hour and the current hour, presenting an accumulated line chart that easily depicts the behavior of votes for the different artworks.
Today Trends

All Day
Last Hour
Current Hour

Presenting options to drill down the data to the hour view shows how sometimes the trend changes constantly making it hard to determine the one that will provide the bonuses.

Players by

Week's Top 10
Registration

This Week

<table>
<thead>
<tr>
<th>Rank</th>
<th>Name</th>
<th>Email</th>
<th>Weekly Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Matt</td>
<td><a href="mailto:jav@auburn.edu">jav@auburn.edu</a></td>
<td>4140</td>
</tr>
<tr>
<td>#2</td>
<td>James</td>
<td><a href="mailto:jav@auburn.edu">jav@auburn.edu</a></td>
<td>2310</td>
</tr>
<tr>
<td>#3</td>
<td>Jayne</td>
<td><a href="mailto:jav@auburn.edu">jav@auburn.edu</a></td>
<td>1760</td>
</tr>
<tr>
<td>#4</td>
<td>Josh</td>
<td><a href="mailto:jav@auburn.edu">jav@auburn.edu</a></td>
<td>710</td>
</tr>
<tr>
<td>#5</td>
<td>Ali</td>
<td><a href="mailto:jav@auburn.edu">jav@auburn.edu</a></td>
<td>600</td>
</tr>
<tr>
<td>#6</td>
<td>Sean</td>
<td><a href="mailto:jav@auburn.edu">jav@auburn.edu</a></td>
<td>520</td>
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<tr>
<td>#7</td>
<td>Gayane</td>
<td><a href="mailto:jav@auburn.edu">jav@auburn.edu</a></td>
<td>440</td>
</tr>
<tr>
<td>#8</td>
<td>Chris</td>
<td><a href="mailto:jav@auburn.edu">jav@auburn.edu</a></td>
<td>50</td>
</tr>
<tr>
<td>#9</td>
<td>Stephanie</td>
<td><a href="mailto:jav@auburn.edu">jav@auburn.edu</a></td>
<td>30</td>
</tr>
<tr>
<td>#10</td>
<td>Erica</td>
<td><a href="mailto:jav@auburn.edu">jav@auburn.edu</a></td>
<td>30</td>
</tr>
</tbody>
</table>

Figure 5 Artwork Stats (Last Hour) - Management Console

Figure 6 Player Stats (Top 10) - Management Console
Player Stats presents information regarding player’s performance, allowing navigation to previous weeks to identify weekly winners and further notify them so they could pick up their prize. At the start of every week the top 10 list is very dynamic changing constantly and getting more stable as the week progresses.

![Registration Stats](image)

Figure 7 Player Stats (Registration) - Management Console

Observing the trends of user registration and activation shows how many players are actually enrolling in the game. Registration data can be correlated with the times that the game was released as well as the introduction of shared displays a month later.

**Client Development**

The most challenging part of the project was the implementation of the game functionality on the iPhone due to the total lack of knowledge of Objective-C and the use of XCode as IDE. One aspect that makes it easier to develop for iPhone is the huge community around the platform, where finding solutions for any roadblock issues is remarkably easy. But when requirements goes beyond
the base controls the learning curve becomes steeper. Also, the problem of screen resolutions makes it harder to accommodate elements on the screen that match old devices.

At the end, the implementation became more an exercise of UI and consumption of the API than making complex computations on the device.

The only issue that presented a big burden was the maintenance of Timers due to the way iOS handles the run-time pool when the device enters in idle mode or the app ceases to be on focus.

The registration process was kept simple. Requesting only the basic data to identify the players and provide a mechanism to contact them in case of a winner notification. Once the registration process completes an activation code was sent to the provided email account to confirm that it is authentic and owned by the player (see Figure 8 and Figure 9).
Once the players have succeeded in activating their account on a particular device, the main game screen appears, and they can start voting (see Figure 10.) Weekly points are shown to keep the players informed of their progress and the possibility to get more details about their statistics. On the vote screen a link to details of the artwork was created as a way to integrate the game with the non-game app content (see Figure 11).
After the players have casted a vote the app won’t allow them to vote again until the allotted 5 minute waiting time has passed (see Figure 12 and Figure 13). This time is controlled by the server through the API to prevent voting from multiple devices.

