



Impact Planning, Evaluation & Audience Research

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Formative Evaluation: CENTC Multi-touch Table

Prepared for
Liberty Science Center
Jersey City, NJ

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SUMMARY AND RECOMMENDATIONS

INTRODUCTION

The following narrative summarizes findings from a formative evaluation of the CENTC multi-touch table conducted by Randi Korn & Associates, Inc. (RK&A) for Liberty Science Center (LSC). The evaluator observed visitor groups using the touch table in the *Energy Quest* exhibition and then interviewed groups afterwards. The summary and recommendations here present the most salient findings. Please read the principal findings section for a detailed account of the evaluation findings.

SUMMARY

The CENTC touch table was a highly engaging exhibit. During the evaluation, it was almost always in use. While a few visitors—often young children—approached the table and simply played with the molecules in the middle unintentionally, the majority used the exhibit correctly and often dwelled at the exhibit for quite a while. The majority of the visitors who stopped at the exhibit completed a molecule, and several completed all the molecules.

The functionality of the touch table was intuitive to most, and especially to children. Only a few visitors were observed struggling with the click and drag technology, and no interviewees reported it as an issue. There were several visitors, however, that tried dragging molecules to the main menu without selecting a molecule to work on, likely because they did not notice the instructions. Additionally, there were a few interviewees who did not seem to know that there were multiple stations. None of these issues seemed to impair visitors' enjoyment of the exhibit. One thing that did seem to impair visitors' enjoyment though was the inadvertent closing of the molecule. The “are you sure you want to start over” option introduced on the second day of testing remedied the matter.

In completing the activity, most visitors understood that they used molecules to make other molecules or to make a product. However, few visitors understood what the exhibit has to do with crude oil. Exhibit developers should include the word crude oil on all of the final product screens (not just two of the six) and include a text panel near the touch table that discusses crude oil to emphasize the content. While this text may still be overlooked by children who tend to read little in exhibitions, it is likely to be conveyed by adults facilitating the activity.

RECOMMENDATIONS

- ◆ Make the stations more visibly distinct. For instance, consider using colors with greater contrast or put a border around each station.
- ◆ Keep the prompt, “Are you sure you want to start over?” upon selecting the “menu” button. Also insert a similar prompt when they select “exit” in the main menu.
- ◆ Move instructions that currently appear at the bottom of each station's screen like “Drag the catalyst to your station” and “Drag an Ethylene molecule to your station to begin” to the top of the station's screen since these directions seem to be overlooked.
- ◆ Program the molecules in the middle to move as they did on the second day of testing—without clumping or flying off the screen when tapped.

- ◆ Consider ways to make the role of the catalyst more obvious. Currently, the prompt reads, “Let the catalyst do the work,” but it is difficult to understand how the catalyst is working since the molecule construction looks the same with and without the catalyst. There also are not any explanations of the work that the catalyst does.
- ◆ Keep the image of an unlabeled plastic bottle or something akin to this (versus a water bottle as shown on the first day of testing) to avoid confusion about the product made.
- ◆ Consider italicizing, underlining, or highlighting key terms like catalyst to draw visitors’ attention to them.
- ◆ Consider including a pronunciation guide for the molecules.
- ◆ On every final screen, consider including a reference to crude oil. Currently, the Barbie and Aspirin are the only ones that reference crude oil.
- ◆ As LSC intends, train floor staff to check in on the touch table exhibit particularly after large groups have visited the area in case the program needs to be restarted.

INTRODUCTION

Randi Korn & Associates, Inc. (RK&A) was contracted by Liberty Science Center (LSC) to conduct a formative evaluation for the development of a multi-touch table in collaboration with the Center for Enabling New Technologies Through Catalysis (CENTC). This evaluation follows a front-end evaluation conducted by RK&A for LSC in January 2013.

