Handheld Computers and Learning in the Informal Museum Setting

Evaluation Report

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Introduction

The Physical Science Exhibit Interpretation (PSEI) department in the Museum of Science, Boston in conjunction with the Concord Consortium is interested in learning how new technologies can be used to augment the educational experience of visitors to the museum. Specifically, PSEI is interested in the usage of the handheld computers with accompanying portable scientific probes and the associated scientific data collection software, listed below.

Computing Hardware:

- 1 Compaq Ipaq Handheld PC
- 2 Palm Pilot PDAs

Scientific Probe Hardware (all designed by the Concord Consortium):

- Temperature
- Force
- Light

Data Collection Software:

- CCProbe Graphing (Authored by Concord Consortium)

This evaluation focused on the following issues:

- Types of Visitors Interested in Handhelds (Age, Type of Group)
- Interaction & Engagement with Technologies (Time Spent)
- Hardware and Software Issues
- How Handhelds affect Learning in the Museum Environment (Conceptual Understanding, Fringe Benefits)

Procedure

This evaluation contains two specific phases that will both be discussed in this document. The first phase of data collection focused on a broader sample with less variable controls and served as a screening experiment to help isolate variables for future phases. The first phase also helped to identify experiments that would be successful indicators of learning in future phases. Experiments included in the first phase were temperature, force, and light and occurred in a variety of locations such as the Human Body Connection, Science in the Park, and the Theater of Electricity. Both IPaq and Palm Pilots were used in this phase with their corresponding versions of CCProbe. The descriptions of these experiments and locations can be found in Appendix B.

In the second phase, two experiments and technology configurations were chosen to be studied in a more controlled manner. Variables such as experiment type, location, concepts being conveyed, hardware, and software were kept constant in each of the two data collection rounds that took place during this phase.

In the first part of the second phase, an experiment for detecting the intensity of light being reflected from varying shades of colors was used in data collection. The description of this experiment can be found in Appendix B. A Palm Pilot equipped with CCProbe software and the light probe were used for all data points. The experiment was always conducted in the same part of the museum, outside of the Human Body Connection.

In the second part of the second phase, an experiment for measuring force when pulling objects of varying weight at varying speeds was used in data collection. The description of this experiment can be found in Appendix B. A Palm Pilot equipped with CCProbe software, the force probe, and the force cart were used for all data points. The experiment was always conducted outside of Science in the Park.

During all data collection processes an interpreter would conduct an experiment with a group of self selected museum visitors while a second interpreter collected observational data according to the protocol assigned on the data collection instrument [see Appendix A]. The interpreter collecting data did not interact with the visitors until the experiment was complete, at which time the interpreter would approach the visitors (if available) to ask the interview questions contained in the second half of the data collection instrument.

Sample: Demographics and Background

Subjects were self selected from the general museum visitor population and represented a sample comparable to the average visitor demographic. Each group interaction contained a varying number of participants.

Phase 1 - Screening

Demographic Breakdown		Percent of Sample
Type of Group	Family	70%
	School	10%
	Individual	20%
Ages of Visitors	0-5 years	8%
	6-10 years	28%
	11-15 years	16%
	Adult	48%
Number of Visitors Per Group	1	20%
	2-3	60%
	4+	20%

In the first phase, a majority (70%) of the group interactions took place with families, while 10% were school groups, and 20% were individual visitors. Sixty percent (60%) of the groups consisted of two to three visitors, while the groups of one and groups of four both represented 20% of the sample.

Almost half (48%) of the visitors comprising these groups were adults, while the remaining sample consisted of children under 15 years. Twenty-eight percent (28%) of the entire sample was made up of children between the ages of 6-10, while children between the ages of 11-15 represented 16% of the sample and children of age five or below only comprised 8% of the sample.

