Open exhibits

Research Report: Wall versus Table Form Comparison

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EXECUTIVE SUMMARY

This reports details the findings of a comparison between a multitouch interactive wall display and a multitouch table display. The research was done as part of the *Open Exhibits* project, a National Science Foundation funded project (#1010028) designed to develop, test, and disseminate a suite of original, open source, multitouch-enabled, exhibit software. The project goal was to transform the ability of museum professionals to assemble interactive computer-based exhibits for use in museums under the leadership of Principal Investigator Jim Spadaccini, Founder/CEO and Creative Director of Ideum, Inc., a company that develops commercial software and multitouch hardware primarily for museums and other public spaces.

The *Open Exhibits* project includes hardware and software development, an online community of practice, and research studies aimed at understanding the impact of multitouch technology in museum exhibitions. In order to investigate how the format of a multitouch display impacts a visitor's experience, cued testing of a multitouch wall screen and multitouch table was conducted.

One potential of the multitouch table the research team explored is whether the table as a format is more social experience for visitors than the same content if it were shown in a multitouch vertical environment, i.e. hanging on a wall. This cued study was New Mexico Museum of Natural History and used a controlled condition to review the same content within the Collections Viewer in both a horizontal and vertical format. Both devices were running the same Open Exhibits (OE) software.

KEY FINDINGS

The median time spent at the different devices was similar; however, the range of use time was greater for the Wall. The sample at the Wall also demonstrated a lower minimum and higher maximum use time, i.e. there were a greater ranges of time spent at the Wall. Participants at the two devices also demonstrated similar behavior. While in this study, there were slightly more social behaviors on the Table over the Wall, independent t-tests found no statistically significant difference between the number of those social behaviors, or in participants' ratings of how interesting the content on the devices was.

The majority of participants in both samples indicated that they had learned something from using the display. Interestingly, a larger proportion of the Table sample thought there was a main message to the content on the display. However, chi-square tests indicate that there was no difference between wall and table users' perceptions of a main message or learning (ps>.05).

We believe that the lack of these differences might vary by type of content. The content test here was an open-ended fossil collections-viewing activity. A game, time-line or map-based interactive may or may not produce the same results.

METHODOLOGY

Between December 15, 2012 and January 14, 2013 data was collected from museum visitors interacting with either an Ideum multitouch wall screen or Ideum multitouch table. Both devices were running the same Open

Exhibits (OE) software. Focused observation, and semi-structured interview data was collected by one evaluator at New Mexico Museum of Natural History and Science (NMMNHS).

Visitors ages 7-85 were eligible to be observed and interviewed. The researcher recruited participants using a continuous random sampling method by imagining a line at the entrance of the museum and asking the next eligible visitor who crossed the line to participate in the research study. Once a visitor agreed and signed the consent form, the researcher and participant walked over to the multitouch device. The researcher then started her stopwatch and unobtrusively observed the participant while he/she used the multitouch wall or table. When the visitor was finished interacting with the display, the researcher conducted a brief semi-structured interview, which concluded the visitor's participation in the study. The researcher then returned to the entrance to wait for the next eligible visitor to cross the imaginary line.

MULTITOUCH DISPLAYS

On the MT wall/table were 4-7 dual-sided virtual cards which contained an image on one side and text on the other. They could be turned over by pressing a virtual button (*i*) on the card. The cards also had a virtual close button (x), that when pressed would cause that card to disappear from the screen and be replaced by another card that would fly in from the side of the screen. There also was a non-interactive timeline graphic along the bottom of the screen (see Figure 1).

