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Years ago, starting in 1988, we launched a long-term exhibit plan at the Museum of Science in Boston that was connected with constructivist learning theory. We worked with George Hein at Lesley University and he both provided the field with perspective on constructivist approaches and served as the evaluator for one of the exhibits in our series. Several of the practitioners who were building upon those concepts, organized sessions at the ASTC conference with very dynamic ways of presenting the concepts in George's book on Learning in the Museum -- costumes, songs, audience participation, rewards, etc. So it was a very nice relationship. We felt really good about working at the cutting edge of the educational theories and research, worked hard to build exhibits that lived up to those ideas, and had fun sharing our thoughts, and George's, with the ISE community.

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Recently I have gotten quite interested in the idea that in addition to informal education research, our field might benefit by being more knowledgeable about science communication research, especially in activities that are meant more for adult audiences and deal with applying scientific knowledge to socio-scientific decision-making. The National Academy of Science's Sackler Symposium this past year on the Science of Science Communication presented some interest ideas that might benefit our work.

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We have been using employing a “strategic framing” approach to communication (Bales and Gilliam, 2004) that supports meaning-making by building on careful empirical research to understand what people already value, believe, and understand, and then designing and testing communication strategies that help translate complex science in a way that allows people to examine evidence, make well-informed inferences, and embrace science-based solutions. This evidence-based approach can help to address conceptual, psychological, and social barriers… These three areas of expertise are brought together via Study Circles -- teams of 20 interpreters working with climate scientists and communication experts to build a community for learning and practice. The Study Circles meet in person and online for approximately 100 hours over 6 months, involving reading, practice, coaching, and reflection. It is here that research and practice connect and are integrated within a context that provides cognitive, social, and emotional support. One thing we have learned is that learning strategic framing is a lot like learning a new language. There is certainly a cognitive learning component, but a social context for learning/practice/reflection and an emotional support network are equally important.

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I’d say our best experiences connecting research with practice have emerged in situations that: 1) broadened who is assumed to be a practitioner (shop staff, grounds crew, and others traditionally marginalized from these activities can become more powerful advocates for the institution if given the opportunity) 2) pushed the researcher/practitioner boundary, particularly in ways that enable diverse practitioners to become researchers themselves.

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Since we are concerned about conservation we have looked broadly at social science research to help us understand where our potential impacts may lie. While a 3 hour visit to a zoo, aquarium or museum is unlikely to have a direct impact on conservation behaviors, we have seen where we impact the areas where people can get information, provide a sense of belonging to a group concerned with conservation, and one that models behavior, and provides experiences that open up a small window of attention where changes in perspective (or reinforcement of already held beliefs) can occur. The field of Conservation Psychology has been of immeasurable value. Similarly, we are looking at the sociology of human development where we may be able to show how a visit to the aquarium can influence general well-being, family cohesion and self-efficacy.

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There is a lot of research on ISE in Science Museums and lots of research on Science Anxiety among teachers and students. I am not finding much research or many established models on public libraries and what role we might have.

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Research practitioners are not program developers or exhibition designers, and the goals of researchers do not necessarily align with the goals and timetables for program development. With all the good will in the world from both the researcher and program development groups here (and those who straddle both), it continues to be a challenge to bring research-based work into the actual public arena. We are working hard on this and have some progress to show for sure.

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Any time that people cross disciplinary boundaries -- as I am trying to do with moving between life science and education -- there is a steep learning curve. Every discipline has its own specialized vocabulary, it's "best journals" and best practices in research design. I would say the best resources I have personally found avoid jargon and focus on reasonable and actionable recommendations, with empirical evidence supporting their usefulness. Also, it's helpful if these resources are easy to find, by using plenty of intuitive keywords so that they may be found in ERIC without knowing at first the particular ISE jargon required.

I have typically not worked with learning scientists, but I have worked with several decision scientists and a neuro-economist, who also looked at decision making, to conduct research on the floor. The fields of decision science and neuroeconomics are particular relevant for museums who are interested civic engagement.

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The most successful collaborations that I've seen have occurred when both practitioners and researchers clearly had something to gain from participating. It helped, too, when members of each group had some experience of the life/work of the other group; for example, a researcher who has been a museum practitioner or a practitioner who has done some solid research.

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In looking for reliable, validated scales measuring aspects of impact we've found there are many science knowledge and attitude scales that have been developed for students in the formal education arena (and these I am sure can be modified fairly easily for use with students in informal education classes). What has been more difficult is finding equally rigorous scales that are appropriate for adults visiting with a wide range of ages of children, and that can be applied to an entire visit rather than a specific exhibit. We have one on views of science that has worked well for us (Rennie & Williams 2000). One of the rather surprising finds outside of science is in the area of social work. While the scales there have been developed for therapeutic use, it has been possible to apply them to a leisure setting in looking at the social aspects of a visit… In talking to social scientists, most find it surprising that their work can be applied to a museum visit - the crossover was not on their radar.

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The main goal of our website is to provide readable summaries of current peer-reviewed education research that would be relevant for practitioners in ISE. There are over 150 research briefs already on the website, and with feedback from our pilot year, we are experimenting with expanded resources that will hopefully be more easily taken up by practitioners in professional development settings. A barrier to dissemination for us had been the need to login to the website (even though it was and continue to be free). All of content is now available without the need to login: www.research2practice.info

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I'm glad you brought up NSF's Climate Change Education Partnership program. This program is a good example of a funder building research and practice connections into an RFP. Each project needs to have Co-PI's who represent education, climate sciences, and learning sciences. There's risk in that kind of top-down, funder driven mandate. We're starting to hear a lot already in the forum about the need to learn each other's language, develop shared goals, and building trust.

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One key to our success has been that there has been strong overlap between the goals of the museum staff and the goals of the researchers. A second key element is that we have worked closely together as a team -- with researchers and practitioners present together in bi-weekly meetings through the life of the project.

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A number of years ago I had the opportunity to serve as a member of the board of trustees at the Institute for Learning Innovation, where there were a number of initiatives that nicely blended research and practice. A signature program was a series of meetings that led to the "In Principle In Practice" publications, in which practitioners and researchers worked together to outline issues and propose solutions. A number of people engaged in this conversation played important roles in that project, and so may already have mentioned it.

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If you're looking for a tool you can use to examine learning for all ages, generic to all exhibits, I highly recommend the Visitor Experience Profile developed by Chantal Barriault at Science North (Barriault & Pearson, 2010). It does not track one family through an entire visit, but does allow for the same tool to be used across exhibits. I wonder whether it could be adapted to follow one visitor at many exhibits, though, since the behavior coding is not exhibit-specific.

