The NRC and NSF frameworks for characterizing learning in informal settings: comparisons and possibilities for integration

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Background:

Recent work in the informal science education (ISE) field has begun to systematically categorize aspects of learning in a variety of ways. Most notable are the "Framework for Evaluating Impacts of Informal Science Education" (Friedman, A. (Ed.), 2008, henceforth 'NSF') and "Learning Science in Informal Environments" (LSIE, National Research Council, 2009, henceforth 'NRC'). Both frameworks have potential implications for assessment as well as project planning.

How we got here:

In 2008, the NSF ISE program published a framework of categories that was meant to bring a more systematic approach to reporting the range of impacts achieved by NSF-funded projects as determined by their individual summative evaluations. One of the key goals, as explained by previous director of the ISE program (NSF, pp. 9-13), David Ucko, was to make it easier for NSF ISE to review its investments and overall impacts because every project's main impacts would be articulated and categorized in ways that could be monitored, sorted, potentially aggregated, and reported to various stakeholders. This specific framework was proposed by a cross-agency Informal Education and Outreach working group in response to the Academic Competitiveness Council (ACC) concerns about federal STEM education program effectiveness in a time of budget concerns. It was based on an empirical categorization previously developed by Westat to classify project impacts. Once the categories were established, a team of invited experts from the ISE field wrote a report to help flesh out the framework and show how it might apply to a range of projects.

Almost concurrently, the NRC framework was created by a consensus committee of the National Research Council. Funded by the NSF ISE program, its most basic charge was to review a range of literatures and assess the evidence of science learning in informal settings. The committee generated a “6-strand” framework of the capabilities supported by informal settings, adding two additional strands to a “4-strand” framework previously proposed by an NRC consensus study report on K-8 science learning in schools (National Research Council, 2007). The committee hoped that the strands would broaden school-based definitions of science learning, encompass (via the two additional strands) the particular strengths of informal settings, and play a central role in creating and refining assessments. The strands all begin with verbs (e.g., “experience”, “manipulate,” “think about”) to “reflect the ISE field’s commitment to participation.” (NRC p. 4)

<u>Some points of comparison:</u>

Framework	**NSF ISE “Impacts” (bins)**	**NRC (LSIE) “Strands”**
Date of publication	2008	2009
Primary intended users	NSF ISE Program Awardees	Entire ISE field
Significance	Flexible planning and reporting framework to collect key outcome data	First-ever NRC consensus study to identify and summarize research on

	with minimum constraints on project design/evaluation	learning in informal settings
Initial driver	ACC requirement + Creation of an Online Project Monitoring System (OPMS) for monitoring ISE program and assessing its impact	NSF interest in funding synthesis study of evidence of learning in informal science settings
Primary creators	NSF ISE and Westat staff	NRC consensus committee
Basis for categories	Emergent categorization of project impacts previously developed by Westat, incorporated into ACC report	Building on prior NRC report: *Taking Science to School,* with 2 additional categories appropriate for informals: interest, identity
Use / commitment	NSF requirement for all proposals, well-known by ISE evaluators, basis of OPMS system (~7 years of data collection & coding)	ISE field, researchers in both formal and informal settings (degree of penetration unclear)
Language	Nouns emphasize outcomes as products of learning, though process measures also possible	Verbs emphasize participation of learners, so evidence has a process-focus
Research/evaluation niche	Only one aspect of summative, calls for specification of a few generalizable, potentially aggregatable impacts with indicators for each. Focus is on final outcome (though not necessarily pre-post, could be practice)	Could be basis of any stage of evaluation (front-end, formative, summative) or research. Focus is on process (what learners do)
Assumptions of sequence & hierarchy	No hierarchy of importance, no sequence.	No hierarchy of importance, but suggested sequence (esp. of interest and identity) reflect typical ISE setting
Scope	Includes behaviors such as stewardship, affect such as caring, careers as well as science per se	Limited to science (or sometimes STEM)
Assumptions re mediators	Includes a parallel set of outcomes for ISE professionals	Recognizes importance of mediators (e.g. parents, facilitators, ISE professionals) but no explicit outcome for

		them
Common categories	Interest, knowledge, inquiry skills	
Differences in categories	Includes "attitude" to capture long-term stance toward something; Includes "behavior" to capture typical outcomes in environmental/stewardship projects; Includes "other" category to allow for future categories as needed	Includes "reflects on science" and on one's own learning of science; Includes "participates with others using scientific language and tools"; Includes "identity" to capture long-term building of learner's sense of self as user and even creator of science

Motivation for integration:

There are several arguments for integrating these two frameworks into a unified whole. Among them:

- In a fragmented field that sees itself as having to "make the case" for its value, having multiple frameworks for learning outcomes makes it harder to build, compare, and test impacts of different learning environments.
- The two frameworks currently in use are similar enough to call for some kind of integration or at least applicability guidelines.
- Both frameworks were based on research and evaluation, but from a pragmatic perspective, building on prior work but making no claims of finality or comprehensiveness.

Issues

Integration could offer an opportunity to address related outstanding issues:

- Aggregation: The NSF framework was based on the presumption that some form of aggregation of impacts would be possible; however this is very challenging due to: (a) lack of standardized or commonly used assessments, and even (b) lack of consistency even of the target impacts (e.g. "attitude" could be to crocodiles, to science, to pseudoscience, to science careers…). The very breadth of the NSF "bins" makes aggregation challenging.
- Process versus outcome: It is unclear whether the kinds of process-focused forms of evidence will meet NSF's needs for claiming overall impact of the NSF ISE program.
- Ambiguity of NRC Strand 5: Even in the original NRC report, Strand 5 was less conceptually clear than other strands, and has been variously interpreted as being chiefly about moment-by-moment free-choices ("participates"), social learning ("with others"), or scientific discourse and tool-use ("using scientific language and tools").
- Overlapping or loosely defined categories: Strands 1 (excitement / motivation), and 6 (identity) have been taken as typically early and late in a learner's development, but this makes them inconsistent with the other 4 strands and also could be seen as suggesting learners lose excitement over time or that identity is an unsuitable starting point for a learner. Perhaps both could be seen as parts of a continuum of investment. Also in this mix might be persistence (choice to continue), and affect (beyond interest). The strands use a rope metaphor but this makes them difficult to disentangle.

