Social Media to Support Science Learning & Engagement: *NOVA Wonders*

FINAL RESEARCH REPORT

March 22 2019

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Project Overview

In this collaboration with NOVA/WGBH Boston, we explore how to measure informal science learning and how to moderate a social media space to enhance learning. We present findings from a six week "live" experiment where NOVA changed its social media facilitation style during the broadcast of *NOVA Wonders*. These findings have implications for how media producers, educators, and social media managers can use social media to increase impact.

GOAL: This project explored the potential of social media to promote informal science learning online, specifically NOVA Facebook & Twitter.

BIG QUESTION: How can we design and moderate NOVA social media spaces to enhance informal STEM learning online?

DESIGN COMPARISONS: We did an experiment to test whether *resource type*, *post style*, *facilitation style*, and *science topic (NOVA Wonders episode)* had an impact on engagement and learning.

METRICS: We used a combination of platform-based engagement metrics and a new qualitative measure of informal learning that we developed using the strands of informal STEM learning and the NSF impact categories.

OUTCOME: Small changes in social media design can have a big impact on learning and engagement online. High facilitation of social media spaces, which includes asking big questions, posing follow-up questions to individual users, and actively responding to comments, will increase overall engagement. It also can promote greater learning outcomes, such as curiosity and applying concepts to other knowledge. We also learned that videos and teaser questions were effective ways to engage more audience members.

The Problem

Can social media support learning—and how?

Science communicators are turning to social media to promote engagement, tracking "impressions" and similar metrics to assess content effectiveness. Despite this increased reliance on analytics, there is limited evidence to suggest that social media enhances learning.

So, how do science communicators know whether effort spent on social media is truly helping users learn or engage? How can we measure learning effectively, and can we design social media to better promote meaningful learning outcomes?

We have yet to capture what informal STEM learning looks like on social media, leaving opportunities for deeper engagement and learning largely untapped. This project therefore developed a measure for informal STEM learning online and tested various social media designs for STEM learning potential.

Research Questions

1. Can social media help users learn or engage more deeply with science topics?
2. How can we measure LEARNING on social media? Platform-provided metrics are lacking in this area.
3. Can we design social media to better promote meaningful learning outcomes?

The Potential

Social media works in the classroom to promote learning – can it work online?

There is clear potential for social media to support informal STEM learning, due to its inherent connectedness, reduced barriers to entry, the ability to personalize learning, and its "egalitarian design," which distributes social power. Furthermore, research shows that social media can promote learning in classrooms, using a semi-structured, community-based approach. We reviewed 21 case studies on the use of social media in classrooms (k-12 and higher education) and museums and found that it can promote knowledge gains, excitement and awareness, and a sense of community.

TWITTER use w/classroom learning can support:
retention of course concepts *(Blessing et al., 2012)*
reading skills & student-reported understanding *(Cano, 2012)*
increased engagement & higher grades *(Junco et al., 2011)*
greater understanding of other perspectives *(Rinaldo et al., 2011)*

FACEBOOK use w/classroom learning can support:
collaboration, extra-help seeking, homework discussion, & organization *(Fewkes & McCabe, 2012)*
self-reported knowledge-building *(Chunngam et al, 2013)*
heightened awareness of concepts & sharing *(Sackey et al. 2015)*

Main takeaways from successful social media learning: design matters.

- Semi-structured learning environment—not just a "free for all" comment board
- Active facilitator—present and participating, but not overly controlling of the space
- Community-driven learning—plenty of space for participation by users

Measures

If we can't quantify it, we can't improve it

Analytics can tell us about the type of behavior a particular post elicits. For instance, we can see what content is most shared, liked, or commented on. However, these fall short of describing the quality of that engagement—and tell us nothing about learning.

We therefore developed a new measure of informal STEM learning for this project by hand-coding NOVA social media posts and comments. We also used the typical quantitative analytics provided by Facebook and Twitter. The codebook we developed was based upon the AISL Strands of Informal Learning and the NSF Impact Categories.

