

**Informal Science Supporting Education Reform:
Theory and Practice/Beliefs and Actions¹**

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Introduction

After the horrors of two weeks ago, I need hardly remind you that we need to take stock and reflect on who we are and what we do. We've all suffered both a terrible shock and a dreadful loss. My deepest sympathy goes to all those who lost their loved ones. My admiration and gratitude goes out to all who have worked so hard these two weeks to try to reestablish the infrastructure of our lives, to contribute to rebuilding our nation and to reach out to neighbors, friends and strangers to reaffirm the possibility of positive human relations. I'm grateful for everyone who calls and sends an email, or gives me a smile on the street to acknowledge that we are fellow humans on this earth.

The terrorist bombings, carried out by individuals who had no doubts about their beliefs and the overwhelming righteousness of their cause, can also serve to remind us of the significance of our work as educators. Their actions deprived us of fellow humans, shook our sense of security and forced us to confront the dangers of the world today. Our future actions, what our nation does in response, require that we confront, acknowledge and affirm our own beliefs. As a nation, we are discussing the costs of our future actions, not just the practical cost in lives and resources, but the cost in values. Do we engage in limited responsive action or in "crusades?" Do we affirm our faith in civil liberties or curtail them? Do we distinguish between terrorists and others or classify whole categories of people together indiscriminately?²

The current political situation and the public discussion it has engendered, focus our attention on the power of education and of mis-education; on the

importance of questioning, inquiry and independent thinking, and the tragic consequences of blind allegiance and absence of challenge to orthodox thinking. John Dewey, about whom I will talk more later, argues in his powerful book, The Quest for Certainty, that the human need for certainty leads us to seek answers (absolute truths) when we should be asking questions and examining our actions. That our desperate need for certainty long limited our thinking to avoid the “uncertainties and woes” associated with active inquiry.

The awful experience of September 11, 2001 can remind us how important it is for us to urge students to challenge accepted wisdom, to think for themselves — in short, to inquire — and how fortunate we are to live in a nation where these values are fundamental. Now, more than ever, we need to affirm these values and need to appreciate that we do significant work when we provide venues for students to ask questions of nature, to struggle to understand, not only to acquire answers they can repeat on tests.

All of us also need to be concerned that we don't compound our loss by wavering from basic American beliefs in freedom, democracy, respect for others and the value of every human being. And education — the educational theory I want to address today and that you practice in your museums — is a key component for preserving these values.

Museum Education

Education has long been a major concern of museums. The modern museum — by this I mean the grand (and not so grand), public institutions developed in the last 200 years — is an educational institution. American museums are proud of this heritage, and some writers suggest that this early stress on education is a unique U. S. contribution.³ But a similar venerable tradition applies to European museums. Conversion of the Louvre from a royal palace to a public museum, first to make royal art accessible to the public and then to exhibit Napoleon's trophies from the Egyptian campaign was certainly an act to establish an educational museum (whatever we may think of this kind of education.)⁴ British museum literature of the 19th century is full of references to the educational role of museums and the need for curators and directors who understand pedagogy.⁵

The significance of education for museums is emphasized by Alexander⁶ in his *Museum Masters*, an influential study of a dozen museum pioneers

In tracing the history of museums . . . I was fascinated to discover that the early concept of the museum as an encyclopedic collection of miscellaneous curiosities of interest chiefly to collectors and scholars has been transformed. . . . Today the museum has become a powerful teaching medium, reaching not only the researcher and the expert but, with its exhibitions and varied interpretive and educational programs . . . the whole community.

Conn, criticizing museum historians for being “at once insightful but historically shallow” argues that they fail to recognize that “knowledge was *always* understood to be what museums had to offer but also that knowledge was what they were charged to create and what they were obliged to provide to a visiting public.”⁷ That is certainly an educational purpose for museums.

In the 19th century, before universal public education for children was mandatory, museums were often a primary source of education for the general public. The dramatic rise of public education during the last half of the 19th century eclipsed the museum’s role in this public effort. Even in Europe, where the museums were usually government-supported institutions, government money became available for public schools, as it never had been for museums. Yet, museums continued to be actively engaged in formal education. In the United States, a century of close bonds between museum education and formal education exists, including museums within school systems and intense collaborations between art, history, science and children’s museums and public schools.

So the first point I want to make is that museum-school “bridges are as old as museums and schools. Informal science institutions have always supported formal education institutions and their constant reform efforts. Second, this role is necessarily connected with the important concept that education is a social and political activity and the kind of education we promote is closely linked to our ideology. School “reform” is never just an intellectual exercise about improving educational quality; it is always intimately linked to ideological political ideas about the role of schooling in society, the purpose of schools in nation building and various advocates’ worldviews. All major educational policy

statements from AAM — most recently, the Belmont Report, Museums for a New Century and Excellence and Equity⁸ — reflect and respond to the current national political agendas. The Belmont Report, for example, was the result of a conference explicitly convened to discuss the role of museums in support of President Johnson's social and educational agenda.

