Children's Engagement in New and Old Exhibits Summative Evaluation Report

Prepared for Imagine Children's Museum

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Executive Summary

This evaluation project aimed to systematically assess how effectively the new and old exhibits at Imagine Children's Museum engage children between the ages of 3 and 12. I focused on three things: how long children stayed at each exhibit (dwell time), the types of activities they engaged in, and how deeply they participated. The goal was to give the museum a clear picture of what's working, what could be improved, and how to plan for future exhibits.

Children's engagement was measured at five key exhibit areas: Piccolo Restaurant, Treehouse, and the Train from the older section, as well as the Fishing Pond and Distribution Center from the newer expansion.

Since expanding after the pandemic, the museum has added many new exhibits. However, there had been no systematic data to compare these newer installations with the original ones in terms of appeal and interactive quality. To help fill that gap, I created an observation tool tailored to the museum's needs and observed 250 children at random. The data was then visualized and cross-analyzed. Based on the results, I offer several practical recommendations, including improving exhibit flow, enhancing instructional signage, and refining the management of props and materials. These suggestions are intended to help the museum continue its mission of learning through play.

Main Findings

- Children's dwell time and behavior patterns are closely linked to the complexity and interactivity of each exhibit. Differences in structure and how children interact with the exhibit can significantly affect how engaged they become.
- The level of parental involvement and the number of visitors in the space influence how deeply children participate. When parents are involved, children tend to stay longer. In contrast, crowded environments may limit the quality of engagement.
- Some exhibits lack clear instructions or cues, which can prevent children from fully understanding how to use the interactive features.
- Each exhibit supports different types of engagement. Some encourage observation and self-expression, while others promote exploration or collaboration.

Based on these findings, this report includes several suggestions to improve the visitor experience, such as optimizing traffic flow within exhibits, adding clearer guidance for interaction, and improving the upkeep and availability of interactive tools. These improvements can help the museum better deliver its educational goals in an engaging and playful environment.

Evaluation Background

Children's museums play a crucial role in providing educational and interactive learning environments, and they provide valuable opportunities for preschoolers to develop and practice a range of skills through play (Andre et al., 2017). Imagine Children's Museum, based in Everett, Washington, is guided by the mission to "enrich children's lives through playful learning."

In 2022, the museum completed a major expansion, doubling its size with the addition of a new three-story building that features cutting-edge exhibits and play spaces (Imagine Children's Museum website).

The museum now houses both recently developed exhibits, in use for just under two years, and original ones that have been in place for 20 to 25 years. As digital learning becomes more widespread, children's museums face increasing pressure to update their exhibits and integrate modern technology to stay relevant and educational.

This evaluation study was designed to help the museum understand how kids are currently interacting with exhibits. The results are intended to guide future planning, identify strengths and gaps in interactive design, and support the museum's long-term mission of helping children grow through play.

✧ Purpose Statement

The purpose of this evaluation project was to measure children's engagement with both new and old exhibits (including dwell time, activity types, and levels of engagement). It aimed to identify the strengths and weaknesses of exhibit design and layout, compare the evaluation results with the museum's educational framework, and provide improvement suggestions to help the museum optimize the interactive experience of the exhibits, enhance their educational impact, and improve exhibition planning.

✧ Evaluation Questions

1. What is the average dwell time of children aged 3 to 12 at both new and old exhibits? Which exhibits have the longest dwell times?
2. How do new exhibits compare to old ones in attracting children's participation and interaction? Are there significant differences?
3. What is the level of children's engagement? Have the museum's educational goals been met?

✧ Methods

✦ *Evaluation Approach and Framework*

This study was observational in nature. It combined both structured and unstructured observations to closely examine how engaged the children were and how each of the museum's five focus areas supported learning goals. The project design was informed by recent research on children's museums and drew on several well-established evaluation models.

The observation tool (Appendix 1) was informed by Barriault and Pearson's (2010) *Pathways to Engagement* model, originally developed to study visitor behavior in science centers. The model divides engagement behaviors into three categories:

- **Initiation**: Doing the activity; spending time watching others engaging in the activity;
- **Transition**: Repeating the activity; expressing positive emotional responses in reaction to engaging in the activity;
- **Breakthrough**: Referring to past experiences while engaging in the activity; seeking and sharing information with others; engaged and involved.

