# Beyond Just the Facts: Museum Detective Guides

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**ABSTRACT**
We present Museum Detective, a handheld guide designed for use by school children to encourage guided learning through paired discovery of one object displayed within the museum space. Initial analysis revealed that students exhibited a higher level of focused attention and short-term and longer-term retention of information about the artifacts in the gallery. However, we propose that the Museum Detective interface extends beyond the frame of the device and its application into the expanded contexts of space, time and social interaction, as we push on the notion that information delivery does not have to be the sole objective of handheld guides designed for the art museum.

**Keywords**
Handheld guides, children, museums

**INTRODUCTION**
Handheld computer guides in art museums have added yet another tool for providing information to visitors. These new devices differ from audio guides because of the visual channel, from stand-alone kiosks because of their mobility, from web sites because of their situatedness, and from docent-led tours because of the self-direction. Although an oversimplification of these differences, the attributes of handheld guides often lead to designs optimized for exploring a tour of objects at one's own pace and to the desired depth of available information. Critics of these designs have highlighted what museum activities are left un-designed for in this approach [1,2,3,4,5] and how the focus on transmitting breadth and depth of information may present a distraction or even narrowing of the museum experience as a whole.

In this paper, we will present our experience designing a handheld guide for a very different type of interaction in the art museum: paired discovery of only one object, as opposed to individual discovery of a range of objects. The guides we will discuss were designed in collaboration between the Herbert F. Johnson Museum and the Human Computer Interaction Lab at Cornell University as part of a larger curriculum activity for a very specific population: third graders from schools in rural districts. The purpose of this paper is to begin articulating the critical questions and issues to consider when designing handheld programs to support this type of guided learning activity. We will begin by first identifying the goals of the project and the design choices made to support these goals. We will then present preliminary results from a prototype study with over 300 students. Finally, we will end with reflections on improving the guide and its evaluation.

**Background**
The Museum Detective handheld program was initiated by the Johnson Museum as part of a larger educational program called Objects and the Makers New Insights: OMNI, where the emphasis is on offering school children the opportunity to experience the culture with which the curated objects are situated, such as learning a native dance or working with craft materials from the particular period. These exercises are coordinated with the school district's curriculum, in this case, studying the history of Ancient China.

In previous years, the museum's OMNI China program consisted of two exercises: a painting lesson in calligraphy, and an exploration of artifacts in the gallery through a paper and pencil activity called the Museum Detective. In the gallery activity, pairs of students were assigned to an object, given a sheet of questions such as: How old do you think this object is? What do you think this object is made of? Students spend 20 minutes with their object answering the questions and are also instructed to draw a picture of their object on the back of their question page. At the end of the 20 minutes, the students come back together as a class and visit each object assigned. The pair who had investigated an object is responsible for trying to explain the object to their classmates, with the teacher or docent facilitating. It was for this activity that the Johnson Museum felt a handheld computer could be a useful addition.

**Design Objectives**
The museum educators identified three main objectives for using handhelds in the Museum Detective Activity: 1) to present an exercise that is more interactive and engaging than the paper activity, 2) to help contextualize ancient artifacts difficult for contemporaries to connect with, such as the idea of tomb figures, and 3) to introduce the students to technology in the museum. Behind this last objective was the desire to connect the newness of the handheld computers with the typically more conservative and historical face of the museum's Asian art collection.

As designers of the system, we wanted to help the Johnson Museum realize its goals by making the application fun and engaging to use. We were also interested in exploring

how we could use the devices in a way that extends beyond 'just the facts' learning, instead of using the devices simply for information transfer.

### Design Choices and Trade-Offs

As with many applications of new technology, the original application envisioned by the Johnson Museum involved taking the same paper and pencil Museum Detective activity and translating this into the computerized format. The audio-visual and interactive nature of the devices would address the museum's first two objectives; whereas, the implementation of the devices themselves would address the third objective. From the HCI lab perspective, we were originally interested in using additional attributes of handheld technology for the children's tour, for instance, letting the students choose which objects interested them the most and what information they found to be most interesting about an object. We imagined the applications to be more about self-discovery and less guided. However, in working with the museum, it became apparent that the handheld application was part of a larger scripted activity. In other words, the designed interface of the handheld was not contained within the screen.

In order to guide the students through the discovery process, each object would be unpacked through a series of primarily multiple-choice questions, such as "When do you think this object was made? Discuss with your partner and then select one of the time periods below", or "What do you think this object was made of? Discuss with your partner" followed by a selection of possible answers like wood, clay, stone. Selecting the correct answer congratulates the student on getting the question right and provides additional information such as drawing the students' attention to the wood grain in the object. Selecting an incorrect answer prompts the student to try again and gives hints to help guide their next choice. Questions and answers were worded in such a way to try and encourage the students, who would be working in pairs, to discuss with each other their answers. Some questions were open-ended, for instance, "What do you think Quan-Yin (Fig. 1) would say to you if she could talk"?