The program for this conference includes a wonderful array of workshops on components of the current issues that face museum educators as you “Build Bridges”, that is, “work in informal science institutions to support education reform.” You are covering the topics of standards, inquiry, and evaluation, as well as specific content-based workshops. All these are practical and invaluable. As their joint inclusion in this conference suggests, inquiry, standards, evaluation and content are not separate topics but components of a total educational enterprise. I want to concentrate on the essential theoretical and historical connections that underlie this work, and then add few practical action proposals.

It's important to consider the connections between standards, inquiry and evaluation. How do the national and state standards relate to the way we evaluate our programs and assess student learning? Is it possible to reconcile an emphasis on inquiry in a climate that stresses increases in test scores as the prime evaluation tool for individual student and school success? What are the indicators we should be looking for to confirm that our programs are consistent with our educational philosophy?

Each of them and all of them together need to be considered from several perspectives: theoretical, practical and political. It's hardly useful to think only about theory, when we also have to face the task of applying our theories in a world where issues of resources and pressures of various kinds are always with us.

Therefore, I imagine a grid that acknowledges both the categories we need to consider and our educational work as organizers of inquiry activities and/or as evaluators. The components of such a grid are illustrated in Figure 1. Their interrelationship under a larger perspective is indicated in Figure 2. Overriding this grid (or any other set of topics we plan to consider) is a “world view,” some

ideological position that each of us applies to the theories we espouse, the actions we take and the way we attempt to justify them and negotiate in the world.

As Julian Weissglass said recently, describing contrasting world-views that define different approaches to education:

The debate between traditionalists and progressives . . . is essentially a debate . . . about the nature of learning, the nature of society, and the purpose of schools in a democracy. Traditionalists structure schools to prepare students for filling roles in society--not for transforming it. They do not see that traditional approaches may contribute to maintaining the inequity and injustice that exist in our society. Progressives see society as needing improvement and the schools as serving the function of helping students become thinking citizens who can contribute to creating a more just society. John Dewey, the leading progressive educator of the century, wrote that "education is the fundamental method of social progress and reform."⁹

My own world view supports the progressive educational ideal (derived from Dewey and others) keeps in the forefront commitments to equity, inquiry and valuing personal meaning making.

As you address the topics of the conference, I urge you to keep in mind not only the short term goal of providing a particular service that teachers request, but also a longer perspective of your fundamental beliefs, your view of the nature of society. In the remaining time available, I'll present some of my thoughts about the nature of museum education as it applies to museum school connections using my interpretation of our history as a guide.

Educational Theory

What educational theories apply most appropriately to museum education? I've spoken frequently about examining educational theories from the perspective of both a theory of knowledge and a theory of learning, and stated these two categories of theories allow us to classify educational approaches into contrasting sectors. The diagram I've used¹⁰ (see Figure 3) offers four different kinds of educational theories: traditional, stimulus-response, discovery and constructivism. I've also argued that I believe that the most appropriate quadrants for museums are those on the right hand side of the diagram, and especially the bottom right, the "constructivist" view.

Historically, this is the quadrant associated with progressive education. The history of museum education is closely linked with progressive approaches to education. In fact, until about a decade ago, many people tried to make a distinction between “formal” and “informal” education by attributing to the latter the various qualities we generally associate with progressive education — choice on the part of the learner, the use of objects, recognition that learning is connected to previous experience, acceptance of the learners’ results without formal assessment¹¹ and a rich, relatively unstructured learning environment.¹²

We’ve since realized that the distinction between “formal and ‘informal” (or “free-choice” environments) is more administrative than programmatic and some classrooms include many of the attributes of “good” museum education, while some museum education programs look quite formal.

I want to argue, with the examples I’ll provide below, that museum education is structurally linked to what we now call “constructivism” and can be more generally described as a form of “progressive” education. If museum education doesn’t follow that ideological bent, I believe that it doesn’t take advantage of the unique educational qualities of museums.

On reflection, the parallels between museum education and progressive education are not surprising. However we chose to define museums, they are primarily institutions that contain “stuff” rather than words (a classic critique of a museum exhibit is that it is a “book on the wall”). In some way, we must believe that all visitors, including students, benefit from their interaction with a selection of material that represents the natural world – whether it is models illustrating physical phenomena, animals, plants or modern technological representations of these phenomena.

This reliance on material resources (as well as books) is one characteristic of progressive education. It is certainly what its supporters and critics alike emphasize. Any illustration of a progressive classroom invariably shows children doing something that uses the “stuff” of the world. In Schools for Tomorrow, the book Dewey wrote with his daughter, Evelyn to illustrate progressive education practice through descriptions of several exemplary

schools across the United States, there's a lovely photograph of both boys and girls in a carpentry workshop, "solving problems in school as they would have to be met out of school."¹³ Similarly, the essence of museum education programs should be to use the "stuff" of the museum, both the exhibits, usually meticulously developed to allow visitors to interact with this material, and any other resources available. The primacy of objects requires that museum educators subscribe to the tradition of object learning¹⁴ and to the notion of learning by doing.