Phase 2, Part 1 [Light Probe Experiments]

Demographic Breakdown		Percent of Sample
Type of Group	Family	72%
	School	14%
	Individual	14%
Ages of Visitors	0-5 years	5%
	6-10 years	35%
	11-15 years	15%
	Adult	45%
Number of Visitors Per Group	1	14%
	2-3	64%
	4+	22%

In the first part of the second phase (light experiment), a majority (72%) of the group interactions took place with families, while school groups represented and individuals

both represented 14% of the sample. Sixty-four percent (64%) of the groups consisted of two to three visitors, while the groups of one and groups of four both represented 20% of the sample.

Almost half (45%) of the visitors comprising these groups were adults, while the remaining sample consisted of children under 15 years. Thirty-five percent (35%) of the entire sample was made up of children between the ages of 6-10, while children between the ages of 11-15 represented 15% of the sample and children of age five or below only comprised 5% of the sample.

Phase 2, Part 2 [Force Probe Experiments]

Demographic Breakdown		**Percent of Sample**
Type of Group	Family	43%
	School	43%
	Individual	14%
Ages of Visitors	0-5 years	0%
	6-10 years	47%
	11-15 years	6%
	Adult	47%
Number of Visitors Per Group	1	43%
	2-3	28%
	4+	28%

In the second part of the second phase (force experiment), an equal percentage (43%) of the group interactions took place with family groups and school groups, while individuals represented 7% of the sample. Forty-three percent (43%) of the interactions only involved one visitor, while groups of 2-3 visitors and groups larger than four visitors both represented 28% of the sample. Visitors aged 6-10 years old represented 47% of the groups, as did adult visitors 16 years or older. The remaining 6% of visitors taking part consisted of 11-15 year olds.

Results & Discussion

Types of Visitors Interested in Handhelds

During all three phases the evaluation focused on collecting data about what types of museum visitors were most interested in using handheld computers during their experience. In order to answer this question we looked at the demographics of our sample and made inferences about those who chose to approach the experiment. As evidenced by the demographic data above, differences could be found between the different types of experiments being performed. For example, during the experiments of phase 1 and phase 2, part 1, a majority (70%) of the groups were families. During phase 1 many of the "Thermal Mapping" experiment was performed most often, which involved an interpretation table where several participants could gather around. During phase 2, part 1, a very similar setup was used to present the light experiment. However during the experiments using the force probe a small standalone pull cart was used with no table. This type of setup made it difficult for more than two people to participate. Also, adults seemed deterred from participating by the prospect of sitting in a pull cart.

We were also interested in learning about the ages of the audience that would most often approach experiments using handheld computers. Because of the high concentration of family groups during the screening experiments and light experiment phase, almost half of the participants were adults. The children taking part in the experiments during these phases had an average age of 8-9 years. During the phase using the force pull cart where school groups represented a greater population we still saw almost half adult participants while the average child age was slightly higher, between 9-10 years. Again, the nature of the force experiment (using a pull cart) may have influenced the ages of the interactions. It should be noted that many of the adults fell into the teenage range rather than the parenting age found in phase one and the light experiments.

Also of interest to this study was the size of the groups participating with the handheld computers. During phase one and the light experiments both samples showed more than half of their groups containing 2-3 members. During the force experiments almost half of the interactions took place with a single individual and an interpreter. As stated previously, the force cart experiment attracted a specific type of visitor, interested in being pulled in a cart.

Interaction & Engagement with Technologies

Usage of technology

During all phases of the evaluation observers were careful to take note of how the visitors were interacting with the technology. Though each phase used the technology in a different way, visitors were always encouraged to handle the probes, handheld computer, and use the stylus to interact with the screen. Overall, visitors were very willing and enthusiastic about using the technology. During most experiments multiple users were

able to take roles using the technologies by dividing up roles. However, in some interactions users were reluctant to use the technology or were too young to interact. Great precaution was used when allowing visitors to interact due to the delicate nature of the hardware. The most common configurations of visitors with hardware during each type of experiment is are listed below:

- Temperature
    - Handheld computer left stationary while one visitor took the temperature of another.
    - Visitor being measured filled in a corresponding worksheet.
- Light
    - One visitor held the stylus while the handheld computer was left on the table.
    - Another visitor held the light probe in place, while a third changed the dataset.
    - All were able to view the data graph

- Force
    - One visitor rode in the pull cart while holding the handheld computer and watching data.
    - Another visitor pulled the cart with the force probe.
    - Subsequently the users would switch places and compare data.

