PJIM PARSONS JOURNAL FOR INFORMATION MAPPING

THE PARSONS INSTITUTE FOR INFORMATION MAPPING
68 Fifth Avenue
New York, NY 10011
212 229 6825
piim.newschool.edu

Icons of Educational Apps as Media Artifacts: Understanding EdTech Apps via Cultural Analytics

EVANGELOS KAPROS, PHD & KERRI MCCRORY, PHD

KEYWORDS *Cultural analytics, data visualization, educational technology, icons mobile apps, media analysis, software studies*

DATE November 2014–May 2015

ABSTRACT While cultural analytics has become a well-established visualization method for big image and video data, the domains in which it has been used have focused on traditional media. Magazine covers, photography, manga, and video frames have been the main domains of exploration so far. In this paper, we propose cultural analytics as a means to analyze icons from software applications—these are not traditionally analyzed as media artifacts; however, new and interesting results may occur from treating them as traditional media. The aim is to better understand an application domain by analyzing the icons of its software applications.

As a case study, we visualized and analyzed the icons of 158,200 educational apps that were uploaded to Apple's App Store from July 2008 to November 2014. The contribution of this project is twofold. Firstly, we demonstrate how analyzing the software icons of an application domain (in our case, education) can help researchers gain insights into the domain. Secondly, within cultural analytics we developed a visualization technique ("time-freeze" timeline) that helps follow a trail of an app's icon through its updates. We anticipate the "time-freeze" timeline visualization to be useful for cultural analytics at large, as a way to present imagery that is updated, and not specifically for visualizing icons.

INTRODUCTION

In this paper we describe a project to analyze the Educational Technology (EdTech) application software that exists in mobile app stores, in order to help the Learnovate Centre at Trinity College, the University of Dublin, to better understand this space. Analyzing and understanding mobile apps is an important step in a state-of-the-market analysis for EdTech, since educational institutions have invested significantly on either 1:1 or BYOD (bring your own device) initiatives, namely programs where students are using mobile devices such as phones or tablets to access educational applications. Understanding these applications facilitates the formation of better hypotheses and research questions concerning the design and development of future EdTech apps.

BACKGROUND ON SOFTWARE STUDIES: WHAT IS AN APP?

Endeavors such as understanding how software is related to a field have been typically associated with the field of Software Studies. Software Studies can be limited to a set of users, for instance when studying users who take selfies, or a specific type of software, such as mobile apps.[1]

The Imaginary App (2014) by Miller et al. seems to be the one that has pushed the question of what apps are and what they can do furthest than any other. An app is defined as "an abbreviated software application—figuratively and literally, [and] linguistically" (Miller et al. 2014, i), that "turns the device into modulation of the hand."[2] Less attention has been given to the icons of apps, and they have not been typically treated as design or media artifacts.

In this paper, we do not consider an icon as a symbolic object "melting" with an "imaginary" app or the reality, as in the post-modernist presentation of Kittler et al. (2010). Rather, we agree with the modernist critique in Castoriadis (1991) that "history without a subject" is a sophistry as much as "design without a subject," and that the imaginary props in a layer of the real: in our case—and arguably many others—an icon is never an artifact of and in itself, it is an icon of an app, designed for a set of users.[3] Thus, analyzing icons of apps gives us insight on the actual apps themselves. As with other forms of technology, this makes clear that icons are not neutral tools to open an app, but purposeful pieces of design that do more than serve as the functional app initiator; rather, icons are, in a way, representing their apps.

Icons, being visual media, can be analyzed using the Cultural Analytics method. Cultural Analytics continue the use of computer graphics as a research method, especially for large collections of visual media, to "turn 'culture' into 'data.' "[4] Various projects have implemented Cultural Analytics for a variety of media ranging from photography and manga to video frames (Hochman et al. 2013, Manovich et al. 2009, Rabinovich 2015).
To the best of our knowledge, this is the first attempt to perform this type of analytics to icons. However, to better provide context, the next section we will first present the traditional, numeric, data analysis. We will then proceed to describe the cultural analytics.