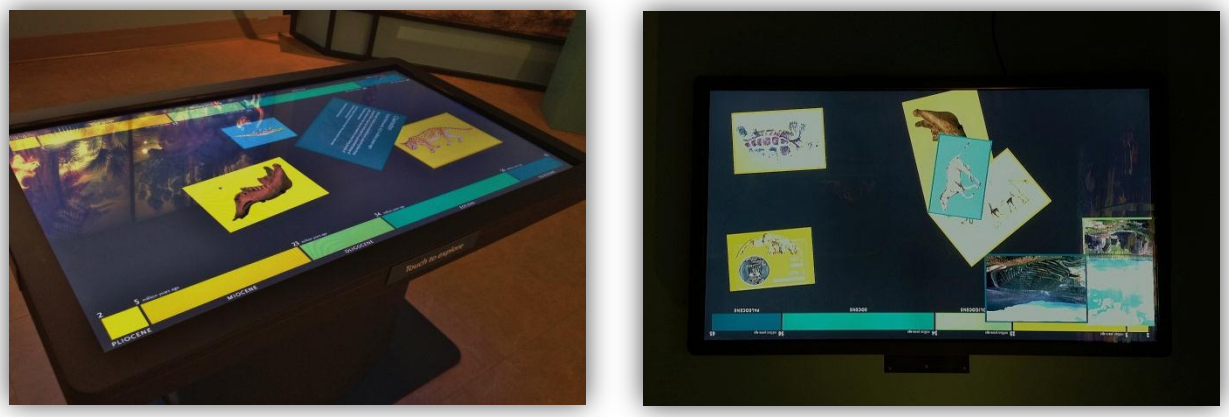

Figure 1: Multitouch table (left) and multitouch wall mounted screen at NMMNHS

RESULTS

Overview

Focused observations and interviews were collected from a total of 60 museum visitors, 30 at each MT device. Except for their gender makeups ($\chi^2(1, N=60)=5.46, p<.05$), the samples were very similar. Ages of participants ranged from approximately 7 to 71, and the median age was about 23. And while there was some ethnic diversity in the samples, the majority of participants self-identified as non-Hispanic White (see Table 1).

Table 1: Demographics

	N	Sex (F/M)	Age (Min/Max)	Median Age	Race/Ethnicity (White)
MT Wall	30	70% (n=21)/ 30% (n=9)	7/71	23.5	63.3% (n=19)
MT Table	30	40% (n=12)/ 60% (n=18)	8/71	23	66.7% (n=20)

The median time spent at the different devices was similar; however, the range of use time was greater for the MT wall. The sample at the MT wall also demonstrated a lower minimum and higher maximum use time (see Table 1).

Participants at the two devices also demonstrated similar behavior. Independent t-tests found no statistically significant difference between the number of social behaviors exhibited at the MT devices, or participants' ratings of how interesting the content on the devices was (*p*s > .08) (See Table 2).

Table 2: MT Display Use

	N	Time (Min/Max) (mm:ss)	Median Time (mm:ss)	Exhibited Social Behavior†	Interesting Rating† *(1=not very, 7=very)*
MT Wall*	30	0:36/21:19	4:39	83.3% (n=25)	*M* = 5.83
MT Table	30	1:11/15:15	5:01	93.3% (n=28)	*M* = 5.60

*N=29 for time statistics
†NS

The most and least popular social behaviors exhibited were similar among the two devices. For both the MT wall and MT table, the most common social behaviors were watching another visitor use the surface, discussing a concept, and calling attention to content; the least common social behaviors were calling attention to technology, interacting with visitors outside the group, and making negative statements about surface technology. It is also interesting to note that more interaction between visitors in different groups occurred at the MT table.

Answers provided during the semi-structured interview were also similar among participants who used the different devices. A majority of both samples were surprised by the devices' technology. When asked about what they enjoyed the most, both samples mentioned aspects of technology and content. Participants in the two samples reported being confused about how to use the table, or about nothing at all. When asked for suggestions for improvement, most participants in both samples offered suggestions about table features/functionality.

The majority of participants in both samples indicated that they had learned something from using the display. Interestingly, a larger proportion of the MT table sample thought there was a main message to the content on the display. However, chi-square tests indicate that there was no difference between wall and table users' perceptions of a main message or learning (ps>.05).

Multitouch Wall

Data was collected from 30 visitors between December 15, 2012 and January 4, 2013. Participants' ages (estimated from year of birth) ranged from 7 to 71. The median age was 23.5. Females accounted for 70% (n=21) of the observations/interviews, and males accounted for the remaining 30% (n=9).

Participants visited the museum in groups that ranged from 0 to 5 other people. The median number of companions was 1, and 84% (n=42) of companions were at least 18 years of age or older.

There was some racial/ethnic diversity in the sample, but the majority of participants were White (63.3%, n=19) (see Table 3).

Table 3: Sample Race/Ethnicity

	n
White	63.3% (n=19)
Latino(a) or Hispanic	16.7% (n=5)
Asian / Asian American	6.7% (n=2)
African American/Black	3.3% (n=1)
American Indian/Native Alaskan	3.3% (n=1)
Multiple ethnicities	3.3% (n=1)
Prefer not to answer	3.3% (n=1)

Half of the participants had visited the museum before (50%, n=15), and the other half had not. Among those who had visited before, the median number of visits in the last year was 1.