Engagement

Observations were also noted on visitors' engagement with the technology and experiment material. Visitors' quotes were recorded that pertained to their learning, excitement, engagement, or frustration. Observations and quotations are listed for each phase of the evaluation.

<u>Phase 1 – Screening</u>

During the screening phase, engagement was a key issue for determining future rounds of evaluation and experiment design. Through the various experiments, we saw constant levels of excitement and engagement with the handhelds.

- Initial confusion on what buttons to push or where to look
- Most visitors took to the software quite rapidly after the initial confusion and became more and more interested in the data they were collecting
- Younger children were often more interested in collecting more data than their older counterparts
- Many onlookers passing by were interested in how we were using technology
- Family groups tended to stay engaged longer than other types of groups and collect more comparative data between family members

Users also provided windows into their engagement and interest by their expressions during the experiments. Quotations include:

- "Interesting"
- "Wow, look at that!"
  "I want to try!"
- "Wow!"
- "Woah! That was a big one!"

However, not all visitors were as enthusiastic. One visitor, indicating his lukewarm interested in the experiment, asked,

- "Will this take very long?"

Phase 2 – Light Experiments

The light experiment provided a unique opportunity to let multiple visitors interact with the technology at the same time, which enabled heightened engagement between group members. Observations included:

- Young visitors very engaged in the beginning of the experiment
- Young visitors' interest waned later in experiment – not very interested in comparison
- Adult visitors very engaged throughout and would continue the experiment after their young groups members lost interest
- Activity engaged groups with high variance in age and experience

Quotations from the groups during the light experiment were very positive and pertained to both the novelty of the hardware and the data collection itself. Some quotes about the Palm technology included:

- "I've never seen one of those before"
- "You can write on there? Oh my gosh!"

Other quotations coming during the data collection showed visitors' understanding and enthusiasm for the experiment:

- "Wow!"
- "That was really cool, thanks!"

Phase 2 – Force Experiments

During experiments using the force cart interest and engagement were a little more difficult to maintain. Many younger visitors were interested in participating as the cart rider, but were less likely to ask questions and make comparisons about the on-screen data. Observations included:

- Adults reluctant to participate
- Younger visitors drawn to this active type of experiment
- Technical difficulties often made it difficult to keep experiment running smoothly and contributing to waning interest
- Because only one person could watch data change at a time students were unlikely to see data other than their own
- Confusion over force concepts led to lack of interest in some cases

One visitor who seemed very engaged with the experiment but confused with the concepts commented,

- "I don't quite know what this means"

Interest in Using Technology

After completing experiments some visitors were interviewed about their experience. When asked the question, "What did you like most about using the technology?" many users gave similar answers.

Of the nine users from across all samples who answered this question, six (67%) mentioned seeing the data live in graphical form.

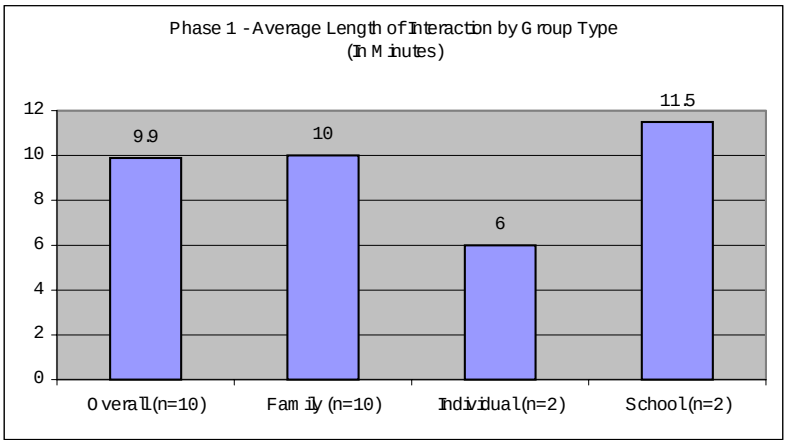
- "I liked that you could actually see the force go up and down and not just hear someone tell you what is going to happen."