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For strategies, I favor any that expands who is considered a researcher (beyond external or in-house research professionals). For example, I saw some excellent presentations by "practitioner" teams at the Shedd who were given the opportunity to construct and test their own hypotheses about visitor responses to animal encounters. One team experimented with how a conservation message is delivered; another team addressed the impact of ambassador animals, another team focused on the transition period between animal encounters. The expert role of the professional ISE researcher remains absolutely critical in this approach (providing the conceptual context, improving experimental designs, providing relevant references, etc.)--but practitioners also play vital research roles, and staff inquiry teams inform each other. Even better when this approach is embedded in a larger plan to envision the institution, including every staff member, as part of a broader community of inquiry. While acknowledging the many good reasons to draw the line between ISE researchers and practitioners, I am inclined to believe it is worth questioning the integrity of that division, and perhaps stepping back from it a bit by envisioning both researchers and practitioners as investigators capable of generating knowledge to inform shared goals.

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Key to the way we operate is to completely blur the distinction between practitioner and researcher and the subjects so each become interchangeable.

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There are two experiences in applying research to practice that are memorable for me. Both were team-oriented projects in which we were learning together to review related research literature and discuss implications for the project we were working on. Both of them related to family engagement strategies. We are still involved in one of them. A powerful component in both was cross-division participation, including people from marketing, education, floor staff, evaluation, and exhibits. We learned from each other, and valued the variety of perspectives.

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At the NAS Colloquium Dan Kahan showed that when it comes to certain issues on which people are strongly divided, more knowledgeable people are even more divided. So the idea that if we just communicate the scientific facts and findings of research to folks they will all come to the same informed conclusion, doesn't seem to hold water, in part because social values play a key role in how people process the information. We used three social values scales that we got from talking with Kahan in the Provocative Questions prototypes and people seem to get that their place on these values scales influences their decisions and the decisions of others despite what the science says. So we include that in the exhibit experience along with the science and ask people to make choices and talk with each other about it.

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I feel that I've been straddling the research/practitioner role since I started working in science centers. A couple of key lessons that come to mind: --what counts as valid, reliable and useful evidence differs for the on-the-ground practitioner and in academic research. --Theory is present in informal setting's practitioner work but not always articulated as such, and it doesn't always align with theory about learning developed in school settings. (Big opportunity here!)

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I've found that productive collaboration required three things: 1) Intentional efforts to build trust. For example, I often describe my work as an extension of theirs, because we both have the goal of improving practice through better understanding of learning. More practically, we've also built trust through going on overnight retreats together, sharing occasional meals, etc. 2) Time and effort spent communicating and clarifying goals and values. This involves really listening to practitioners' needs and values. I spent 6 months once arguing with a developer about the goals of a project until I finally heard that he was afraid that my goals would exclude his. Once we had that realization, we reframed the goals a bit and found compatibility. 3) Blending of roles, with researchers sometimes developing exhibit ideas or even fabricating exhibits and developers generating research questions or even collecting data.

Challenges have included: - Time, time, time. Do we really have to spend all this time talking and listening, arguing and convincing? I believe so, at least I haven't found a more efficient way to align our values, goals and understanding of the joint project. But sometimes it can be exhausting.

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In several projects, I've run into the issue that we researchers often take an analytic stance, meaning we pull things apart a bit in order to understand the relationships among components. Many of the practitioners I've worked with, however, want to view the work holistically, preferring to think simultaneously about all the features of a program (design and outcomes). Sometimes, we've been able to ameliorate this challenge by identifying it and then creating representations and language that shows the whole picture as comprised of its parts.

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One of the most fascinating parts of [our] conference was that almost immediately it was evident that the word "research" meant something very different to each role represented at the conference - perhaps even to each person. When we thought we'd clarify things by narrowing it down to "learning research," things became even stickier because "learning" means so many things to so many people. The result was four days during which everyone at the conference worked very hard to try to make sense of how learning researchers, practitioners, science researchers, administrators (and others) could find common language, build trust, and work together to reach the potential of natural history museums to make a difference in the public understanding, engagement, and participation in scientific and sustainability questions of the 21st Century.

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With the science festival experimenting heavily in non-traditional ISE programs and locations, I have found it difficult to find applicable science education research as a guide. Since festivals are new on the scene, it has been hard to engage beyond evaluation - even though some interesting research questions are emerging. I have started to reach beyond traditional social science/science education research - delving into festival tourism research to understand motivations and community impact.

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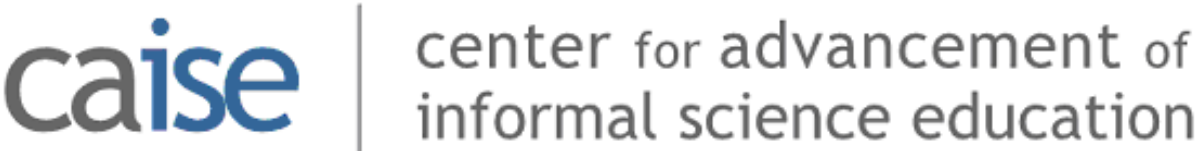

I wanted to post separately about Design-Based Implementation Research. The article that best describes this idea is called "Organizing Research and Development at the Intersection of Learning, Implementation, and Design" by Penuel, Fishman, Chang and Sabelli. It appeared in the October 2011 edition of Educational Researcher. According to the article, Design-Based Implementation Research is "design research at the level of educational systems... an expansion of design research, which typically focuses on classrooms, to include development and testing of innovations that foster alignment and coordination of supports for improving what takes place in classrooms." The article describes several projects that illustrate the DBIR approach. I don't know of any examples of this approach being used explicitly in informal settings, although there are certainly many projects whose philosophy is consistent with it.

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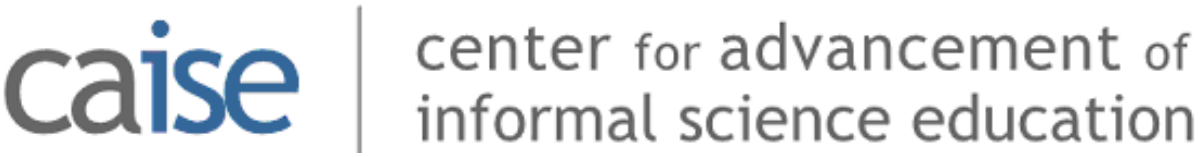
I agree that a top-down mandate can be problematic, but in our case I think NSF has done a good job of identifying the kinds of expertise that are necessary to do the work. As Larry Bell and others have pointed out, we really do need learning and social science experts engaged in science education especially when we are dealing with value-laden issues.