Participants were asked to indicate how often they visited museums, zoos, or aquariums, and most reported visiting monthly or 3-5 times a year (see Table X). Therefore, most participants visit informal learning institutions with some regularity.

Table 4: Museum, zoo, or aquarium visit frequency

	n
First time	0
Monthly	23.3% (n=7)
3-5 times a year	60% (n=18)
Once a year	6.7% (n=2)
Less than once a year	10%, (n=3)

Despite being somewhat regular visitors to informal learning institutions, most participants had not used a MT wall screen before (83.3%, n=25), and only 24% (n=6) of non-users had ever seen one before.

Time spent using the MT wall ranged from 36 seconds to 21 minutes and 19 seconds. The median time was 4 minutes and 39 seconds (n=29; time was not recorded for 1 P).

Participants found the table content to be slightly interesting (Mean=5.83) on a scale from 1 (not very interesting) to 7 (very interesting).

Focused observations of participants using the MT wall were made for a variety of social and non-social behaviors. While using the MT wall, 83.3% (n=25) participants engaged in at least one social behavior (see Table 5 for breakdown). The most popular social behaviors included watching another visitor use the surface, calling attention to content, and discussing a concept. The least popular included calling attention to technology, making negative statements about technology, and interacting with a visitor outside the group. It is interesting to note that the social behaviors recorded took place within a group, not between groups.

Table 5: MT Wall Behaviors

Nonsocial Behaviors	n	Social Behaviors	n
Turns item over (photo to text or vice versa)	90% (n=27)	**Watches another visitor use the surface**	50% (n=15)
Resizes an item (i.e., makes bigger or	83.3%	**Calls attention to/ points at content in**	46.7%

smaller)	(n=25)	**exhibit**	(n=14)
Emotionally reacts to exhibit: Positive (smiles, laughs, etc.)	63.3% (n=19)	**Discusses a concept (facilitate learning)**	43.3% (n=13)
Moves objects around for fun (drag, twirl, toss, resizing, etc.) (P1)	53.3% (n=16)	**Makes positive statements about surface technology**	26.7% (n=8)
Emotionally reacts to exhibit: Negative (frustration, disappointment, etc.)	10% (n=3)	**Reads aloud to another person**	16.7% (n=5)
Makes connection between surface content and the overall exhibition	3.3% (n=1)	**Helps/assists/instructs (how to use, do something)**	10% (n=3)
		Calls attention to/ points at technology in exhibit	6.7% (n=2)
		Makes negative statements about surface technology	3.3% (n=1)
		Interacts with visitor outside the group	0

[N=30]

After the observation period, participants were asked about their experiences using the MT wall.

Participants were asked what they found surprising about the MT wall display, and the most of the respondents (60%, n=20) indicated that their surprise stemmed from the table's technology. Examples are as follows:

- *That you could manipulate things. That made it more interactive than just pushing a button. It made content more interesting.*
- *How you could get rid of one thing and a new thing would come up.*
- *How sensitive it is to touch. Pinching it causes it to zoom.*
- *That it's so perfectly organized and perfectly calibrated.*

When asked what they enjoyed most about the MT wall, half of the respondents (50%, n=15) indicated that they enjoyed the content most. Other respondents indicated that they enjoyed the technology the most (23.3%, n=7), and the remaining respondents (26.7%, n=8) reported enjoying aspects of both the content and the technology. Examples of answers follow:

- Content
  - *I guess the information you got about different animals. Seeing pictures of different things.*
  - *Probably reading about all the animals and stuff.*
  - *Probably identifying what time frame some of these animals came from.*
  - *Learning about older animals.*
- Technology
  - *That it was interactive. You could move around, click through.*
  - *That I got to slide them around and see new pictures after you slide one away.*
  - *Changing the size of the pictures, because it's fun.*
- Content & Technology
  - *The information. The historic aspect of it combined with today's technology.*
  - *I enjoyed how responsive it is and the information.*
  - *The information and photos. Both giving information about what you're reading about and background. I like that it's not overloaded. You can close images to get new ones.*

Participants also were asked whether they found anything about the MT wall confusing. No clear majority answer emerged, and some respondents' answers fit into more than one category. The two most common

categories into which respondents' answers fell were not being confused at all (43.3%, n=13), and being confused about how to use the MT wall display (43.3%, n=13):