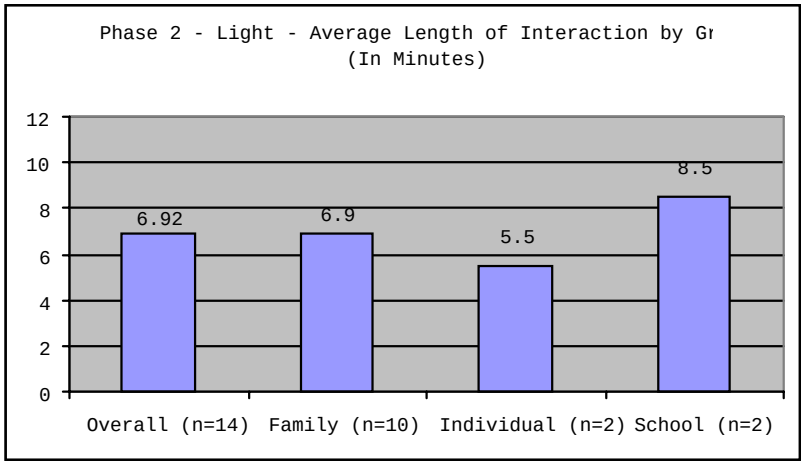
Twenty-two percent (22%) enjoyed using the handheld computer equipment, while one user expressed that he did not understand what the technology was presenting.

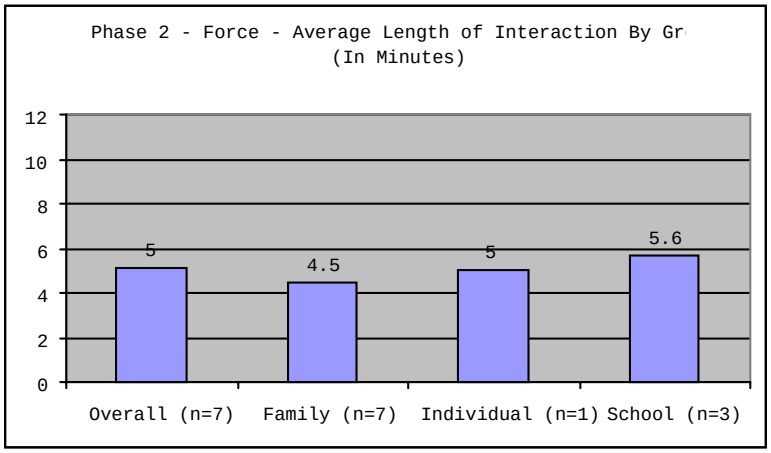
Length of Interaction

Each group interaction was timed in order to gauge interest. The charts below express the differences in interaction time in each experiment between types of group. [Note: During phase 1 many of the experiments involved the thermal mapping experiment, which contained a worksheet that took several minutes to complete]. On average, school groups (which usually contained the most members) stayed the longest, and visitors were

engaged by the experiments during phase one for the longest periods of time. It is interesting to note that all three phases showed an overall average time above that of normal PSEI interactions.







