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Museum 4.0 as the Future of STEAM in Museums

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Museum 4.0 as the Future of STEAM in Museums

Abstract

Informal STEAM (Science, Technology, Engineering, Art and Math) activities (programs) and exhibits are common in science centers, children's museums and natural history museums. As museums change to Museum 4.0 models (1), the STEAM exhibits and programs in museums also change. Museum 4.0 is the transformation of museums from a monolithic fixed location institution to a nimble community driven event driven organization. The Museum 4.0 becomes personalized to the visitor without fixed outcomes and without the physical restrictions of a single fixed location. As museums evolve to a Museum 4.0 model with visitor lead activities, STEAM activities within museums also change to peer to peer activities that begin outside the museum and continue as part of activities. Museum 4.0 STEAM will be a "host" connecting communities that existed before, during and after a museum's "bricks and mortar" experience. Instead of "cookbook" experiences where you follow a specific pattern, STEAM activities become experiences that grow and change depending on the user and community involvement. Museum STEAM experiences are transitioning from workbench activities to workbench and smartphone experiences where tactile, and digital involvement are integrated. The future of STEAM Museum 4.0 experiences are opened-ended community based experiences that are customized to a user's interests, knowledge and skills.

(1) Museum Generations 1.0, 2.0, 3.0, 4.0 <http://museumplanner.org/future-of-interactivity/>

Keywords

Future of Museums, STEAM in Museums, Human Computer Interaction, HCI, Museum 4.0, Museum Maker Spaces, Museum Programs, Tangible User Interface

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Cover Page Footnote

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Museum 4.0 as the Future of STEAM in Museums STEAM: Science, Technology, Engineering, Art and Math

Mark Walhimer

Introduction – Museum generations

Below is a list of each museum generation by number, a) name, b) time period, c) main characteristics and d) representative example museum.

Museum Generations¹:

Museum 1.0

- a). “Cabinet of Curiosity”
- b). 530BCE-1899 Collection of objects on display for study by scholars and the wealthy, not until 1660 did museums become public institutions.
- b). Collection cases, static displays, dioramas, object centric, “collector vision driven”
- c). Mutter Museum <http://muttermuseum.org/>

Museum 2.0

- a). Interactive; Children’s Museum / Science Museum / Science Center
- b). 1899-1969 “Interactive Museum” 1899 Brooklyn Children’s Museum² is opened with a “teaching collection” of art and objects for handling by children. In 1908, Deutsches Museum³ visitors encouraged to manipulate “interactive” exhibits.

¹ Museum Generations, 1.0, 2.0, 3.0, 4.0 <http://museumplanner.org/future-of-interactivity/>

² <http://www.brooklynkids.org/index.php/howeare/history>

³ <http://www.deutsches-museum.de/en/verkehrszentrum/information/history/>

c). Collection cases with push buttons and cranks, teaching collection with objects visitors can touch.

d). Museum of Science, Boston <http://www.mos.o>

Museum 3.0

a). Open Ended, Constructivist

b). 1969-1987 “Open Ended”, 1969 with the opening of the Exploratorium, multilayered and inquiry based exhibits, based on constructivist learning theory.

b). Open ended, multi-layered, visitor centric, informal education and encourages conversations

c). Exploratorium <http://www.exploratorium.edu/>

Museum 4.0

a). “Museum” with Walls

b). 1987⁴ - Present

b). The Museum is without walls; the museum experience starts prior to the visit to the physical location and continues through digital means and resources. Museums of the fourth generation can use the techniques of museums 1.0, 2.0 and 3.0, plus the museum experience is customized to the visitor (similar to Web 3.0).⁵

⁴ Start date still being defined

⁵ <http://hyperallergic.com/267096/the-evolution-of-the-museum-visit-from-privilege-to-personalized-experience/> website accessed July 14, 2016

c). “Semantic Museum”, difficult to date, 1987 “Body Works” of the Pacific Science Center⁶, visitors enter their information and the exhibits are “customized” to their needs and exhibition gathers data of the current participants.⁷

Museum 4.0 STEAM

It is difficult to separate project based learning, STEAM and Museum 4.0 as each is developing simultaneously and are interlinked. Below is a list of the five attributes of STEAM informal education in Museum 4.0. Each attribute is then expanded in sections one through five below.