As an internal Research & Evaluation Department, we often work with practitioners to develop the research questions that will define studies of mutual interest. In addition, we also partner with outside researchers who are interested in the ISE setting to help them shape their research so that findings will be relevant and interesting to the field and push our institution's knowledge and/or practice forward.

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What we have learned from this experience is that cooperation between researchers specialized in science communication initiatives (mainly social scientists working in areas as science education, sociology, science communication, politics of science, etc) and science communication practitioners (working for science museums and exhibitions; for science events and festivals; and for scientific culture political initiatives) not only is possible but also very productive.

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I think that language is definitely a potential barrier to collaboration. For example, researchers and informal educators may share understandings about content and pedagogy, but they may not know how to relate these understandings to each other easily and/or with confidence.

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Success? I think that successful collaborations and partnerships occur when each group empowers the other to participate equally, both in terms of physical work or time involved as well as conceptually/theoretically. For example, I do think that informal educators should be empowered to see themselves as knowledge producers in terms of helping to build theory, generate empirical support, and also add to what we know regarding best practices.

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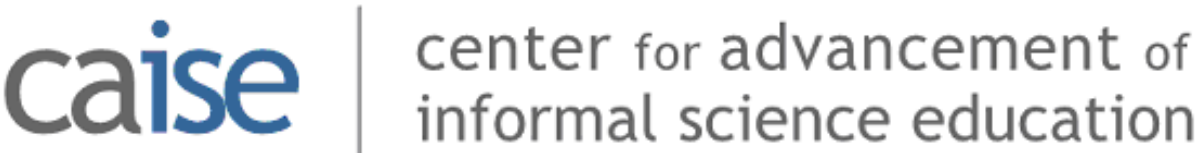

What makes our project unusual is that the practitioners are the ones doing the research on visitors' experiences. The "professional" researchers are studying how to most effectively help practitioners become more reflective. Our final products will include action research case studies collaboratively written by zoo/aquarium educators and their mentor. Our collaboration is supported by 1) yearly meetings of all participants; 2) monthly assignments for each team; 3) monthly phone calls between each team and their mentor and 4) annual visits by each mentor to his/her sites.

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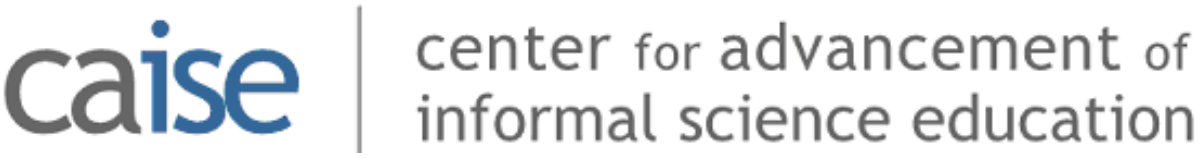
One issue that I have observed is that our staff (the "practitioners") tend to have very practical questions that are sometimes different from the more theoretical questions that the "professional researchers" think about. I dont' think this is an insurmountable obstacle, but it is an interesting challenge to work with. "Reflective practice" is a great term because it captures the emphasis on both the reflection and analysis, as well as the application to practice. Perhaps this a good framework for thinking about research/practice collaboration. I'm going to go back and reread my copy of Donald Schon's The Reflective Practitioner!



I've worked with wonderful practitioners and wonderful researchers, but am still struck by the rifts between the two worlds, and - for that matter - between an array of research sub specializations (e.g. there's only 2% overlap between the cited literatures of physics education researchers and chemistry education researchers. Wow.) Maybe I'm naive but I really think we could use our oh-so-limited resources more effectively if we found better ways to learn from each other, and to prioritize what's really important to know, and to invest in just-in-time learning on the professional level. So I'm always wondering about knowledge-building and knowledge-sharing systems, and how both researchers and practitioners can learn in an era of isolation alongside info-overwhelm.

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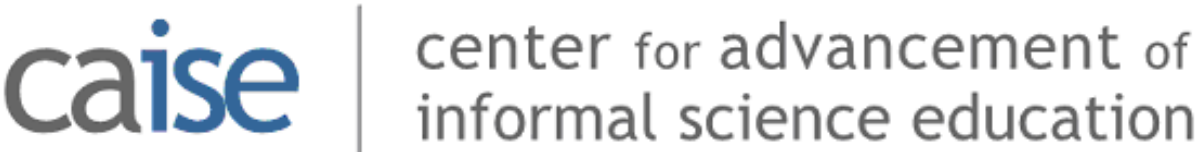

The research working group notes from our 2011 conferences (http://artofsciencelearning.org/conference-reports/116-education-practice-working-group-notes.html give a clear sense of the tremendous gaps between research and practice in this field. The body of practice-based insight into the value of the arts in fostering 21st Century innovation skills and learning in both formal and informal environments (including but not limited to STEM learning) is growing rapidly, accompanied by an equally rapid increase in the application of arts-based learning to innovation processes and the teaching of innovation. Research, which historically has lagged far behind, is only starting to catch up. Catch up is urgently needed, and I'm very grateful for this initiative!

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Anyway, here's a concept from Sandoval that helped me think about it: "educational designs as embodied conjecture." EDUCATIONAL PSYCHOLOGIST, 39(4), 213–223 "In part, it is a plea for the field of education to resist viewing the development of learning environments, and learning technologies specifically, as simply making things and seeing if they work. Instead, both the very idea of what it means for a design to work and the ways in which its working can be shown rest on theoretical assumptions that design-based research strives to make explicit and testable. Second, this paradigm is aimed at developing theories of practice rather than developing theory that can be translated later into practice. This aim inherently assumes that learning is situated. More than this, however, is the assumption that specific designs are a lever for studying particular contexts.

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We are co-developing public research and conservation action stations at zoos and aquariums. Research plays a continuing role in informing design, from mundane decisions like: “hmmm, let’s not put a station there because it will not allow enough room for families to interact,” to fundamental decisions about the structure and wording of our interactives. As for questions that seem to warrant further attention, we remain curious about how collaborative knowledge creation relates to behavioral and social change. Because of our interests in sustainability, we are also seeking ideas for how to assess social and environmental impacts in community science contexts, and welcome any info on these or related fronts.

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We did a series of small embedded research components in larger projects. The choice of research question was heavily influenced by the team, especially the exhibit developers - they helped us find questions that were at the heart of real design dilemmas, but still potentially generalizable. E.g. Do walls around an exhibition enhance or hinder learning? Or... are there really trade-offs between supporting inquiry and explaining a concept? They helped us identify a bunch of design-tensions and their implications for learning.. This was a big change from the question I pursued when I first arrived at the museum as a post-doc (about facilitating different kinds of inquiry through labels), which was interesting but had less immediate practical value and didn't bubble up from practice.