Hardware and Software Issues

Hardware and software issues were noted during all phases of the evaluation. Many of the problems were resolved throughout the process as software versions were improved and hardware adjustments were made. The issues are listed below by type:

Hardware

- Fragile (probes and handhelds)
- Cords easily detach from handheld and stop data stream
- Several wires, interface, and handheld together create cumbersome device

Software (Coding)

- Software anomalies… low batteries, bad readings
- Cut interaction short due to malfunction
- Program error caused reboot and lost data.
- Marking function producing some strange results (same bar over and over regardless of actual measurement, multiple bars per measurement - 2 or 3)

Software (User Interface)

- Kids missed the fact that the actual reading was being displayed above the graph even though it was pointed it out beforehand – they mostly guessed and approximated from the graph
- Hard to find numbers on scale for young students
- A little confusion as to which bar goes with which reading
- Bar graph: didn't understand how the bars were being added on the right and current reading was on the left.
- Axis ranges aren't always saved
- Many problems with visitors touching the wrong part of the screen accidentally

In spite of the various hardware and software issues, when visitors were asked if there were anything they'd like to change about the hardware or software interfaces, none of the visitors answering had any suggestions for change.

How Handhelds and Scientific Software Affect Learning in the Museum Environment

During each experiment observers paid close attention to indicators of learning during the interaction. Visitors' predictions, questions, and comments were noted pertaining to understanding or confusion.

Phase 1 – Screening Experiments

During the first round of evaluation, several different experiments were performed Appendix B for description). During the thermal mapping experiment it was the goal of the interpreter to convey the following concepts:

- Changing body temperature
- Thermal mapping
- Different temperatures on the surface of the skin at different places on the body
- Difference in temperature between individuals
- How thermal imaging is used in medical diagnosis
- Radiant heat

Overall the thermal mapping experiment was quite successful at getting across these concepts, as evidenced in the observations below:

- Even very young children were able to read the graph and make inferences about the data
- After seeing thermal graph images a young girl hypothesized that the scrape on her face would be a higher temp than the surrounding areas
- Young visitors asked "Why?" about data on graph and made predictions about the answers to their own questions
- Visitors made predictions about what areas of their face would be hotter and tested their hypotheses by collecting data
- Visitors made comments such as
    - "I never knew that"
    - "How does that work?"
    - "So my prediction was correct?"
- Example of prediction: "So if your nose was further away, would it be colder?"

Following their interaction, some visitors were interviewed about their experiences. The visitors interviewed following the thermal mapping experiment both seem to have had successful learning experiences, and gave the following answers:

- "How different parts of your body are different temps and why."
- "Why we wear a scarf."

Phase 2 - Light experiments

During the light experiment a variety of concepts were being conveyed about light and graphing, including the following:

- Intensity
- Absorption
- Reflection
- Bar Graphs
- Line Graphs

Over the course of the experiment, visitors were prompted during the interaction to make a variety of predictions pertaining to light and the graph. When visitors were asked how the graph would look moving from one block (the darkest) to another (lighter) block, all made hypotheses and tested them with the software. Some of the predictions and questions included:

- "It should keep going up."
- "It's going to get more stuff – It's going to keep going up"
- "So it should read the highest on the dark?"
- "Would white be way up and black be way down?"
- "It's going to get even more intense"
- "Bar should go up"
- "It will get lower"

During the experiment, visitors also made predictions and observations about why they saw the readings they were getting on the graph:

- "Brighter colors … reflect more light"
- "Light is more attracted to black stuff"
- "Sun's attracted to the dark"
- "Darker colors attract light and light ones don't"
- "Wait, this means that it's absorbing more light? No, less light?"

Visitors were also given the option to make predictions about various colored plates that had similar configurations of light-to-dark colors. Those who tried this part of the experiment made the following comments:

- "You would think that it would be the same (between two different colors)"
- "Is this what actually creates the color too?"
- "Would they be the same?"
- "Blue is reflecting a little bit more"

After visitors collected their bar graph data, they were asked to think about what a corresponding line graph would look like. They were reminded to look closely at the data surface to help them make predictions. (There were sections of black between the colored plates.) Most were able to predict the sharp dips that would occur between their color readings.