- *The only first part was how to change the pictures. I had to learn how to kinda use it.*
- *Um, besides the fact that I couldn't figure out what to touch? It seems that what comes up is random as opposed to me being able to control what comes up.*
- *I thought the bar at the bottom would be functional. That by pressing the bar, the tiles would change to show items from that time period.*
- *Yes. What I was supposed to do? It didn't give me any directions.*

When asked how the MT wall display could be improved, some respondents' answers fit into more than one category. A little over half of the respondents (56.7%, n=17) made suggestions about table features and functionality. Some respondents suggested providing instructions (33.3%, n=10), and the remaining respondents did not provide any suggestions (16.7%, n=5). Examples of provided answers are below:

- Features/functionality
    - *I didn't really see an option to have a whole new set of slides, or how to change them. I didn't know how they kept showing up, so an option for that. Maybe a button to come up with a new set of slides.*
    - *If there was more stuff. If timeline eras popped up menus of images to choose from.*
    - *Being able to see image and text all at the same time. If when reading something, the appropriate place on timeline would highlight.*
- Instructions
    - *Direction or a menu that tells you how to use it.*
    - *Some directions as far as purpose of display and what we're supposed to find out.*

Participants also were asked what they would ask the MT wall display developers, if given the opportunity. One answer fell into two categories, and no clear majority answer emerged. Some respondents wanted to know about display content (36.7%, n=11), some were interested in knowing more about features and functionality (33.3%, n=10). A few indicated that they had nothing to ask developers (20%, n=6), and a minority inquired about the purpose of the display (13.3%, n=4). Example answers follow:

- Content
    - *Why did he pick the certain photos he has on here, all the information?*
    - *Did he see the bones himself or are they just pictures?*
- Features/functionality
    - *Why did he put the timeline? I didn't get why he put it there. Because when you touch it nothing happens.*
    - *If there was a way, so when you close, if not just random things come out. To have more control.*
- Purpose
    - *I guess I'd ask what they were hoping visitors would get out of it.*

When asked whether there was a main message to the content on the MT wall display, 46.7% (n=14) thought that there was, 23.3% (n=7) thought that there was not a main message to the content, and 30% (n=9) were not sure. Some explanations given were as follows:

- Yes
    - *About what has been found, and where it fits into archeological time frame. Also connecting it to New Mexico. But it's subtle, not very clear message.*
    - *Just to give information about animals/dinosaurs from earlier eras.*

    - *There is a message. I think it's trying to get us to recognize some of these things and correlate them with the dates they were here.*
- No
    - *It's just old stuff.*
- Not sure
    - *Just a different way of presenting information.*
    - *Other than the fact that it's fossils from this time period. I don't know that there's a main message.*

Finally, participants were asked whether they learned anything new from the MT wall display. The majority indicated that they had learned something (83.3%, n=25), and the rest indicated that they had not (16.7%, n=5). Examples of explanations are as follows:

- Yes
    - *Oh yeah. I was not aware of all of these animals. Some I'd seen before, some I hadn't.*
    - *Yeah. I learned about the animals. The time span and the different animals. It was interesting.*
    - *Yeah. I learned little facts of natural history. Very user friendly. You learn without realizing you're learning.*
    - *Yes. I learned how to use a touch screen. All the info is either new or refresher.*
    - *Yes. That we've been around for a long time. Definitely learned about our state.*
- No
    - *No. I didn't use it long enough. I was just trying it out, not looking to learn anything.*
    - *Not really.*

Multitouch Table

Data was collected from 30 visitors between January 4, 2013 and January 14, 2013. Participants' ages (estimated from year of birth) ranged from 8 to 71. The median age was 23. Males accounted for 60% (n=18) of the observations/interviews, and females accounted for the remaining 40% (n=12).

Participants visited the museum in groups that ranged from 0 to 3 other people. The median number of companions was 1, and 87.2% (n=41) of companions were at least 18 years of age or older.

There was some racial/ethnic diversity in the sample, but the majority of participants were White (66.7%, n=20) (see Table 6).

Table 6: Sample Race/Ethnicity

	n
White	66.7% (n=20)
Latino(a) or Hispanic	20% (n=6)
African American/Black	3.3% (n=1)
Multiple ethnicities	10% (n=3)

Most participants had visited the museum before (66.7%, n=20). Among those who had visited before, the median number of visits in the last year was 1.

Participants were asked to indicate how often they visited museums, zoos, or aquariums, and most reported visiting monthly or 3-5 times a year (see Table 7). Therefore, most participants visit informal learning institutions with some regularity.