These levels of engagement capture the progression in a visitor's learning experience (Barriault, 1998). Based on pilot testing and feedback from the museum, a fourth category "Negative behavior" was added to reflect disengaged or passive responses. The *Engagement Trajectory Curve* developed by Barriault and Pearson (2010) was also used to assess how effectively each exhibit area encouraged children to reach deeper levels of engagement.

The evaluation was further guided by Falk and Dierking's (2016) *Contextual Model of Learning*, which highlights how learning is shaped by personal background, social context, physical environment, and exhibit design. For young children, aspects like how clear the exhibit is, how challenging the tasks are, the type of feedback provided, involvement of caregivers, and how crowded the space is can all influence attention and engagement. These factors were integrated into the observation and analysis framework to evaluate how well each exhibit supported the museum's broader educational goals.

✦ *Observation Methods*

To address the evaluation goals and questions, two types of observation were used:

- **Structured Observation**: Tracked each child's dwell time, points of entry and exit, and categorized their behavior into four types—Initiation, Transition, Breakthrough, and Negative.
- **Unstructured Observation**: Focused on more open-ended elements like emotional reactions, collaboration, problem-solving, and adult involvement. These insights provided valuable context to complement the structured findings.

✦ *Data Collection*

Data were collected over a 10-day period between February 10 and March 1, 2025, totaling around 50 hours of observation. A total of 250 individual children were observed across five exhibit areas:

- **Older Exhibits:** Piccolo Restaurant, Train, and Treehouse
- **Newer Exhibits:** Fishing Pond and Distribution Center

These areas were chosen to balance older and newer exhibits and to represent a mix of interactive styles and educational goals. For example, the Restaurant focuses on role play, encouraging social interaction and language skills, while the Distribution Center emphasizes task logic and operational thinking. This variety made it possible to compare different types of learning experiences.

Each observation focused on one target child, starting as they entered an exhibit area. Observers noted how long they stayed, how they interacted, specific behaviors, crowd levels, and whether parents were involved. All behavior data were recorded using the observation tool, and key moments and behavior changes were noted in additional written comments. A guide for using the observation form is provided in Appendix 2.

Piccolo Restaurant

Train

Fishing Pond

Distribution Center

Treehouse

Evaluation Results

✧ Section1： Average Dwell Time and Differences Across New and Old Exhibit Areas.

