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Original Article

Examining Teacher Choices for Science Museum Worksheets

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Preservice and inservice teachers were asked to examine 2 considerably different museum-based worksheets and to choose which, if any, they might use if they were conducting a science field trip for upper elementary or middle school students. The more detailed, survey-oriented worksheet was chosen more frequently than the open-ended, concept-oriented worksheet. Although different rationales were given for these preferences, findings suggest that teaching experience was not strongly related to worksheet choice. Furthermore, while particular worksheet characteristics were valued by some teachers, others perceived these same characteristics as a drawback. The study suggests that teacher perspectives toward museum visits are quite complex and that these viewpoints must be taken into account when looking to improve learning experiences during school field trips.

Introduction

In this time of dwindling classroom resources and limited time for inquiry-based science, it would seem prudent for teachers to look for alternate avenues of support for maintaining a strong classroom science curriculum. One possible set of resources includes the informal or "free-choice" science institutions within a community, including science centers, natural history museums, zoos, aquaria, and nature centers. These institutions typically consider students and teachers as an important audience and often provide programming geared to support science learning in the classroom and at home. Finding an effective way to bring schools and informal learning institutions together may be one way to facilitate student learning in science.

Probably the most traditional use of these institutions has been the class field trip. Within the past few decades, researchers have begun to look more carefully at the school field trip in order to better understand cognitive and affective outcomes for the experiences, as well as factors that are likely to improve the learning experience (Anderson & Lucas, 1997; Bitgood, 1994; Delaney, 1967; Falk, 1983; Falk & Dierking, 1992, 1997; Farmer & Wott, 1995; Flexer & Borun, 1984; Gottfried, 1980; Koran, Lehman, Shafer, & Koran, 1983; Orion & Hofstein, 1994; Ramey-Gassert, Walberg & Walberg, 1994; Rennie & McClafferty, 1995). Not only do these studies suggest that field trips have both positive affective and cognitive outcomes

for students, but they also suggest that certain strategies, such as previsit preparation and postvisit follow-up, can greatly improve student learning resulting from field trips. Fewer investigations, however, have looked at the role of the teacher within the field-trip setting or the strategies used *during* the field trip. These studies reveal that teachers often fail to link their field-trip experience to the classroom curriculum and may not always subscribe to an agenda that facilitates student learning within the museum (Griffin & Symington, 1997; Tuckey, 1992). Further, it appears that teachers may have intentions to connect with their classroom curriculum, but there may be other perceptions or concerns that override these intentions (Anderson & Zhang, 2003; Kisiel, 2005). Thus, although teachers see the field trip as an important experience in itself, they may not be aware of how best to use these informal learning settings to support learning in their classroom.

Museum Worksheets and Museum Learning

Teachers use a variety of strategies to facilitate school field trips, and it is not uncommon to see students in these informal learning settings completing some sort of written assignment as part of their visit. A recent survey of upper elementary teachers indicated that more than 40% would use some sort of structured engagement, such as a worksheet, during field trips (Kisiel, 2003a). However, educators seem to have mixed opinions about the learning potential of museum worksheets. Price and Hein (1991) discouraged the use of worksheets during a school visit to the museum, claiming that, while they may be useful for focusing observation and assisting with identification, they can "actually impede student learning by inhibiting true observation, preventing students from formulating their own questions, and causing students to focus on the narrowly described task to the exclusion of broader questions" (p. 515). Students interviewed in another study remarked that the imperative to complete the worksheet kept them from looking at exhibits and took away their learning choices (Griffin, 1994). Yet these same students felt that they would not learn anything if they had no worksheet. Similarly, teachers may also feel that students will not learn if they don't have a worksheet to guide them (Kisiel, 2003b). Fry (1987) noted that, while many educators disapprove of worksheets as a means to keep students out of trouble, properly constructed worksheets may enhance the learning experience. She suggested that teacher-generated worksheets that use a thematic approach, with an eye to student ability and prior knowledge, may improve the effectiveness of worksheets as a learning tool. McManus (1985) recommended that worksheets focus on the exhibits themselves, rather than the labels, to encourage younger children to develop their powers of observation.