- **Quantitative Metrics:** Facebook & Twitter analytics, including all engagements (Likes, Shares, Comments, Reach)
- **Qualitative Metrics:** Codebook of informal STEM learning on social media. We developed this based upon the strands of STEM learning, the NSF impact categories, and (Krippendorf's alpha for inter-coder reliability > 0.7)

Codebook of Social Media Informal STEM Learning (annotated)

Awareness & Engagement			
Excitement	Awareness	Curiosity	Networking

Understanding		
Knowledge gain	Restatement	Application

Attitude	
Change in opinion	Trust / Distrust in science

Coding categories are not exclusive, see Appendix I for complete codebook.

NOVA Wonders Broadcast Experiment

Testing which social media design elements impact learning & engagement

We explored several dimensions of social media design: the "style" of the content, based upon what NOVA and other science media producer create; the type of resource shared; STEM content, based upon *NOVA Wonders* content; and facilitation style, which accounts for how active or present the social media managers are in curating content and responding to posts.

Post Style
Full Facts
Teaser Question
Tune In
Participation Ask
Informal

Resource Type
Image
Article
Video

Facilitation Style
High facilitation (Simulcast)
Low facilitation (traditional)

Episode (STEM topic)
What Are Animals Saying?
What's Living in You?
Are We Alone?
Can We Build a Better Brain?
Can We Make Life?
What's the Universe Made Of?

Dependent Variables / Outcome Measures:
Quantitative total engagements (Likes, Comments, Shares, Reach)
Qualitative codes for informal STEM learning outcomes

Facilitation: We created a "high facilitation" condition during the Simulcasts (live broadcast of *NOVA Wonders* on Facebook), when NOVA social media managers would engage the social media community through increased questions and responses. In particular, they followed a procedure of responding through *affirmation*, *elaboration*, or *probing*, selected at random:

- o *Affirmation:* The facilitator simply "likes" and makes a general comment to indicate they appreciate the comment.
- o *Elaboration:* The facilitator asks for the commenter to simply elaborate on what they said, which is an affirmation plus a request for more information or for clarification.
- o *Probing:* This final category of "engagement" with followers is the most specific, and requires the facilitator to ask highly specific questions to get the commenter to either link their comment to other knowledge or experience.

Post-style: We categorized NOVA posts into one of five categories; examples of each post-style are below

Full Facts up Front
"Beneath the surface of Inner Mongolia's saline lakes are a potential Rosetta stone of paleoclimate."

Teaser Question / More Inside
"Is our government prepared for a world with artificial intelligence?"

Tune In
"Did you miss "Secrets of the Forbidden City" this week? Catch it streaming online here"

Participation Ask
"What did you think of "Secrets of the Forbidden City?""

Informal
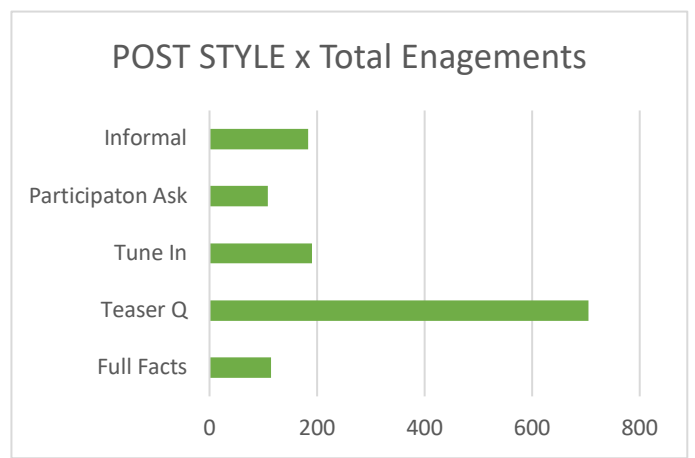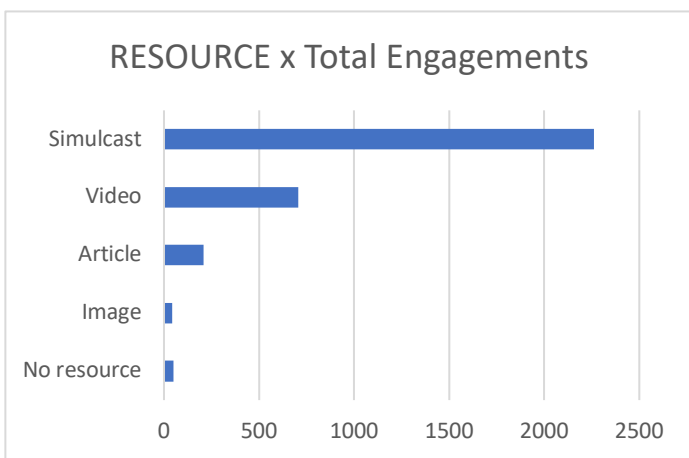"If you think your dog is making faces at you, you're probably right."