Attributes of Museum 4.0 STEAM

- Without “Walls” (pre-visit, in-person visit and post-visit)
- Visitor Predicative and Customized
- Community Based
- Open Source
- Project based, Haptic and Digital HCI

Museum Without “Walls”

Museums are moving from monolithic institutions reliant solely upon visits⁸ from tourist and community members toward global community based institutions that extend beyond their physical location. The *museum walls* are coming down; museums now create online digital pre-visits,

⁶ <http://www.pacificsciencecenter.org/Exhibits/exhibits>

⁷ Science centers / science museums tend to be early adaptors to new trends in museums and the trends spread to other types of museums.

⁸ Museums becoming visitor-centric <http://www.wallacefoundation.org/knowledge-center/Documents/How-Museums-Can-Become-Visitor-Centered.pdf>

brick and mortar in-person visits and digital post-visits. Millennials⁹ are no longer content to participate in activities with known outcomes and instead desire experiences with multiple outcomes to create emotional connections between user and content. Millennials learning styles¹⁰ also demand inquiry based learning instead of didactic “cookbook” activities.

Example: Smithsonian Life Mask Cast a 3D scan of a life mask of Abraham Lincoln, museum visitors can print a 3D model of the life mask before their museum visit¹¹. The Smithsonian now has a program of digitizing objects of the collection and visitors can 3D print the object at home prior to their museum in-person visit, potentially bring the print to the museum with them as part of a museum program and have as an object for study after the museum visit.

⁹ Millennials <http://www.pewresearch.org/topics/millennials/>

¹⁰ The Millennials learning styles <https://www.nyu.edu/frn/publications/millennial.student/Challenges%20and%20Implications.html>

¹¹ <http://3d.si.edu/explorer?modelid=27>

Web 3.0 / Museum 4.0 predictive experiences

STEAM museum activities are incorporated into the change as museums move to Museum 4.0, which is similar to Web 3.0, a predictive web that knows background, interests and skills. Additionally, Museum 4.0 *knows* who the visitor are and can provide a true authentic experience specific to each user and the differing interests of multiple groups of users. Using Radio Frequency Identification RFID, Interior Mapping of the museum gallery layout, Social Media, Bluetooth mesh technologies¹², the museum building becomes part of the STEAM experience.¹³

Example: Rijksmuseum ibeacon system¹⁴ that works with visitors smartphones, as visitors approach objects additional layers of content appear on their smartphone.¹⁵ The content shown on the smartphone can be specific to the user; a family might have different content on family members device depending on age, interests and path through the museum.

Community based without walls

As museums include forms of crowd curation, the dynamic of interaction changes to peer to peer engagement between museums and visitor. The visitor becomes an active participant in the mu-

¹² Bluetooth Mesh <https://www.bluetooth.com/news/pressreleases/2015/11/11/bluetooth-technology-to-gain-longer-range-faster-speed-mesh-networking-in-2016>

¹³ Museums and the internet of things <http://www.fastcompany.com/3040451/elasticity/the-internet-of-things-plan-to-make-libraries-and-museums-awesomer>

¹⁴ <http://mw2015.museumsandtheweb.com/proposal/social-augmentation-using-ibeacons-augmenting-masterpieces-in-the-rijksmuseum-hide-your-story/> website accessed July 14, 2016

¹⁵ <http://mw2015.museumsandtheweb.com/proposal/social-augmentation-using-ibeacons-augmenting-masterpieces-in-the-rijksmuseum-hide-your-story/>

seum content development and visitor engagement increases through use of surveys, tweeter follower count, Instagram photos, trip advisor and Snapchat story telling amongst other forms of feedback. The museum now becomes a community based around the vision and values of the museum itself (museum brand) without the constraints of location. A visitor to a museum might be interacting with a *visitor* in their home anywhere in the world. The museum's communities are built on typical innovative cycles (Rogers innovation adoption curve¹⁶) of early adopters, early majority, late majority and laggards. Now, the segmentation within a community is defined by community member interests¹⁷.

