

# A Conceptual Approach and Test Case: Art Analytics as an Approach for Integrative, Hands-on Learning

Dominic Thomas  
dthomas@suffolk.edu  
Information Systems and Operations Management

Ilona Anderson  
ianderson@suffolk.edu  
New England School of Art and Design

Susan Nichter  
snichter@suffolk.edu  
New England School of Art and Design  
Suffolk University  
120 Tremont St.  
Boston, MA 02108 USA

## Abstract

A significant body of research over the past 20 years indicates that integrative, hands-on learning in real contexts advances student comprehension, retention, and capacity to reapply concepts later in life. Nonetheless, such experiences often involve outside collaborations through internships or non-curricular projects. This paper presents a conceptual approach developed through a three-year project that has been implementing art analytics as an internal, curricular collaboration between information systems (project management) and art students. The approach involves figuring out how to build the cross functional teams and project specifications as well as setting up actual art shows during which visitor responses can be analyzed. The primary learning value for art students focuses on gaining measured insight into viewer reactions and emotions with biometrics and psychometric data. For the information systems students, the primary learning value focuses on learning how sensors and data can be collected and analyzed across a portfolio of projects to evaluate objectively emotional responses against stated goals from artists.

**Keywords:** analytics, art, psychometrics, biometrics

## 1. BACKGROUND

A multi-year project spearheaded by the Carnegie Foundation for the Advancement of Teaching and the American Association of Colleges and Universities has examined the importance and impact of integrative teaching and learning. According to findings in that

project: "Fostering students' abilities to integrate learning—across courses, over time, and between campus and community life—is one of the most important goals and challenges of higher education. The undergraduate experience can be a fragmented landscape of general education courses, preparation for the major, co-curricular activities, and "the real world"

beyond the campus. An emphasis on integrative learning can help undergraduates put the pieces together and develop habits of mind that prepare them to make informed judgments in the conduct of personal, professional, and civic life" (Huber & Hutchings, 2004, p. 13).

Though integrative learning holds great promise for improving student experiences, adding such activities to curricula remain challenging due to coordination challenges, cultural divides between contexts, and issues that arise from sharing control over potential outcomes (Fink, 2013).

A typical faculty response to such a challenge would be to minimize the risk by limiting the degree of integration. This could be achieved by cutting out interactions with people outside of the course participants, reducing the scope and importance of the integrative activity within the course, or collaborating with people in the same or a similar field. However, such curricular choices would also reduce the potential for integrative learning (Huber, 2006).

A central challenge for university faculty remains exploring how we can more effectively design and deploy integrative learning experiences that cross-disciplines, interact with real participants beyond the students themselves, and serve as significant learning drivers for course content, particularly in new and emerging topics. We present this work as a conceptual approach to just such a solution.

## **2. ART ANALYTICS: A NATURAL MARRIAGE**

We began this process in 2013 through a grant-funded project to support innovative teaching. The art faculty were teaching a core creativity and innovation course, which focused on getting first-year students to learn creative art making skills beyond the two-dimensional work in their prior courses. The business faculty member was teaching a senior, elective course on project management, which emphasized analytics. Both courses already had hands-on learning. The art courses produced various artworks and installed them at the art school. The business course worked with local businesses to design, implement, or evaluate actual projects.

For the art course, we could identify a key growth opportunity for collaboration. Studies of creativity recognize effective critique as a core opportunity for growth (Hocevar & Bachelor, 1989). A principle opportunity for critique would be having an outside group do a structured

evaluation of art efficacy based on its actual impact on real viewers (Eisner, 2017). Such an experience would enable students to see beyond typical self-critiques conducted either by fellow students or art faculty, enriching their understanding of audience engagement, one of the ultimate goals artists target.

Meanwhile, from the project management perspective, one central challenge involves teaching students how to measure and evaluate relative performance of projects, particularly for outcomes beyond standard internal metrics of cost, schedule and quality (Levin, 2015). While teaching cases can easily present data for effective analysis of standard scheduling or return on investment measures, a real context would be needed in order to measure emotional impact, engagement, or other similar intangible goals. Getting students to practice and walking them through an example of how do such an evaluation during the course would increase the chance they could do it effectively later in their work life. They would also be able to practice giving feedback to project teams when they presented their analysis to the art teams.

### **"5 Senses" Project Design**

As part of the art class, students develop and install immersive environments to solicit specific emotions and engage all five senses from their viewers. These projects are titled "5 Senses" due to that primary objective. While past projects had been evaluated by faculty and students producing them, there had not been organized responses from their audience nor explicit, objective ways to comparatively assess which were more or less effective.