**Figure 1. Students looking at the Quan-Yin goddess statue.**

In addition to the question-based format, each object had one interactive element. These interactive elements included: a building exercise (for the Watchtower), drawing activities (e.g. for the Scholar's Screen), painting activities (e.g. for the Court Lady), and a narrative (for the Jue). For the Watchtower (Fig. 2), the building activity consisted of taking separate pieces of the tower and re-building it in the appropriate order. When the student completes the task, selecting the checkmark makes the tower sway back and forth. If the tower is constructed incorrectly, it falls down and the game begins again. This exercise requires the student to look closely at the object in order to construct their model in the same manner.

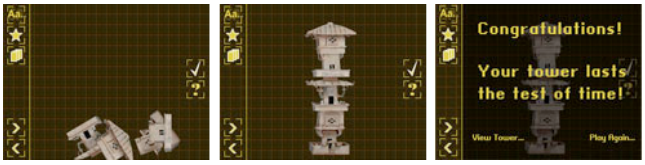


**Figure 2. Three screen shots from the Watchtower activity.**

The Scholar's Screen object presents the students with a blank lacquer screen and instructions to make his or her own carving that they might like to have on their desk. The Court Lady tomb figure's interactive exercise is a painting activity (Fig. 3) where students refresh or redo her colors. Contrary to the Watch Tower exercise, the painting and drawing activities have no right or wrong answer – as such, they required less direct looking at the object. Finally the narrative activity for the Jue wine vessel involved no manipulation on the students' part providing instead an audio story of the taotie ogre legend.

The interactive elements broke up the series of multiple choice questions and took advantage of the audio-visual nature of the handhelds. All of the activities, including the multiple choice questions, were attempts to promote active looking – scrutinizing the object more closely than a cursory glance – and/or active imagining – for example projecting the object into the present day or projecting the student back to ancient China.

The overall look and feel of the program are intended to reinforce the detective role-play. The colors and graphics of the program evoked a slicker, spy-feel of Mission Impossible than a traditional Asian motif of Tao Te Ching. However, where possible we did add traditional Chinese music elements to accompany the questions or the games. The music was added at the very end of the development program almost as an afterthought for it had no 'educational' content but served as extra exposure to the Chinese culture (and since one standard clip was put at the end of the exercise, it also served as a signal when the students had completed the exercise). As we will discuss in the later sections, this afterthought ended up being one of the most popular aspects of the program.

**Figure 3. The Court Lady painting activity.**

## METHODS AND RESULTS

The Johnson Museum's education staff wanted to compare the handheld version of the Museum Detective tour with the previous pencil and paper version of the same activity. This presented an opportunity for observing as outside evaluators how the activity changed with the addition of the handheld. We were not interested in creating direct comparisons or to establish that the handheld performed 'better' or 'worse', but instead saw this as an opportunity to explore how the experience differed from each other. For the purposes of this paper, however, we will mainly present our observations of the handheld version of the activity and use the pencil and paper version as a comparison point.

Overall, 211 third grade students participated in the Museum Detective activity with the handheld and 264 participated with the pencil and paper activity. We were able to directly observe and video record 4 classes of students (approximately 80 students) using the handheld and 3 classes (approximately 60 students) using pencil and paper, and the following observations are drawn from these 140 students. These numbers are an approximation due to the manner in which students were recorded during this preliminary data collection period. We are currently conducting a more rigorously designed round of video recorded observations to build upon the preliminary trends gleaned from this pilot study.

When a class arrived at the museum, the students were separated into two groups, one group of approximately 10 students participated in a calligraphy painting exercise in the craft room and the other group went to the Asia Gallery for the Museum Detective activity. Half-way through the students' field trip, the groups switched so that everyone participated in both activities. As discussed above, some of the classes used the handhelds for the Museum Detective portion and some used pencil and paper.

For both the handheld version and the pencil and paper version, students participated in the activity in pairs. For the handheld version, they had to share the device and were encouraged to take turns being the one in control. For the pencil and paper version, both students had their own clipboard with identical sheets of questions and a pencil for adding their responses and drawing a picture of their object on the back of their page. Although the paper version would allow the students to register different responses than each other, in the papers we collected, they all wrote the same response to each question and their responses differed only by their individual drawings.