The objectives of the evaluation are to explore:

- ◆ How visitors use the table, including:
 - ❖ How quickly visitors understand the objective of the program and how to use it;
 - ❖ Whether visitors struggle with the drag and drop aspect of the challenge or any other functionality;
 - ❖ Whether visitors build the molecules through to completion;
 - ❖ To what extent visitors understand that their station is their area to build a molecule while the central portion is a communal area to select molecule components;
 - ❖ How visitors interact with others at the table;
 - ❖ How many different molecules are attempted by the average guest.
- ◆ What messages visitors take away, including:
 - ❖ To what extent do visitors perceive that the starting molecules come from crude oil;
 - ❖ To what extent do visitors understand that they have built a molecule that is part of a common household product;
 - ❖ To what extent do visitors make an overall connection that many products come from crude oil;
 - ❖ To what extent do they learn/understand that they are performing “chemistry” (building/changing molecules) in order to make the final product;
 - ❖ To what extent do they understand that chemistry in general is about changing the shapes of molecules or the arrangements of atoms in molecules;
 - ❖ Whether visitors want to learn more about how molecular chemistry works or what it does;
 - ❖ Whether visitors want to learn more about what products come from crude oil.

METHODOLOGY

The multi-touch table was displayed in the *Energy Quest* exhibition near other exhibits that discuss crude oil. RK&A targeted walk-in adult visitors who were visiting with children ages 8 to 12. Some visitors were cued, meaning that RK&A asked the visitors to use the multi-touch table. Other visitors were uncued, meaning that they were not specifically asked to use the multi-touch table but chose to do so. See the interview guide in Appendix A to see the script used to cue visitors.

While visitors used the multi-touch table, RK&A took open-ended, handwritten notes on visitors' behaviors and conversations. After visitors completed their experience, RK&A interviewed the visitor group, taking handwritten notes. Following the interview, RK&A recorded demographic information, including gender, age, and first-time/repeat visit to LSC. As a token of appreciation for their participation, each visitor received a pencil from LSC.

Between the first and second day of testing, a few changes were made to the program. For instance, on the first day, molecules floating in the middle clumped together and flew away when touched. Both of

these functions were eliminated on day two. Additionally, the prompt “Are you sure you want to start over?” was added upon selecting the “menu” button to prevent visitors from inadvertently restarting the program. A few glitches and color issues were also resolved, and the names of molecules showed alongside the molecules in the stations. See Appendix B for pictures of the touch table.

DATA ANALYSIS AND REPORTING METHOD

Observations and interviews produce descriptive data that are analyzed qualitatively, meaning that the evaluator studies the data for meaningful patterns and, as patterns and trends emerge, groups similar responses. Both observation and interview data are presented as narrative bullets within themed sections versus by methodology. Proportions presented in the report represent the groups versus individuals (e.g., one-half of visitor groups versus individuals). Where possible, participants’ verbatim language (edited for clarity) is included to exemplify trends.

SECTIONS OF THE REPORT:

1. Introduction
2. Observations
3. Interviews

PRINCIPAL FINDINGS

INTRODUCTION

The CENTC touch table was tested during two consecutive days in August in the *Energy Quest* exhibition at Liberty Science Center. RK&A conducted observations and interviews. More than one-half of the observations and interviews were uncued.

For interviews, RK&A approached 23 groups of visitors, and 22 groups agreed to participate in an interview, for a participation rate of 96 percent. The 23 groups consisted of 50 interviewees. Of individual interview respondents:

- ◆ The majority were children.
- ◆ More than one-half are male.
- ◆ Three-quarters are repeat visitors.
- ◆ Children's median age is 8 years.
- ◆ Adults' median age is 41 years.

Many other groups were observed but not interviewed, including about six camp groups and dozens of family groups. Approximately 200 visitors in addition to the 50 interviewees were observed.