Dewey and Dana

A useful way to emphasize that museum education is fundamentally progressive education is to look at the careers of two of the most influential figures in museum education in the United States, John Dewey and John Cotton Dana. There are striking parallels between their lives, as well as powerful parallels in their ideas about education. Both have been influential in shaping what we mean by museum education.

John Dewey was born in Burlington, Vermont in 1859, the son of a small businessman (his father owned a succession of stores), and the grandchild of New England farmers on both sides of his family. He went to University of Vermont, taught school for a few years, finished higher education at Johns Hopkins and then went west (Michigan, Minnesota and Chicago) holding several university positions for about 20 years before he eventually settled in New York. He taught at Columbia until his retirement in 1939, and continued active writing and lecturing almost to his death in 1952.

John Cotton Dana was born in Woodstock, Vermont, not far from Burlington either geographically or culturally, just three years earlier in 1856. He, too, was the son of a small businessman (his father ran a general store), and the grandchild of New England farming families on both sides. He went to Dartmouth; studied law then moved west (Minnesota and Denver) where he held various jobs. He practiced law for a short time and eventually became chief librarian in Denver. After almost 20 years, he moved back east, to become director of the Springfield, Massachusetts library. Two years later, Dana settled in Newark, NJ for the rest of his life where he was director of the Newark

Museum. John Cotton Dana did not live nearly as long as Dewey; he died in 1929, but he spend an active fruitful 25 years shaking up the museum world with his radical and outspoken ideas and his accomplishments in Newark.¹⁵

Dewey is well known for his advocacy of learning through doing and his insistence that the knowledge in books is dry and dead until it is put to use; until it is associated with action. He argued forcefully that people learn through experience, through activity. In The School and Society, one of his early but particularly influential educational works (still in print), he suggests a metaphor for the school in a diagram. A school should be like a two-story building that houses the various activity centers of life: kitchens and artist studios, gardens and industries. In diagrams accompanying his text, Dewey pictures the library and the museum as central rooms on the first and second floors, linking the various real-world activity centers.¹⁶

Museum education programs today frequently resemble and strikingly reflect the vision the progressive educators advocated. To cite one example, Dewey disliked school furniture, describing it as made only for listening not for action. His idea was that students should build their own furniture.¹⁷ Compare that to the following statement

The first projects on the agenda for the [San Diego] Museum School . . . is to design and build desks that the students will use throughout the school year,"¹⁸

To further support for the argument that museum education is inevitably linked to ideas of progressive education, let me relate a personal story. Recently I attended a reunion of staff members who worked at the Elementary Science Study (ESS), one of the elementary curriculum projects funded by the National Science Foundation in the 1960's, and generally recognized as the most progressive of this set of projects. We certainly thought of ourselves as progressive educators, dedicated to preserving and re-introducing active modes of education into the schools. The first director of ESS, David Hawkins, a philosopher, has written brilliantly about Dewey. All of us were committed to producing materials that would match the philosophy we espoused. Frank Oppenheimer, the founding director of the Exploratorium, was also an early staff member. At this reunion several of us noted that one of the most powerful

legacies of our work is its influence on science museums and science museum education today. The range of the relationships between our curriculum units of the 1960's and today's science centers museums is manifold. Frank Oppenheimer, Philip and Phylis Morrison and others subsequently associated (with science museums, were also early staff members. Bernie Zubrowski, who'll lead a workshop "Inquiry for All" at this conference, is an ESS veteran.) And our actual curriculum materials — optics boxes, spinning tables, pattern blocks, etc. — are found in museums all over the world.

The point of this historical journey is to emphasize that museum educational work needs to focus on it's roots and its unique opportunities: the exploitation of the educational potential of the stuff of the world, the phenomena we can exhibit, illustrate and use as educational tools. Museum education is not particularly adapted to the more paper-and-pencil, language based pedagogic strategies commonly associated with traditional formal education and re-emphasized in this period of educational "reform."

How does this theory apply to practice? Here we come to John Cotton Dana's work. Unlike Dewey, the philosopher, he was a practical man, a doer. All of Dana's efforts, first in libraries and then in museums, were devoted to "opening-up" institutions, to making them available to the whole community as broadly as possible.¹⁹ He advocated lending materials to schools, nature study outside the museum, and activities in the galleries²⁰ He constantly stressed that objects should be used; that their value was not in being rare but in being practical. He was clear about where money should be spent—on education, and said so frequently in his non-compromising style.

Our own modest experience [with a collection of lending objects] in Newark has led us to the conclusion that a collection of objects costing, say \$1,000, plus the activities of a group of museum workers, costing \$10,000 per year, would be of far more value to a community . . . than would be a collection which cost \$100,000 and is merely presided over in the ancient manner by a few curators.²¹

He also advocated displaying and using local objects, both from the community and created by children, extended hours to accommodate working people, and initiated projects with and for community groups. In short, he would try anything

that would make the museum more open, more popular and allow visitors to become engaged with objects.