Figure 1

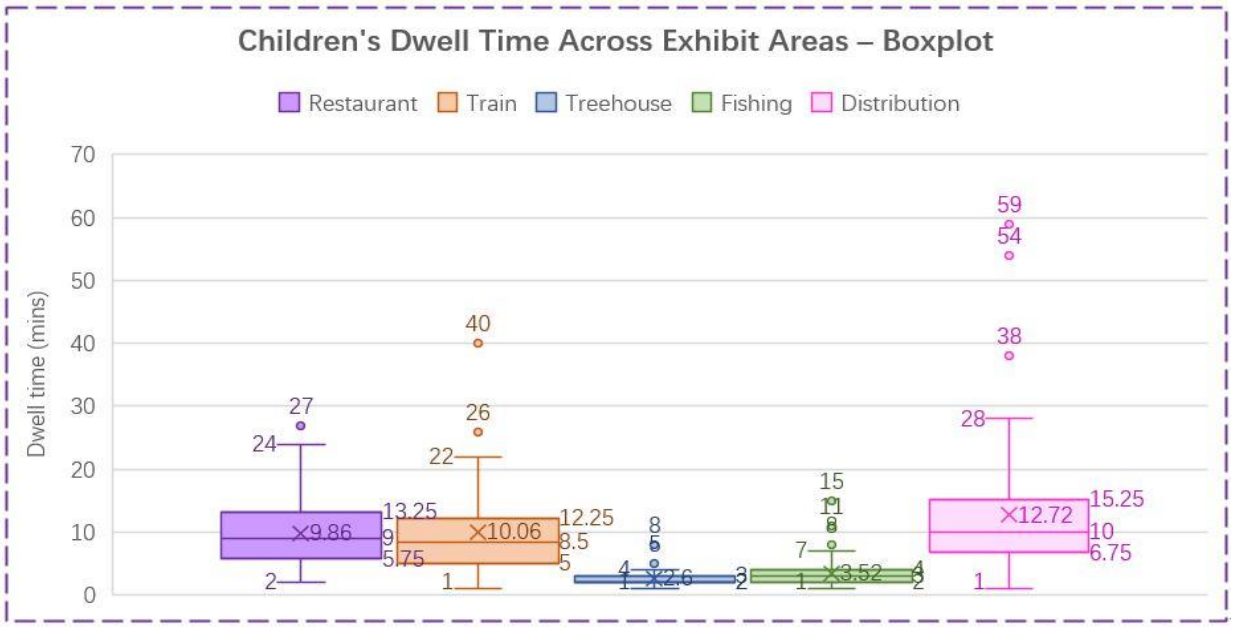


Chart Interpretation:

Figures 1 shows box plot of children's dwell times in each exhibit area, illustrating how long children typically stayed and how that varied by location. Each element of the chart represents the following:

- **Box:** Represents the middle 50% of the data (from the first quartile [Q1] to the third quartile [Q3]).
- **Horizontal line inside the box:** Indicates the median dwell time, meaning half the children stayed longer and half stayed for less time.
- **"X" symbol:** Marks the mean (average) dwell time for that exhibit.
- **Whiskers:** Show the minimum and maximum values within the non-outlier range.
- **Dots (●):** Represent outliers—times that are significantly higher or lower than those of most children.

✦ *Finding 1: Children Spent More Time in the Distribution Center, Train, and Restaurant.*

Figure 1 shows that children spent noticeably more time in the Piccolo Restaurant, Train, and especially the Distribution Center, compared to the Treehouse and Fishing Pond. Among these, the Distribution Center recorded the longest average dwell time at 12.72 minutes, followed by the Train at 10.06 minutes and the Restaurant at 9.86 minutes.

In the Restaurant and Train areas, the average and median times were relatively close, with a difference of less than two minutes. This suggests that longer engagement was common across most visitors, not just driven by a few outliers. These findings indicate that both areas are broadly appealing and accessible to children of various ages and interests.

It's worth noting that the Distribution Center had several extreme high values: 38, 54, and 59 minutes, which likely raised the average above the median more than in the other areas. Still, this doesn't change the fact that the Distribution Center had the longest dwell time overall, making it the most engaging space in this evaluation.

Taken together, the data suggests that the combination of interactive depth, varied play opportunities, and chances for social interaction in these three exhibits encouraged children to stay longer and revisit activities. They emerged as the most effective areas for sustained engagement.

✦ *Finding 2: Children spent less time in the Treehouse and Fishing Pond, with more concentrated dwell time distributions.*

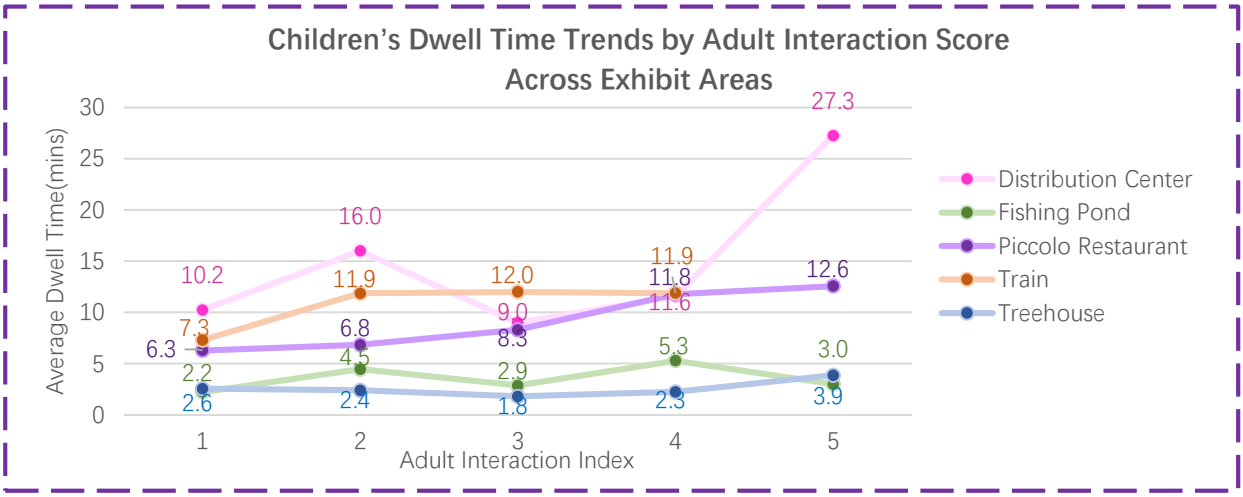
In addition to the previous findings, Figure 1 shows that the Treehouse and Fishing Pond had the shortest average dwell times among all five exhibit areas. Both had noticeably smaller interquartile ranges (IQRs), meaning that most children stayed for relatively short and consistent periods.