OBSERVATIONS

VISITOR INTERFACE

OVERALL USE

- ◆ Most visitors, both children and adults, used the stations individually (e.g., a group of two would use two different stations). The exception was when the exhibition was crowded, then groups would use one station, and generally, one person would take the lead while the others stood back.
- ◆ The majority of touch table users were children, although several adults used the exhibit too—either on their own or alongside a child in their group.
- ◆ A few visitors were observed working on a molecule with another person but *without* that person's permission. For example, young children (less than 6 years) sometimes stood at the end of the table and dragged pieces into another visitor's station. One boy was overheard telling a young girl, "Please stop doing that," when the girl dragged pieces into his station.
- ◆ Regardless of whether they were cued, the majority of visitors completed more than one molecule, and several completed all six molecules. About one-quarter did not attempt to complete any molecules—they either played with the molecules unintentionally or never selected a molecule template to complete. A few others completed just one molecule.
- ◆ Many visitors completed the molecules they started. The majority of those who did not complete a molecule were pulled away from the exhibit by parents, guardians, or other group members to another area of LSC, while a few others seemed to lose interest and decided to leave.
- ◆ The majority of children did not seem to read the instructions as evidenced by the direction of their gaze and the apparent trial and error behavior.

- ◆ The majority of children did not read the final screen, or read it only once after completing the first molecule. For instance, many children were observed starting a new molecule seconds after completing one.
- ◆ Several adults facilitated content for children. For instance, one woman was overheard reading the final screen aloud to her child and then said, “All of those green dots make it strong,” referring to chloride atoms. Another adult was observed telling her child, “See it is a different plastic. A really hard plastic,” regarding polypropylene.
- ◆ When camp groups were in the space, the table was usually occupied by eight to twelve children at one time. They generally used the table aggressively—leaning on it, lunging across it so that the table rocked, and drumming on it. The program closed out twice (once each day) during camp group use; however, these were the only occasions when the program closed out during use.

INTUITIVENESS AND FUNCTIONALITY

- ◆ Most visitors did not have trouble with the click and drag technology.
- ◆ Several visitors did not seem to notice that there were multiple stations. For instance, one visitor watched another visitor in his group work but did not use an open station until he saw the evaluator select “touch to begin” or select a molecule to complete.
- ◆ A few visitors were observed moving from one station to another, potentially because they thought that the stations provided different options.
- ◆ Several visitors did not select a molecule to start. The majority figured out to do so eventually, but a few did not.
- ◆ About one-quarter rotated molecules to make them fit into the molecule template. Some did so only until they realized that it was not necessary.
- ◆ A few visitors tried to fit shapes other than the one intended into the template. This most often happened where visitors tried to use Ethane in Propylene or Carboxyl for Acetyl. These visitors generally figured out the error within seconds.
- ◆ Several visitors made comments about sharing the communal pieces, such as “Oh no! That’s the one I need. Stop that!” Visitors who made comments were often children making these comments to another member of their group.
- ◆ On the first day of testing, several visitors accidentally closed the molecule they were working on as well as accidentally restarted the exhibit. This sometimes happened when the individual visitor using the station rested his/her hand on the perimeter of the table and inadvertently selected the “menu” button. Most often though, it happened when camp groups were at the space and several children tried to use the table at once (e.g., one child would close out another child’s molecule by accident).
- ◆ On the first day of testing when pieces in the middle clumped together, several visitors did not seem to know that they could unclump pieces, or they could not see the piece they needed within the clump. These visitors simply watched the molecules go by.
- ◆ At least one visitor group tried to pass each other molecules to use. For instance, on the first day of testing, one boy said to another “You may need that one,” and tried to pass the other boy a molecule. The same boy later said, “I just sent one to you,” indicating that he did not realize that this functionality was not possible.
- ◆ Only one adult was observed leaving the table after being seemingly unable to find the piece she sought. This woman was observed looking for propylene. She tried fitting many different

pieces into the propylene template. Then after about 20 seconds of watching the pieces in the middle, she walked away from the exhibit.