The design to keep this process tamper-proof was achieved by incorporating a final check in the server between the time of the last vote and the one being posted to guarantee that the right to vote should be granted. In the game model where every vote could alter the trends for players or artworks, it was necessary to look for extra protection.
As the last feature in the game app, detailed information about the game status was provided to the players (see Figure 14 and Figure 15). These screens show total points of the week, odds to win the grand prize\(^1\) and a partial leaderboard view. Besides the points given to players for votes, bonuses were also a mechanism to increase the points count. Player could observe how they were doing on the game with respect to the trend based on the hourly bonuses awarded.

**Display Dashboard**

As the last piece of implementation is the creation of the dashboard-like shared display experience, initially thought to be developed as a Windows 8 application looking to take the advantage of the new user experience pushed by the new modern applications model. Ultimately, it was decided to

\(^1\) Only players who registered with a gvsu.edu email address were eligible to win the grand prize.
build on the UI already created in the Management Console. Hence another Silverlight application was authored to drive the situated display user interface.

The shared displays were planned to present two categories of information: game data related to day and hour trends and player’s performance, and a way to advertise and encourage people to download and participate in the game (see Figure 16 and Figure 17).

Pulling the data from the service was straightforward as it leveraged what was already learned building Management Console. The only extra effort involved introducing some animation and rotation of content.

Silverlight provides a good framework to inject time based animations to on-screen objects but when it comes to off-screen animations some hacks need to be implemented. One of the advantages of the UI containers is the feature to adapt the content to the available screen dimension. But positioning objects off-screen requires adapting or overriding the automatic location that objects received during initialization.
Although making such a change is not an implementation burden, fine tuning the animation to be closely similar to those found in slide presentation applications (such as PowerPoint) where content comes in from one side of the screen and goes out to the other was a challenge. In public facing scenarios this detail is very important. It might seem silly but a clumsy animation could jeopardize the perceived quality behind the information being presented.

After a trial and error series of test a proper animation was in place and deployment of the displays was accomplished. The Shared Display was identified as a data intense client, for the constant pull of data from the server. Although small amounts of data were retrieved, it was retrieved frequently to keep people informed with up-to-the-minute trends.
Data between the main display content was pulled as the animation was flipping around waiting for the last piece of data and looping again. Analysis of the data consumption by the client needed to be measured to avoid quota limitations imposed by the Windows Azure trial subscription terms.

Additionally, a more “real-time” time of information was added to the pool, notifications of the last vote casted by players which checks every 5 seconds for the voting activity in the transactions logs as a means to motivate players to show off their names in the displays specially if there were not yet in the top ten list.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Name</th>
<th>Weekly Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Matt J</td>
<td>4140</td>
</tr>
<tr>
<td>#2</td>
<td>James E</td>
<td>2310</td>
</tr>
<tr>
<td>#3</td>
<td>Jayne D</td>
<td>1760</td>
</tr>
<tr>
<td>#4</td>
<td>Josh E</td>
<td>710</td>
</tr>
<tr>
<td>#5</td>
<td>Ali A</td>
<td>600</td>
</tr>
<tr>
<td>#6</td>
<td>Sean D</td>
<td>520</td>
</tr>
<tr>
<td>#7</td>
<td>Gayane K</td>
<td>440</td>
</tr>
<tr>
<td>#8</td>
<td>Chris C</td>
<td>50</td>
</tr>
<tr>
<td>#9</td>
<td>Stephanie K</td>
<td>30</td>
</tr>
<tr>
<td>#10</td>
<td>Erica G</td>
<td>30</td>
</tr>
</tbody>
</table>

Figure 19 Top Ten Leaderboard
For the high data consumption of the displays it was required to control the access to them or the content being presented on them from any unauthorized source. A one-time access code mechanism was implemented that notified via email of the new code to be used for further access.

Trending Today
Start voting now to change it!