That is precisely what you all do. I know these ideas are not new to you, but I believe it's worth reemphasizing that the focus of museum education needs to continue to be in the direction of open, inquisitive use of material resources, not in the direction of the constrained, answer-driven minutiae of worksheets. This is one of the tensions I see between the directions in which many school districts are moving and the core ideas of museum education.

And this brings us to the next topic, inquiry.

Inquiry

What is science inquiry? I think in its simplest form, we can say that science inquiry is asking questions of nature. And the emphasis is on the asking of questions not on reaching an answer, and certainly not on reaching a specific answer. Finding good questions that allow rich exploration, engage the mind and the heart, and feel worthy of the time and effort these questions may take, is a complex task. That's why creating either natural science curriculum or exhibitions is a long expensive activity. It's also why both need extensive evaluation. To return to our ESS reunion, we agreed that one of the outstanding attributes of our work back in the 1960's was the time we had to develop materials, try them out in schools, revise them, try them again, think about them, subject them to the scrutiny of scientists, teachers, and others and only finish them after years of trial. We had the privilege of "messaging about" as David Hawkins put it.²² The development process also included considerable time spent on what we now call "formative" evaluation.

In our evaluation work with the Program Evaluation and Research Group at Lesley University over the past two decades, I've repeatedly been amazed and disappointed at how administrative demands — from funders for results, from publishers to shorten time lines, from impatient staff who want to "get on with the job" — have cut into the timetables for material development. Developing questions worthy of inquiry is not easy and preparing them with appropriate and sufficient materials for those doing the inquiry is even more difficult. If you

look at *Investigate!*, the exhibition on scientific experimentation at the Museum of Science, it's strength is not in the large set of questions that adorn one wall, but in the smaller set of activities that allow people to experiment. Here, as in some other museum exhibits, we find inquiry because there are activities you can do and can explore. The actual "hands-on" stuff is not directed at illustrating specific answers, but on exploring phenomena. And, like all successful hands-on exhibitions, *Investigate!* required extensive trials, field-testing and modification before it was ready for fabrication. So, the criterion I want to stress for you as you discuss inquiry is not which scientific principle is illuminated by a particular activity, but how many engaging ways are there for students to use the materials to increase their experience with nature? If the material is captivating, principles will emerge for participants.

Dennis Bartels makes the same point describing the Exploratorium's reliance on its exhibits as the basis for much of its teacher professional development work.²³

The genius of this approach to teacher-training is especially evident when teachers encounter exhibits that baffle them, compelling them to ask questions for days at a time and figure things out for themselves.

Program Evaluation and Student Assessment

Finally, we come to evaluation and assessment, the twin components of documenting the results of our work. Program evaluations tell us the results of our activities, to what extent we have accomplished what we set out to do, while student assessment (sometimes a legitimate component of program evaluation) informs us about what students have learned.

Program Evaluation

Active, progressive educational practices advocated by museums require naturalistic (sometimes called qualitative) forms of program evaluation.²⁴ I'm sure that Elsa Bailey will discuss these in her workshops. Such approaches inevitably seek multiple forms of evidence of program outcomes. Reliance on single outcome measures, such as student test scores, are simply inadequate to demonstrate the rich learning that comes from engagement with objects,

long-term projects, such as exhibit development, or learning resulting from participation in carefully designed “learning communities.”

It has become increasingly clear, as educational reform efforts occur throughout the United States that such multiple program evaluation efforts are essential. It is also clear that significant change takes years to implement and additional years to evaluate.²⁵

Student Assessment

Finally, the ideological perspective of museum educators generally support use active, alternative, authentic, or supply-type assessments, as opposed to passive select-type, multiple choice tests.²⁶

Those of us in Massachusetts need to thinking about the state mandated tests, the Massachusetts Comprehensive Assessment System (MCAS) in relation to our programs. But similar issues exist nationally, especially where there are “high-stakes” tests. Since the MCAS is currently a moving target, and information on its development and theoretical structure is not easily available, it is difficult to predict structure of the test, what it will cover and how it will be scored. But it’s clear that the MCAS system is not congruent with progressive educational practice. For example, there’s the matter of the ratio of supply side (where students actually perform, either in paper and pencil or actually manipulating materials) to demand side (multiple choice) questions. The MCAS is proclaimed to be a test that uses both forms, but alas, they are hardly equally represented, and there are no items are of the “performance type, that is, questions that require students to actually do something. Decades of research have shown that student results on actual performance measures differ greatly from their performance on paper and pencil descriptions of performance. To give just one example, on the 2001 5th Grade science test students are shown pictures of the objects described below and asked

Mark has three small rocks about the same size. He wants to know which one is the heaviest but he does not have a scale. Mark has a meter stick, a spring, two baskets with hooks, a pair of scissors and some string. Explain how Mark could use some or all of these materials to find out which object is heaviest.²⁷

British research that looked at student results from a similar kind of prompt, found dramatic changes when students were provided with written descriptions only, written descriptions plus an illustration (as is used on the MCAS,) or asked to actually perform the experiment.²⁸ When 13 year olds were given a similar opportunity to describe an experiment, (in this case to plan an investigation that could determine the relative absorption qualities of different kinds of paper towels), 51% mentioned only qualitative measurements or no measurement at all in their written responses. When they had the opportunity to perform the task, only 23% failed to carry out some form of quantitative measurement. In short, MCAS will not work as a measurement of the success of science museums' educational programs if these programs focus on what museums can contribute to formal education.