Findings

Small changes in social media design can impact learning & engagement.
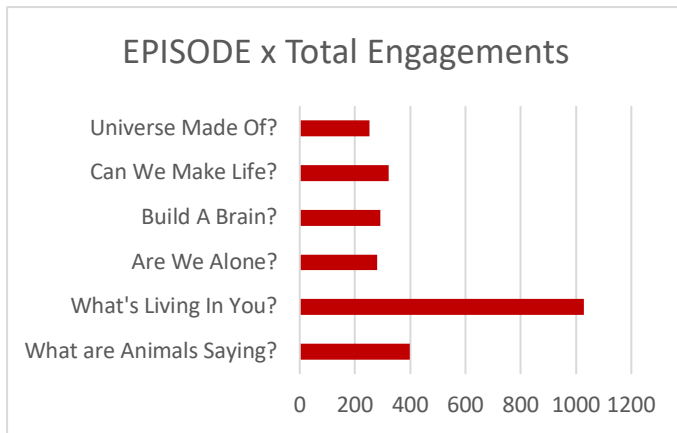
We learned that changes to social media design can have an impact on learning and engagement, both in terms of engagement and learning outcomes.

ENGAGEMENT: several content decisions made big impacts on overall engagement
For engagement, we looked at all engagements, likes, comments, shares, and reach (135 Tweets, 75 Facebook posts).
- **Resource type:** <u>short videos</u> outperform all other NOVA social media posts
- **Post style:** <u>Teaser questions</u> outperformed all other types of posts, receiving the most total engagements. Teaser questions also received the most comments.
- **Facilitation:** <u>High facilitation</u> outperformed the other traditional media posts
- **STEM content:** <u>"What's Living In You"</u> outperformed the other episodes for overall engagement. *There may be too many other factors at play here to say that the topic definitively made the difference in engagement, however.*
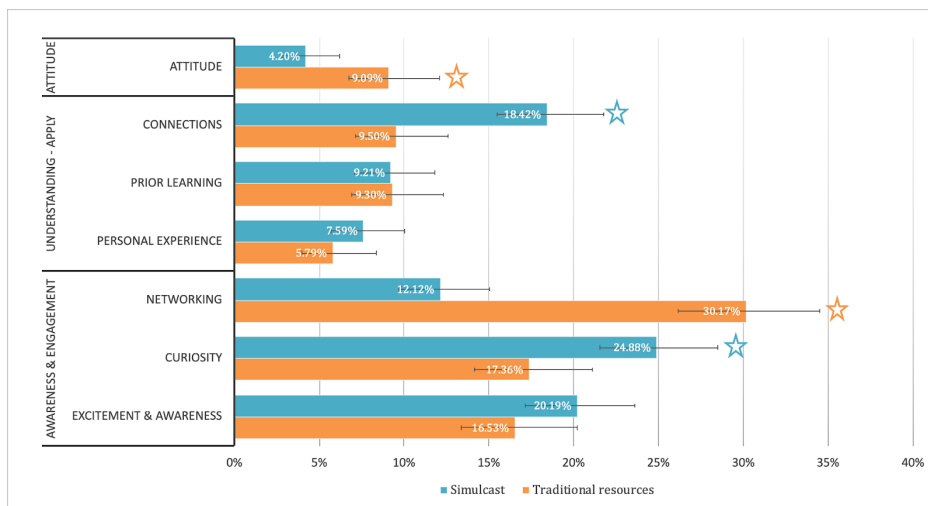