In the project management class, students study ways of analyzing a project portfolio and assessing stakeholder engagement and satisfaction. This had been achieved in the past with a case study and readings from the course textbook. Techniques like the "nico-nico" chart from agile project methods were discussed and noted as not generally used in US companies, due to their focus on emotions and engagement. A similar course taught to graduate students drew on their personal experience with projects at work when covering these topics, but with the undergraduate students, it was difficult for them to understand portfolio management as a real issue. The undergraduates also struggled to understand stakeholder engagement and how it might be objectively measured.

The "5 Senses" project from the art classes offered a solution. The business students would build the infrastructure for assessing these projects (6 of them) as a portfolio. They would also run the administrative processes necessary to advertise the projects and get audiences to visit. This would increase awareness and visitation across campus for the art installations and provide a sample of viewers.

To make the joint project work, the art students were asked to title their works and describe the emotions they hoped the audience would feel. The business students would work with them in the design process to refine this targeting and perhaps even help build some of the spaces. Since the spaces took up whole classrooms and/or lounges, they had to be built and taken down within a single day. Thus, the project management had to be effective to ensure availability of the spaces when audience members arrived.

#### **What is Art Analytics? Where does it fit?**

We define art analytics in alignment with Harris and Davenport's analytics conception as "the use of data, statistical and quantitative analysis, explanatory and predictive models, and fact-based management to drive decisions and actions" (Davenport & Harris, 2007, p. 7) in relation to art making. In the field of art, researchers have long-discussed how to understand the dynamics of appreciating and consuming art from all manner of aesthetic and critical approaches (Kelly, 1998). This focus largely centers on expert aesthetics. We identify these efforts as *expert*, because we find little evidence in these analyses of data or evidence directly from viewers of the art in question other than the authors or other "expert" opinions.

The irony of such an approach is that society widely agrees that art is subjective. If so, individuals may have completely different interpretations of any given work. This may be especially true of untrained or non-expert viewers. Yet, they may be the primary audience for the work. An expert opinion may completely miss the value such an audience experiences. Calls for further scientific approaches to art making and analysis date back many years (Munro, 1928), but we find few examples related to art analytics.

A blog posting from the Smithsonian Institution's Studio Arts homepage emphasizing that artists use and target some objectivity (Baker, 2011), indicates to us that further improvement

remains important. Meanwhile, within an art history context, some recent effort has been expended on analyzing how art interacts with and impacts art markets and viewers through data analytics (Szabo, 2012). Art analytics offers a means to examine the experiences viewers have of art works in order to move beyond expert aesthetics and incorporate and understand audience impacts.

### **3. ART ANALYTICS CONCEPTUAL APPROACH DEVELOPMENT**

Our conceptual design targeted identification of the important representational constructs for effective art analytics systems (March & Smith, 1995).

In the past three years, we have run this project each spring. Over that time period, art students produced 18 "5 Senses" installations, six each year (one per team). Themes ranged from a kitchen counter in which students sat in a giant frying pan with giant bacon and eggs smelling breakfast smells (Figure 1) to a casino with fake bar (Figure 2) to a "scary" space with broken glass under a fake floor (Figure 3). Other notable themes included a crashing airplane, a hippy hangout, a 4<sup>th</sup> of July cookout, a snail shell, purple, the Vietnam War, etc. They were very creative and unlimited as long as they met the basic guidelines.



*Figure 1 Kitchen Counter*



Figure 2 Casino Bar



Figure 3 Scary Space

### Success Measures

The artists began with an objective requirement to engage the five senses of people experiencing their works. They also were told to evoke emotional responses. We (the information systems students and faculty) brainstormed success measures that would objectify these requirements each time we ran the project. The strength of information systems students rests in the application of technology to solve real-world problems. As we brainstormed, we realized emerging technologies for remote monitoring and biometric response testing offered some interesting and new options. For each potential option a student group would explore it through literature review and direct testing, often discovering key limitations such as device unreliability (e.g. Shcherbina et al., 2017). Each year we would build off of prior lessons learned and continue refining and adding better methods.

Measurement issues like validity of measurement, non-intrusiveness in the experience of the art, comparability (reliability)

of measurements across audience members, ordering of survey items to avoid biasing open-ended questions, all entered our discussions. This led to rich learning on data and information integrity. Ideas like video capturing each viewer and coding their facial expressions were considered but discarded due to impracticality of the work load required to implement them. Solutions like applying facial recognition processing to these videos with sentiment analysis artificial intelligence have been considered but remain to be tried. Over the three cycles of this project, we actually implemented the following:

First, we asked participants to describe what they experienced with three adjectives. They could be any words so long as they expressed the person's experience.

Second, we used a validated tool from the psychology field titled the Positive and Negative Affect Schedule - Expanded Form (PANAS X) (Watson & Clark, 1999). This tool enabled us to survey audience members after they experienced an art work and capture their emotional state as well as summarize the overall positivity/negativity they felt and 11 key emotional dynamics.

Third, we used before and after biometric measurements of blood pressure. This would indicate some level of physiological response to the art if we could see systematic changes in certain spaces but not in others.

