Leah M. Melber

Museums and Teacher Professional Development in Science: Balancing Educator Needs and Institutional Mission

The author examines the museum as a valuable resource for providing professional development within informal learning environments, especially in the area of science instruction and curricular methods.

A distinct need for quality professional development in the area of science instruction for all educators has been identified by recent reform documents such as the National Science Education Standards (National Research Council, 1996) and independent researchers (O'Brien, 1992). In working within urban areas, like the community surrounding the museum at the focus of this study, Huinker (1996) further highlights the difficulties faced by these educators who cite a lack of appropriate professional development as one reason why the science programs at their schools suffer. Neatherly (1998) asserts informal learning institutions can assist with this challenge by providing educational resources for classroom instruction and "valuable knowledge" for use in developing science lessons (1998, p. 44). This support is shared by national science organizations such as the National Science Teachers' Association which recently issued a statement acknowledging informal learning sites as providers of quality professional development (National Science Teachers Association, 1998).

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In addition to supporting classroom science instruction, and pedagogical theory, in-services held in museums can serve to prepare educators for field trips they may take later with their students. Research has shown that field trips can be better utilized when educators receive training prior to coming with their classes (Smith, McLaughlin, & Tunnicliffe, 1998) and thus maximizing the learning experience of all involved. Cox and Pfaffinger (1998) suggest that museum educators and teacher educators should be partners in presenting in-service training to assist educators with using informal sites with their students. Kubota (1997)

speculates that it is a lack of this collaborative modeling that often leads a teacher to "close their doors to their colleagues, ignore the rich resources outside the classroom" (p. 138). This is in direct opposition to the National Science Education Standards that advocate "good science programs require access to the world beyond the classroom" (p. 220). While a number of different natural history museums do cater to educators, offering a pathway into this "outside" world of science, research in this area is limited (Melber & Cox-Petersen, 2005) and would benefit from further study.

Changing Models Reflect Changing Priorities

With the focus on basic skills, and primarily literacy, occurring nationwide, the professional development needs of area educators are constantly changing. Contradictory to Howe and Stubbs (1996), who emphasize the importance of educator in-services serving as vehicles for empowerment, rather than skill development, professional development activities at the time of this study and within the com-

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munity surrounding the museum, were becoming more focused on intense methods instruction. This was primarily true in the areas of language arts and math. In the district from which study subjects were drawn, principals were under strict orders that "all professional development activities that do not support literacy and mathematics will be discontinued" (Cortines, 2000, p. 1) leaving little room for an in-service focused on elementary science methods. This decree came after two of the four in-services had already been conducted, lending a natural situation for comparative study.

Theory does support the importance of clear integration between science in-service content and classroom expectations (Desimone, et.al. 2003). Thus, in line with this research base, district policy and specific request of the organizing principal, an alternative model emphasizing language arts/science integration was implemented for the final two of the four scheduled in-services. The issue at the focus of this study is whether or not this adherence to district policy- though it may fall outside the area of expertise of the in-service provider- is in the best interest of the participating educators and whether without this change, the in-services are sufficiently supportive of educator needs.

Study Focus

This study focused on a half-day educator in-service program for elementary educators delivered by a large, natural history museum. There were two different models of in-services provided, one focused strictly on science (Model A) and one focused on the integration of science and language arts (Model B). This study focused on gaining insight into the impact these in-services had on participating educators, and to inform in-service efforts in the future.

Program Models

Four groups of elementary educators (N=72) participated in the two types of in-service programs at a large natural history museum: Model A (n=42) and Model B (n=30). Each educator attended only one model and did not have a choice of models. While the in-service programs were similar in most regards, Model B had a stronger language arts connection in the material that was presented. This resulted in each of the models carrying slightly different goals.

For both Model A and Model B, specific activities and discussions were created to meet the following goals (see Table 1).

While some of the activities were similar for both Model A and B, the emphasis for each was slightly different. For example, creating a classroom museum was discussed in both workshops. In Model A, methods of engaging in scientific inquiry were the focus of the activity while for Model B, the concept of literacy skills was the focus, highlighting the exercise of creating labels during the activity as a real world connection to development of writing skills as emphasized by Reed (1996). Vignettes A and B provide examples of how the same activity was presented differently to meet the respective goals of each model.