Example: Cecile Bernard thesis describing “in-person” social interaction in museum and post-museum visitation¹⁸. Visitors become visually aware of the interests of other visitors through floor projections, virtual pop-up screens and can choose to enter into a dialogue with other community members with

shared interests.

¹⁶ Rogers innovation adoption curve https://www.researchgate.net/profile/Anja_Christinck/publication/225616414_Farmers_and_researchers_How_can_collaborative_advantages_be_created_in_participatory_research_and_technology_development/links/00b4953a92931a6fae000000.pdf#page=37

¹⁷ Visitor segmentation similar to consumer segmentation <http://www.bloomsbury.com/us/fashion-trends-9781847882936/>

¹⁸ <http://cecilebernard.com/projects/museum/>

Open-source exhibit & activity development

Following an open source computer software model, activities and exhibits are iterated and shared within the community. With peer to peer relationships between the museum and visitors, STEAM programming can manifest from the community and not just the museum. With a github¹⁹ type of tracking and attribution STEAM activities and exhibits are now shared amongst like minded museums. Museum STEAM programs are also continuously iterated within the public forum as community users now have a sense of ownership of activities.

Project based, Haptic and Digital HCI

Museum Maker Spaces have become the model of STEAM programming as an expanding number of museums have involvement in the Maker Movement. With the new “without walls model” the museum has developed into an internet of things^{20, 21} model STEAM activities are moving toward a mix of tactile and digital before, during and after a museum visit. The types of interaction also changes from simple push buttons, cranks and levers to a combination of digital, haptic and tangible user interfaces. Social interaction is predominantly facilitated through social media channels such as Snapchat, Instagram, Twitter and Facebook. Social media becomes a “digital layer” of visitor participation that has never existed before and only helps to extend areas of interest and knowledge to visitors. Social media also becomes a bridge for dialogue in the

¹⁹Github as open source <https://guides.github.com/activities/hello-world/>

²⁰ Museums and the internet of things <http://museum-2015.wiki.nmc.org/The+Inter-net+of+Things>

²¹ Museums and the internet of things <http://futureofmuseums.blogspot.mx/2013/09/trendswatch-update-internet-of-things.html>

museum, and online as visitors can converse around shared interests both in the museum and outside the museum.

Example: KidsMakers²²

At KidsMakers²³ visitors can learn programming languages such as Scratch from home on the museum's website, prepare their program at home for the robot they will build in the museum, at the museum using their smartphone, can program the robot they have built, and then continue to build new projects at home in preparation for their next in-person museum visit. Arduino Con-

trolled Robot from the
Children's Museum of
Houston KidsMakers²⁴,
²⁵ Also includes MIT
Scratch²⁶ at home pro-
gramming

²²<http://www.kidmakers.org/arduino-controlled-robots/>

²³<http://www.kidmakers.org/arduino-controlled-robots/>

²⁴<http://www.kidmakers.org/arduino-controlled-robots/>

²⁵<http://makered.org/wp-content/uploads/2015/09/YMSPB-Childrens-Museum-of-Houston-Site-Survey.pdf>

²⁶<https://scratch.mit.edu/>

Conclusion

As societies become more complex so does their culture. As museums move into their next phase of development, they are changing from warehouses of objects that narrate a history to communities that explore multiple histories and perspectives. Museum 4.0 takes advantage of technologies including STEAM programming that can become predictive and customized to the visitor's interest and abilities. As schools move toward project based learning, so do museums and STEAM programming align with the project based learning itself. As our ability to distinguish real from virtual becomes more difficult, the authenticity of museum objects grow in importance and STEAM programming gains value to engage visitors in authentic artifacts of history and culture.

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