A side effect (that was not experienced under controlled circumstances) started to appear in the deployed displays. After long running periods of time the timer and sliding mechanism implemented for the animation collapsed and all the content was present on-screen at once causing the data to be unreadable. Given the tight schedule for the project it was not possible to do further analysis and looking for a solution that prevented this issue. Instead a simple reset workaround method was devised.
Result Analysis

In general it was observed that gamification had a positive impact in user engagement into the app. However, it was shown that a significant amount of that engagement was around game features exclusively, and not so much to non-game content in the app. The situated displays also had an impact on engagement, although it was more qualitative than quantitative.

For the purpose of this analysis, *Version 1* refers to the version of the original app that was published in January 22, 2012 with data collection occurring until February 26, 2013. *Version 2* refers to the version of the app that included the game features. It was published on February 27, 2013 with data collection occurring until April 15, 2013. During the client implementation the Google Analytics components were updated to version 2.0 of the API to gain the advantages of new features for mobile app usage analytics.

Google Analytics 1.0 was designed to gather web site usage statistics, although the API for iPhone and Android allowed mobile apps to publish certain behavioral data it is only until version 2.0 when the API treats them as real apps. This is a good improvement but certain categories of the data contain additional elements on the measurements that could make the comparison not exactly identical but similar in what is important for this study.

Gamification Impact

Determine the impact of gamification in the app involves measuring the changes in the number of visitors or users, the number of times each user interacts with the app and also analyzing how much time users spend each time they use the app. This impact is viewed as the total experience of users, without distinguishing their activities or sections they pay attention to.
An initial peak in the visits to Version 1 is the result of the public relations conducted by the GVSU Art Gallery staff in notifying the community about the newly introduced app. This resulted in a sustained user base for about 5 months, after which the number of daily visits started to wane. The Android version (introduced in early September 2012) did little to stem this decrease in engagement.

![Visits from Version 1 to Version 2](image)

**Figure 21 Visits in all versions of the app**

In Figure 21 it can be observed how the visits trends moved during the first months from its initial release having multiple peaks, most of them following media announcements after reaching a more steady behavior and eventually sustaining an audience of only a few loyal users.

While the impact of the game was not significant in terms of number of users it did have a qualitative impact on engagement. A steady level of engagement with the app was maintained on both platforms of the app (iOS and Android), as is shown in the framed portion of Figure 21.

There was no significant media coverage of the game besides an article posted on GV\textsuperscript{Now} [16] right after Spring Break on March 11. As can be seen on the chart, the game activity was reduced during the break (3/4 – 3/8).
The duration of the Version 2 experiment was very short compared to the timespan of Version 1, over 1 year vs. 7 weeks. However, a clear trend can be seen in that there is an increased and sustained usage of the app with an average daily visitor count of 23 users in Version 2 compared to 5 users in Version 1.

![Version 1 vs. Version 2 (Same timeframe)](image)

Figure 22 Comparison of Visits between the app before and during the project.

Observing the number of visits during the same period of time (2012 vs. 2013) between Versions 1 and 2 highlights this behavior more clearly. The outcome of engagement represented by daily visits is clearly seen where Version 1 was characterized for sudden peaks, Version 2 shows a more stable behavior. This behavior indicates more constant and longer use of the app. Users were driven either by the content or the game section what in general constitutes the engagement increase as the expected result from this project.

Another supporting measure to determine user engagement is the time spent by users in the app. An approximation of this behavior can be seen by comparing active users to screen views.
The amount of screen views and active users increased remarkably compared to Version 1 (see Figure 23). Another element to observe is the comparison between active users vs. screen views in a given instance which is translated to users spending longer periods of time using the app. Even in a shorter period of time Version 2 achieved larger numbers of screen views (metric to the left of Figure 23) by many times the amounts of Version 1. Active users remained more constant and higher in Version 2 compared to Version 1.

While surveying players (see Appendix A for details about the survey) regarding their motivation to use the app and interact with the game contest, more than half of the responses expressed interest for the prizes while a quarter of them said that it was fun to play (see Figure 24).
Figure 24 Survey – What motivated people to participate in the game?