Table 7: Museum, zoo, or aquarium visit frequency

	n
First time	0
Monthly	13.3% (n=4)
3-5 times a year	56.7% (n=17)
Once a year	6.7% (n=2)
Less than once a year	23.3% (n=7)

Despite being somewhat regular visitors to informal learning institutions, most participants had not used a MT table before (86.7%, n=26), and only 3.8% (n=1) of non-users had ever seen one before.

Time spent using the MT table ranged from 1 minute and 11 seconds to 15 minutes and 15 seconds. The median time was 5 minutes and 1 second.

Participants found the table content to be slightly interesting (Mean=5.60) on a scale from 1 (not very interesting) to 7 (very interesting).

Focused observations of participants using the MT table were made for a variety of social and non-social behaviors. While using the MT table, 93.3% (n=28) participants engaged in at least one social behavior (see Table 8 for breakdown). The most popular social behaviors included watching another visitor use the surface, discussing a concept, and calling attention to content. The least popular behavior was making negative statements about technology.

Table 8: MT Table Behaviors

Nonsocial Behaviors	n	Social Behaviors	n
Turns item over (photo to text or vice versa)	93.3% (n=28)	**Watches another visitor use the surface**	66.7% (n=20)
Resizes an item (i.e., makes bigger or smaller)	86.7% (n=26)	**Discusses a concept (facilitate learning)**	53.3% (n=16)
Emotionally reacts to exhibit: Positive (smiles, laughs, etc.)	76.7% (n=23)	**Calls attention to/ points at content in exhibit**	40% (n=12)
Moves objects around for fun (drag, twirl, toss, resizing, etc.) (P1)	36.7% (n=11)	**Helps/assists/instructs (how to use, do something)**	30% (n=9)
Makes connection between surface content and the overall exhibition	10% (n=3)	**Makes positive statements about surface technology**	30% (n=9)
Emotionally reacts to exhibit: Negative (frustration, disappointment, etc.)	6.7% (n=2)	**Reads aloud to another person**	23.3% (n=7)
		Calls attention to/ points at technology in exhibit	16.7% (n=5)
		Interacts with visitor outside the group	13.3% (n=4)
		Makes negative statements about surface	3.3%

	technology	(n=1)

[N=30]

After the observation period, participants were asked about their experiences using the MT table.

When asked what they found surprising about the MT table, some participants gave answers that fit into more than one category. The majority of participants mentioned the table technology (73.3%, n=22), some indicated they were surprised by the table content (20%, n=6), and a minority indicated that they were not surprised by anything (13.3%, n=4). Examples of answers are as follows:

- Technology
  - *That it was so interactive, and it draws people in. Usually with these you see one or 2 people, but here people gravitated towards it.*
  - *The technology. The speed at which it comes up. How it flips easily from pressing 'i'.*
  - *That it was all touch screen and you could move it and do whatever you want with it. You can pick what to look at.*
  - *That the timelines aren't interactive. Expected objects to pop up from the time frames.*
  - *Just the way it operated. I'd never seen anything like it before.*
- Content
  - *That it was color-coded to show different time period for each fossil or animal.*
  - *Probably the facts. Like how interesting they were.*

When asked what they enjoyed most about the MT table, no clear majority emerged. Some participants reported enjoying aspects of the table technology (46.7%, n=14), and others reported enjoying the content on the table (33.3%, n=10). The remaining participants reported enjoying both the content and the technology (20%, n=6). Examples of answers are as follows:

- Technology
  - *That it's user-friendly. It's easy to go back and forth from text to picture. It was easy to scale up/down.*
  - *Just messing around with it. Enlarging the pics, and more info coming in. Just fooling around with it. Because I never used one before.*
  - *I liked how you can move it and make it bigger/smaller. That was fun.*
- Content
  - *The different animals that were there, and that it was in New Mexico, too.*
  - *The natural formations, learning about them and seeing them.*
- Technology & Content
  - *It was very interactive. You can enlarge images, and it's still very clear. Informative. I like that it says where it is (i.e., mentions location of objects).*

Participants also were asked if they found anything confusing about the MT table display. No majority category emerged from the answers. The two most common answers were being confused about how to use the display (46.7%, n=14), and not being confused at all (43.3%, n=13). Examples of answers describing how participants were confused about how to use the display are as follows:

- *Yes. It seemed so random. If you close by accident, there's no way to recover. It took a while to figure out.*
- *At first it was a little bit confusing how it turned bigger/smaller.*
- *It was confusing because I didn't know how to work it at first.*

- *Yes. I thought I was clicking on 'i' button, but it wasn't doing anything. I thought you could press on one of these periods and you'd get info from that period.*

When participants were asked to describe ways in which the table could be improved, some respondents gave answers that could be grouped into more than one category. The majority of participants made a suggestion about the table features/functionality (73.3%, n=22). Some respondents indicated that instructions would be useful (33.3%, n=10), and a minority did not provide any suggestions for improvement (10%, n=3). Examples of answers are as follows:

- Features/functionality
    - *Maybe it could show videos of how it moved, hunted, animals' normal day.*
    - *It's perfect. Maybe sounds (animal sounds or pronouncing the names).*
    - *Making it easier to control. Make timeline interactive. Have stuff from that time period come up when you touch it.*
    - *If it told you where animal was in mural. I would like to be able to see on a map where things are. If you could choose to see landscapes or animals. Press time period and have images pop up from there. Have new images pop up from time period instead of corner. I would prefer to see images from one time period only at a time.*
    - *Instructions about color-coding. She'd like to be able to see objects chronologically by picking from timeline. I'd like little picture icons on timeline so I know if I've seen it all.*
- Instructions
    - *Somewhere to get some help. How do I do this? Something like an overview, and then you drill down in content. It's an excellent start.*
    - *If there was a bigger sign. I didn't see 'touch to explore' sign.*
    - *Maybe a brief set of instructions.*

Participants also were asked what they would ask the developer of the MT table if they were given the opportunity to do so. No clear majority emerged, and some participants' answers could be grouped into more than category. Half of the respondents indicated that they had nothing to ask the developers (50%, n=15). Of the remaining answers, 33.3% (n=10) mentioned wanting to ask about table features/functionality, and 13.3% (n=4) mentioned table content. Examples are as follows:

- Features/functionality
    - *How did they program the pictures into it? How can you make it bigger and stuff?*
    - *What's the pattern behind why it feeds you new images. Why isn't there a pattern?*
    - *Why did he put these age brackets around table if it doesn't do anything?*
- Content
    - *How many items are there per section? And why did they choose those items?*

When asked whether they thought there was a main message to the content on the display, the majority of respondents indicated that they thought there was (n=60%, n=18). A few respondents thought that there was not a main message to the content (23.3%, n=7), and a minority of respondents were not sure (16.7%, n=5). Examples of explanations provided are as follows:

- Yes
    - *It was helping kids learn when animals were here, when they were back then. And how similar they are from back then to today.*
    - *Local natural history. We noticed everything was from New Mexico.*
    - *These are all fossils, and it's color-coded and tells you how old they are.*
    - *Just time periods and stuff based on this room. Post-dinosaur mammalian world.*
- *No*

- *Looking at old animals and history, but no real theme.*
- *No. just descriptive of certain things.*

Participants also were asked whether they learned anything new from using the MT table display. The majority of respondents reported that they had learned something new (80%, n=24), while the remainder reported that they had not or weren't sure (20%, n=6). See below for examples of answers:

- Yes
  - *Yes. I learned about the animals, when they were here and what happened to them, and how long ago they were there.*
  - *Yeah. We learned about the little cat and the little horse.*
  - *Yeah. The technology is coming down to a level that it can be used by kids, in a place like this.*
  - *The species that lived back then look like what they do now (like hippo thing). Yeah, that there were weird-looking dinosaurs.*
  - *Yes. Some of those natural landscape formations.*
  - *Yes. Different finds during different time periods in New Mexico.*
- No
  - *No. I didn't really read much. I mostly looked at pictures. I clicked on things I already knew about.*
  - *Not really. Because it's a lot coming at you. I don't feel like sitting down and reading each one because it's so random you can't focus on one thing.*
  - *Not really. I was just looking at stuff. I wasn't trying to study it.*

CONCLUSIONS

- Either device could potentially be successfully used in museum exhibitions.
- Time spent using the two devices was similar, but the time spent at the wall was more variable.
- Number of social behaviors exhibited at the two devices was not statistically different.
- Participants found the two devices' content equally slightly/somewhat interesting.
- Interacting with visitors in other groups was uncommon for both wall and table users; however, there was not a lot of opportunity for this to happen.
- Both wall and table users indicated that they had learned something from using the display.