Practice/Politics

In the sections above, I've laid out some interconnected components of museum education as they relate to working with schools. Effective museum education activities that take advantage of the unique qualities of museums are based on active participation of learners with the stuff of the world — that is, with the objects in museums. They allow students to ask questions of nature and explore the processes that lead to richer understanding of the world around them. They are not focused on providing the predetermined answers to canonical concepts. And the results of student work are demonstrated through an array of demand-type assessments, while the programs are described and evaluated using multiple, in-depth methods.

That's simple to say, but it leaves museum educators with a number of challenges. This is hardly what the school systems today are demanding of museums. Teachers want/need to know how the museum programs match their local or state curricula, how they will enhance their students' understanding of the "standards" and most important, how they will increase scores on the tests all 50 states now demand.

We cannot afford to ignore these components of current practice and politics. While the principles I've outlined need to be kept in mind, we also need to

consider what we need to do to stay in contact with schools and continue to have teachers bring classes to the museums.

I suggest the following actions. All require a complex balancing of time energy and resources. It's difficult to find the time to add one more activity to the typically overwhelming schedule most of you have. I'm constantly impressed by how many responsibilities fall on the shoulders of museum educators. So I acknowledge that any suggestions about additional tasks have to fit within the limits of time, energy and support you have for your work. Do what you can.

They also require a balancing of our ideological stance with current political realities. I'm not arguing for theoretical purity, but for recognition of the relation between practice and theory. For example, teachers now frequently need (or think they need) justification to bring classes to a museum. Museum educators are called upon to demonstrate how a field trip will support the local, state or national learning standards. I've seen some of these rationales and I usually admire their ingenuity of those who write them. It appears that it's possible for science museums to fit in with the standards, no matter what they may be. Practically, that is both a strength and a weakness. I don't want to suggest that you ignore this request from teachers, but that you recognize that this may be primarily a bureaucratic requirement, not a fundamental programmatic one. The point is that it's important that we constantly remind ourselves, and remind our partners in the schools, about what we value and believe.

Here is my list of practical items

1) What's the "system"?

First, it's very important that in all your actions you know at what level you're addressing the educational system, and that you recognize the actions that are appropriate for that level. In your educational work, be aware at what level you interface with the complex multi-layered system that comprises the public schools. It's useful to engage teachers in a conversation about the items on the MCAS, but makes no sense to suggest to them that they take responsibility to change them. It's useful to join committees that are addressing modification of the tests, but only if these are going to coordinate with and have some power

to influence the state Department of Education. In your various roles as museum educators, be clear where you are interfacing with the system, and what you can do at that level.

2) Remain engaged

It's crucial that science museum educators remain engaged in the reform process, that is, in the political battles about science education. You have a unique voice, public credibility and resources not available to schools. Susan Sprague, a distinguished former public school science coordinator, says, Have your museum provide special, specific assistance to districts and consortiums who are working on systemic reform. You can be a major or minor player - but you should be on the team.²⁹

3) Educate yourself

It's important to educate yourself and the people with whom you work about the actual content of the relevant documents, especially the student tests.

What do the national education standards state and what do they imply? National standards have wonderful statements about process, inquiry, etc., but the fact-oriented content material is picked up most frequently for assessment purposes and that leads to a much more deterministic approach.

The need to be informed, and educate others is constant. State standards and tests change. For example, the Massachusetts state science tests for 2001 were based on content strands only; the strand on Inquiry, included in the 2000 test, was dropped completely. The testing was moved from 4th to 5th grade, and the total number of questions dropped from 39 to 20. Also, in 2000, 5 open response questions contributed 37% of the total points possible; in 2001 the 2 open response questions counted for only 31% of the possible points. Such changes make comparisons difficult and will effect the scores of individual students in unpredictable ways.

What counts for students (and therefore for teachers) is what's on the tests. In Massachusetts there is an added irony: teachers worry about the standards and the state tests when they contemplate including museums in their

curriculum. But science doesn't count at all for the state's high stakes consequences!

4) Collaborate

It's crucial that you talk directly with the teachers who bring their classes to your museum. First, you need to get in touch with them just so they know what you have to offer and how you can work together. I've been working with a group of educators at the Museum of Science to look at their school programs in relation to the needs and desires of their schools. After doing some interviews with teachers, the group has been reminded of how difficult communication with schools and teachers is. There is a constant need to share information, develop programs collaboratively and stay in touch with your clients at the individual teacher level.

5) Modify and update

The consequence of communication and collaboration is that you may frequently have to modify programs and negotiate to keep true to what you think museum visits can accomplish for children and what teachers expect. Unfortunately, the educational scene changes so rapidly, that last year's school program or exhibit based activity may not be appropriate this year. You have to constantly upgrade and revise what you offer to schools.