In measuring how much people liked the game, the survey shows that it was positively accepted by most of the audience, although a significant portion expresses dissatisfaction with the mechanics as presented later in the conclusions.

Figure 25 Survey – How much did people like the game?
Even with some people expressing that the actual game implementation was not totally enjoyable or that it presented challenges for people to catch up with the leaderboards, the responses shows that a new version of the game would be welcomed by existing users, whether it be an improved version of the existing game or a completely new game (see Figure 26).

![Figure 26 Survey – Do people want a new game next semester?](image)

What is clear is that people will expect prizes to be part of future games. This was indicated as a strong motivator to drive people’s participation as can be shown in Figure 27.

![Figure 27 Survey – Will people play without prizes offered?](image)
Impact of Situated Displays

A month after the game was released two of shared situated displays were deployed in public places on GVSU’s Allendale campus in Mackinac Hall and the Performing Arts Center. The game dashboard appropriated already mounted displays that previously displayed content unrelated to the game (see Figure 28).

The visit trends on the app didn’t changed drastically after deployment of the displays (see Figure 29). It is difficult to conclude that the displays are an ineffective method to increase user participation or adoption of the app due to circumstances in the context of this particular experiment. The physical locations used already had a situated display that the project re-used. One possible explanation is that given the displays had been there for a long time (years!) and never really displayed data that was engaging. Hence, most people in the campus community have simply tuned them out and do not pay any attention to them.
In addition to the data gathered by Google Analytics, the game server collected information about the contest activity that helps understand in a more precise way how voting trends evolved and how the integration of shared displays have impacted game play.

By observing the behavior of votes during the course of the game we can identify a series of higher values in the days following the deployment of the Shared Displays significantly outperforming previous values (see Figure 30).
The data also shows a decline from April 10, due to a series of technical difficulties that started to appear in the Windows Azure service when the web server account became suspended due to quota reached in the data out limits. It was not clear why this quota was reached because there is no considerable voting or activity to support the data consumption reported by the service provider.

Another way to look for the effects of the deployment of the displays in the voting behavior is to analyze how often players were able to determine the trend of the hour (see Figure 31) and the day (see Figure 32). The core advantage of the displays in the game was to provide a global view of the trends and increase the player’s chances on following them. Also part of the goal with the displays was to feed motivation to challenge the trend.
In both cases (hourly and daily) there is a significant increase on awarded bonuses after the displays were deployed, compared to the amount of them granted to players before that.

Registration behavior over the course of the project was not very predictable. There is no clear trend in users enrolling in the game and the situated displays did not seem to encourage additional participation as we had anticipated.
With data from surveys, additional insights into how the situated displays impacted game participants was collected. Although the impact was not as significant as anticipated, there does appear to be a qualitative impact. However, increase on user participation by the advertisement efforts from the displays didn’t work out as expected. This is an area that could be studied more carefully in the future by placing new displays in public places that users aren’t already accustomed to ignore.

In all 75% of the survey respondents did indicate they were aware of the displays. Perhaps stronger media coverage of the displays placement could of increases awareness and use of the displays.

![Pie Chart](image.png)

Figure 34 Survey – Did players knew about the displays?

Altering player behavior in voting for a particular artwork was one of the intention of the displays by providing information about the current trends motivating players on following or challenging the observed trends. After all, the more closely players followed the trends the more the chances they had to increase their odds of winning bonuses and ultimately the grand prize.

It appears that early votes during any given day were driven by the quality and characteristics of the artwork themselves, but soon after it was seen that a couple of artwork pieces stood out from the rest and began receiving the bulk of the votes.
Figure 35 Survey – What motivated the first vote in the day?

During the day as playing increased and favorite trends began to emerge, people relied on the information being shown on the shared displays to increase their overall standing by voting the trend.

Figure 36 Survey – Were displays an advantage?
At the start of the game experiment there were a few players that got the leadership of the game due to their constant voting actions. These highly active players took advantage of the 5 minute gap between votes, but this resulted in a few players very high on the leaderboard, leaving other players with little incentive to vote until the beginning of a new week, when all scores were reset to zero.