Specifically, the Treehouse had the shortest average dwell time at 2.6 minutes, with an IQR of roughly 2 to 3 minutes. The Fishing Pond was slightly higher, with an IQR of 2 to 4 minutes, and a couple of outliers (11 and 15 minutes) showing that a few children were more interested than most.

Beyond the numbers, I also noticed this pattern clearly during data collection. While it was usually easy to find new target children in other areas right after the previous one left, the Treehouse often remained empty for extended periods. On several occasions, I waited more than 20 minutes before another child entered. This pattern points to lower overall appeal and less frequent voluntary use compared to the other exhibits.

✦ *Finding 3: Children with more involved parents tended to stay longer—but this varied by exhibit.*

Figure 2



During the observation, I used a 5-point scale to assess the level of adult caregiver interaction. The scoring guidelines were as follows:

1. The caregiver was entirely disengaged, showing no interaction—for instance, using a phone or waiting outside the area.
2. The caregiver was present but only minimally involved, occasionally watching or responding to the child without taking part.
3. The caregiver showed moderate involvement, offering brief reminders, encouragement, or light assistance.
4. The caregiver was actively engaged, participating in the activity and helping the child with certain parts.
5. The caregiver was fully involved, working closely with the child throughout most of the activity while providing steady guidance, feedback, and support.

Initially, I assumed that parental involvement would help children stay more focused and engaged—that is, the more engaged the parent, the longer the child would remain at the exhibit. However, as shown in Figure 2, the relationship between the Adult Interaction Index and children's average dwell time was not consistently linear across all areas.

In the Treehouse and Fishing Pond, for example, children's dwell times remained low (around 2–5 minutes) regardless of the level of parental involvement. These exhibits inherently had shorter engagement, so even highly engaged parents didn't significantly increase children's time spent there.

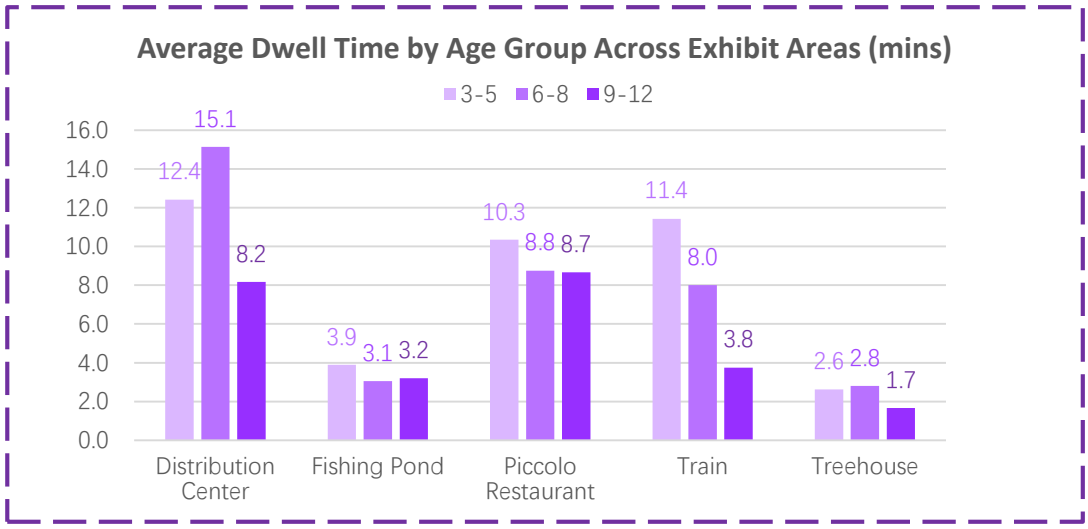
Given this, I focused the analysis on the three exhibits with generally longer dwell times—Restaurant, Train, and Distribution Center—where the relationship between parent involvement and child engagement was easier to observe. In these areas, the data did align with my initial assumption: the more involved the parent, the longer the child stayed. The trend was especially strong in the Distribution Center, where higher parental involvement correlated clearly with increased attention and sustained play.

