Evaluation of Adult Science Media: Retrospect and Prospect

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Media and Informal Science Education

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Learning Science in Informal Environments: A Review of the Research Past, Present, and Future:

Supported by NSF, the National Research Council (NRC) of the National Academy of Sciences through the Board on Science Education (BOSE) has been conducting a comprehensive synthesis of research on science learning in informal environments.
A Starting Point

- Some definitions
  - What is included, what is not
- The audience
- The lay of the land
Definitions

- Television (including podcasts)
- Radio (including podcasts and RSS)
- Large format films (IMAX)
- Planetarium shows

- Not: Websites, print, brief videos in museums, etc.
The Audience

• Adults
  – Older, wealthier, whiter, more educated
• Science, news, arts (persistent)
• Increasingly using multiple media
• Autonomous, self-directed, practical, looking for respect and relevance
The Lay of the Land

- More than PBS / NPR
- Attributes of science and nature programming
  - Big eyes and fur, crocodiles and dinosaurs, Voice of God, existential questions, very large or very small, sex and reproduction role of women in science, planetary exploration, code breaking, submarines
Why are Programs Like This?

• Schedule drives design and production
• Media requires significant funding
• The money is in production
• Built on values, not theory
• Review process focuses on media, not outcomes
There would be no bucks without Buck Rogers.

– Old NASA adage
<table>
<thead>
<tr>
<th><strong>Children’s media</strong></th>
<th><strong>Adult media</strong></th>
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<tbody>
<tr>
<td>Series</td>
<td>One-offs</td>
</tr>
<tr>
<td>Repetition</td>
<td>Content not consistent</td>
</tr>
<tr>
<td>Iterative</td>
<td>Informational</td>
</tr>
<tr>
<td>Curriculum design</td>
<td>News focus</td>
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<tr>
<td>Intentional</td>
<td></td>
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</tbody>
</table>
You take the truth and I’ll take repetition and I’ll beat you every time.

– Old advertising adage
Review of the Literature

• More than 50 studies from 1999 – 2006
• Covers both adult and children programming
• Much is fugitive literature, not accessible
• Categorized by media form
Findings

• Learning: self-reports, recall, little application of learning
• Engagement: self-reports, appeal associated with regular viewing/listening
• Attitude change: short term, increased interest, rarely a control group
• Behavior: information seeking, discussions
Summary of Outcomes

• Limited range of outcomes
• Methodological weaknesses
• Limited generalizability (selection bias)
The difference between outputs and outcomes is like the difference between what is so and so what?

– Michael Scriven
Constraining Factors

- Funding patterns (NSF)
  - Needs, formative, summative
  - Time frame
  - RFP process
- Sample selection/IRB
- Funding
- More powerful designs
Getting to “So What?”

- Policy and practice
  - More focus on research in RFPs
  - Enhanced funding
- More creative research approaches
- More powerful research methodologies
- Interactive multiple media strategies
Of course it works in practice, but will it work in theory?

– French research saying
Informal Science Evaluation
Methodologies

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Two Big Questions

What will you look at?

How will you look at it?
What: The Media

- Television/video (including video files on the Internet)
- Radio/audio (including podcasts and streamed audio)
- Film
- Large Format Film (e.g., IMAX)
- Planetarium shows
Most research has been done at either end of the spectrum. We are starting to see more research here.
Research Themes

• Differences between adult learning and youth learning.

• Differences between formal and informal learning.