![Figure 37 Survey – Did the display affected people vote habits?](image)

**Engagement in Non-Game Content**

A key goal of this project was to use gamification to cause people to engage with the app’s non-game content. That is, usage will flow from the game features in the app, into the non-game more serious parts of the app. Engagement flow is a complex component to analyze. Google Analytics provides some very useful information that shows engagement from multiple perspectives. Metrics such as the time users spend on every session, the number of screen views and how are those related to the sessions they belong help understand overall app engagement. Another view called Engagement Flow visually represents the navigation behavior of users between screens with
information that helps understand how much impact the game features have on getting users to engage with the serious parts of the app.

To better understand the impact of engagement let's review the structure that encompasses Art@GVSU. The application under study is formed by 4 main sections: Tours, Browse, Search and Favorites. Plus the game functionality added as result of this project.

When users start the application it goes straight to the Tours section causing the statistics to be skewed towards it. This behavior was very evident in Version 1 of the application where Tours got 86.7% from the initial navigation (data combined from the period adding up iOS and Android devices). Part of this behavior can be seen in Figure 38 from the iOS version of Google Analytics. Making it very hard to discern how many of those events really reflect the user intention to navigate to these sections. From there, Maps (which is an internal part of the Tours) and Browse are the sections that capture the user attention.
In Version 2 of the iOS application\(^2\) it is the Game section that captures the majority of the users (see Figure 39) which reflects players keeping the application running, so initialization events do not executed as frequently as before.

\(^2\) Due to the Android navigation schema, most users closed the app when navigating back multiple times. In iOS users leave the app running more frequently.
This indeed is part of the evidence that suggests the game increased engagement, although given the anonymous nature of the stats and the upgrade to the version 2.0 of the Google API is hard to tell if the engagement change affected already existing users or completely new users in the app.

Analyzing this flow of navigation looking to prove or disprove the presented hypothesis regarding how other parts or the app get affected or benefitted from the introduction of the game mechanics.
is a matter of searching for navigation jumps into other sections of the app content, being those jumps coming from the game section or not.

As part of the design of the game experience a link between the vote screen and the artwork details in the app was created looking to motivate integration with the non-game content.

Figure 40 Traffic through 'ITEM_INFO'
From all the visits received during the game period (around 14,000) about 16.4% went through content screen of the app not related to the game, but here are all the activity from initialization (Tours) and unintentional navigation to the Favorites section due to the proximity of “My Stats” button to the navigation bar.

From the navigation to non-game content, the one that is important to note is ITEM_INFO (see Figure 40) as the bridge between the game and the app. About 2.5% of traffic landed into this screen from different sources, being the game accounted for 68% of those views. The achieved impact in non-game areas of the app was not significant to reach a conclusion related to the benefits of gamification. But getting users in constant activity with the app game content will drive them to explore the app content areas over time.

The drop-off rate in Version 2 was higher from the initial screens where people load the app with the intention to vote and check stats and then shift to their normal activities. The nature of the simplicity of the game allowed players to dedicate just an instance every so often to vote and by this behavior is natural to see people leaving the app after a couple of screen views. After navigating through 4 screens, in Version 1 about 45% of users remained using the app, in contrast with Version 2 where only 9% continued interacting with the app. The observed behavior is logical to the game mechanics. In Version 1 the few users that interacted with the app were truly engage with the content areas that required a deeper connection with the navigation and artwork’s browsing. In Version 2, most of the users just interacted with the app to vote and then left. Further work can be made to reduce the drop-off rates in the app by integrating the gamification mechanics deeper with the content.
Conclusions

The experiments in this study were designed to test the stated hypotheses. In general, obtained results were positive, although not all of them as initially expected. Over the execution of the project there were unforeseen elements that affected the intended results of the study. Following are the results finding in more detail applied to each hypothesis.

Does gamification increase user engagement on an existing smartphone application?

Clearly gamification had an observable positive effect on user engagement. In this case the application under study became again part of the community attention and its usage increased compared to previous months. At the same time the users had more frequent activity with the app.

Some people expressed frustration due to the high challenges posed by a small number of participants that dominated the leaderboard. Once people started to dominate at the beginning of the week, usage of other players began to drop off.