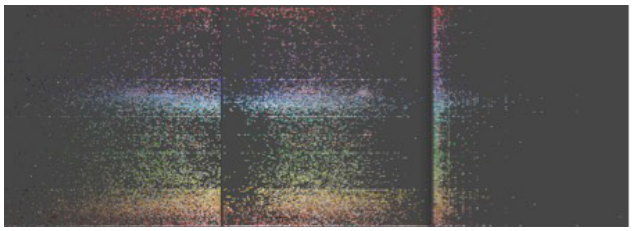

FIGURE 1: *Three panels visualizing icons from the "education" section of the Apple AppStore. The vertical axis is the median hue, and the horizontal axes are brightness, saturation, and app price.*

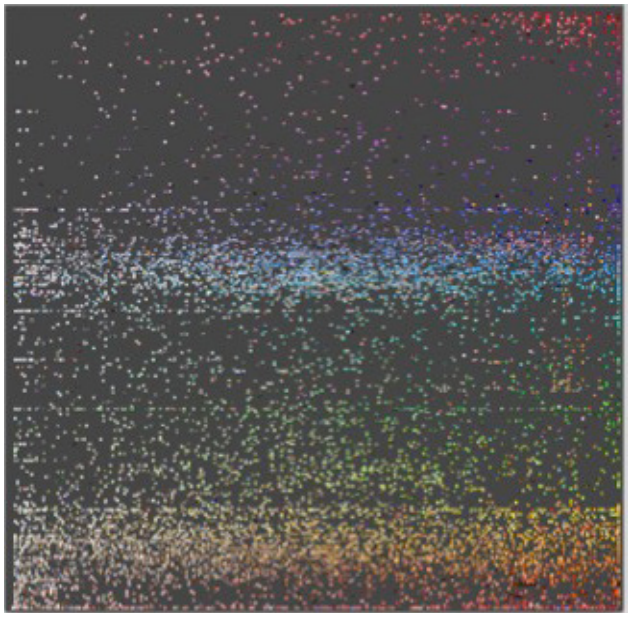

FIGURE 2: *Educational apps tend to have less saturated red icons and more saturated blue or yellow ones.*

DATA ANALYSIS

This project involved extracting the data associated from 161,786 apps listed in the education category of the Apple App Store. The data associated with the apps were extracted from July 11, 2008, the day after the App Store opened, until November 26, 2014. The downloaded app data was imported to statistics software in an aim to understand the data and to identify trends. A total of 161 variables were defined which indicate what was being measured, and how. Examples include 'AppID,' a string used to identify one or more apps from a single development team, 'title,' a string used to list the name of the app and the 'price,' a string used to list the app price in USD. In aiming to provide beneficial insights into the data it was determined that nine areas of interest would be the most prevalent to the intended audience of educational technologists, including: 1) pricing tiers, 2) publisher information, 3) customer ratings, 4) app categories, and 5) updated and released status. Some of the nine areas are beyond the scope of this paper, thus each of the related areas are introduced with the key findings presented.

PRICING TIERS

The Apple store provides eighty-three tiers of pricing which range from free to $999.99. Apps will either be free or will have a pricing tier assigned, which can be scheduled to change. It is worth noting that Apple has recently changed the terminology surrounding free apps moving from a 'free' button to a 'get' button. This get button reflects that although apps are free, many of these apps will be based on a freemium model or include in-app purchases. The key findings reveal that over half of the apps are free (55.07%) and that most of the pricing increase gradually, with the exception of $19.99 which places in the top ten. There has been an increase in the number of free apps since 2008, the biggest increase was in 2010 with a 120% increase followed by 2014 with an 83% increase, and there is a steady and consistent growth of the remaining app prices across from 2008–2014. Ninety-two apps were listed in the most expensive categories, from $109.99–$999.99 USD, four apps are priced at $999.99, the highest price a developer can charge for an app.