- Tricky constructs: For example, "behavior" is so broad that it includes any observable actions by learners, or if interpreted narrowly as conservation-related behaviors, perhaps this goes beyond science education and moves more toward a public service campaign. Also it has a different level of generality from the other categories: it doesn't apply to all ISE projects but is sector-specific. Could it be an example of something more cross-cutting (e.g., application of science to real-world settings)?
- Could use clarification of which are the key outcomes (e.g., strands or bins), which are audiences (e.g., public, professional), which are objects of interest that these focus on (e.g., science, program participation, career trajectory, etc.), and which are assessment lenses (e.g., seen by self, seen by others, observed actions, formal scoring performance, builds over time, applied innovatively).
- Does either framework really work for the professional audience?

<u>Possible actions</u>

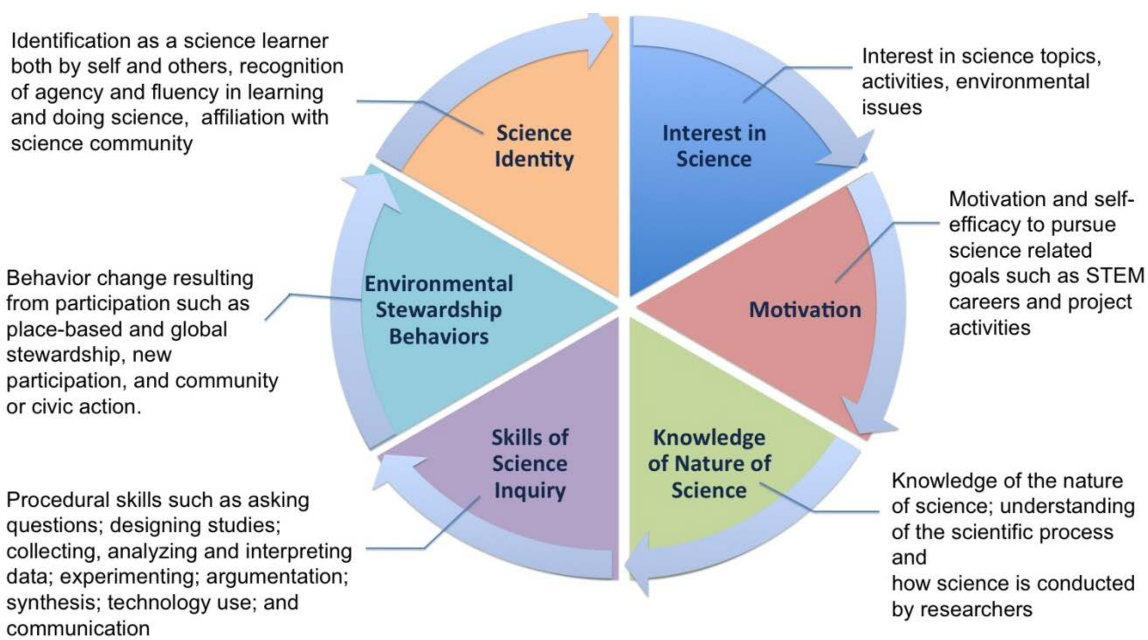
a) Keep both for different purposes:

- For NSF, individual projects are held accountable for process-based evaluation, while pre-post changes are part of summative evaluations conducted by external evaluators on <u>groups</u> of projects with similar goals. (e.g., all funded projects that hope to engender stewardship of ecosystems).

- This might allow the strands to be used for formative or within-project evaluations, while cross-project summatives use the ISE framework.

b) Integrate into a common framework used throughout the ISE field

- Example: DEVISE (a project from the Evaluation Group at the Cornell Lab of Ornithology) has a version of this already, for PPSR projects. DEVISE is most concerned with measuring individual learning outcomes, many of which are generalizable across multiple domains. The project is building scales to test and validate to measure outcomes in each category.



- Others have published alternative or similar typologies to consider (e.g., Moore Foundation's *Activated Learner,* Framework for the Next Generation of

Science Standards, Common Core for Math/ELA, synthesis of informalscience.org data, ATIS categories of instruments, Change the Equation criteria, etc.)

<u>Some questions:</u>

- Is it worth integrating these frameworks? If so, should this be sector-level (e.g. citizen science) or across the entire ISE field?
- Who are the key stakeholders and what are the real costs of integration? For example, NSF has invested many years of data gathering and analysis into the existing ISE Online Project Monitoring System (OPMS) using the NSF framework – what would it take to recode or even re-collect these data?
- What process, people, values, and timeframe should do the work of integration, such that it will have buy-in from the ISE field, funders, policy-makers, and academics, when complete? How much should this be driven theoretically versus pragmatically (e.g., based on availability of instruments, existing coding schemes, alignment with typologies in related fields, etc.)?
- What kinds of aggregate data are expected from this framework? (e.g., just output data? Self-report bins? Actual outcomes achieved?)
- What values would drive the specific choice of categories for an integrated framework: (e.g., fewest number? Most inclusive? Independent (orthogonal) categories? Ease of OPMS recoding? Alignment with existing standardized instruments?) What are the implications of a particular choice for systemic

validity (i.e., What properties should a framework have such that if the ISE field aligns to it over time, it moves in a productive direction?)

References

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