6) Be honest

It's terribly important that you make no false promises and only do what you can. You need to remind yourself, and tell your clients, the school teachers and administrators that **SCIENCE MUSEUM EDUCATION PROGRAMS WILL NOT IMPROVE TEST SCORES.**

It's certainly possible that students who have come to your program may have higher scores afterwards, but never, never even suggest that your program might have anything to do with that. There is almost zero likelihood that there is any correlation between museum programs and MCAS scores. If you take

credit for any positive change you will be blamed for a negative change when the inevitable consequences of random distributions comes around.

There are many reasons why museum education won't change test scores. It is actually difficult to demonstrate that any specific yearlong school activities change them very much. In general, standardized tests are good measures of demographic factors, primarily of socio-economic indicators. In a study of the 1999 MCAS scores, Robert Goudet argues³⁰ that 86% of the variance in average district scores can be accounted for by six demographic variables: median level of educational attainment, median income level, percentage of households above the poverty level, percentage of single-parent families, percentage of non-English speaking households and level of private school enrollment. If the entire in-school experience only accounts for 14% of the variance in scores, how much can a few hours out of the 180-day school year, influence the scores?

7) Document

Finally, back to evaluation. Do document what you do and its consequences. One lesson we've learned from the work of the past decades is that although local, detailed documentation and evaluation of the wonderful results of a program are no guarantee that it will be valued by parents, teachers or school systems, the lack of any evidence leaves you particularly vulnerable and defenseless in the face of criticism. If you can show the splendid work the children have done, either in school or in museums, you may get and maintain support.

It is never certain that any evidence is sufficient in the real world. How much evidence do we need that cigarettes cause cancer? How much evidence do we need that students learn in museums? If you are facing critics with an ideology totally opposed to museum education, for example, people who fundamentally believe that children should not be taught to question and investigate, then your evidence for the value of investigations will not sway them. You need to realize that you collect evidence and document your wonderful work for those who support you. They need to be reassured.

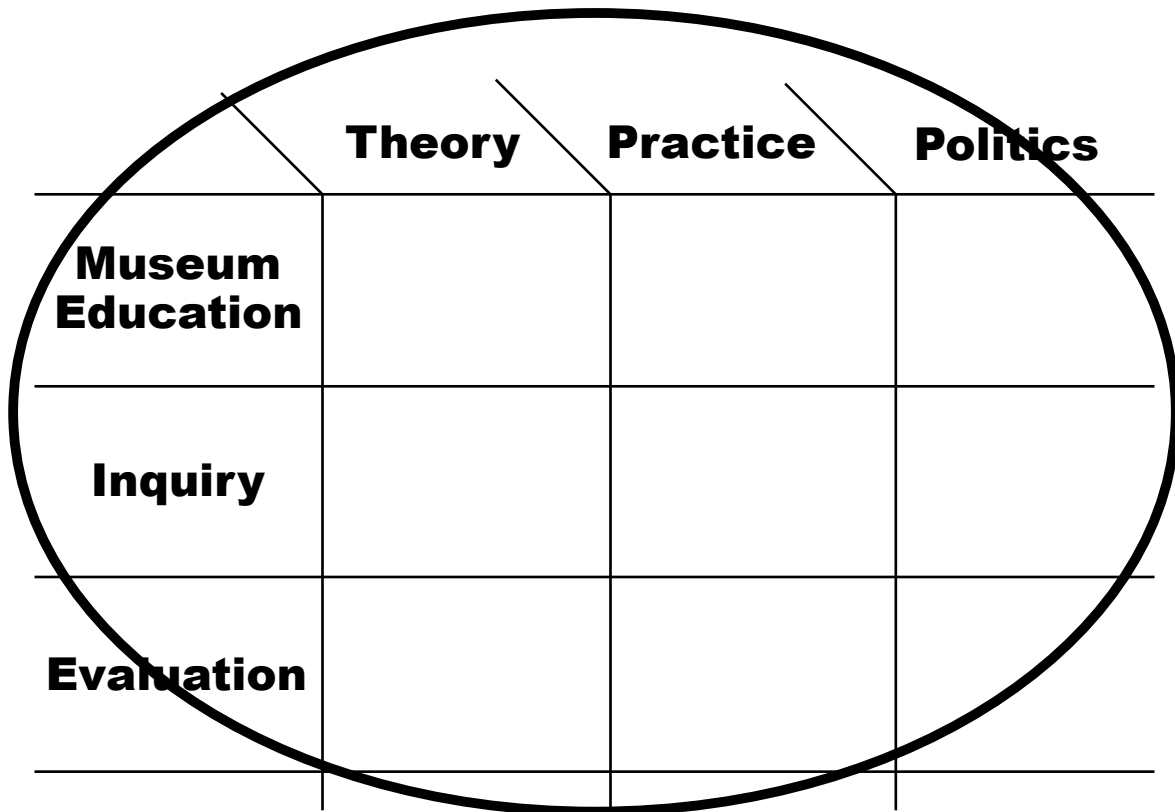
Conclusion

These generalizations about politics are hardly sufficient for you to do your important work. What you need is to hear examples of good practice, to share your own situations with colleagues and to think together about how you can survive and prosper in a highly politicized, and sometimes hostile, education world. That's what NISEN Conference workshops are about. Enjoy them!