PUBLISHER INFORMATION

Apple requires each publisher (either an individual or a company) wishing to release an app to enroll in the iOS Developer Program. Once enrolled each publisher takes part in a three step process: 1) the development of the app, 2) the testing and debugging of the app and 3) the distribution of the app. The key findings for publisher information reveal that there are 49,287 distinct publishers within the education category, this results, on average, with each publisher publishing three apps with the median resulting in one app per publisher. The top ten publishers reveal that not all of the apps are specifically educational, i.e. they include a large number of travel dictionaries and parent communication tools.

CUSTOMER RATINGS

Customer ratings play an important role. Apps which rate highly can be featured in the top charts within the App Store, which lists the top free and paid apps to a potential worldwide market. Addtionally the customer ratings can play a central role for customers when browsing apps, with some customers opting to purchase or download an

app which has positive or higher ratings. There are five different rating tiers available to customers ranging from one to five. Once a number of customer ratings have been submitted, more rating tiers are introduced, they include, 1.5, 2.5, 3.5, and 4.5. Once an app has been downloaded, it can be rated by the customer at any time, or developers can prompt users to the rate the app during its use. It is worth noting that there are issues associated with ratings in the App Store, these issues mainly refer to fake ratings and scams (Liu & Sun, 2014). With this in mind the key findings for customer ratings reveal that only 33.99% of all apps have an associated rating, the average app rating is 3.5, the most popular rating category is 4 with 15.1% and from the 49,287 distinct publishers only two have achieved rating of 5 stars.

APP CATEGORIES

App categories play an important role in the discoverability of apps with the App Store. Currently there are twenty-four categories in the App Store. When releasing an app, the publisher must specify the primary category, the secondary category is optional. Apps with a secondary category will be featured within the primary category results and vice versa. Given key findings for publisher information, it is evident that the interpretation of education is a very broad. Taking this into consideration, the key findings for app categories reveal that 20,450 apps have one category—education—assigned. Apps cannot have the same primary and secondary category, though 161 apps have education and educational combination. The top three combinations of app categories are education and games (19,552 apps), education and reference (12,800 apps), and education and entertainment (9,373 apps).

UPDATED AND RELEASED STATUS

Once an app has been approved by Apple it is released into the App Store. Once released an app can be updated, usually providing new version of the app. Updated app versions are available free to customers who purchased a previous version. The key findings reveal that it is evident that more apps are updated (60.77%) than released (39.22%) within the education category. September 2014 saw a significant increase of apps being updated, coinciding with Apple's iOS 8 release and July 2010 saw an increase in the number of apps being released, coinciding with the release of the iPhone 4.

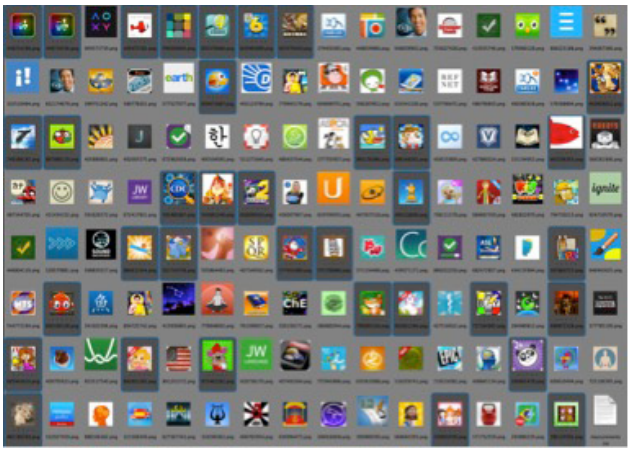

FIGURE 3: *The icons of the top-rated 130 apps sorted by rating. Selected icons have "Games" as their secondary category. More educational games icons feature character-design than in apps other educational categories.*

CULTURAL ANALYTICS

The analysis of the icons provided interesting results that complemented and validated the above analysis. The analysis was twofold: firstly, the totality of the icons was visualized according to their visual attributes, and then a narrowed down analysis was performed on some selected icons.