For example, during my observations, I noticed that turning the gear-based conveyor belt was physically challenging for younger children. When highly involved parents stepped in to operate the mechanism, children were able to focus more on the package delivery tasks and seemed to enjoy the experience more.

In comparison, the Restaurant and Train also showed a general upward trend, although less pronounced. Interestingly, dwell times dipped slightly at the highest interaction level in the Train area, which may be due to additional variables such as layout, prop placement, or individual preferences.

✦ *Finding 4: Children's dwell time shows clear age-related differences, reflecting exhibit preferences at different developmental stages.*

Figure 3



As shown in Figure 5, I analyzed the average dwell time of children in three age groups: 3–5, 6–8, and 9–12 years, across the five focus areas. The results show that while children's engagement time does vary by age, most exhibits show only small differences between groups. The clearest age-related patterns were found in the Distribution Center and Train areas.

In the Distribution Center, children aged 6–8 stayed the longest, with an average dwell time of 15.1 minutes. This was noticeably higher than the 12.4 minutes for 3–5 year olds and 8.2 minutes for 9–12 year olds. These numbers suggest that the tasks and structure in this area matched the

abilities and interests of the middle group. Older children showed strong interest in mechanical systems and task sequences, and were able to stay focused as they moved through each step.

In contrast, in the Train area, the youngest group stayed the longest, averaging 11.4 minutes. This was much more than the 6–8 group at 8.0 minutes, and especially more than the 9–12 group at just 3.8 minutes. The simple, repetitive nature of the interactions in this area seemed to suit the needs of younger children, helping them stay involved longer.

It is also worth noting that 9–12 year olds did not have the longest dwell time in any of the five exhibits. This does not mean they were less focused, but likely reflects that many of the activities were too easy for their age. When challenges feel too simple, interest tends to drop.

Overall, age does play a role in how long children engage with exhibits. When the difficulty or format of an activity does not match a child's developmental stage, sustained interaction becomes harder. While most exhibits were designed to accommodate a wide age range, there is still potential to create more complex, engaging experiences for older children.

✧ Summary 1

Table 1: Count: Adult Interaction Index

Exhibit Area	1	2	3	4	5	Total
Distribution Center	26	9	4	7	4	50
Fishing Pond	9	13	16	7	5	50
Piccolo Restaurant	7	6	10	18	9	50
Train	20	14	8	8	–	50
Treehouse	20	5	5	12	8	50
Total	82	47	43	52	26	250

Based on the box plots of children's dwell time across the five focus areas and the trend chart showing the impact of parental involvement, it's clear that children's engagement is shaped by multiple factors and varies significantly between exhibits. Drawing from both the data and real-time observations, I've outlined below the key reasons behind these differences in dwell time.

First, the Treehouse had the shortest dwell time. This area features elements like animal fact panels, a speaking tube, and a prism mirror. While these components are simple and easy to understand, most of them require cooperative play. As seen in Figure 2, when the Adult Interaction Index reached level 5, children's average dwell time peaked at 3.9 minutes—noticeably higher than the typical 2–3 minute range shown in Figure 1. Unfortunately, most caregivers (30 observed cases) showed low levels of interaction, typically scoring between 1 and 3. For example, on February 21, one child repeatedly tried to engage a parent for joint play, but the parent remained absorbed in their phone and did not respond.