A recent investigation of teacher-prepared worksheets in a natural history museum suggested that worksheets might be an indication of teacher intentions (Kisiel, 2003b). Based on the results of that investigation, museum worksheets can be classified as *survey-oriented* or *concept-oriented*, based on several characteristics. Survey-oriented worksheets are identified as having greater numbers of questions requiring the visitation to a greater number of exhibit areas, thereby allowing less time overall for each question and less time in each exhibit area. These worksheets

include questions that depend on examining specific displays and require responses derived from label copy. Survey-oriented worksheets are also less likely to utilize higher order questions and rarely allow students to respond to exhibits of their choosing. In contrast, concept-oriented worksheets have fewer questions overall, giving students more time to spend on each question. Responses are more often generated from observation of objects than reading text, and questions may be broad enough that they might be answered in a number of different settings, such as a natural history museum, zoo, or aquarium. Finally, the concept-oriented worksheet is more likely to utilize higher order questions and provides for some student choice.

A comparison of these worksheet styles with recommendations in the literature regarding factors that facilitate learning in museum settings indicated that the use of a worksheet featuring a concept agenda seemed more likely to lead to meaningful learning (Kisiel, 2003b). Note that within an informal learning setting, the learner voluntarily participates in activities that would be considered self-paced and exploratory, with opportunity for choice and control, social interaction, and without the explicit pressures of assessment (Falk & Dierking, 1992, 2000; Screven, 1986; Wellington, 1990). Within an informal environment, meaningful learning involves placing the learner at the center of the experience. During a visit to a natural history museum, for instance, the individual is in control and can choose what to investigate and what to ignore. The learner determines how long to attend to the dinosaur fossils or mammal dioramas—or whether or not to pay attention at all. The voluntary nature of the learning, unlike mandated schooling, requires that the experience *must* be engaging to the learner, or the learner will choose to do something else (Schauble, Beane, Coates, Martin, & Sterling, 1996). Referring to some of the unique characteristics of learning in informal settings, Lucas (1983) suggested that "even for those of us whose main activity is teaching science in formal settings, it could be quite important to understand how learning in the informal sector interacts with formal teaching" (p. 3). I present here attempts to provide some sense of how teachers perceive these sites and how they might better exploit the learning context of a museum. Properly constructed worksheets that allow students more time to actively engage in the exhibits and permit personal control over their learning, such as the concept-oriented worksheets described above, might help teachers to do just that.

Of course, a worksheet is not the sole determiner of a museum learning experience; the role of the teacher is critical (Griffin & Symington, 1997; Wolins, Jensen, & Ulzheimer, 1992). Even the most dense, fill-in-the-blank worksheet has the potential to support a strong learning experience with proper teacher guidance. Unfortunately, the logistics of the museum setting often requires teachers to break students into smaller groups with chaperones who are unable to foster the same kinds of learning experiences. The worksheet then becomes a mechanism to ensure that all students have a similar experience. Therefore, if students feel that worksheets are necessary for real learning, and if teachers believe that worksheet materials are necessary for what they consider a successful field trip, whether or not they are in the same group as their students, it seems that building a tool that emphasizes the

qualities inherent in an informal setting may be one way to help teachers better exploit the museum setting.

Without question, the school field-trip experience is a complex phenomenon. Many factors can potentially influence what happens, including teacher perceptions of field-trip pedagogy, teacher prior experiences (both as student and teacher), student prior experiences, school support of field trips, museum policies, and even weather. The following investigation attempts to further understand one aspect of the school field-trip experience by examining teacher perceptions of effective museum-based activities. By asking teachers to select (or reject) museum worksheets that they feel are appropriate for enhancing the student experience, we begin to see evidence of these different field-trip perceptions. Understanding *why* teachers chose a particular worksheet or instructional strategy can help us to identify their concerns and allow us to better see what they believe can or should happen during museum field trips.

Methodology

Several questions guided this investigation:

1. What style of worksheet are teachers more likely to use (if any) in conjunction with a school field trip to a science museum?
2. Do inservice and preservice teachers' views differ regarding worksheet choice?
3. What reasons do teachers give for their preference of one style of worksheet over another?