When the Museum Detective activity started, again for both the handheld and paper versions, the students started with a "clue", a fragment of their object that they needed to find in the gallery. They were instructed that once they found their object, they would work with their object and discover as much as they could before telling the class about their object. Throughout the exercise, the educator used language to try and encourage the students to think of the object as theirs (e.g. "What can you tell us about *your* object?" "Which one was *your* object?" "You are the *expert* about *your* object.").

At this point, the handheld version and the paper version begin to diverge. In the handheld version the students walk through a series of questions and finding the correct answer (e.g. When was this object made?) plus they each had one interactive module, such as the painting or building activities discussed earlier. In the pencil and paper version, the students were asked the same questions with multiple-choice answers, but there was no immediate feedback in terms of whether they selected the right answer. The interactive activity for the paper version was sketching the object on the back of the paper.

At the end of approximately 15 minutes, the students all came back together and walked around the gallery as a group stopping at each object and learning about it from their peers. This took place for both the handheld and paper version – the students who explored the object during the first part of the activity were then responsible for telling their classmates about it.

Both groups received instructions, assistance and supervision from the same museum educator. Moreover, they studied and discussed the same six artifacts: the model of an ancient watchtower, the statuette of a court lady, a tree-sap paper holder, a life-size statue of the Goddess of Mercy, a decorated wine warmer and an incense-burner.

When delivering their presentations, participants in both groups were given time to share with their peers what they had learned about the artifact. If any relevant information was left out, the museum educator proceeded to ask specific questions and, when necessary, probed the participants so that, at a minimum, the following topics were covered for each object: age of the object, the object's material composition, and use of the object.

After approximately one month, we returned to the participants' school for an in-depth interview with a smaller subset of the participants regarding the museum activities and the specific artifacts they had studied. The museum educator served as the "moderator"; she separately interviewed the 34 students from the handheld groups and 33 students from the paper-and-pencil groups on all six artifacts. Such as in the immediate recall process, the educator allowed participants time to present what they remembered of the artifacts in question, and then followed up with specific questions if any relevant information had not been offered. However, due to the structure of the group interview, we were unable to tease out targeted information regarding the student pairs that were observed and recorded in the museum setting.

In assessing the role played by the addition of the technology in the delayed recall process, we looked at several variables across the handheld and paper and pencil conditions. To begin with, we considered the total number of correct and incorrect responses provided by the two groups and observed that the group using handheld devices offered 107 correct responses and 34 incorrect responses as compared to the 92 correct responses and 44 incorrect responses from the paper-and-pencil group. This suggests that the handheld guides may have contributed to overall greater accuracy of information recall with technology-assisted learning in our study.

We then took a closer, more focused look at these results by measuring whether the information provided by participants had been solicited or unsolicited by the educator/moderator across the two conditions. In other words, did the participants volunteer the information, or was recall prompted by a specific question? We observed that the handheld group provided 78 instances of correct unsolicited information and 14 instances of incorrect unsolicited information as compared to 59 instances of correct unsolicited information and 31 instances of incorrect unsolicited information from students using the pencil and paper version. Thus, the group using technology did not require as many specific prompts in order to bring back to memory correct information of the artifacts, nor did they make as many mistakes as the paper-and-pencil group in the free recall of information.

Furthermore, we distinguished between the specific types of information recalled by the two groups. More specifically, we categorized this information as either "hard"—referring to information intrinsic to the object per se (such as design, age, material out of which it is made), and "soft"—referring to attributes that are not inherent in the object itself, but rather external attributes associated with it (such as social usefulness, its surrounding mythology, etc.) Our preliminary analysis indicates that 72% of the participants in the handheld condition correctly remembered the "hard" facts about the objects as opposed to 62% participants in the paper-and-pencil condition.

However, both groups showed a similar facility for recalling "soft" facts, with 82% of the students in handheld groups showing correct recall as opposed to 78% of the students in the paper and pencil groups. We can speculate that any difference in recall between "hard" and "soft" may be accounted for by the fact that, through their use of activities, the handheld devices made difficult-to-remember information (such as an artifact's exact age or its material composition) more salient, which may, in turn, improve recall.

The observations discussed above focus on the delayed recall condition. In addition, we reviewed the video records from the students' engagement in the Museum Detective activity. This information provides initial anecdotal evidence for further controlled exploration. When using the handhelds, students seemed to be engaged with the devices and were highly focused on the interactive modules. In terms of attention, we noticed that the handheld groups seemed to be able to concentrate on the exercise for long periods of time without interruptions, or without succumbing to other environmental diversions.