Other questions and observations indicative of learning and the visitors' ability to generalize the scientific concepts to outside scenarios noted by the observers were:

- A boy tried reading the light reflected from his shirt
- A woman asked about applications to painting and interior decoration
- "What does lux mean? How does it relate to lumens?"
- "Would the temperature (of the plates) go up too?"

Following their interaction, some visitors were interviewed about their experiences. Though only three responses were obtained to the question, "What did you learn about light through this experiment?" they all showed evidence that the experiment had successfully conveyed the concepts:

- "I Learned about the light absorption and reflection"
- "Darker colors absorb more"
- "I learned two things about light"

<u>Phase 2 – Force Experiments</u>

The force cart experiment was designed in order to teach visitors about:

- Friction
- Force
- Gravity
- How force changes with:
  - Speed
  - Angle
  - Weight

Visitors engaging in the force cart experiment seemed to have varying levels of understanding from their interactions. While some visitors understood the concepts and made good predictions about the graph, others were confused.

- Visitor noticed the graph reach a constant force and explained that it reaches the point where no extra energy can be put in

- Visitor described graph well, “It went down sharply, then leveled off and back down again.”
- Changed pulling speed to test differences
- “A big pull would do more.”

- When asked what the zigzag graph meant, a young visitor said that she had no idea
- Visitor thought of force as energy
- Was confused why it went down and not up, thought that it should have gone up
- “I don’t quite know what this means”

When visitors who took part in the force cart experiment were asked, “What did you learn about force through this experiment?” three of the six respondents gave answers that indicated an understanding of the concepts. The others indicated that they were confused or did not understand.

- “If you pull harder, the graph will go lower.”
- “Weight or rate of pull effects the force needed.”
- “More force to pull at first, then it levels off as overcame friction.”

- “I don’t know.”
- “It went down.”
- “I thought a hard pull would make graph go up, but it went down. Different than what I expected”

Graphical Display

Eleven participants of the entire sample were asked, “Did you understand the way the data was presented on screen?” following their interactions with interpreters. Of this sample, 82% answered yes. The 18% that did not understand the way the data was presented on screen were both taken from Phase 2 – Force Experiments.

Recommendations

Types of Visitors Interested in Handhelds (Age, Type of Group)

With the exception of the force cart experiment, many of the handheld interpretations attracted a large number of family groups and adults. Handheld program developers should consider harnessing this interest by strategically using handheld technologies during hours and days when family groups make up the largest portion of the museum population. Adult interest should also be kept in mind when creating adult oriented events. In order to attract more school groups, program developers should consider using the handhelds in a more controlled environment with more measurement units, and possibly create tie-ins with current science curriculum.

Interaction & Engagement with Technologies (Time Spent)

Usage of technology

Visitors were very engaged and eager to use the handheld technology. The technologies were successfully integrated into each type of experiment and allowed for greater interaction between interpreters and visitors. Program developers should consider continuing to design interactions where multiple users are able to use different pieces of the technologies to work towards a common goal of an experiment.

Engagement

Visitors were initially attracted to the novelty of the software, yet were slightly timid about interacting with the software. However, once this initial novelty and apprehension subsided users became engaged on a variety of levels. Program developers should consider integrating handheld technologies into more facets of museum programming in order to spark more enthusiasm and engagement.

Interest in Using Technology

A majority of users answering the question, "What did you like most about using technology?" mentioned seeing the live graphical data on screen, while a small percentage mentioned using a handheld computer. This suggests that users are interested in what the technology can bring to their learning experience beyond the novelty of using a new piece of hardware. Program developers should consider incorporating other types of handheld software that would allows users to interact with live data and create and test hypotheses of their own.

Length of Interaction

Overall, visitors remained engaged for a considerable length of time, though this varied from experiment type to experiment type. When designing experiments involving

handhelds, program developers should consider the affect that the specific activities of that experiment have on the length of time visitors will have to spend during the interaction.