For this study, open-ended questionnaires were distributed to 66 inservice and 40 preservice teachers ($N = 106$). Participants were either enrolled in an education class at a local university or participating in a museum-based teacher inservice workshop. Teachers were asked to examine two different worksheets created for a field trip to a natural history museum and then provide a rationale for why they would or would not use them if they were leading a class of upper elementary students (grades four or five) on a field trip. They were then asked if their answers would change if they were leading a class of middle schoolers (grades seven or eight) instead. Teachers were also asked to provide a rationale for their choices. Responses were examined for emerging themes and categories; responses were then quantified, based on their frequency.

Most of the teachers questioned were elementary and middle school teachers, although a small percentage of multilevel teachers (e.g., K–8) were also included. Based on the sampling method used, it would be fair to assume that all participants questioned were involved in some form of professional development, either enrolled in university classes or museum workshops. One might expect, however, that the more experienced inservice teachers might respond differently, based on a greater familiarity with the classroom and student interaction. Therefore, as part of the analysis, the responses of the two groups, inservice and preservice teachers, were

Table 1

Comparison of Worksheets Used for This Study

	Worksheet A (survey oriented)	Worksheet B (concept oriented)
Number of questions	31	4
Sample questions	Of what are shark skeletons made? Feel the lion's tongue. All cat's tongues are covered with fleshy hooks called _____ What does triceratops mean? Compare your height to the ultrasaurus. Check here when finished. ____	Write the name of an animal you saw on display Draw a picture of the animal
Number of open-ended questions	3	3
Sample open-ended questions	Describe your favorite gem. Watch the video and describe two things that you learned	Write some information about the animal. (Where does it live? What does it eat? What else do you know?)
Exhibit areas necessary for completion	8	1

compared to determine if these experience differences affected the choices of the two groups.

The worksheets used for this analysis were based on actual teacher-generated worksheets that provided a significant contrast of styles. Worksheet A is characterized as survey oriented (i.e., it provides a broad exposure to many aspects of the museum setting), while Worksheet B is more concept oriented (i.e., it might be considered more focused, possibly leading to learning a particular concept). Table 1 compares specific aspects of these two worksheets.

Results and Analysis

Choosing a Worksheet

Overall, a little more than half (56%) of the teachers surveyed agreed that they would choose Worksheet A (the survey agenda) or either of the worksheets to use during a fourth- or fifth-grade field trip to a natural history museum (Table 2). A similar proportion (54%) of respondents also chose Worksheet A for the seventh- or eighth-grade field trip. Although the percentages are similar, the subgroups are different. Some teachers who felt that Worksheet A was inappropriate for upper

Table 2

Museum Worksheet Choices (N = 106)

Teacher choices	For 4th/5th graders (%)	For 7th/8th graders (%)
Worksheet A (survey)	48	53
Worksheet B (concept)	38	26
Either	8	1
Neither	6	8
No response/other	1	13

elementary students indicated that they would probably use it for middle school students. The opposite held true, as well: Some teachers felt that Worksheet B would be more appropriate for middle schoolers than Worksheet A. Combining these choices to look at the percentage of teachers who would choose Worksheet A for *either* grade reveals that 70% agreed that they would use the survey-oriented worksheet for an elementary or middle school field trip. Recall, however, that a concept-oriented worksheet (B) is actually better aligned with recommendations regarding the needs of learners in an informal setting (Kisiel, 2003b).

Only a small percentage of respondents indicated that they would use neither of the worksheets for a field trip. It is worth noting that several of the teachers were undecided about what they would choose for the older students; a few suggested ways they might modify one of the worksheets, while others simply said "maybe" when asked if they would change their worksheet selection if they were leading middle school instead of elementary students. Few teachers rejected worksheets outright—overall, most indicated that they would use a worksheet.