RESOURCE x Total Engagements

Simulcast, Video, Article, Image, No resource

0, 500, 1000, 1500, 2000, 2500

POST STYLE x Total Enagements

Informal, Participaton Ask, Tune In, Teaser Q, Full Facts

0, 200, 400, 600, 800

EPISODE x Total Engagements

Chart Interpretations: Each chart represents a statistical test of mean differences *(from top left to right):* a) the *Simulcast (2262.2)* and *videos* (706.0) significantly outperformed other resources; b) *Teaser Q* (704.2) significantly outperformed all other post styles, and c) *What's Living in You?* (1027.8) also significantly outperformed all other episode content.

LEARNING: Facilitation impacts learning outcomes

We also saw significant differences in learning outcomes based upon facilitation style, resource type, post style, and episode. This suggests that different types of social media management can encourage different types of informal learning and deeper engagement with content.

The power of high facilitation: we noticed that high-facilitation in general was able to produce *different types of understanding and engagement* than traditional, low-facilitation social media:

TIPS:

➥ **Attitude sharing:** go traditional / low facilitation

➥ **Foster connections to other experiences:** go high facilitation

➥ **Building your network:** go traditional / low facilitation
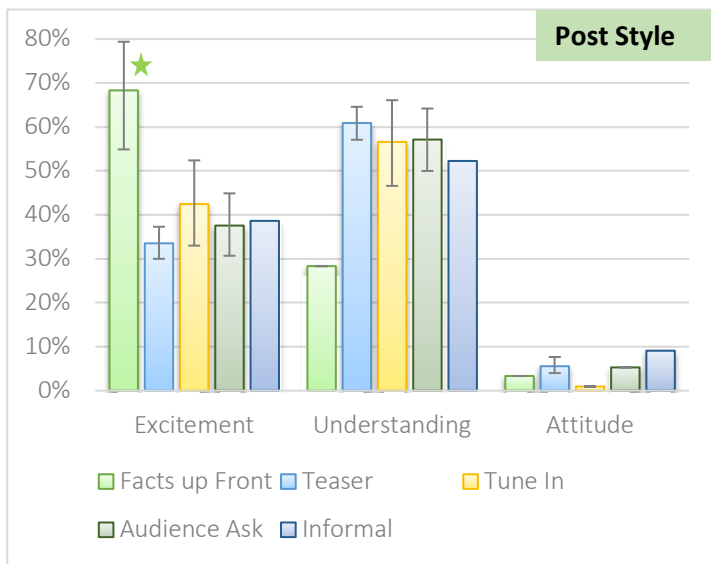
   Fostering curiosity: go high facilitation

Curiosity & making connections: with a more active facilitator, audiences were asking more questions and connecting what they learned to other knowledge and experiences.
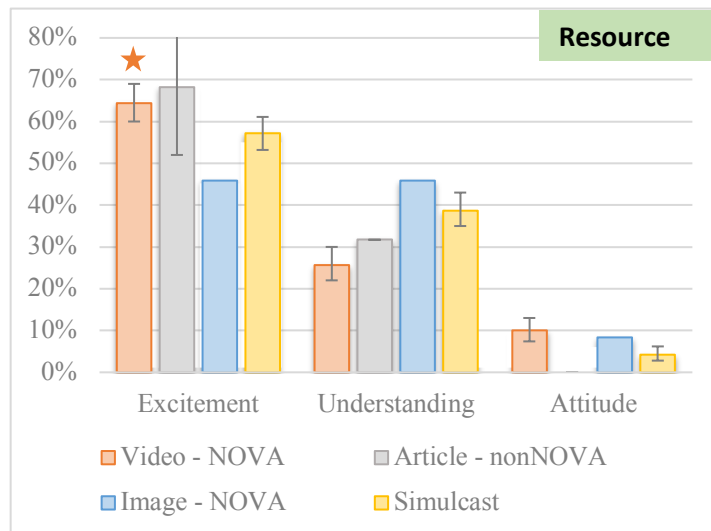
Building a larger following & attitude sharing: traditional social media was much more effective at bringing in potential additional followers, as it was much better at promoting "networking" through shares when a social media follower was excited by the content. Traditional low-facilitation approaches also elicited more attitude sharing about content.