ENGAGEMENT

- ◆ Many visitors responded enthusiastically to the multi-touch technology. While some visitors only flung molecules around, others did so for fun after they completed their molecules. One boy said the multi-touch functionality made him feel like Tony Stark. Even a staff member was overheard saying, “I enjoy flicking things off screen.”
- ◆ Many children and sometimes adults would celebrate over completing a molecule, clapping or exclaiming things like, “Oh yeah!” Some read aloud the onscreen congratulations message, “Nice job! I’ve made high density polyethylene.”
- ◆ Many visitors audibly responded to making a Barbie doll. Boys tended to respond with good-hearted disgust (e.g., “Ewww! Barbie!”), and girls with celebration (e.g., “Cool! I made Barbie!”). Additionally, one boy said to his mom, “I bet that’s why Dad quit,” pointing to the Barbie and referring to his Dad’s departure from the exhibit.
- ◆ Some adults became highly engaged in the interactive themselves. For instance, one woman was working to complete a molecule, and her child called her to another exhibit. She responded, “Just a minute,” and continued to complete the molecule she had started.
- ◆ A few staff were observed using the exhibit. One who had completed all of the molecules previously was overheard telling another staff member, “You think I’d get bored of this.”
- ◆ At least one child completed the molecules more than once. This boy spent about 25 minutes at the table and was observed saying, “I am going to make Barbie,” having completed that one once before.
- ◆ Several times, children were asked to leave the exhibit by their parents or guardians versus leaving by their own choosing. For instance, one woman told a boy he should watch an unrelated demonstration first, while other parents or guardians tried moving the children to another area of LSC.

CONTENT DELIVERY

MESSAGING

- ◆ As noted earlier, several adults facilitated content by moderating their child’s activity and reading the final screen aloud. Adults sometimes asked their children questions too, although they were often close-ended, such as one man who said, “Good job. Do you know what you just made? Aspirin.”
- ◆ A few children asked content-related questions while working on the exhibit, such as one boy who asked his father, “Why do I need so much propylene?”

POTENTIAL MISCONCEPTIONS

- ◆ One woman asked her child why she thought that the molecules in the middle stick together, potentially making greater meaning than intended.
- ◆ One boy about 7 years old said, “Yeah! I made water,” when he got to the final screen for high density polyethylene.