The Effect of Teaching Experience

The population examined for this study consisted of both inservice and preservice teachers. Thus, some of the respondents were more familiar with the context of the classroom and even the experience of a student field trip. It is quite conceivable that these two groups would react differently when asked to choose which worksheet they might use during a class field trip. Table 3 examines respondent choice based on whether or not they were currently in the classroom. The results suggest that experience may have *some* impact on a teacher's likelihood to choose the survey-oriented worksheet, as a larger percentage of preservice teachers selected the survey-oriented worksheet or either worksheet, compared to the inservice teachers. However, a chi-square analysis revealed that group differences were not statistically significant at the .05 level. Thus, it would seem then that whether or not a teacher is currently in the classroom might have a limited impact on choices made regarding a school field trip. Note that the difference between inservice and preservice teachers' choices for the elementary field trip resulted in a p value of only .06. Even though

Table 3

Teacher Choice of Worksheet According to Experience

Choice	All teachers $N = 106$ (%)	Inservice teachers $N = 66$ (%)	Preservice teachers $N = 40$ (%)	χ^2 (1, $N = 106$)	p
Survey-oriented worksheet or "Either" for an elementary fieldtrip (4th/5th graders)	59 (56)	32 (49)	27 (68)	3.65	.06
Survey-oriented worksheet or "Either" for middle school fieldtrip (7th/8th graders)	56 (53)	33 (50)	23 (58)	0.56	.45
Survey-oriented worksheet or "Either" for at least one of the grade levels	76 (72)	45 (68)	31 (78)	1.07	.30

the similarity of the groups (preservice and inservice teachers) may be questionable when it comes to choice of worksheet for an elementary field trip, it is important to note that nearly half of the inservice teachers surveyed still preferred the busy survey-oriented worksheet.

Teacher Reasons

Teacher rationales for their choice of worksheet were typically related to some characteristic of the worksheet itself or a perceived utility of the worksheet. Commonly cited rationales were identified and compiled to reveal several factors that seemed to influence preference for one worksheet over the other. These included task density, level of difficulty, question format, cognitive level, student relevance, and student direction. Table 4 provides examples for each of these comment categories. More than half of the teachers cited "task density," referring to the depth, breadth, length, or complexity of the worksheet, for their choice. "Level of difficulty," typically expressed as how hard or easy the worksheet would be for the given grade level, was also commonly mentioned; in several cases, teachers explicitly referred to the age appropriateness of the materials. Preferences related to "question format" typically referred to the extent to which the worksheet was or was not open ended; although, in several cases, teachers also referred to the mode

Table 4

Rationales Cited by Teachers for Worksheet Choice

Rationale category	Sample comments
Task density	. . .too much information on the page
	. . .the other [B] is too broad and minimalist
	. . .because it covers several different areas of the museum
Student direction	. . .requires students to pay attention
	. . .this worksheet [A] would at least get them to read information and see many exhibits
Level of difficulty	. . .the study guide is a little complex for 4th and 5th graders
	. . .[Worksheet] B is too simple for 5th graders
Student relevance	. . .kids have more options
	. . .could be an animal they liked, and it would mean more to them
	. . .interesting facts [that are] better able to keep student interest
Question format	. . .not enough open-ended questions
	. . .I like the opportunity for students to expand thoughts
Cognitive level	. . .requires higher level thinking and asks for more specific and detailed information
	. . .the questions demand more in-depth thought to answer
	. . .depends on the level of the students

of response, such as writing versus drawing. Teacher sometimes made comments related to apparent "cognitive level"; teachers often referred to higher order thinking or critical-thinking skills. Some teachers spoke of "student relevance," referring to how the worksheet related to student interest or their ability to choose. Unlike the other categories, responses included in this group tended to be more affective in nature. A "student-direction" rationale focused on what students would do as a result of the worksheet assignment—would it or would it not keep them occupied? These teachers also expressed concern about whether or not the worksheet would be effective in keeping students on task. Several other comments surfaced, including reference to font size and spacing, as well ease of grading. However, these were less common that the major factors described above.

In many cases, teacher comments regarding their choice of a particular museum worksheet included multiple reasons. One teacher explained that "Worksheet A covers more items and areas of study; it will keep students engaged longer," indicating reference to both task density and student direction. The frequencies of each of the factors influencing choice are shown in Table 5.