As a downside of the use of technological learning aids, we found some participants that dedicated less time to the museum artifact in favor of focusing on the handhelds. Some of the children spent most of their time looking at the device rather than at the artifact, even though the latter was right in front of them and was, after all, the object of inquiry. As we had designed the interactive modules with varying levels of active looking encouraged between the object and the handheld, further analysis will be conducted on whether this behavior corresponded with a specific Museum Detective exercise as opposed to the handheld device itself.

## FUTURE DIRECTIONS

To date, the Museum Detective application has been used with over 300 students from area school districts During the museum visits, students exhibited a high degree of participation, engagement and excitement while using the system, and its implementation has been successful enough so that the Johnson Museum has phased out the paper and pencil version of the Museum Detective in favor of the handheld guides. As the handheld Museum Detective device moved away from its origins as a paper and pencil activity, the technology has allowed us to design for a richer interactivity. It would, however, be an oversimplification to use these preliminary results to state that the handheld guides provided a more effective guided learning experience. Instead, we would like to investigate how the addition of the handheld system transformed the context of the scripted activity with which the Museum Detective application is situated.

### Design Implications and Evaluative Challenges

Again, it is important to emphasize that the Museum Detective activity extends beyond the software installed on the handheld computer. The integration of the interactive application into the larger context of social interactions between student and student, student and teacher, student and museum educator, and teacher and museum educator should inform any future design directions of the Museum Detective activity. The negotiation between students for the control of the handheld computer is an example of this relationship between the social context and the technological system. While the form of handheld computers encourage mobility, the smaller physical size of the device somewhat limited the collaborative nature of the activity since only one student in each pair could actively control and hold the Museum Detective interface.

Further design improvements will also push upon the concept of 'active looking' through the enhancement and development Museum Detective modules to explicitly share the focus between the device and the physical objects in the gallery. The Court Lady figure introduced earlier incorporated a painting activity as a way to elicit an imaginative response of what the figurine looked like before the coloring had faded. Although the students enjoyed this activity, the museum educators were less

satisfied with the painting module since the students seemed to solely focus on the handheld and did not look upwards to draw inspiration from the physical artifact.

The refinement of the evaluation methods employed is an ongoing process, as we continue to collect data on the different school groups that visit the museum. Metrics of recall must be balanced with the attempted codification of the effects of the experiential and affective aspects of the system. For example, the music clip at the completion of the module had no ostensible educational function but was observed to be a feature highly enjoyed by the students. Determining frequency counts of the correct answers to multiple choice questions is arguably more quantifiable than uncovering the aspects of the system that stimulate curiosity, motivation, and sociality. The evaluation of such constructs, however challenging, must be carefully considered and implemented so that we can learn to design technological systems that move beyond information delivery.

Again, the larger context of the activity, outside the museum environment, must be taken into account as we try to assess the repercussions of the Museum Detective application as the students return to their classrooms. The students' interaction with the Museum Detective application did not occur in a vacuum; instead, the experience was co-constructed by the students, teachers and museum staff. As a result, the evaluation process should not be so student-focused as to provide designers with a restrictive view of how the system affects the interactions between the actors.

### Expanding the Interactive Frame

The notion that the use of handheld guides in the museum space can serve as a distraction reifies the ideal museum experience as one that supports unmediated communion between the curated object and the visitor. However, the implementation of a technological system would not be the only so-called distraction in this narrow definition of a museum experience. The presence of fellow visitors or the architecture of the museum may also serve to draw attention away from the displayed artifacts.

Instead, we propose that the frame of the museum experience should be expanded to include these so-called distractions as a way to make the museum visit richer and more interactive. By broadening the definition of the museum experience away from the passive transfer of information between curator and visitor, a situated technological system can be designed to play upon the architectural details of the space or to encourage reflection upon the social presence of other museum visitors.

An expanded frame of the museum experience should also possess a temporal component as the introduction of a technological system during one visit may affect the visitors' future visits, which seems especially salient in an interactive guide designed for students. Again, the evaluation of the Museum Detective application should not focus solely on the educational facts that may have been retained by the children but should additionally consider whether the 20-minute interaction with the system encourages the notion that the museum experience can be dynamic and entertaining or compels the child to return to the gallery even without an available handheld guide.

We have presented an interactive technological system that was designed to provide support for guided learning and in turn, the educational function of the modern museum. Initial evidence suggests that Museum Detective may have been successful in providing a context for interaction that may have translated to an increased engagement with the physical objects shown in the gallery space. We propose, however, that the handheld guide experience often extends beyond the frame of the device as well as the time and the space in which the application was used. Instead, future work should be cognizant of this extended context, where systems are designed for what comes before and what comes after the encounter with technology in the museum space.

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