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Another really helpful moment was during the details of experimental design studies - practitioners helped us identify versions of an exhibit or experience that were effectively "straw people" because they weren't realistic options, so we could save resources by dropping them. And practitioners helped us stay real about how different learning outcomes might manifest, keeping us more open-minded on assessment issues. Plus they helped us frame implications in a way that would resonate with other practitioners.

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I'd really like to know more about how practitioners make their decisions, and where they turn for best practices / research / eval / minefields etc. What does that even look like? Is it all personal word-of-mouth, asking someone you know whose experience and insights you value? Or going to exhibitfiles.org? Or searching through a string of online sites with differing expertise? We're a highly experiential culture in ISE, yet we expect that our practitioners will be reading literature like printed books and journal articles - it seems unrealistic. Even with research2practice and the great things CAISE is doing, I wonder if there's a way to have "just-in-time" knowledge for ISE professionals making design decisions? Aside from jargon issues etc, where would we put relevant research so that it's most useful? What form would it take?

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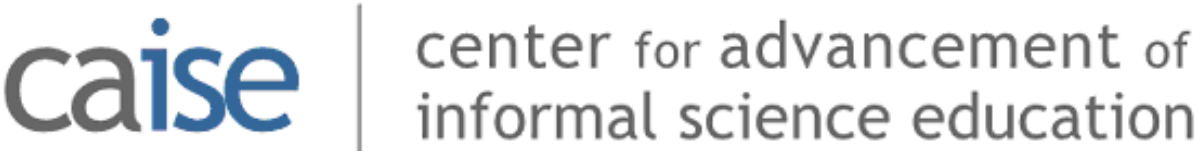

On the other question, I wonder if it would help reduce the obstacles if our field had some kind of Craigslist where people could post themselves as researchers or practitioners, with areas of interest, and looking for connection! Or maybe some focused discussion that moves "In Principle, In practice" into the online world for live discussion - e.g. let's do the next ASTC Connect on a topic -- say, building coherence among disparate learning experiences -- and let people figure out a research agenda over 2 days!

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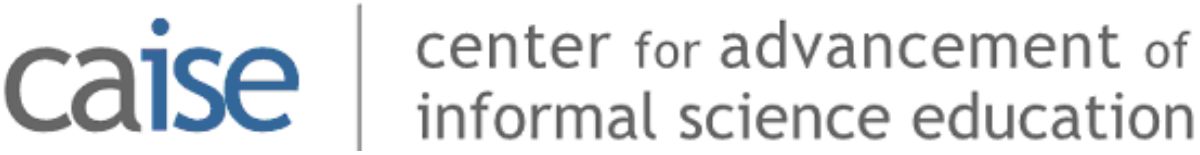

I disagree (at least a little) on the value of having 'a' learning researcher on staff or on project. What Sue suggests sounds exciting, flexible and quick. There are so many subfields of research and opposing theoretical perspectives, that bringing on a person automatically limits a project. [We]... are learning to be a little more nimble in gathering information for decision-making. Especially if using research to help us be a little more experimental, a little less afraid, I'm all for it.

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From a research perspective, I found the most rewarding experiences occurred when questions emerged that opened up an entirely new research area – which in turn influenced exhibit development. Working .....on a children's exhibition on bird-dino evolution we developed what we called a "spiral model" of exhibit development. In this model, there was almost continuous spiraling from early exhibit development decisions, which were impacted by the prior research and formative evaluation, to research project design decisions and studies that yielded new information, which in turn informed exhibit development.... For one-off informal learning experiences like this, the spiral model of decision making, with learning researchers, evaluators, and exhibit developers continually interacting with each other, proved to be a fruitful approach. In this case, a literature review would not suffice.

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I'm an...exhibit developer..who would like to make better use of research in my work. Realistically I don't do much looking at research in the midst of a design project, I rely on first hand input from colleagues and advisors. Maybe it's because we have in house evaluators, but the answer to a question that we actually want to research is to evaluate the thing we're doing rather than looking for research that is adequately relevant. And I've learned from hard experience to be careful about asking for a formal "study" rather than quick and dirty, as the time goes up so much. I'm more optimistic about the idea of using research as a idea generator in the early phase of a project. Something most helpful would be "push notifications" sent when a researcher thinks they've just hit upon an actionable idea that they hope someone will try. Maybe this is the "craigslist" idea, or the new iteration of informalscience.org. I do think it would be helpful to have something more informal than browsing abstracts.

There were several aspects of this "spiral" model that are transferable. Perhaps the major one is a decentralized decision making process. The research/exhibit ideas emerged out of the interaction and were not imposed on the team (the "bubbling" referenced earlier). Of course, we were constrained by the initial research question, but that did not dictate our approach. Our earliest team meetings focused on the issue of generalizability. By examining the good and not-so-good aspects of the decision-making process, we might come up with a model that could be extrapolated to projects with different timelines and different ways of incorporating learning researchers into the team (e.g., in-house, occasional embeds, etc.).

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My idea behind pushing ideas is to try to get more practitioners engaged with research. I'm positing that there are others like myself who go to informalscience or research2practice every once in a while, but then kind of forget to check back. If we could indicate some areas of interest and then get an email when something comes up, we might be more likely to pick it up. That would require only a few saved search terms. Something else interesting might be to let those publishing work be able to actively push it, maybe to those choosing to be signed up, if they see their results as being ripe to be put into practice. Maybe I'm just thinking that the suggestions for future work part of a paper could be pulled out and listed separately for those looking for such suggestions.

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As a former practitioner who now works as a researcher, the idea of a coordinated agenda is extremely valuable. From the researcher point of view, the disciplines that could and should contribute are varied and not always coordinated. Questions to be asked and the methodologies to be used through a coordinated agenda would be richer if we had a group of researchers/practitioners together. ... Of course, some researchers may feel that a coordinated agenda takes away some of the cachet of doing research. That will never change. But a coordinated research agenda that allows researchers to publish their own data while part of a larger effort may alleviate that.

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Without going into what the most important research questions would be, I would recommend that at least one of the unifying themes, perhaps the guiding theme, of a common ISL research agenda should be to serve the public good. By this I mean facilitating the broadest possible participation in the shared creation and application of knowledge to improve healthier relations with each other and with the ecosystems on which we depend. Unlike many other fields of study, much of the ISL domain lies with community-focused institutions that carry a strong public mission. Explicitly linking ISL research to the public good (at least in aggregate) would help ensure research connects with ISE institutions while opening important research questions, particularly at the community level, that the ISE field is particularly well positioned to address.