Another issue in this area was that many children and caregivers didn't notice the speaking tube located deeper inside the exhibit. Although there were some guiding prompts in the Treehouse, they were often overlooked by children during play. Due to the limited space, many parents also chose to stay at the base of the structure rather than entering, which made it harder for them to notice or assist with the activity. In one case observed on February 14, a boy suggested looking for another speaking tube while playing with his sister. They discovered two upstairs but only one downstairs. Their exploration was cut short when their parent interrupted and pointed them to a tube under the tree, effectively ending the search.

These examples highlight how unclear guidance and lack of adult involvement can jointly limit children's engagement. Even if the exhibit has interactive potential, without clear instructions or support from adults, it becomes difficult for children to complete tasks or continue exploring. This explains why the Treehouse showed low averages and tightly clustered dwell times—not just due to the simplicity of its design, but because of a gap between the design's intention and how it was actually used.

A similar trend was observed in the Fishing Pond. The activities here were more limited in scope. During my observations, children rarely interacted with each other or repeated the activity. Most finished the experience after one or two fishing attempts. On February 15, one child took a fish they caught and brought it to the pretend "outdoor cooking" area, suggesting that the Fishing Pond may be perceived more as a transitional space rather than a destination for extended play.

In contrast, the Distribution Center exhibited entirely different characteristics. As the area with the highest average dwell time, it featured a more complex structure that included several components—lifting, transporting, conveyor belts, international shipping stations, and even a forklift. The conveyor mechanism presented a physical challenge for younger children, which created a natural opportunity for adult involvement. For example, on February 28, I observed a mother who repeatedly helped her child turn the gears while encouraging him to move packages across the system. The interaction lasted nearly 30 minutes, with the child remaining highly engaged throughout. This kind of cooperative play not only increased dwell time but also seems likely to enhance children's sense of involvement and accomplishment.

In summary, children's dwell time in different exhibits was shaped by multiple factors, including layout, task design, guidance, props, and the level of adult involvement. Age also made a clear difference. The Distribution Center attracted more sustained engagement from children aged 6 to 8, while the Train area was especially popular among 3 to 5 year olds. These differences suggest that task complexity and interaction style need to align with a child's stage of development.

Most exhibits are already designed to work across a range of ages. Still, for older children, there is room to increase the challenge and offer more chances for extended engagement.

✧ Section 2： Comparing Children's Behavior in New and Old Exhibit Areas.

✦ *Finding 1: The depth of children's interactive behavior is not directly related to whether the exhibit is new or old.*