At first, plotting the entire set of icons was an exploratory process. For example, plotting the brightness median on the X-axis and the saturation standard deviation on the Y-axis produced a rather uninteresting plot, only indicating that there is a concentration of blue icons and a not too strong preference for saturated icons (FIGURE 7). However, even this otherwise uninteresting plot hinted towards a useful result, namely that hue would potentially be a better visual attribute to explore.

Indeed, as one can see from FIGURE 1 and FIGURE 2, the median hue makes obvious patterns in icon design. Moreover, these patterns seem to depend on other, non-visual attributes too: price seems to be a factor that affects icon design (FIGURE 1, right panel). Interestingly enough, price seems to be related to icon design in non-trivial ways. That is, apps in the competitive tiers seem to have focused considerably on the icon design, as their icons are on the more popular hues and averagely bright and saturated. In contrast, the very expensive apps seem to be too bright and saturated; typically these would be apps that the cost of $999 USD includes an iPad and the fee for a very specialized course—the specialization rather than the successful design of the app's icon is the driving force behind the monetization of these apps. Incidentally, let it be

noted that this observation would have been impossible without applying a visual research method equivalent to Cultural Analytics.

It is interesting to see other design aspects in icons, for instance that U.S. history trivia or reference apps sometimes use the "Betsy Ross" flag, thus communicating their historical nature without having to use controversial, to say the least, Confederate flags. In order to better observe such design aspects, a deeper dive was attempted at 130 apps that had a rating equal to or higher than 4.5 from more than fifty users (FIGURE 3). The categories of these apps were slightly different than the ones in the data analysis; for example, apps about religion are a bigger percentage of these 130 top-rated apps than of the entire set of apps (FIGURE 4). Notable observations are that character design is strongly present in educational games, and that religious apps prefer to depict either a book or a sacred figure. While language apps on the overall visualization include many maps, the language apps of the top-130 apps mostly illustrate either letters from the alphabet of the target language, or a corporate logo. Overall, the top-130 apps do not have icons with objects related to a classroom environment; a clear indication that their target model is not formal education.

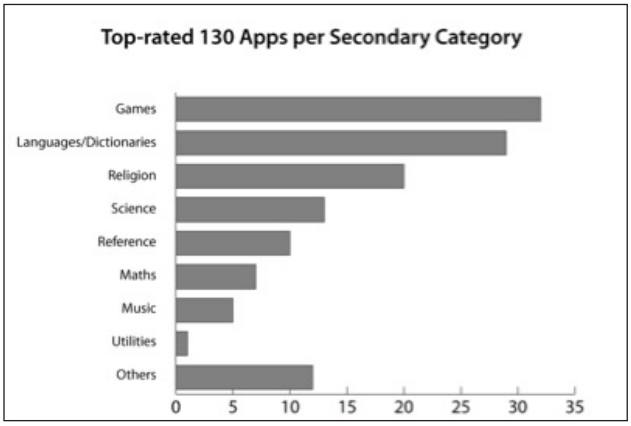

FIGURE 4: *A breakdown of the top-rated 130 educational apps by their secondary category.*