Figure 1
Informal Science Supporting Education Reform

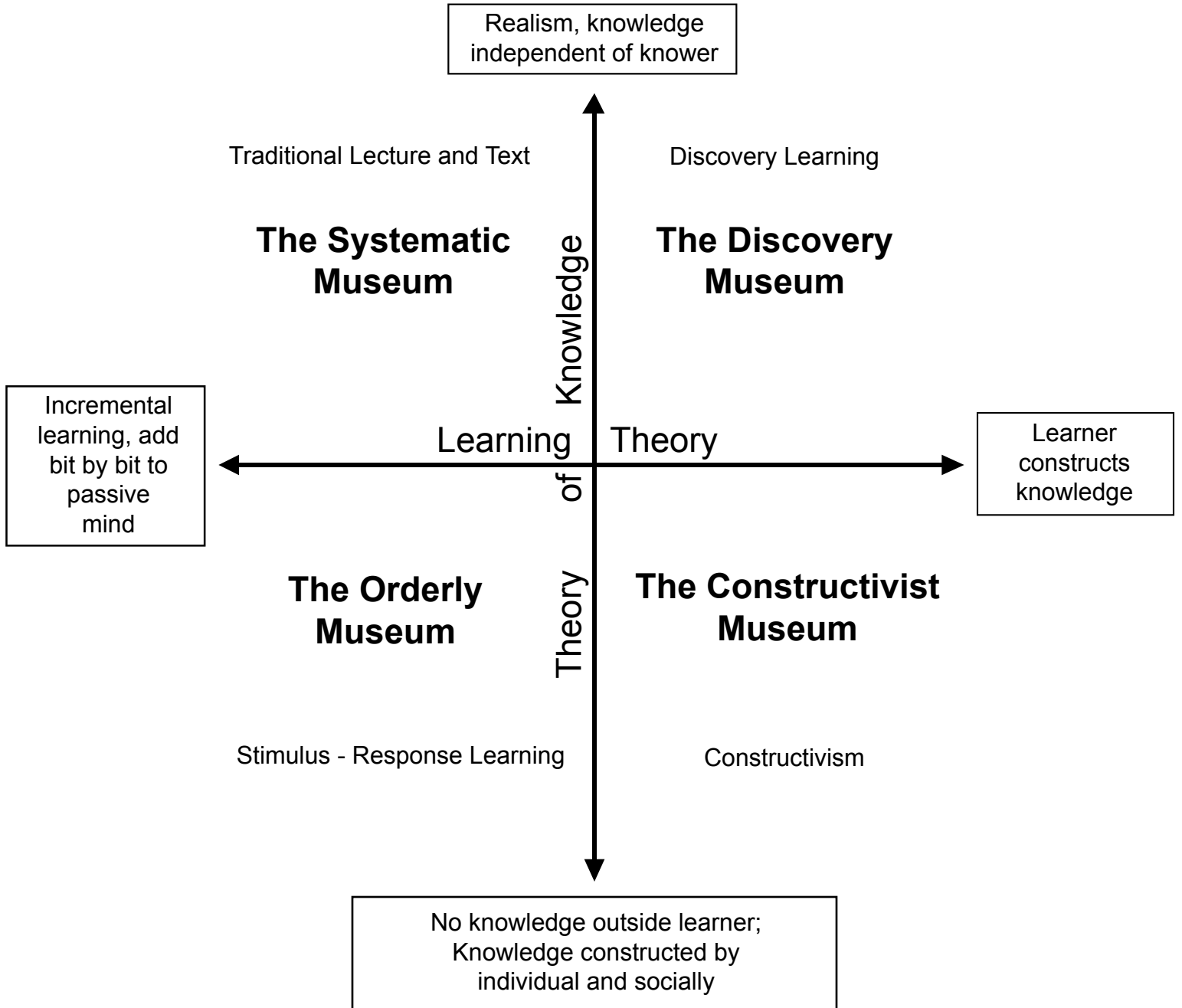
	Theory	Practice	Politics
Museum Education			
Inquiry			
Evaluation			

Figure 2
Informal Science Supporting Education Reform



**Ideology (World View) —
Education for Democracy**

Figure 3



References

¹ My sincere thanks to Judah Leblang, Sabra Lee and Emily Romney for their thoughtful comments and careful editing.

² It took decades for this country to recognize the moral costs associated with our decision to send thousands of Japanese Americans to internment camps in a dramatic and unconstitutional response to the attack on Pearl Harbor.

³ "By 1870, the form of the American museum as an institution which simultaneously provides popular education and promotes scholarly research was completely developed." Orosz, J. J., (1990) Curators and Culture: The Museum Movement in America, 1740-1840, Tuscaloosa, AL: The University of Alabama Press, p. ix.