Fourth, we used some ad hoc questions such as "how well made was the art?" or "did you taste something in this space?" to get a direct response about more specific, physical experiences of the spaces.

Beyond the issues mentioned earlier, in the process of setting up and testing the data collection procedures, the students realized and addressed various additional concerns. Some of the questions they had to solve included how to design capture to be fast and user friendly so that it could be successful within a team of 40 people.

### 4. ANALYSIS AND PRESENTATION

Each of the four different measures actually implemented lent itself to different sorts of analysis and presentation. The free response adjectives collected from participants were aggregated and presented as word clouds in

which more frequent words would be larger. These were then subjectively analyzed against the original descriptions of the art projects to judge the relative success. In Figure 4 you can see the results for an installation called "Saloon," which targeted a fun, Western theme. In Figure 5 you can see the results for another space titled "Vietnam War," which targeted the horror of war. This type of visualization was easy to quickly assimilate and jointly discuss.

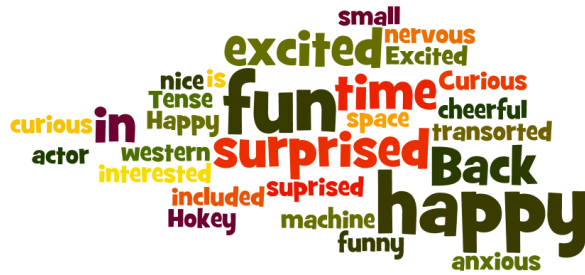


Figure 4 "Saloon" word cloud



Figure 5 "Vietnam War" word cloud

The PANAS X data were analyzed using the formal methods stipulated by the instrument. The results were then presented in tables mapped back to the individual spaces. In Table 1, you can see the summarized results from our second year (the same year that included the Vietnam War and Saloon installations so that you can compare the results for reliability and differences). In this summary table the percentage of negative and positive dynamics from PANAS X that significantly showed up in the survey data were indicated. For example, the Scary Room space responses all had an average of over 1.25 (indicating that most respondents found those dynamics present at some level e.g. our significance indicator) on each of the 6 negative affect scales (thus 100% negative). Clear patterns of positive and negative affect do show up. Additionally, the

degree of affect prompted by the spaces can also partially be inferred from this data.

We also presented the more detailed data from the PANAS X for each space so that specific levels of response for the 11 dynamics (i.e. fear, sadness, guilt, hostility, shyness, fatigue, joviality, self-assurance, attentiveness, serenity, surprise) could be discussed.

Average	Negative	Positive
Scary room	100%	80%
Saloon	17%	80%
Vietnam War	33%	100%
Nostalgia	0%	100%
Casino	0%	80%
War and Peace	50%	100%

Table 1 PANAS X Summary Results Year 2

Biometric data were analyzed following a very specific protocol developed in conjunction with biology faculty members and approved through our institutional review board. The students involved in this piece of the work directly learned about data security and privacy issues and were tasked with training the team and ensuring adherence. Due to the slow pace of data collection using a manual sphygmomanometer, relatively few data points were collected from viewers in the second year. Nonetheless, we could see some results, such as an overall 9% increase (difference between before and after measurements) in blood pressure for viewers of the Vietnam War space. Increased blood pressure would be a sign of emotional stress and activity. Other spaces did not show this level of increase.

All of these results were compiled into a report which was then delivered to the art students in both printed and digital format. The printed version delivery was accompanied by a face-to-face session in which the information systems students split into groups and met with the different artist teams to go through the report and explain it together. This last requirement led students to engage thoroughly in understanding the results and methods involved in the work.

### 5. LEARNING AND FINAL CONCEPTUAL APPROACH

To this point we have not measured student engagement explicitly, as thus far we have focused on the conceptual approach. We do foresee the need to find and use a validated

measure once this approach moves to the instantiation phase of design research (March & Smith, 1995).

We learned that non-intrusive collection with biometrics, psychometrics, subjective measures combined into unified feedback to artists made the process most effective.

## 6. CONCLUSIONS

As the information systems field increasingly moves toward teaching data analytics, faculty face a challenge of finding relevant activities that will engage students. While our data are somewhat anecdotal, we have seen a significant increase in engagement through the process of this collaborative work. When we began, the Project Management course regularly enrolled about 60% of capacity following a more normal, textbook-based approach. Since the development of this art collaboration component, the past two cycles of this course have been 100% full with waitlists. Meanwhile, art students have reported a majority of positive experiences due to the collaboration.

The learning enabled through the art analytics spanned the lifecycle of data analytics issues, while also serving the needs of the project management and art courses. We believe we have also stumbled onto an emerging field for analytics that deserves more attention and provides fertile ground for cross-campus collaborations. We hope fellow faculty will find our example useful as a starting point for launching similar activities.

## 7. ACKNOWLEDGEMENTS

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