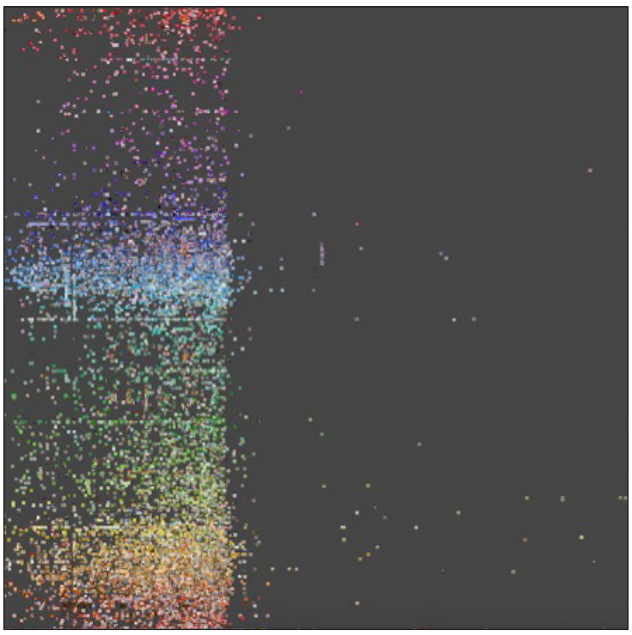

FIGURE 5: *Uploads and updates from 2008-2014 to the App Store of the apps that were originally created in 2008-2010. The iPhone 4 release is visible in July 2010; the vast majority of these apps were never updated, so that the big number of updates on 2014 (for iOS 8) consisted almost entirely from apps created after 2010.*

'TIME-FREEZE' VISUALIZATION

This section describes a technique that was used to visualize updates. The difference between this visualization and the aforementioned ones is that the one dimension is time. The aim of the visualization in FIGURE 5 is to visualize an already interesting attribute to us—the median hue—across time. Moreover, in order to capture the update activity of EdTech apps, the technique illustrated in FIGURE 6 was followed.

This technique was based on the above-mentioned findings of the data analysis with regard to updates. Specifically, the intention was to identify if the apps that updated for the iPhone 4 release were also a significant percentage of the apps that updated for the iOS 8 release. To this end, we visualized uploads to the App Store and updates from 2008 to 2014 of all the applications that were created from 2008 to 2010. That is, we visualized the uploads and updates of apps that were created before the iPhone 4 release, from the "beginning of time" until after the iOS 8 release. That makes the iPhone 4 release a cut-off point in time, thus providing us with a 'time-freeze' view, where we can stop the production of new apps after 2010 and look at the evolution of only the already existing ones.

The results in FIGURE 5 are striking. While there is a surge of uploads and updates to cater for the iPhone 4 release, these apps subsequently fail to update. Since the numeric data demonstrate how a similar surge happened during the iOS 8 release, one can understand that the second surge consisted of a set of apps almost entirely foreign to the ones of the first surge. This result shows a very significant shift in the behavior of app developers and EdTech publishers. From our broader knowledge of

the sector, one possible assumption can be said to be that the first surge consisted of apps where the developers had anticipated an easy monetization of their apps, and over-enthusiastically built and uploaded apps built as products. In contrast, the second surge included a new round of apps where the publishers realized that the apps needed to generate a stream of revenue in order to cover recurring costs; thus, the old apps were discontinued, and the new ones were built as services.

As above, the visual analysis of the icons across times made this observation available. Moreover, the 'time-freeze' method demonstrates that occasionally some resistance to the natural urge to visualize the entirety of a dataset can produce interesting and useful results.

CONCLUSION

From the Cultural Analytics of the icons for approximately 162,000 EdTech apps from the App Store, we derived the following. Firstly, the attributes of the icons correlate with non-visual attributes of the icons, such as the price of the app. Secondly, visual techniques can show the scale of situations such as the lack of updates, and the potential underlying assumptions, such as the realization by many publishers that app design is more similar to service design rather than product design. In conclusion, the analysis seems to validate the modernist hypothesis that the purpose of the design and the active agency of the designers is embedded in the icons, despite their "imaginary" nature; otherwise, observations on the non-visual aspects and underlying update assumptions would not have been possible by analyzing purely visual attributes. Simultaneously, the appropriateness of using Cultural Analytics as a visualization and exploratory research method is showcased for yet another visual medium, namely icons. We anticipate that our methods and conclusions are not EdTech-specific and contribute to the greater body of knowledge in Software Studies.

TECHNICAL BRIEF

Apple's Mac AppStore API was used to download the icons and related data from Apple's AppStore. Queries narrowed the data down to apps related to the education domain. The downloaded app data was imported to IBM SPSS Statistics software. Automator actions were used to perform simple file management, i.e., copying all icons to the same folder. QTIP is a simple application extracting image features for all images located in a directory. It was used to produce a table of features for the downloaded icons and feed them into ImagePlot. ImagePlot is a free software tool that visualizes collections of images and video of any size as timelines and scatter plots which display all images in a collection. It was the main visualization tool used for this project.