• Learning from media vs. learning from non-mediated formats.
Differences between formal and informal learning

Two Key Areas of Difference:

Context for learning
- When and why the learning is taking place
- Locus of responsibility for learning (teacher-directed or learner directed)

Potential or desired learning outcomes
- The goal of ISE is enabling the ideas and information to be integrated more fully into ways of thinking or ways of behaving
- ISE not geared toward formal assessments
Differences between learning in mediated and non-mediated formats

- Mediated content can promote more self-directed learning and therefore deeper processing
- Pacing varies in mediated formats (pros and cons)
# Framework for Adult Learning from Media

<table>
<thead>
<tr>
<th>Media Production Context</th>
<th>Inputs within an Individual</th>
<th>Activities</th>
<th>Short-term (i.e., immediately leaving the experience)</th>
<th>Outcomes</th>
<th>Mid-term (i.e., days or weeks after)</th>
<th>Longer-term (i.e., lifelong, accumulated learning)</th>
</tr>
</thead>
<tbody>
<tr>
<td>topic</td>
<td>Antecedent knowledge, attitudes and behavior</td>
<td>Initial media experience</td>
<td>Initial learning, most likely knowledge gain with some connections with prior knowledge (a-ha! moments)</td>
<td>Outcomes from additive elements</td>
<td>Re-exploration or reinforcement</td>
<td>Educated citizenry who make informed decisions about</td>
</tr>
<tr>
<td>production quality</td>
<td>Prior knowledge</td>
<td>Enjoyment/engagement with the media</td>
<td>Attitude change</td>
<td>- Repeated and varied exposure to science topics (e.g., DNA, global warming, obesity)</td>
<td>- Deeper learning that reconciles multiple experiences or sources of information into a single explanatory, actionable framework</td>
<td>- politics</td>
</tr>
<tr>
<td>dissemination strategy (PBS vs. Discovery vs. freestanding documentary)</td>
<td>Motivation (interest, efficacy, goals)</td>
<td></td>
<td>Behaviors/opportunities for action</td>
<td>- Increased ability to seek out and identify opportunities to act on learning or gain new experiences</td>
<td>- Awareness of the process of doing science</td>
<td>- health</td>
</tr>
<tr>
<td>supplemental materials</td>
<td>Metacognition (i.e., media literacy, knowledge of how media is created, how scientific knowledge is created)</td>
<td></td>
<td>Seek supplemental activities or materials</td>
<td>- Meta-awareness of how to make sense of science in the media, which is itself dependent on knowing how scientific knowledge is created</td>
<td>- consumer actions (e.g., buying a Prius, taking vitamins)</td>
<td>- crime (e.g., in juries)</td>
</tr>
<tr>
<td>gatekeepers</td>
<td></td>
<td></td>
<td>Discuss with others</td>
<td></td>
<td>- education &amp; policy (e.g., influencing the curriculum)</td>
<td></td>
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## Program goals
- Design intentions of media – what do they want people to learn? This varies, but is generally less well-defined for adults
- Edu- or infor-ainment

## External influences
- Who makes media
- Who funds media
- Who is the predetermined audience for adult media
- Moving targets of developments in technology – by the time you’ve figured out how to do podcasts effectively, there’s something new
- Interests or hooks are dependent on current events, that require acceleration of production.
Four Main Categories of Evaluation Outcomes

- Learning
- Engagement/Enjoyment
- Attitudes
- Behavior

Learn • Feel • Think • Do
How: Learning

- Self-rated level/amount of learning
- Subjects answer questions related to content learning
- Observable learning outcomes (applied knowledge)

- Most common
- Obvious limitations
- Basic recall more common than knowledge or procedural questions
- Rarely pre-post testing
- Occasionally control/treatment groups

Methods to Consider: pre-post testing, assessments of higher order thinking skills control/treatment groups, better sampling, transfer tasks, more longitudinal assessment
How: Engagement/Enjoyment

Indicators:

• Attention

• Appeal

+ Reasons why more/less attention and appeal

Attention Measures
• Time-sampled observations
• Instruments to assess enjoyment
• Self-reported attention and appeal (Most common)

• Personal interest in subject
• Age/Gender
• Style of program
• Level/newness of content

Methods to Consider: Measures of physiological responses, better sampling and instrument construction to facilitate multivariate analysis
How: Attitude Change

Self-Report

Towards:
• Science in general
• Science content in program

Examples:
• Science plays a positive change-making role in our society
• Science does more good than harm
• Greater appreciation for the natural world
• Better understanding the role we’ve had on the environment
• Sense of being able to understand scientific concepts