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To have a coordinated RESEARCH agenda for a field as broad and diverse as Informal Science Learning seems to be a task for Sisyphus. Optimal research agendas draw on coherent theories that generate clear hypotheses, which can then be assessed. We do not have that. Even a clear goal, such as improving the public good, leads to a myriad interpretations of the public good, none of which is sufficiently constrained to yield good testable research questions.

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We could construe a series of overlapping research agendas, each of which addresses a distinct and critical issue for the field (and all of which address the public good). Ideally they should be based on the theoretical underpinnings of our field.

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Here is a problem-we do not have many coherent theories. We do have the beginnings of a "practice" approach in NRCs Learning Science in Informal Environments and we should not ignore that volume. Each strand of informal learning (p. 4) offers a (relatively) clear goal, sub-served by micro-level theories, which could contribute to a more distributed research agenda. Current theories of motivation, cognition, affordances, embodiment, distributed learning, etc., all play distinct and different roles in each of those strands. For ISE the trick is to consider how these existing theories differentially contribute to the diverse learning experiences offered by ISE, from field trips to structured and unstructured museum experiences, to citizen science, to after-school learning.

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A distributed research agenda, one that reflects the diversity and strengths of the field of informal learning, with distinct sub-goals, might be achievable. Articulating that agenda requires input from practitioners and researchers, all of whom have experience in the field.

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Science identity would be a reasonable and high priority question for us all to explore. And at the same time, we need a more inclusive sense of what "field-wide" means. As I've continued to explore this question of science identity, I've been enjoying John Falk's book "Identity and the Museum Visitor Experience." As he follows his subjects visits to exhibits, I realize that I could replace "museum exhibit" with "episode of NOVA" in this book and the arguments he makes would apply equally, or at least raise fascinating new questions.

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It seems to me there are three issues here: research agenda, data from that research and access to results from the research. On the agenda question, I tend to the "let 1000 flowers bloom" school of thought -- part of the joy of this field is the different perspectives that people with different research goals have. On the data question, I [agree that] moving toward some kind of public repository or open-access data site (tied to "big data," in the current scientific argot) makes sense.
On the third issue, access to the results, one of the big challenges for the practice/research link is that practitioners often don't have access to the libraries and journals where research is published. At the same time, for researchers in academe, there is little professional benefit to publishing in newsletters or grey-literature reports. So how can we overcome these barriers?

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One way to improve access is through sites like informalscience.org, where grey-literature can be shared more widely. Another approach is the ISE Evidence wiki created by CAISE. I helped create an entry there on public engagement, in which I deliberately posted in a public place a literature review of the sort I might have normally published in a scholarly journal. (I hope I kept it shorter and more comprehendible, but that's another issue. One advantage of the wiki is that other people can help improve it.)

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Some questions are ones that could be addressed in a variety of informal learning settings, including those that do not focus exclusively on science. E.g., In what ways do parents or primary caregivers shape children's identities as lifelong and lifewide learners and what can informal learning institutions do to enhance parents' impact in this arena? While such a question relates to strand 6 of Learning Science in Informal Settings, it is not content-specific and could apply to learning in art museums, history museums, and a range of other settings.

Other questions might be more tightly science-based, such as "Do children who learn science in natural, outdoor environments develop a greater interest in science or a deeper understanding of scientific concepts than children who experience hands-on science learning in indoor settings?" I would argue that research in formal learning settings could bear some relevance to such questions.

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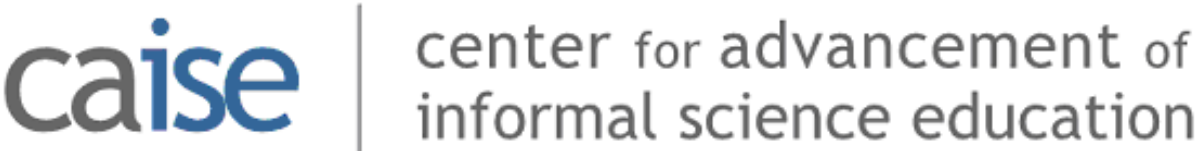

Finding incentives to increase dissemination would be an excellent line of inquiry. There is a huge gulf between the research-driven work at the pinnacle of the field and the day-to-day practice of organizations all over the country. At one end of the spectrum I see the SciGirls television show incorporating elements of storytelling and relationship development in a thoughtful and deliberate way to help girls form an identity engineering-capable, and at the other end of the spectrum I get a YMCA summer camp brochure in the mail offering a choice between --"Twinkle Toes Princess Camp" (princesses age 5-8 enter a world of make believe, read stories, make crafts such as fairy dust and get a tiara for every girl) --"Science Exploration" camp (children 6-12 will learn about rockets, space, and exploring the amazing scientific world around us--join us if you want to be your own mad scientist) Is nothing trickling down, even to organizations as well-established as the YMCA?

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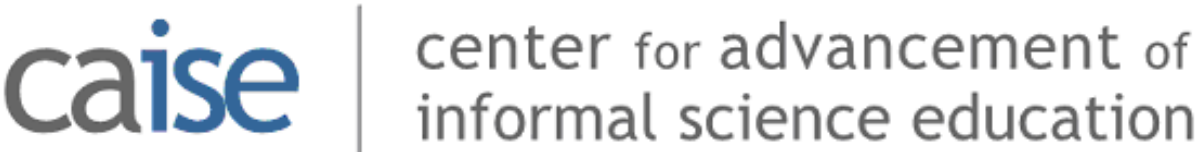

Sometimes research is most helpful when it contradicts one's intuition. It's counter-intuitive to plan a complete exhibition around a concept simple enough to be conveyed in under 20 minutes. And yet, no one would try to pack 20 separate complex concepts into a 20-minute classroom activity or television program. The 20-minute rule reminds us to plan a set of experiences which all reinforce each other instead of going off in a dozen tangents.