A museum educator and author of this study, who held a state teaching credential and had elementary classroom experience, facilitated all four in-service programs. This prior classroom experience of the facilitator addresses Kubota's position that professional development providers be aware of the K-12 culture where teachers "cope with constant pressure, the lack of privacy, no phone, no office, no bathroom break, a 20-min lunch" (1997, p. 145). To address the needs of this particular group of urban educators, an understanding of linguistically and culturally diverse students, overcrowding, unsafe environments, and minimally prepared educators was also imperative.

Table 1: Workshop Goals for Model A and Model B

Model A	Model B
1. Provide educators with information on how to access museum resources.	1. Provide educators with information on how to access museum resources.
2. Provide educators with information on how to connect museum visits with classroom curriculum.	2. Provide educators with information on how to integrate science with language arts activities
3. Provide educators with methods of integrating informal learning techniques into traditional classroom environments	3. Provide educators with concrete project ideas that integrate science and language arts

Program Vignette: Model A

As the teachers filed into the museum classroom they were excited to see unique objects placed in front of each of their seats. Seed pods, bones, antlers, stones, and fur pelts were just a few examples of the treasures strewn around the table. They were going to take on the role of a museum scientist and create an information label for a specimen of their choice. The facilitator provided directions for the first stage of the project.

"When creating a label, it's important to remember that many people do not stop to read labels. After all, how many labels did you read today?" The teachers smiled to themselves in agreement. "You'll want to identify the most engaging aspect of the object. Perhaps it's the first question that came to your mind. Maybe it is something specific about the structure of the specimen. Let that be the start of your label".

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The facilitator holds up a skull with a set of curly horns. Carefully, she pulls the keratin sheath of one horn off, exposing the bone inside. She asks the group what aspect of this specimen is the most intriguing- engaging enough to be the headline of their labels.

One teacher whispers to a colleague, "I didn't know horns were made of two different materials!"

The facilitator responds aloud to the overheard whisper, "I think you just found your topic sentence! Our next job is to review this resource material and determine exactly what the structure of a horn is so we can continue work on our label."

Program Vignette: Model B

The educators almost had a hard time focusing on the facilitator with the collection of unique specimens and reference materials in front of them. They were excited to see how investigation of a scientific specimen could translate into an exercise in expository writing.

"Okay… our next step is to explore label writing as an exercise in expository writing. You'll remember that expository writing is focused on sharing factual information with the reader. Students sometimes find the creation of a concise expository piece difficult. There is often so much scientific detail they are interested in sharing, they may find it a challenge to narrow that information down to the most important facts. Some students may find themselves incorporating language that is more persuasive in nature. It will be important to keep them on track with expository narrative, devoid of personal opinion. This is science- information presented in a public forum such as museum must be supported by the research. A second challenge in expository writing may be new vocabulary. We'll need to work with students and resource materials to be as accurate as possible in our vocabulary choices. For example, the word "amphibian" holds a different meaning than "amphibious" though the two look and sound similar. Lastly, we'll want to work on appropriate grammar and punctuation. Successful labels rely heavily on declarative sentences, with simple sentence structure. These are often easiest for a visitor breezing by to read quickly and move along."

Methodology

Research Questions

(1) To what extent did each of the models meet its respective goals?

(2) What elements of the in-services were cited as the most helpful to educators?

(3) Did the addition of the literacy component to Model B create an in-service model perceived as more helpful by participating educators?

Subjects

Participants (N=72) were from two different elementary schools within the same, large urban district. Both schools served a primarily Latino student body. One school was comprised of 70% English Learners and 93% of the student body received free or reduced lunch (2006a) at the time of the study. The other school was comprised of 64% English Learners and 91% received free or reduced lunch at the time of the study (2006b). Students from both schools performed at the bottom tier of the state's academic performance index (API) during the academic year the in-service took place (California Department of Education, 2003).

In order to accommodate the large number of residents in the urban area, many schools are year-round. Students and educators are arranged into three tracks, with two tracks overlapping at any one time. Three of the four groups that participated in the program were three tracks from the same school. The fourth group was from a second school in the same area. Over half (52%) of the attendees were teachers

with five or fewer years of experience, 16% had between six and ten years of experience, 11% had between 11 and 15 years of experience, and 13% had between 16 and 20 years of experience. Lastly, 8% of participants had over twenty years experience. As all faculty members of each school were required to attend, all grade levels were represented equally- from developmental kindergarten through fifth grade and inclusive of special education teachers.