Other promising trends: We notice some promising trends in post style and resource type in terms of generating different learning outcomes, as well:

- o **Excitement:** To promote primarily excitement, _videos_ as a resource, _full facts up front_ as a post-style work best. We found statistical significance for the levels of excitement associated with these types of social media posts.

- o **Understanding:** While we didn't find statistical significance for differences in _understanding_ due to post and resource type, some general promising trends seemed to be that using NOVA images and the Simulcasts work best, as well as post styles that use _teasers_, _tune-ins_, _audience asks_, and _informal language_.

- **Attitude:** There wasn't much evidence for attitude change around STEM or statements of trust or distrust in science, overall.
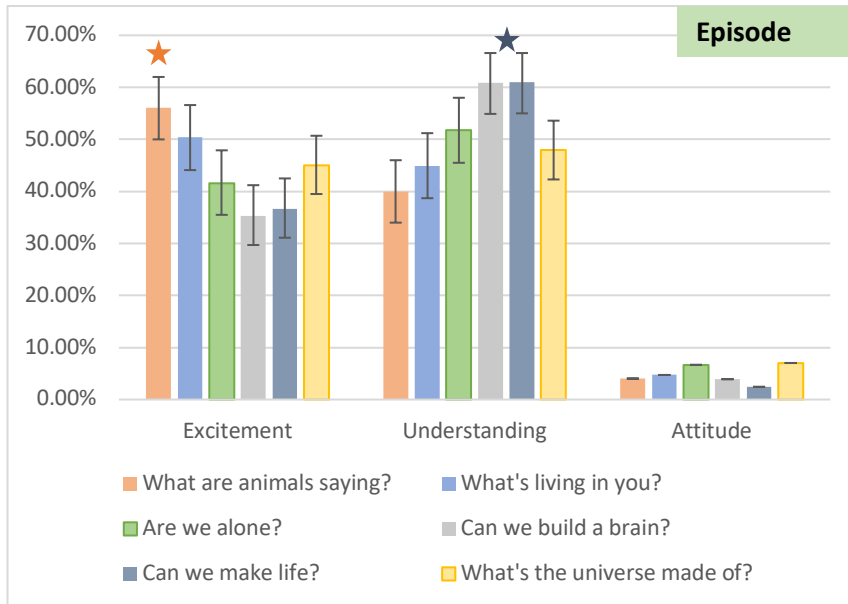

Full facts up front was the most successful as promoting excitement & awareness among users

Videos were most successful at promoting excitement & awareness, as opposed to other posts

In terms of excitement & awareness, 'What are Animals Saying' out-performed the other episodes. However, 'Can we build a brain?' and 'Can we make life' showed higher levels of understanding among followers.

Implications

Overall, this study made significant advances in our understanding of how to use social media to create a more deeply-engaged following. The largest effects were seen with higher facilitation through the Simulcast, which increased overall traditional likes, comments, shares, and reach—as well as generated greater qualitative learning outcomes, particularly curiosity and enhancing connections to other knowledge or experiences. This is significant for social media managers who wish to enhance learning outcomes for their users, as opposed to traditional attitude-sharing or network building, which traditional low facilitation can help with.

This study also created a new measure for informal STEM learning on social media, the qualitative codebook; this is a significant addition to the literature. While this form of measurement is rather time-intensive and requires training, perhaps the codebook in Appendix I will at least provide a rough guide for social media managers looking to increase a particular type of deeper engagement.

This study suggests that yes, informal learning is possible on social media, at least within the codebook developed here, which reflects the Strands of informal STEM learning and the NSF impact categories. We also saw that with small changes to post style, resource type, and overall social media feed facilitation, learning outcomes *can* be influenced for social media users. This helps social media producers move away from focusing strictly on platform-derived analytics and instead consider how to more deeply engage their audiences.

MAIN TAKEAWAYS

① There is evidence that people have measurably different social media experiences.

② Social media users appear to experience a wide range of informal learning.

③ Small changes in social media management can make a big difference in both traditional engagement and informal STEM learning outcomes.