The engagement achieved was very dependent to the game and the prizes offered. Once the game or the prizes are removed it is likely that engagement will drop back to Version 1 levels, though we did not have time to test this conjecture. Based on the survey results, the prizes clearly were a key source of incentive among players. A valid area of research in the future would be to determine how frequently tangible prizes have to be awarded as incentive in order to keep users engaged.
Does incorporating a shared situated display in the game increase the engagement in an existing smartphone application?

The effects of the shared displays were seen in the voting trends and the increased bonuses that were awarded. From the survey responses we learned that almost half of the respondents agree that their odds to win prizes increased due to the additional information being presented on the displays. The same percentage of people indicated that the information provided by the displays acted as an incentive to keep them voting. Even though they were deployed later in the game and in locations where other displays (with unrelated content) already existed, 75% of the survey participants were aware of their presence.

The experience of the shared displays resulted in the creation of a semi-interactive activity where players could see in near real time, their impact on the game by watching their casted votes. The screens also helped them determine what was trending and how to vote in a way that garnered them more points.

The more active players were able to control the trends without using the shared content from the displays but others not so enthusiastic were able to start impacting the game by getting insight information.

Although the content on the screens encouraged others to join, the displays had little impact in terms of attracting new users to download the app.

The location where to situate the shared displays has an important role in the effect generated by them. In our experiments it appears that our users were preconditioned to ignore the displays which minimized the impact. Future experimentation needs to be done to confirm this and to study the problem that placement has on overall impact on engagement.
Will users engage with the app’s main content as part of the experience, or will they just use the game-related content?

The effect caused by the gamification methods applied to the app created a situation where the game got almost exclusive attention from the users. Hence, the game content in this particular app seemed to cannibalize the non-game content. People liked the artworks being presented to them and some users expressed that interest relating to the artwork started but still the data collected by the app seems to indicate people was pre-occupied with the game itself.

Future efforts with the app should seek ways to integrate the game features more tightly throughout the app, instead of having the game consist of a separate navigable set of screens in the app, separate from the non-game screens in the app. Tighter integration of the game features with social media would also be a more interesting area of further research.

Though user engagement in the game portions of the app dominated rather than engagement in the non-game portions of the app, it is harder to measure the overall positive impact the experience had on awareness of art in general and the GVSU Art Gallery’s mission within the university community.

This findings suggest that gamification should be integrated throughout the app rather than be a single discrete and separate component added to the existing app content. Without a more pervasive integration of the game mechanics one risks having the game content cannibalize engagement with the non-game content.
Appendix A: Survey

As a way to gather some feedback from players a small survey was sent to all the players who besides being registered had some game activity. Total responses collected came from 16 participants.

Art@GVSU Game Survey

This short survey is to collect some information about the experience during the game in the Art@GVSU Application, looking forward to know your thought and use it to think on future improvements.

Were you aware of the public display panels with game information in Mackinac Hall and the Performing Arts Center?

- Yes
- No

How did you find out about the game?

- GVSU Now
- A Friend
- Had the app installed previously
- Art Gallery Facebook page
- Saw the Display at Mackinac Hall or the Performing Arts Center

What makes you vote for a particular artwork at the start of the day?

- I liked the artwork
- Pick any artwork to vote for
- A friend told me to vote for a particular artwork
- Saw the trends in the display
- Other
How much did you like the game?

1 2 3 4 5
Not at all  o o o o o  Very much like it!

Can you tell us what you like most and what you didn't like about the game?

Would you like to see a new Game the next semester?

o  Yes
o  No

Will you play if there were no prizes?

o  Yes
o  No

Did the presence of the display panels cause you to vote more frequently?

1 2 3 4 5
Not at all  o o o o o  They motivated me to vote

Did the presence of the display panels help you improve your overall standing in the game? (e.g. odds of winning the Xbox)

1 2 3 4 5
Not at all  o o o o o  My odds to win increased

What was your primary motivator in playing the game?

1 2 3 4 5
I wanted to win the prizes  o o o o o  I played because it was fun
References