Data Collection and Analysis

All participants were given a retrospective questionnaire at the end of the half-day program. Questionnaires of this nature ask participants to respond both to their current status as well as their past status retrospectively. The questionnaire was organized in order to (1) address model-specific goals, (2) compare responses of participants from both models, and (3) address topics that were common to both models. In addition, several questions were asked to determine how participants felt museums could be most helpful to their classroom instruction overall.

The questionnaire relied on both Likert scale responses and open-ended questions. Likert scale responses were analyzed quantitatively using a paired samples t-test to determine significant differences between participants self-report of knowledge before and after participation in the program. Statistical analysis of current and retrospective views on the same instrument is a technique found to be effective by Smith, et. al. (1998). Open-ended responses focusing on helpful and useful aspects of the program were analyzed qualitatively by identifying recurrent themes through a constant comparative technique and later category construction (Merriam,

1998) and then grouping responses into categories. Response percentages were then calculated in order to make comparisons between participants of the two different models, as supported by Miles and Huberman (1994) and in line with the combination of qualitative and quantitative data in order to lend more depth to reported results.

Analysis and Results

Data analysis indicated that both Model A and Model B clearly met their respective goals. Participants of both Model A and B (N=72) indicated statistically significant knowledge gains in how to access museum resources after the in-service as opposed to before (see Table 2) meeting the first goal which was shared by the two models. In addressing the second goal specific to Model A, "provide educators with information on ways to connect museum visits with classroom curriculum", participants (n=30) indicated statistically significant knowledge

gains after in-service participation in linking classroom curriculum with visits to informal learning environments as opposed to before (see Table 2). In addressing Model A's third goal of providing educators with information on incorporating informal teaching techniques in the classroom, participants indicated statistically significant knowledge gains in ways to use informal instructional techniques within their classroom setting after in-service participation (see Table 2). Model B also met its second goal of assisting teachers with linking science and social science activities with language arts as participants indicated statistically significant knowledge gains after in-service participation in (1) perceived knowledge of methods to link science and literacy in the classroom as well as (2) projects that incorporate science and language arts (see Table 2).

In addressing the second research question, determining which elements

Table 2: Perceived Helpfulness of Workshop Models

	N	Pre-In-service		Post-In-service		T	P
		Mean	SD	Mean	SD		
Model A and B Knowledge of… museum resources	72	2.00	.65	4.22	1.15	18.93	<.05
Model A Only Knowledge of… linking classroom curriculum with museums	30	2.33	.96	4.33	.66	11.15	<.05
Informal teaching techniques	30	2.83	1.23	4.27	.69	6.92	<.05
Model B Only Knowledge of… Linking science and literacy in the classroom	42	2.88	.99	4.29	.67	8.58	<.05
Projects incorporating science and language arts	42	2.88	.99	4.29	.67	8.40	<.05

Table 3: Categories of Museum Support as Cited by Participants

	Percentage Cited	
Category of Support	Model A	Model B
Contact with Real Objects	20%	26%
Museum Tours	10%	5%
Resources/Programs for Teachers	10%	12%
Resources/Programs for Students	**23%**	**14%**
Activity Connections to Curriculum	**37%**	**36%**
Affective (enrichment, motivation, etc.)	7%	12%
Exhibit Reference	3%	7%
Other	4%	5%
Blank	9%	12%

* Percentages total more than 100% due to responses in multiple categories

of the in-services were perceived as helpful to educators, the question was addressed in several different ways. First, educators were asked in an open-ended question to "please explain how you feel a museum can best support your classroom curriculum". Most of the elements most commonly cited by the participants fell into the category of "Activity Connections to Curriculum" (see Table 3).

When the results of this question are compared across models, the area that shows the greatest disparity is the category of "Resources/Programs for Students". Due to Model B's emphasis on language arts activities, discussion of student programs within this model was more limited due to time constraints.

Secondly, participants were asked in an open-ended question "What activities and/or information from the workshop will you be most likely to use?" Again, responses were grouped into categories and the frequency of each response was calculated in a percent format (see Table 4). For Model B, where learning about specific activities connecting science and language arts was at the focus of the program, responses more often fell into the categories of "Creating Museum-

like Exhibits", "Worksheets/Activity Ideas", and "Object Related Activities"— all categories with an emphasis on 'ready-to-implement' curricular support. Participants of Model A, also most frequently cited elements within the category of "Creating Museum-like Exhibits" but also cited categories referring to more theoretical information related to museum-specific services such as "Members' Loan Service Information" and "Field Trip Related". Within this model, the focus was more on transforming perspectives and empowering educators as professionals than on training on a specific activity.