⁴ Alexander describes it as "the art museum as symbol of national glory." Alexander, E. P. (1983) Museum Masters, Nashville, TN: American Association for State and Local History, p. 79.

⁵ "[Museum directors] may be prodigies of learning and yet unfit for their posts [if they do not understand pedagogy]" Greenwood, T. (1888) Museums and Art Galleries, London: Simpkin, Marshall & Co (p. 185) In saying this, he is quoting a 1853 lecture by Prof. Edward Forbes on "The Educational Role of Museums."

⁶ Alexander, E. P. (1983) *op. cit.*, p. ix

⁷ Conn, S. (1998) Museums and American Intellectual Life, 1876-1926, Chicago: U. of Chicago Press, p. 11.

⁸ America's Museums: The Belmont Report (1969) Washington: American Association of Museums; Museums for A New Century, (1984) Washington: American Association of Museums; Excellence and Equity: Education and the Public Dimension of Museums, (1992) Washington: American Association of Museums.

⁹ Weissglass, J. (1999) Education Week, April 21.

¹⁰ Hein, G. E. (19998) Learning in the Museum, London: Routledge.

¹¹ Frank Oppenheimer's famous quote on this is, "No one ever fails a museum."

¹² The same confusion plagues Malcolm Knowles' description of adult learning. Knowles, M. S. (1970) The Modern Practice of Adult Education: Andragogy versus Pedagogy, New York, Association Press. He attributes all the qualities that progressive educators want to institute in formal schools to educational policy appropriate for adults to his "androgogy."

¹³ Dewey, J. and E. Dewey, (1915) Schools of Tomorrow, New York: Dutton, facing p. 159.

¹⁴ Object learning goes back at least to Comenius (1592-1670). For example, "Things are the kernel, words the shells and husks. The proper education of the young does not consist in stuffing their heads with a mass of words, sentences, and ideas dragged together out of various authors, but in opening their understanding to the outer world. " and "The scholar should be taught first to understand things, and then to remember them, and no stress should be laid on the use of speech or pen, till after a training on the first two points." Comenius, J. A., The Great Didactic (English Translation,) Keating, M. W. 1910, London: Black., Quoted in Ulich, R., (1954) Three Thousand Years of Educational Wisdom, 2nd. Edition, Cambridge, MA: Harvard University Press, 339-354.

¹⁵ There are two interesting footnotes to Dana's move from Denver to Springfield. One illustrates how US geopolitics has changed. Dana had become restless in Denver and looked for a more prestigious

job in a larger community. The move to Springfield provided this. Secondly, one of the attractions of Springfield was the opportunity to include the newly established museums within his domain since the Library Board was also in charge of the Art Museum and the Museum of Natural History, the former with a new building and the latter opened in 1899. But, G. W. V. Smith, curator of the Art Museum disapproved of Dana's community-service philosophy and they clashed.

¹⁶ Dewey, J. (1900/1956) The School and Society, Chicago: University of Chicago Press.

¹⁷ Another illustration in Schools for Tomorrow bears the caption "learning moulding, and building school equipment." Dewey J. and E. Dewey, *op. cit.*, opposite p. 255.

¹⁸ Fowler, G. (1998) "The Museum School: A Model for Educating Through the Arts," Museum News 77/5, p. 49.

¹⁵ Peniston, W. A., (ed.), 1999, The New Museum: Selected Writings of John Cotton Dana, Washington, DC: AAM.

²⁰ One of the reasons he got into trouble in Springfield was because he decorated the museum with flowers to make it more welcoming.

²¹ Dana, J. C., "Schools and Museums," in Peniston, W. A., (ed.), 1999, *op. cit.*

²² Hawkins, D. (1965) "Messing About with Children" Science and Children, February, 1965.

²³ Bartels, D. Education Week, Sept. 19, 2001, p.45.

²⁴ Hein, G. E., (1997) "The Maze and the Web: Implications of Constructivist Theory for Visitor Studies," keynote speech to the 1997 Visitor Studies Association (VSA) conference, July 18, 1997, Birmingham, Alabama.

²⁵ See Herman, R. (1999) An Educator's Guide to Schoolwide Reform, Washington, DC: American Institutes for Research.

²⁶ Madeus, G. A., A. E. Raczek, and M. M. Clarke, "The Historical and Policy Foundations of the Assessment Movement," in Goodwin, A. L. (ed.) (1997) Assessment for Equity and Inclusion: Embracing All Our Children, London: Routledge.

²⁷ Released items are available on line. The 2001 5th grade science test can be accessed at http://www.doe.mass.edu/mcas/01release_na/g5sci_na.pdf

²⁸ Gott, R. and P. Murphy (1987) Assessing Investigations at Ages 13 and 15, London: Department of Education and Science, p. 33.

²⁹ Sprague, S. panel presentation, "Can Informal Science and Mathematics Learning Coexist with High-Stakes Testing?" Oct. 7, 2001, ASTC Annual Meeting, Phoenix, AZ.

³⁰ Gaudet, R. D. (1999) Effective School Districts in Massachusetts, Boston: U. of Massachusetts President's Office.