Hardware and Software Issues

Hardware and software issues were one of the major factors contributing to the success or failure of a given interaction. Users would often lose interest in an experiment or become frustrated when hardware or software elements would malfunction. If this program was to be implemented more regularly on a larger scale a more robust hardware and software system should be implemented. Specific recommendations for hardware, and software, and user interface include:

Hardware

- Develop a more compact hardware interface between handheld and probe hardware
- Create cords that are shorter and are more difficult to disconnect from the unit
- Develop a more robust handheld with a protective casing
- Incorporate neck-cords into the design that connect to the handheld and prevent dropping
- Connect the stylus to the unit to prevent misplacement

Software (Coding)

- When final version is completed and bugs have been worked out, include error checks that would result in experimenter being kept in the same program with the same data rather than rebooting or closing program.

Software (User Interface)

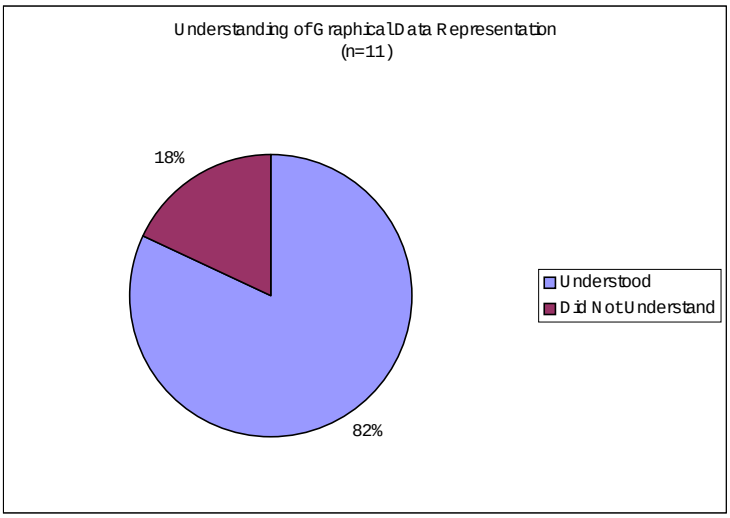
- Less buttons and hotspots on user interface
- Create more intuitive buttons so users can take full advantage of software functionality
- Create "lock" button for the interface that disables all buttons and interactions until unlocked in order to prevent loss of data
- Change bar graph marking function to a more intuitive system (e.g. Bars are saved in the position where they were marked and new bars appear to right instead of left)
- Make important information stand out more (e.g. Current reading from probe)

How Handhelds affect Learning in the Museum Environment (Conceptual Understanding, Fringe Benefits)

During each of the phases of the evaluation, it was noted that the introduction of the handheld and graphing software had an overall positive effect on learning. In all types of experiments concepts were correctly conveyed in most instances. Visitors were also successful at making and testing hypotheses using the technology. Program developers should consider incorporating handheld technology and accompanying software into facets of museum education to utilize its positive influence on learning. Experiment creators should also consider including carefully scaffolded prompts to aid users in creating and testing hypotheses.

Graphical Display

A large majority of visitors interviewed following their interactions expressed an understanding of how the graphical data was presented on screen. Program developers should consider using this powerful data representation in other programs where quantitative data can be collected and analyzed.



Appendix A - Observation Template and Questionnaire

Prototyping Questionnaire

This questionnaire is meant to accompany prototyping activities with the handheld hardware and software developed by the Concord Consortium in its testing phases in the PSEI department of the Museum of Science. It should be filled out during and after prototyping activities and should hopefully include some visitor feedback (pg. 2).