When asked through an open-ended question to explain "How helpful was this workshop to your classroom teaching", those that participated in Model B and elaborated beyond the Likert scale response cited elements equally within the categories of "Museum Resources/Offerings" and "Worksheets/Lessons/Activity Ideas" where as participants in Model A overwhelmingly cited "Museum Resources/Offerings" (see Table 4). These resources included the museum's Members' Loan Service which provides educa-

tors with the opportunity to "check out" natural items such as taxidermied animals or skeletons, for use in their classroom.

An interesting disconnect is observed when the results of both Table 3 and Table 4 are reviewed in connection to each other. In Table 3, participants within both models indicate that "Activity Connections to Curriculum" were a significant resource that museums can provide educators. However, in Table 4, with reference to specific in-service components participants were most likely to use, "Activity Ideas" and "Instructional Techniques" were cited with different frequencies by participants within the two models. Model B participants were more likely to cite "Worksheets/Activity Ideas" than participants in Model A. More Model A participants cited "Instructional Techniques" than did participants in Model B. It is possible that these differences are reflective of the school site curricular emphasis. Model B provided very specific activities linking science and language arts, immediately replicable in the classroom under the new curricular emphasis on language arts. Perhaps some of the science specific activities presented

Table 4: In-service Component Participants Were Most Likely to Use

	Percentage Cited	
Category	Model A	Model B
Members' Loan Service	27%	10%
Other Museum Resources	13%	12%
Field Trip Related	27%	10%
Creating museum-like exhibits	30%	41%
Worksheets/activity Ideas	7%	27%
Specifically object related activities	10%	27%
Instructional techniques	20%	10%
Content topic or exhibit	10%	7%
Other	0%	5%
Blank	7%	2%

* Percentages total more than 100% due to responses in multiple categories

in Model A were deemed helpful in Table 3 yet the reality of a language arts emphasis in the classroom made the actual implication of these more difficult as indicated in Table 4. Another possible reason is that Model A provided instruction on a slightly broader scale, devoting time to general instructional techniques in the area of science (i.e. importance of experiential learning) than within Model B. This led to citation of instructional technique by Model A participants over specific activity ideas.

In addressing the third and final research question, it was determined through paired t-tests that participants from both Model A and B (n = 69) felt their respective in-service was more helpful to them than other non-museum in-services in which they had participated (see Table 5).

However, it was not evident through statistical analysis that the added literacy component increased perceived helpfulness making one specific model more "helpful" than the other. Rankings of helpfulness of participants in Model A and Model B were compared through an independent samples t-test and no statistically significant differences in perceived helpfulness were demonstrated. This indicates that the addition of a language arts emphasis did not make the in-service any more helpful as perceived by the participating educators. Though overall rankings of the two models did not display statistically significant differences, there were differences observed between the individual elements participants

within each model found most helpful (see Table 6). While differences are clear, it is important to note that many respondents left this question blank so those responses that are present represent the views of only a percentage of the participants. Further studies into this area are warranted.

It could be argued that trying to infuse an emphasis not core to the specialty of the museum too deeply may have compromised the transmission of information that would have been helpful and well received by participating educators and most appropriate for delivery by the museum. The area that is perhaps the museum's strongest asset is the student programs it provides, yet when faced with the question of "how a museum can best support your classroom curriculum" nearly 10% fewer participants in Model B than in Model A identified this as a way the museum can support their instruction. As these participants were from the same district, city area, and sometimes the same school, it can be inferred that this lack of mention is due to the different formats of the two in-service models.

Limitations

There are several key limitations to this study that should be considered before broad application of these

Table 6: In-service Component Participants Found Most Helpful

	Percentage Cited	
Category	Model A	Model B
Connecting museums w/classroom curriculum	7%	12%
Museum resources/offerings	**30%**	**14%**
Exhibit Hall Related	13%	0%
Worksheets/lessons/activity Ideas	**0%**	**14%**
General Science Instruction	3%	7%
General Positive Reference	7%	7%
In-service Format/instructor Reference	3%	2%
General Negative Comments	3%	0%
Other	10%	7%
Blank	*27%*	*41%*

* Percentages total more than 100% due to responses in multiple categories

Table 5: Museum and Non-museum In-services Compared

n	Other In-services		Museum In-services		T	P
	Mean	SD	Mean	SD		
69	3.07	.67	3.75	.99	-6.96	<.05

results. Though the study instrument adequately addressed the three focus areas of the study, it is not without its limitations. There were no reliability measures for the instrument. In addition, though retrospective self-report is an oft used technique, many will argue it is not the most desirable way to measure actual gains in knowledge. Lastly, the small number of indicators/questions scored with a Likert scale can also be considered as problematic.