INTERVIEWS

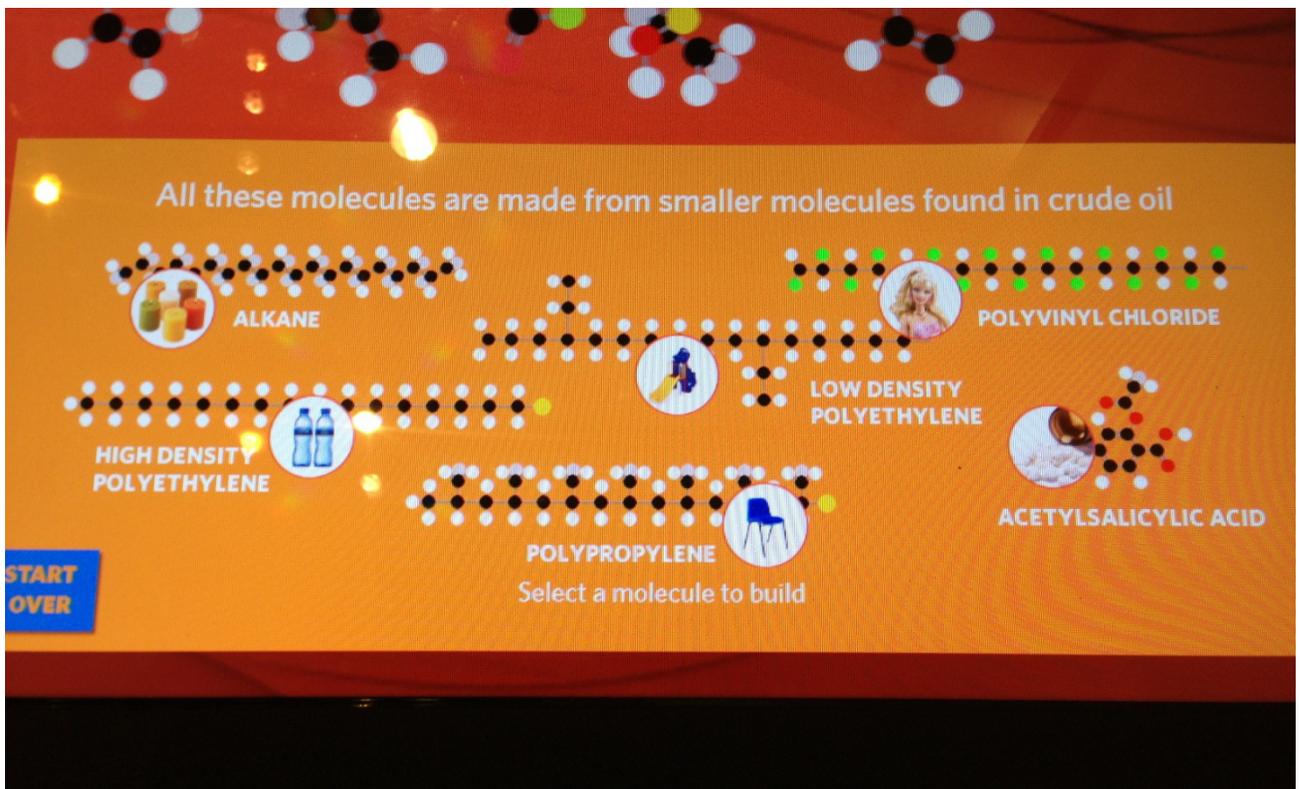
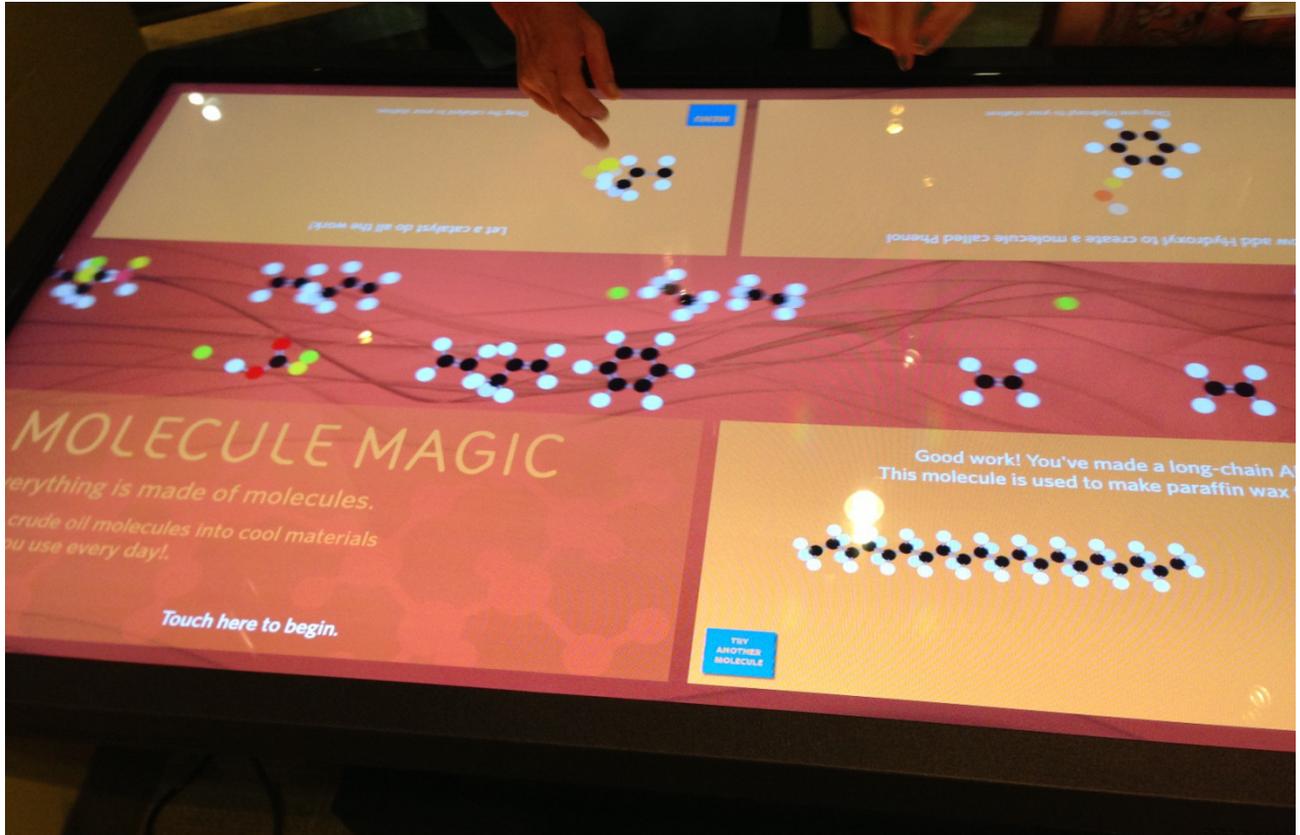
- ◆ All interviewees accurately described the purpose of the exhibit although with varying degrees of specificity. For instance, one described “building molecules” or “using pieces to make something.”
- ◆ Most interviewees said they did not have any trouble figuring out what to do, with many saying it took about 15 seconds to figure out. A few described initial troubles figuring out that they were supposed to select a molecule to work on.
- ◆ The majority of interviewees said that they used trial and error to use the exhibit, while several others said they read the instructions, and several others said they watched someone use the touch table.
- ◆ When asked what they liked most about the touch table, most interviewees said it was moving the molecules around or the hands-on nature of the exhibit. Several also liked that it was a “puzzle” or a “fun challenge.” A few said they liked building the molecules or making products from smaller parts. Additionally, a few adult interviewees liked that the touch table was educational or simply exposed their children to molecules; furthermore, one woman liked that it was simple and accurate, saying “sometimes when they simplify chemistry you get it wrong but this looks pretty accurate.”
- ◆ When asked about what they liked least, the majority said there was not anything they liked the least about the exhibition. A few said they did not like that the molecules flew away once touched, and a couple did not like when the molecules clumped together because they could not find what they were looking for; both of these issues arose in the first day of testing and changes were made before the second day of testing. Additionally, a couple said building the molecules was repetitive because they needed many of the same molecules.
- ◆ When asked if there was anything confusing, many said there was not anything confusing. A few said they did not know how to pronounce the different molecules.