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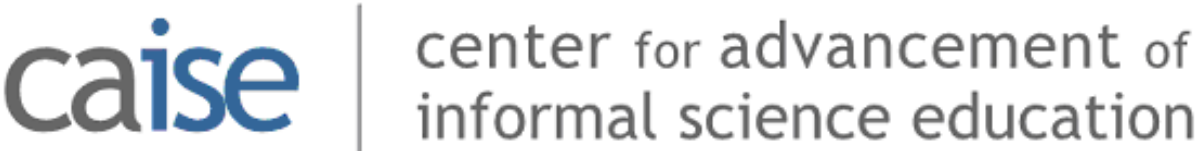

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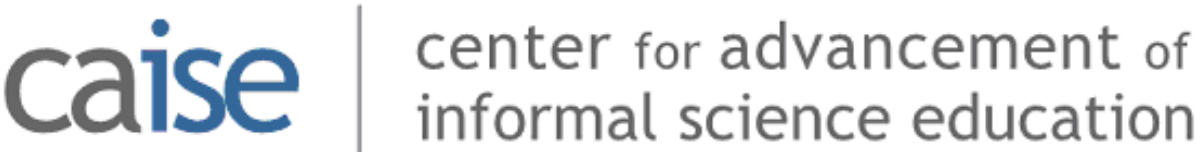

To build off of your post on the need for researches to publish, I think a huge draw back in the ISE field is that practitioners don't have many avenues for peer-reviewed publication unless they are teamed with a researcher. I am interested in exploring what a practitioner journal would look like - peer reviewed case studies perhaps?

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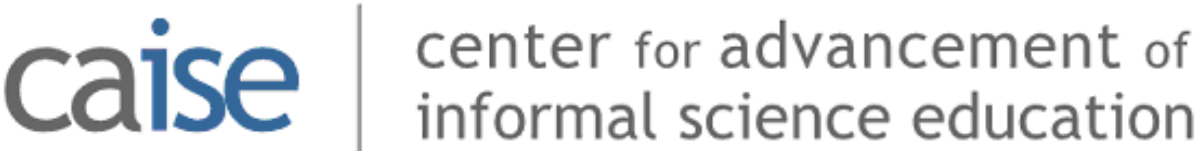

The route to a 'field wide research agenda' must start with the long, hard work of building the research infrastructure. .... I see that we have a lot of work to do on the research infrastructure before we can afford the luxury of shared research agendas: What reliable, shared data do we already have that might be used as evidence of outcomes, and how do we come to agreement on which of these indicators count as evidence? And, How can we fully populate the existing research portals with seamless searches of both qualitative and quantitative data? Once these two are in place -- and thank you, ASTC, ACM, IMLS, CAISE, UPCLOSE and VSA for your efforts on these two foundational pieces, we might have a robust research base, and transparent access to aggregated data. Then we can explore using research agendas to guide our explorations.

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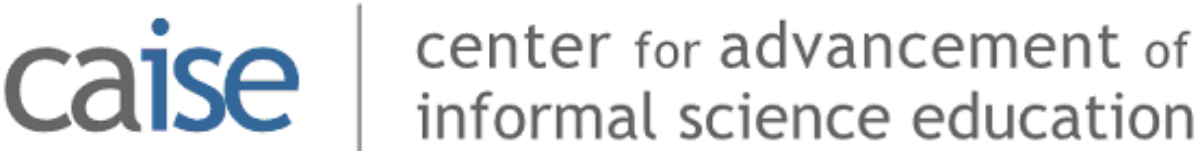

"Don't we need the agenda first to guide the formation of this infrastructure?" Perhaps, but this is also tricky question with resolution either years away or not possible/desirable. Research agendas change, while the infrastructure is more permanent. Our field is building this infrastructure, but we still have a long way to go.

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.The real issue with a shared research agenda is that we need a diversity of agendas within the ISE field. From the previous comments on this thread, I read Mary needs a research agenda to help understand STEM learning outcomes in giant screen films. Rachel, Richard and Chris need an agenda to research methods of altering behaviors and attitudes in girls. Our team needs a research agenda to study the impact of ISE museums on their communities. STEM learning is a part of this, but so are personal identity, social capital, workforce development, economic impact and other public and private goods produced by the ISE field. The diversity of research agendas may be as huge as the diversity of desired and received outcomes.

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The goal of research agendas for each sector may be important, if difficult and a few years away. Now, all of us need to be part of moving forward on the infrastructure for research, and that means work in the trenches establishing data definitions, a wide selection of indicators and shared collection and dissemination methods.

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I'd say our best experiences connecting research with practice have emerged in situations that: 1) broadened who is assumed to be a practitioner (shop staff, grounds crew, and others traditionally marginalized from these activities can become more powerful advocates for the institution if given the opportunity) 2) pushed the researcher/practitioner boundary, particularly in ways that enable diverse practitioners to become researchers themselves.

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Since we are concerned about conservation we have looked broadly at social science research to help us understand where our potential impacts may lie. While a 3 hour visit to a zoo, aquarium or museum is unlikely to have a direct impact on conservation behaviors, we have seen where we impact the areas where people can get information, provide a sense of belonging to a group concerned with conservation, and one that models behavior, and provides experiences that open up a small window of attention where changes in perspective (or reinforcement of already held beliefs) can occur. The field of Conservation Psychology has been of immeasurable value. Similarly, we are looking at the sociology of human development where we may be able to show how a visit to the aquarium can influence general well-being, family cohesion and self-efficacy.

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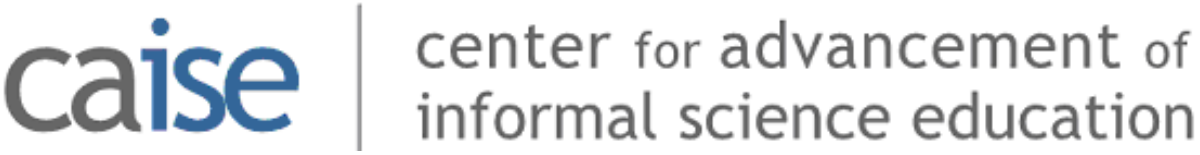
Any time that people cross disciplinary boundaries -- as I am trying to do with moving between life science and education -- there is a steep learning curve. Every discipline has its own specialized vocabulary, it's "best journals" and best practices in research design. I would say the best resources I have personally found avoid jargon and focus on reasonable and actionable recommendations, with empirical evidence supporting their usefulness. Also, it's helpful if these resources are easy to find, by using plenty of intuitive keywords so that they may be found in ERIC without knowing at first the particular ISE jargon required.



In looking for reliable, validated scales measuring aspects of impact we've found there are many science knowledge and attitude scales that have been developed for students in the formal education arena (and these I am sure can be modified fairly easily for use with students in informal education classes). What has been more difficult is finding equally rigorous scales that are appropriate for adults visiting with a wide range of ages of children, and that can be applied to an entire visit rather than a specific exhibit. We have one on views of science that has worked well for us (Rennie & Williams 2000). One of the rather surprising finds outside of science is in the area of social work. While the scales there have been developed for therapeutic use, it has been possible to apply them to a leisure setting in looking at the social aspects of a visit… In talking to social scientists, most find it surprising that their work can be applied to a museum visit - the crossover was not on their radar.