In addition, a longitudinal follow-up of the educators and the lasting impact (if any) the program may have had on their classroom instruction would have greatly contributed to this study. Unfortunately, longitudinal studies can be difficult for fiscal and logistical reasons and continued contact was not possible in this case due to those barriers.

A final limitation not of the study itself but of the two models is their half-day nature. A significant literature base indicates half-day in-service programs do not carry the impact that lengthier and intensive educational opportunities, particular the National Science Education Standards that cautions specifically against "fragmented, one-shot sessions" (1996, p.

72). However, one might argue that with school district budgets as they are and the many competing demands or educators' time, though not the most pedagogically effective, the half-day workshop is the most we can expect at the present, in line with actual district protocol.

Conclusions and Implications

Three themes emerged from the data that future studies can build upon in looking at effective models of using informal learning institutions as the setting for elementary educator in-service programs in the area of science. Both museum in-service models were ranked more positively than in-services attended outside the museum setting, indicating that informal venues are indeed institutions that can successfully support professional development efforts in the traditional setting. This reinforces what earlier studies have found: informal learning sites can be effective venues for teacher professional development. The novelty of these locations can go a long way in sparking educator interest and creating a dynamic science learning environment much like that the environment we advocate for students. Research indicates that learners who are intrinsically motivated may demonstrate greater cognitive gains (Covington, 1998). The physical context of the learning environment can go a long way toward promoting intrinsic motivation.

Secondly, while informal institutions can certainly create professional development programs that connect with issues that are at the forefront of reform efforts within the traditional education setting, this may not be necessary from the educators' view in creating a meaningful experience.

In fact, it may hinder the transmission of resources and information that are precisely what makes informal learning venues unique places for professional development. While the literacy-based in-service in this study did significantly increase participants knowledge in connecting science and literacy, it did so at the expense of information specific to museum offerings in the area of science education for educators and students, perhaps the strongest selling point for holding an in-service within such an environment. Subjects of this study clearly indicated that the most helpful resources museums could provide would be well grounded in the area of the museum's science and social science expertise as resource provisions strongly linked to the museum's mission (i.e. specimen access, integrated curriculum projects, field trip destinations) were those most often cited as desirable by educators.

The physical context of the learning environment can go a long way toward promoting intrinsic motivation.

The reality is that language arts is a critical component of the work that science and social studies researchers do at the museum on a daily basis. Museum researchers are consistently taking notes on specimens- in the field and in the laboratory. Discoveries are routinely summarized in publications, oral presentations, and exhibit labels. Research libraries are extensive and routinely visited by the curatorial staff. Thus there are infinite possibilities for creating K-5 curriculum opportunities

that authentically integrate science and language arts in connection with the work of these researchers. However, while elements of these authentic connections between science and language arts were included at the most basic level within the two models, time precluded a more in-depth treatment of how these connections can be implemented into a K-5 curriculum.

This brings us again to the conversation of what instructional priorities should take precedence in the reality of a limited duration professional development program. And more importantly, what can be infused into an in-service on the school site and what unique elements can only be effectively transmitted in an informal setting? Instruction on how to take scientific notes related to an unknown specimen can be done in any setting-museum or school. Demonstrating effective use of exhibits, visits to a working curatorial lab, or displaying the items available for loan from a local museum cannot.

It is clear that educators clearly took away from the workshop exactly what was presented. If student programs and resources were not discussed, knowledge in this area was not cited as helpful or important. This reinforces again the potential museums have for providing educator professional development but also reinforces the importance of constructing these experiences with attention to the unique messages science museums are best positioned to deliver.

Certainly, this small case study is only the start of what should be a further investigation into the role of museums as in-service providers. However, it does emphasize the importance of focusing on the unique qualities and offerings of the institution in creating a professional development model

to improve science instruction in the classroom while tapping into the rich resources informal learning institutions offer. These findings can serve to further efforts in creating stronger formalized partnerships between museums and school districts and look to creating formalized professional development collaborations that build on the strengths of the institution together with the needs of the schools.

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