Although teachers cited different rationales to support their choice of worksheet, the very same reason was used by some to support their choice of worksheet and by others to reject the very same worksheet. For instance, several teachers rejected Worksheet A as having "too many questions" or "too much information on the page." Others praised the worksheet because it provides "more specific things to look for" or "covers more information." Overall, 37% of teachers chose the survey-oriented worksheet for reasons related to its *high* task density, while about 13% rejected the survey-oriented worksheet because they felt the task density was *too* high.

Conflicting perspectives showed up in several other places during the examination of teacher rationales. As one teacher explained, "Higher level thinking was involved with Worksheet A"; another teacher commented that there were "more critical-thinking skills in B." Some liked the short answer, "scavenger hunt" form of survey-oriented worksheet; others disliked it because the students "don't have to think—they only find the answer on the plaques." Again, we see different teachers looking at similar characteristics in their choice of worksheet, yet valuing the characteristic differently, in turn leading to a choice of different worksheets.

Only one of the rationales described here was found to be closely aligned with a choice of worksheet (A or B). Teachers who mentioned student relevance when explaining their choice were more likely to reject the survey-oriented worksheet for either grade level, $\chi^2(1, N = 106) = 16.6$, $p < .001$. One teacher explained that the worksheet involved "too much 'fact' gathering; too little (personal) observational information." Another explained that the survey-oriented worksheet ". . .looks like a drag to do and takes away the fun. [Worksheet] B has fewer questions and allows the students to choose." Clearly these teachers recognized the limitations of the survey-oriented worksheet and saw the other worksheet as an alternative that allowed for a more enjoyable and more meaningful learning experience.

Table 5

Frequencies of Teacher Rationales for Worksheet Choice

Rationale category	All teachers $N = 106$ (%)	Inservice teachers $n = 66$ (%)	Preservice teachers $n = 40$ (%)	χ^2 (1, $N = 106$)	p
Task density	53 (50)	34 (52)	19 (48)	0.16	.69
Student direction	37 (35)	23 (35)	14 (35)	0.00	.99
Level of difficulty	31 (29)	22 (33)	9 (23)	1.41	.24
Student relevance	30 (28)	17 (26)	13 (33)	0.56	.46
Question format	21 (20)	14 (21)	7 (18)	0.22	.64
Cognitive level	10 (9)	7 (11)	3 (8)	—[a]	—[a]

[a]Cell size too small for valid chi-square analysis.

Discussion

This investigation emphasizes the importance of recognizing the teacher perspective when examining the school field-trip experiences and outcomes. Almost 70% of the teachers questioned indicated a preference for the survey-oriented worksheet for elementary students or middle schoolers (Table 3). A previous investigation of worksheet use suggested that the use of a survey agenda for a museum visit limited the likelihood of in-depth student involvement or understanding with any particular topic (Kisiel, 2003b). Although students do get a "museum experience," the opportunity for the development of a deeper understanding of a particular concept is lost. By limiting students' choices and ignoring students' interests and connections to prior knowledge, survey agendas, as suggested by Worksheet A, miss valuable opportunities for student learning.

The overall teacher preference for the longer, detail-oriented Worksheet A, especially for middle school students, also suggests that teachers may be relating task density to age appropriateness. That is, the worksheet covering more questions and more exhibit halls was considered as being more appropriate for older students, compared to the other, shorter worksheet. Recall that teachers were less likely to refer to question level (20%) or cognitive level (9%), compared to task density (50%), in their explanations of worksheet choice. Therefore, it seems that teachers may be more likely to consider using the longer, more dense worksheet, regardless of its content or types of questions, for older students. Yet, it seems unlikely that a higher task density would do much more than keep older students busier for a longer time.

Certainly the more dense Worksheet A seems likely to keep students busy during the trip, as there may not even be enough time available to complete all questions. About one third of respondents mentioned some aspect of student control or directing students' attention in their reasoning for choosing Worksheet A. The overall preference for the survey-oriented sheet may be a reflection of the teacher's concern for keeping students on task and under control during the visit. It is worth noting that only a small percentage of teachers indicated that they would not choose either worksheet, suggesting that most teachers considered that having students use a worksheet on a field trip was better than not. This tendency is likely a reflection of the teachers' concerns about both student control and student learning.