For strategies, I favor any that expands who is considered a researcher (beyond external or in-house research professionals). For example, I saw some excellent presentations by "practitioner" teams at the Shedd who were given the opportunity to construct and test their own hypotheses about visitor responses to animal encounters. One team experimented with how a conservation message is delivered; another team addressed the impact of ambassador animals, another team focused on the transition period between animal encounters. The expert role of the professional ISE researcher remains absolutely critical in this approach (providing the conceptual context, improving experimental designs, providing relevant references, etc.)--but practitioners also play vital research roles, and staff inquiry teams inform each other. Even better when this approach is embedded in a larger plan to envision the institution, including every staff member, as part of a broader community of inquiry. While acknowledging the many good reasons to draw the line between ISE researchers and practitioners, I am inclined to believe it is worth questioning the integrity of that division, and perhaps stepping back from it a bit by envisioning both researchers and practitioners as investigators capable of generating knowledge to inform shared goals.

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At the NAS Colloquium Dan Kahan showed that when it comes to certain issues on which people are strongly divided, more knowledgeable people are even more divided. So the idea that if we just communicate the scientific facts and findings of research to folks they will all come to the same informed conclusion, doesn't seem to hold water, in part because social values play a key role in how people process the information. We used three social values scales that we got from talking with Kahan in the Provocative Questions prototypes and people seem to get that their place on these values scales influences their decisions and the decisions of others despite what the science says. So we include that in the exhibit experience along with the science and ask people to make choices and talk with each other about it.

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Challenges have included: - Time, time, time. Do we really have to spend all this time talking and listening, arguing and convincing? I believe so, at least I haven't found a more efficient way to align our values, goals and understanding of the joint project. But sometimes it can be exhausting.

In several projects, I've run into the issue that we researchers often take an analytic stance, meaning we pull things apart a bit in order to understand the relationships among components. Many of the practitioners I've worked with, however, want to view the work holistically, preferring to think simultaneously about all the features of a program (design and outcomes). Sometimes, we've been able to ameliorate this challenge by identifying it and then creating representations and language that shows the whole picture as comprised of its parts.

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One of the most fascinating parts of [our] conference was that almost immediately it was evident that the word "research" meant something very different to each role represented at the conference - perhaps even to each person. When we thought we'd clarify things by narrowing it down to "learning research," things became even stickier because "learning" means so many things to so many people. The result was four days during which everyone at the conference worked very hard to try to make sense of how learning researchers, practitioners, science researchers, administrators (and others) could find common language, build trust, and work together to reach the potential of natural history museums to make a difference in the public understanding, engagement, and participation in scientific and sustainability questions of the 21st Century.

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With the science festival experimenting heavily in non-traditional ISE programs and locations, I have found it difficult to find applicable science education research as a guide. Since festivals are new on the scene, it has been hard to engage beyond evaluation - even though some interesting research questions are emerging. I have started to reach beyond traditional social science/science education research - delving into festival tourism research to understand motivations and community impact.

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I agree that a top-down mandate can be problematic, but in our case I think NSF has done a good job of identifying the kinds of expertise that are necessary to do the work. As Larry Bell and others have pointed out, we really do need learning and social science experts engaged in science education especially when we are dealing with value-laden issues.

What we have learned from this experience is that cooperation between researchers specialized in science communication initiatives (mainly social scientists working in areas as science education, sociology, science communication, politics of science, etc) and science communication practitioners (working for science museums and exhibitions; for science events and festivals; and for scientific culture political initiatives) not only is possible but also very productive.

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I think that language is definitely a potential barrier to collaboration. For example, researchers and informal educators may share understandings about content and pedagogy, but they may not know how to relate these understandings to each other easily and/or with confidence.

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Success? I think that successful collaborations and partnerships occur when each group empowers the other to participate equally, both in terms of physical work or time involved as well as conceptually/theoretically. For example, I do think that informal educators should be empowered to see themselves as knowledge producers in terms of helping to build theory, generate empirical support, and also add to what we know regarding best practices.

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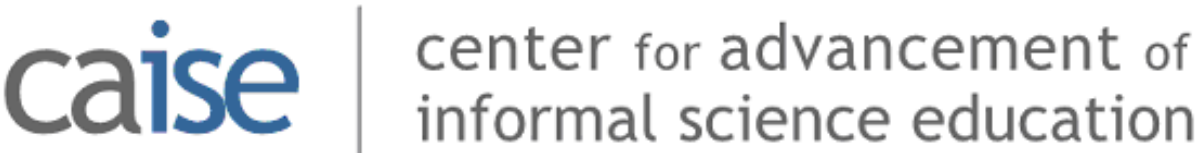

What makes our project unusual is that the practitioners are the ones doing the research on visitors' experiences. The "professional" researchers are studying how to most effectively help practitioners become more reflective. Our final products will include action research case studies collaboratively written by zoo/aquarium educators and their mentor. Our collaboration is supported by 1) yearly meetings of all participants; 2) monthly assignments for each team; 3) monthly phone calls between each team and their mentor and 4) annual visits by each mentor to his/her sites.

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One issue that I have observed is that our staff (the "practitioners") tend to have very practical questions that are sometimes different from the more theoretical questions that the "professional researchers" think about. I dont' think this is an insurmountable obstacle, but it is an interesting challenge to work with. "Reflective practice" is a great term because it captures the emphasis on both the reflection and analysis, as well as the application to practice. Perhaps this a good framework for thinking about research/practice collaboration. I'm going to go back and reread my copy of Donald Schon's The Reflective Practitioner!

I've worked with wonderful practitioners and wonderful researchers, but am still struck by the rifts between the two worlds, and - for that matter - between an array of research sub specializations (e.g. there's only 2% overlap between the cited literatures of physics education researchers and chemistry education researchers. Wow.) Maybe I'm naive but I really think we could use our oh-so-limited resources more effectively if we found better ways to learn from each other, and to prioritize what's really important to know, and to invest in just-in-time learning on the professional level. So I'm always wondering about knowledge-building and knowledge-sharing systems, and how both researchers and practitioners can learn in an era of isolation alongside info-overwhelm.

Anyway, here's a concept from Sandoval that helped me think about it: "educational designs as embodied conjecture." EDUCATIONAL PSYCHOLOGIST, 39(4), 213–223 "In part, it is a plea for the field of education to resist viewing the development of learning environments, and learning technologies specifically, as simply making things and seeing if they work. Instead, both the very idea of what it means for a design to work and the ways in which its working can be shown rest on theoretical assumptions that design-based research strives to make explicit and testable. Second, this paradigm is aimed at developing theories of practice rather than developing theory that can be translated later into practice. This aim inherently assumes that learning is situated. More than this, however, is the assumption that specific designs are a lever for studying particular contexts.