- ◆ When asked what the exhibit showed them, many said it showed them what products are made from, saying things like: “there are a lot molecules that make things,” “molecule structure of different materials,” and “simplistic breakdown of what something is.” No one mentioned crude oil, although one adult interviewee said it showed how to “build a complex hydrocarbon.”
- ◆ Most interviewees understood what the exhibit had to do with chemistry; these visitors described putting together molecules and making molecules from other molecules (sometimes using the word particles or atoms instead of molecules). A couple children said they did not know what chemistry is about.
- ◆ When asked specifically, many interviewees did not know what the exhibit had to do with crude oil; these interviewees did not notice the word “crude oil” anywhere while working on the exhibit. A few, mostly adults, said that the molecules constructed at the touch table come from crude oil or petroleum; some of these noticed the word “crude oil” on the screen with the molecule templates. A couple remembered reading that the Barbie is made from crude oil.
- ◆ When asked if there was anything that intrigued them or piqued their interest, most interviewees provided miscellaneous responses. However, two interviewees were curious about how products are made from crude oil, and two others were interested in knowing what other products are made from crude oil.
- ◆ In interviews, children often used the word “stuff” or “things” when talking about the molecules instead of using specific terminology.

APPENDICES

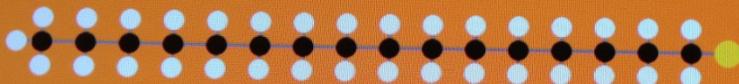
APPENDIX A: INTERVIEW GUIDE

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APPENDIX B



Nice job! You've made High Density Polyethylene. This molecule is made from hundreds or even thousands of Ethylene molecules chained together. It is used to make plastics for items like juice bottles with recycle code 2.



TRY ANOTHER MOLECULE

Now add Carboxyl to create a molecule called 2-Hydroxybenzoic Acid.

Are you sure you want to start over?

YES NO

Drag one Carboxyl to your station