As mentioned, a previous study of teacher-generated museum worksheets identified several notable characteristics that might impact the learning experience (Kisiel, 2003b). Those characteristics found to distinguish survey-oriented worksheets and concept-oriented worksheets are described in Table 6. Several of the categories related to rationale for worksheet selection described in this investigation are quite similar (task density) or closely related (student relevance and centeredness) to these worksheet characteristics. Note that there was almost no mention by any of the teachers from the investigation presented here regarding choice based on how the worksheet might connect with their classroom, although previous studies have suggested that this connection is critical for creating a strong learning experience (Bitgood, 1994; Falk & Dierking, 2000). Thus, certain worksheet characteristics

Table 6

Characteristics That Distinguish Survey- and Concept-Oriented Worksheets

Characteristic	Description
Task density	How many questions and how many exhibits are required for completion of the worksheet?
Orientation cues	Does the worksheet direct students where to go and what to see?
Centeredness	Is the worksheet student centered or museum centered?
Classroom connection	To what extent does the worksheet relate specifically to classroom curriculum?
Information source	Where does student find information to complete worksheet?
Site specificity	Are questions based on specific exhibits and labels, or could they be used at a variety of sites?

may seem more important or relevant to teachers, while others are simply not part of their consideration.

The results described in this study indicate that teachers clearly have differing ideas as to what sort of worksheet (if any) might make for a successful class visit to a museum. For instance, many commented on the length or detail of the survey-oriented worksheet; some saw this as a positive attribute, while others saw it as a negative. The same worksheet was deemed appropriate by some, but inadequate by others, often for the same reasons. The fact that these beliefs varied considerably suggests that teachers may not be aware of research-based, pedagogical practices that support learning in museum settings and that a model for a "best" museum visit may not be universally accepted by all teachers. Furthermore, teacher comments suggest that concerns related to logistics and student control may have considerable influence on a teacher's conception of a successful field trip.

Implications for Practice

By asking teachers which worksheet they would be more likely to use if they were taking students on a trip to a museum, this study provides new information regarding teacher perceptions of science field trips. The results indicate that practices recommended by researchers and informal educators for optimizing museum learning experiences (exemplified by the concept-oriented worksheet in this study) may not be congruent with actual teacher practices and intentions for a museum learning experience. Reaching beyond worksheet choice, the findings also suggest that teacher perspectives and objectives for field trips are somewhat contradictory and may not be closely tied to their experience as a classroom teacher. Moreover, the investigation supports the idea that keeping students on task—and, ultimately, under control—may be an important underlying consideration that drives teacher decision making for the field-trip experience.

In addition to control concerns, the study indicates that teachers have real concerns about content breadth over depth and student interests and ability levels when planning and conducting a visit to a science museum. These same concerns are often expressed by beginning classroom teachers (Veenman, 1984), suggesting that teachers (as well as students) may have difficulty adapting to the novel learning setting of a museum. It is likely that their knowledge of dealing with students in the classroom is, to some extent, situated in the classroom setting. Therefore, experience or pedagogical inclinations within a classroom may not necessarily translate to effective pedagogy within a museum setting. Instead, a teacher's prior experiences as a student participating in field trip, or more recent experiences as a teacher leading a field trip, may be more influential in shaping the teacher's view of the museum experience.

In order to confront and change teacher conceptions of a museum field trip, informal educators must consider different means of teacher support that may help reduce apprehensions and shape attitudes regarding what a successful excursion might look like. Helping teachers to become more aware of the characteristics of these nonclassroom settings that facilitate learning, such as visitor choice and control, may lead to instructional objectives that truly take advantage of the unique experience and move beyond a traditional tour. Furthermore, teacher educators can help teachers reflect more carefully on their pedagogy, regardless of the location of the lesson. The presence of dinosaur skeletons or live animals within the instructional setting is a great opportunity for introducing or reinforcing important concepts—whether or not a teacher covers the hundreds (or thousands) of other specimens also found at the site is less important. Building a teacher's "museum efficacy," or confidence in success in teaching in a museum setting, must first address teachers' real concerns about control and coverage and then gradually lead them to what research says about the unique nature of science learning in informal settings.

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