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As for questions that seem to warrant further attention, we remain curious about how collaborative knowledge creation relates to behavioral and social change. Because of our interests in sustainability, we are also seeking ideas for how to assess social and environmental impacts in community science contexts, and welcome any info on these or related fronts.

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We did a series of small embedded research components in larger projects. The choice of research question was heavily influenced by the team, especially the exhibit developers - they helped us find questions that were at the heart of real design dilemmas, but still potentially generalizable. E.g. Do walls around an exhibition enhance or hinder learning? Or... are there really trade-offs between supporting inquiry and explaining a concept? They helped us identify a bunch of design-tensions and their implications for learning.. This was a big change from the question I pursued when I first arrived at the museum as a post-doc (about facilitating different kinds of inquiry through labels), which was interesting but had less immediate practical value and didn't bubble up from practice.

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Another really helpful moment was during the details of experimental design studies - practitioners helped us identify versions of an exhibit or experience that were effectively "straw people" because they weren't realistic options, so we could save resources by dropping them. And practitioners helped us stay real about how different learning outcomes might manifest, keeping us more open-minded on assessment issues. Plus they helped us frame implications in a way that would resonate with other practitioners.

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I'd really like to know more about how practitioners make their decisions, and where they turn for best practices / research / eval / minefields etc. What does that even look like? Is it all personal word-of-mouth, asking someone you know whose experience and insights you value? Or going to exhibitfiles.org? Or searching through a string of online sites with differing expertise? We're a highly experiential culture in ISE, yet we expect that our practitioners will be reading literature like printed books and journal articles - it seems unrealistic. Even with research2practice and the great things CAISE is doing, I wonder if there's a way to have "just-in-time" knowledge for ISE professionals making design decisions? Aside from jargon issues etc, where would we put relevant research so that it's most useful? What form would it take?

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I disagree (at least a little) on the value of having 'a' learning researcher on staff or on project. What Sue suggests sounds exciting, flexible and quick. There are so many subfields of research and opposing theoretical perspectives, that bringing on a person automatically limits a project.

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I'm an… exhibit developer… who would like to make better use of research in my work. Realistically I don't do much looking at research in the midst of a design project, I rely on first hand input from colleagues and advisors… I've learned from hard experience to be careful about asking for a formal "study" rather than quick and dirty, as the time goes up so much. I'm more optimistic about the idea of using research as a idea generator in the early phase of a project. Something most helpful would be "push notifications" sent when a researcher thinks they've just hit upon an actionable idea that they hope someone will try.

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My idea behind pushing ideas is to try to get more practitioners engaged with research. I'm positing that there are others like myself who go to informalscience or research2practice every once in a while, but then kind of forget to check back. If we could indicate some areas of interest and then get an email when something comes up, we might be more likely to pick it up. That would require only a few saved search terms. Something else interesting might be to let those publishing work be able to actively push it, maybe to those choosing to be signed up, if they see their results as being ripe to be put into practice. Maybe I'm just thinking that the suggestions for future work part of a paper could be pulled out and listed separately for those looking for such suggestions.

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As a former practitioner who now works as a researcher, the idea of a coordinated agenda is extremely valuable. From the researcher point of view, the disciplines that could and should contribute are varied and not always coordinated. Questions to be asked and the methodologies to be used through a coordinated agenda would be richer if we had a group of researchers/practitioners together. ... Of course, some researchers may feel that a coordinated agenda takes away some of the cachet of doing research. That will never change. But a coordinated research agenda that allows researchers to publish their own data while part of a larger effort may alleviate that.

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Unlike many other fields of study, much of the ISL domain lies with community-focused institutions that carry a strong public mission. Explicitly linking ISL research to the public good (at least in aggregate) would help ensure research connects with ISE institutions while opening important research questions, particularly at the community level, that the ISE field is particularly well positioned to address.

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We could construe a series of overlapping research agendas, each of which addresses a distinct and critical issue for the field (and all of which address the public good). Ideally they should be based on the theoretical underpinnings of our field.

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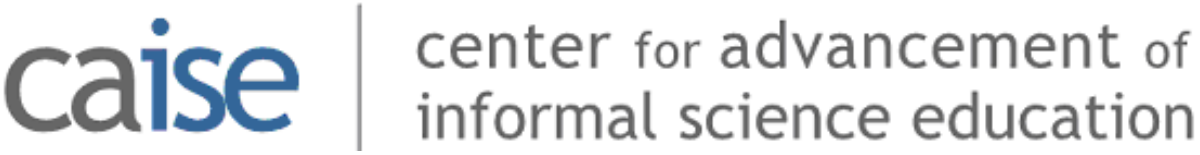

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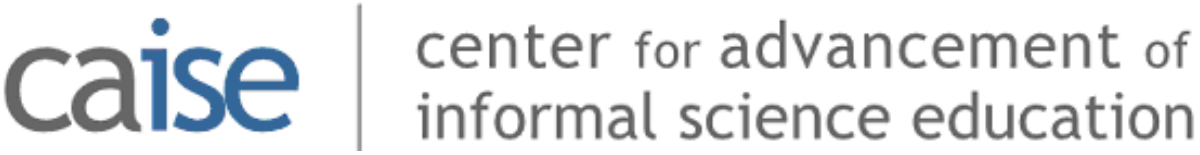

The route to a 'field wide research agenda' must start with the long, hard work of building the research infrastructure. .... I see that we have a lot of work to do on the research infrastructure before we can afford the luxury of shared research agendas: What reliable, shared data do we already have that might be used as evidence of outcomes, and how do we come to agreement on which of these indicators count as evidence? And, How can we fully populate the existing research portals with seamless searches of both qualitative and quantitative data? Once these two are in place -- and thank you, ASTC, ACM, IMLS, CAISE, UPCLOSE and VSA for your efforts on these two foundational pieces, we might have a robust research base, and transparent access to aggregated data. Then we can explore using research agendas to guide our explorations.

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.The real issue with a shared research agenda is that we need a diversity of agendas within the ISE field. From the previous comments on this thread, I read [one practitioner] needs a research agenda to help understand STEM learning outcomes in giant screen films. [Some practitioners] need an agenda to research methods of altering behaviors and attitudes in girls. Our team needs a research agenda to study the impact of ISE museums on their communities. STEM learning is a part of this, but so are personal identity, social capital, workforce development, economic impact and other public and private goods produced by the ISE field. The diversity of research agendas may be as huge as the diversity of desired and received outcomes.

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