Methods to Consider: More in-depth assessments and longitudinal studies
How: Behavior

Categories:
• Intended - self-report
• Actual - self-report or observed

Depth:
• Shallow/Casual
• Deep/meaningful

Examples:
• Talking to others
• Further exploration of the topic
• Change in behaviors directly related to topic: e.g. water conservation, exercising more

Methods to Consider: More observed behavioral change, longitudinal behavioral change, randomized control/treatment studies
Challenges

• **Funding:** More rigorous evaluations cost more - The money needs to be on the screen

• **Timing:** Interest in quick-results, move on to next thing

• **Lack of buy-in:** necessary evil, luxury more than necessity, good reviews/ratings are perceived to count for more

• **Reality:** a thirty minute program isn’t going to change someone’s life dramatically
Solutions

Given adequate funding/timeframes…

- **Deeper assessments:** more specifics on what people say and do
- **Building on Theory:** psychology, mass communication, cognitive science
- **Beyond the individual:** thinking about dyads and groups
- **Multivariate analysis:** finding new connections
- **New methods:** specific to informal learning
- **Better samples:** broader swath of likely audience members - including the reluctant
- **Paying more attention to new modes of dissemination:** Web, games
- **More rigorous and powerful methodologies:** Media may call for different types of studies that fall outside of traditional research paradigms (Control Group Studies, Panel Studies, Strategic Audience Sampling)
- **Longitudinal studies**
Assessing Knowledge of *Exploring Time*

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New Directions in ISE Evaluation

- Rigor
  - Design
  - Instrumentation
- Practicing what we preach
• TV show with accompanying website (http://www.exploringtime.com/)
• Program objectives
• Program format
Assessing Learning

Constructs → Items → Item scores → Review and Validation → Constructs
<table>
<thead>
<tr>
<th>Concept</th>
<th>TV/Web</th>
<th>Question/Task</th>
<th>Measure</th>
</tr>
</thead>
</table>
| Many concurrent changes at different timescales. | Web    | View a still image and respond to… a) Open response: “Describe what is changing in this scene.” or “What is changing?” | • Obvious events  
  • Breadth of timescale  
  • Extension beyond the obvious |
Item Generation

- Prior evaluations
- Show producers
- Script
Item Example 1

Please describe what is changing in the following scene.
In order to explain why a heart muscle goes into arrhythmia, scientists have to drill down to a chain of events in the thousandths of a second. Why is this?
Item Scoring

- Top-down
- Bottom-up
  - Pilot responses
  - Pre and post responses
- Inter-rater reliability
Review and Validation

• Pilot response results
• Scoring agreement
• Patterns of responses
Results

- Improved awareness of time
- Improved timescale identification
- No change in understanding of adjacent timescales
Lessons Learned

- Begin at the beginning.
- Need items? Use the script.
- Budget enough time.
- Remember less is more.
Future Directions

- Group assessments
- “Authentic” assessments
Survey and Panel Studies of Quest Science Programming

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QUEST

Radio

Television

Community Science Blog

Original Web Content
Audience Study

Year 1: 2007
Baseline surveys in Spring and Fall

Year 2: 2008
Panel surveys in June, August and October
New Media Users survey in September
Recruiting

High Engagement
Members * Recent visitors * Content consumers

Medium/Family Engagement
Families with children under 16

Lower Engagement
Non-members * Infrequent visitors * Interest in arts
## Participants

<table>
<thead>
<tr>
<th>Engagement Group</th>
<th>Age Group</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>18-40</td>
<td>41</td>
</tr>
<tr>
<td>Low</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Family</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>High</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td>41</td>
<td>125</td>
</tr>
</tbody>
</table>
Findings

• Collectively, engagement was steady
• Families are most engaged
• Environment-specific activities most popular
• Growth of new media audience
New Media Survey

Recruiting
  Links and aggregators

Findings
  Half were outside Bay Area
  On-air broadcasts are still primary medium
Things to Consider

Influence on participant behavior
Increased awareness