- Hardware Used in Prototyping (type of probe):

_____

2. Type of Group (School/Family/Organization)

_____

3. Ages of Visitors:

_____

4. Location of Interaction

_____

5. Length of interaction (in minutes)

_____

6. Number of Visitors taking part in the interaction

_____

7. Concepts being conveyed during interaction and theme of experiment

_____
_____
_____
_____

8. Notes about visitor response (include “wow moments”, confusion, attention, onlookers, who’s got control of the probe and computer, problems/issues ... etc)

_____
_____

_____
_____
_____
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_____
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_____

Questions for Visitors (can be asked orally or given to teen/adult visitors to complete)

9. What did you like the most about using the handheld computer today?

_____
_____
_____
_____

10. Did you understand the way the data was presented on the screen?

Yes No

If no, why?

_____
_____
_____

11. What did you learn about [the subject matter presented such as light, temperature, etc] through this experiment?

_____
_____
_____
_____

12. Do you have any suggestions as to how we could make your experiences with the handheld computers better?

_____
_____
_____
_____
_____
_____

Appendix B - Experiments Used in Observations

Light Absorption and Reflection

Materials:

- Three black plates with five colored plates attached to each. (The five colored plates on each black plate progress from lightest to darkest. Three different colors were used in making the black plates: Red, Green, and Blue.)
- Light Probe
- Handheld Computer
- CCProbe Software
- Lamp

Procedure:

Up to three visitors could have a role in the experiment, one controlling the stylus and marking the data graph, one changing the colored plates, and one holding the light probe. Initially visitors were asked about what they knew concerning light absorption and reflection. Prompts sometimes followed such as "Do you know what types of clothes we are supposed to wear in the summer? Why?". Next, visitors were familiarized with the interface and were shown how the light probe responds to darkness and brightness. Next, the visitors would start by collecting data on either the lightest or darkest of the color plates. Subsequently they would make predictions as to how the next color plates would read on the graph. They were also asked to predict why this would happen. After collecting all of the data in bar graph format, visitors were then asked to predict what the corresponding line graph would look like.

After this phase of the experiment the concept of reflection and absorption were reviewed and visitors had the option to try another set of color plates to test the differences in reflection and absorption between the same intensities of different colors.

Lightning Show

Materials:

- Light Probe
- Handheld Computer
- Theater of Electricity Lightning Show

Procedure:

A visitor was approached and asked if they would like to measure the intensity of light from the sparks created in the theater. First, the visitor was familiarized with the interface and were shown how the light probe responds to darkness and brightness. Over the course of the show the visitor collected data and compared different size sparks with the readings on the graph.

Force Cart

Materials:

- Handheld Computer
- Force Probe
- Force Cart

Procedure:

One visitor was asked to sit inside the force cart while the other pulled using the force probe. First, visitors were familiarized with the interface and were shown how the force probe responds to negative and positive forces. The visitor sitting in the cart held the handheld computer and watched as the data changed. The visitor holding the force probe was asked to go slower, faster, change direction, and do anything else they thought might make a change on the force graph. They then had the chance to look at the data over the course of the experiment to test their hypotheses. Visitors were given the option to switch positions to see how different weights would affect the force.

Thermal Mapping

Materials:

- Handheld computer
- Temperature probe
- Thermal mapping worksheet (map of face with different circled regions, and temperature – color key.
- Markers
- Pictures of thermal maps used in medical diagnosis
- Alcohol and cotton to sanitize probe

Procedure:

First visitors were explained the concept of a thermal map, and were offered the thermal mapping worksheet. Next, visitors were familiarized with the interface and were shown how the temperature probe responds to hot and cold. Next, one of the older visitors or the interpreter would being measuring the temperatures of different areas on the face of the visitor completing the worksheet. All visitors would watch the temperature graph and decide the reading together. Then the reading from the graph would be converted into a color using the temperature-color key on the worksheet, and the visitor being measured would color in the area of the worksheet corresponding with the data collected. Visitors would then continue taking readings and filling in worksheet areas. After visitors were done with the worksheet or were ready to move on they were shown the pictures of thermal maps of injuries and explained whey some parts of the boy become hotter and how doctors can use that information to diagnose problems.