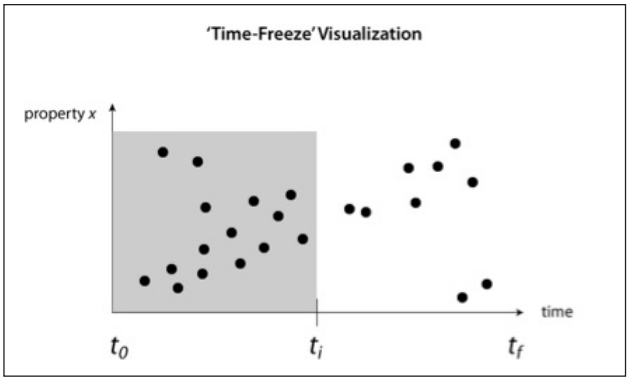

FIGURE 6: *The generic method used to produce (*FIGURE *5). All icons were produced from 2008 to 2010, but were updated until 2014.*

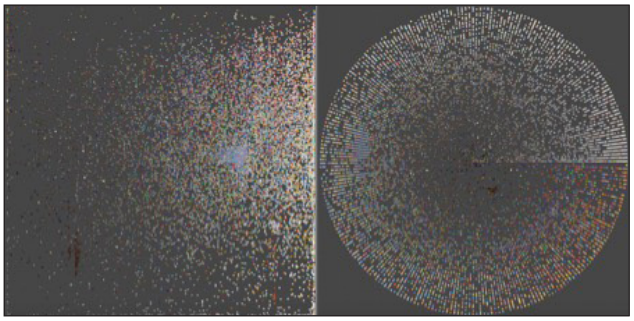

FIGURE 7: *Brightness x Saturation visualizations in different coordinate systems. The distribution of icons revealed almost no patterns and thus indicated that hue was probably a better attribute to visualize.*

ACKNOWLEDGEMENTS

This research is supported by the Learnovate Centre at Trinity College, the University of Dublin. The Learnovate Centre is funded under the Technology Centre Programme through the Government of Ireland's state agencies Enterprise Ireland and IDA Ireland.

BIOGRAPHY

Evangelos Kapros is working on educational technology as the User Experience Lead in Learnovate Centre and as a researcher at the Knowledge and Data Engineering Group in Trinity College, the University of Dublin.

Kerri McCrory is working on educational technology as a Technology Lead in Learnovate Centre and as a researcher at the Knowledge and Data Engineering Group in Trinity College, the University of Dublin.

NOTES

1 Hochman, Nadav, and Lev Manovich. "Zooming into an Instagram City: Reading the local through social media." First Monday 18, no. 7 (2013); Paul D. Miller and Svitlana Matviyenko. The Imaginary App. (Cambridge: MIT Press, 2014).

2 See note 1, Hochman.

3 Cornelius Castoriadis, Crossroads in the Labyrinth. (Ypsilon, 1991), 240

4 Lev Manovich and Jeremy Douglass. "Visualizing Temporal Patterns in Visual Media." Visualizing the 21st Century (2009).'

BIBLIOGRAPHY

Apple. (2014). iTunes Connect Developer Guide. Apple.

COPPA. (2015). COPPA - Children's Online Privacy Protection Act. Retrieved 6 10, 2015, from COPPA: http://www.coppa.org/coppa.html

Kittler, Friedrich, and Anthony Enns. Optical media. Polity, 2010.

Liu, Y., & Sun, Y. "Securing Digital Reputation in Online Social Media [Applications Corner]." IEEE Signal Processing Magazine (2014).

Rabinovich, Misha."Gaining Insight Into Films Via Topic Modeling & Visualization." Parsons Journal for Information Mapping 7, no. 1, (2015):1-8.

Xu, Weijia, Maria Esteva, Suyog D. Jain, and Varun Jain. Interactive visualization for curatorial analysis of large digital collection. Information Visualization (2013).