④ High-facilitation Simulcasts made a big difference for social media users:
      → *generated the most (traditional) total engagements & total comments*
      → *they fostered unique learning outcomes among users: CURIOUSITY and BUILDING CONNECTIONS to other knowledge or experiences*

⑤ Traditional low-facilitation social media seems best for BUILDING YOUR NETWORK and encouraging basic SENTIMENT SHARING.

APPENDIX I:
SOCIAL MEDIA INFORMAL STEM LEARNING CODEBOOK

Social media posts may be coded with more than one category.
Krippendorf's alpha for inter-coder reliability: over 0.7

Awareness & Engagement
- *Excitement*: reports that the experience of learning was enjoyable or they're looking forward to the experience
- *Awareness Only*: has heard of the topic, but does not report or exhibit deeper knowledge (e.g. "I've heard of this," or "everyone knows this")
- *Curiosity*: asking a question to seek more information. Needs to suggest curiosity and not a rhetorical question, for example.
- **Networking**: connecting actively with other social media users by tagging them to bring them into the conversation or to continue the conversation

Understanding
- *Reported knowledge gain*: admit that they didn't know the idea, but now they do
- *Restatement*: reflecting back on material and restating the main fact, but using different words (e.g. "regurgitating"), need to refer to the parent post for this
- **Application**: active application of subject to prior knowledge or experience, based upon: *personal experience, prior learning, connections, high motivation to learn more*, or *other evidence.*

Attitude
- *Changing an opinion*: demonstrates a shift in position or attitude (e.g. I didn't think this before, but now I do)
- **Trust in science**: expresses that they are a *science advocate, science denier, or that they identify with science* or they share their *expert credentials*

APPENDIX II:
CODING EXAMPLES

NOVA Post	Follower Comment	Coding Category
Peer into the universe's deep unknowns to explore the mysteries of dark matter and energy."	Thank you NOVA! So awesome!	EXCITEMENT & NETWORKING NOVA
Take a listen to yesterday's episode of PRI's "The World in Words" podcast, "If you could talk to the animals." PRI Public Radio International caught up with our Senior Digital Producer Ari Daniel, who studied animal communication before entering the world of science journalism, to talk about frog, whale and monkey sounds.	I do! All the time:))))))) Do you know why your dog sniff your breath??? My neighbor dog wants to know if I ate anything, and hints to me to share a tidbit...	CURIOSITY & APPLY PERSONAL EXPERIENCE
What did you think of "NOVA Wonders: What Are Animals Saying?" #NOVAWondersPBS	Think about how we would communicate with no language.	APPLY CONNECTIONS
"I know it sounds weird, but I felt an almost father-child relationships with this organism that was growing in my body."	[NOVA follower], when I took parasitology I was gobsmacked with how many of them did wildly weird things for their passion project. The common tale is of those who inject themselves with some experimental vaccine. Most end badly.	NETWORKING FOLLOWER & APPLY PERSONAL EXPERIENCE & TRUST SCIENCE ADVOCATE
How does today's artificial intelligence actually work—and is it truly intelligent?Stream "NOVA Wonders: Can We Build a Brain?" online, at pbs.org/wgbh/nova/wonders/#build-a-brain	Actually there are plenty of arguments against consciousness being computational in nature; too detailed to go into here but you can look them up under the computational theory of mind. We understand how integrated circuits and software work. We understand the basics of how neurons work. But we have absolutely no idea, whatsoever, how consciousness occurs or is even possible.	APPLY PRIOR LEARNING & APPLY CONNECTIONS & PROVIDE EVIDENCE
How does today's artificial intelligence actually work—and is it truly intelligent?	http://www.antipope.org/charlie/blog-static/2014/02/the-singularity-is-further-tha.html	APPLY EVIDENCE
How do we program moral decision-making into autonomous vehicles?	...and my questions is kinda answered...	KNOWLEDGE GAIN
Some scientists want to genetically engineer elephants to be more like woolly mammoths. Could this save elephants from extinction–– AND save us from climate change?	Climate Change is a HOAX!	TRUST SCIENCE DENIER