Figure 4

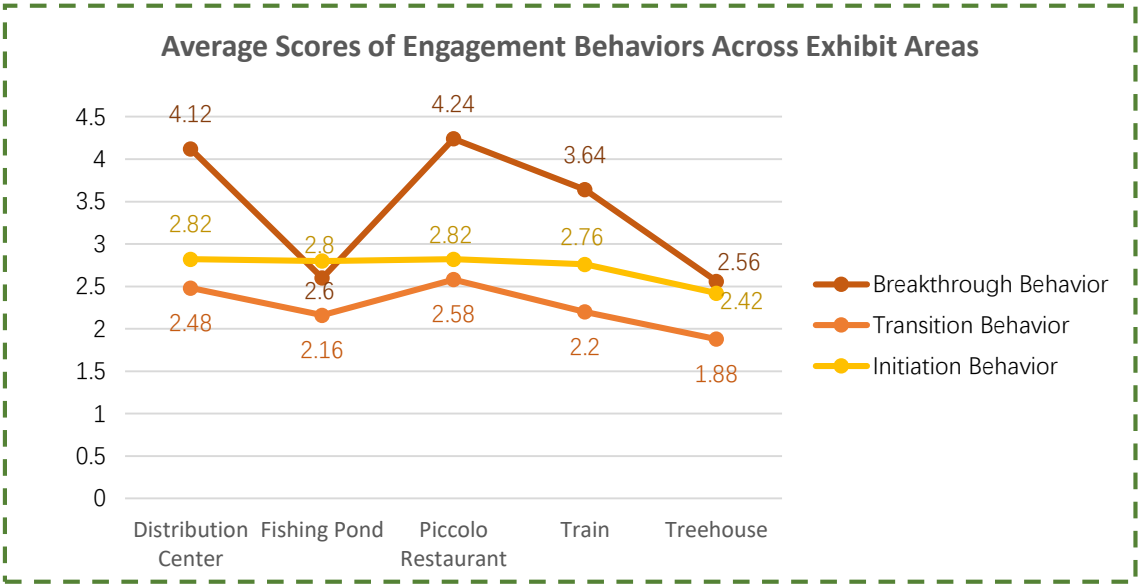


Table 2： Standard Deviation of Engagement Behavior Scores Across Exhibit Areas

Behavior Type	Standard Deviation	Interpretation
Initiation	0.42	Moderate variation
Transition	0.16	Very small variation; highly consistent
Breakthrough	0.76	Large variation; significant differences across exhibits

From Figure 2, we can see that as the level of interactive behavior deepens, the differences between exhibit areas become more pronounced. The gap is widest when it comes to Breakthrough behaviors. Figure 4 shows the trend in behavior scores, indicating that both new and old exhibits include areas where children show either high or low levels of deep engagement. This suggests that the age of an exhibit is not a determining factor in how deeply children engage.

In my observations, whether an exhibit had a clear task goal was based on whether children could understand how to engage with it without adult guidance. This included whether they could start playing quickly, try the correct actions within a short time, or showed signs of confusion that led them to stop or wait for help. For example, in the Treehouse, some children showed interest in the speaking tube but gave up after not being able to find the other end. This kind of behavior

was seen as a result of unclear prompts or limited signage, rather than the activity itself being hard to understand.

For example, the Distribution Center (new exhibit) and Piccolo Restaurant (old exhibit) both received high average scores for Breakthrough behavior, with 4.12 and 4.24 respectively. These two exhibits share several characteristics: they offer clear task goals, a wide range of hands-on activities, and strong opportunities for imaginative role play. These elements encouraged children to explore continuously and express themselves actively.

In the Restaurant, clear examples of Breakthrough behavior included children taking on the role of a chef, responding to customer orders, making multiple dishes, and even combining different food items to create more nutritious meals. In the Distribution Center, some children stayed fully immersed in the process, moving and organizing multiple packages while working cooperatively with others, like a team. They also interacted with the touchscreen to plan delivery routes and package types, completing one or two full delivery tasks.

In contrast, the Fishing Pond, although part of the new expansion, had a relatively low Breakthrough score of 2.6. This shows that even a newly built exhibit may not foster deeper engagement if it lacks challenge, task progression, or interactive complexity. Children in this area often stayed at the initial or transitional stages, engaging only briefly before moving on.

Overall, it is not whether an exhibit is new or old that matters most. What truly influences the depth of children's engagement is the quality of the design—including task structure, clarity of instructions, the availability of responsive interactions, and the potential for social collaboration.

✦ *Finding 2: Exhibits with weaker interactive design are more likely to trigger negative behaviors in children.*

Table 3: Frequency of Challenging Behaviors Across Exhibit Areas

Area	Lack of Confidence	Displasy Frustration	Rule Deviation	Distracted Attention	Totle
Treehouse	6	0	8	1	**15**
Train	1	2	3	4	**10**
Piccolo Restaurant	0	0	6	2	**8**
Fishing Pond	5	1	5	2	**13**
Distribution Center	0	0	3	6	**9**
Totle	**12**	**3**	**25**	**15**	

Table 4： Engagement Score Rates by Exhibit Area

Area	Initiation Rate (%)	Transition Rate (%)	Breakthrough Rate (%)
Distribution Center	70.5	62	58.9
Fishing Pond	54	65	40
Piccolo Restaurant	70.5	64.5	60.6
Train	55	55	52
Treehouse	47	60.5	36.6

By combining the data from Table 3 and Table 4, we can see a clear pattern: exhibits with lower engagement scores also tend to be the areas where children displayed the most challenging behaviors. This trend appears in both new and old exhibit areas.

In the Treehouse (an older exhibit), the Breakthrough score rate was only 36.6%, and the Initiation score was just 47%—the lowest of all five areas. It also recorded the highest number of challenging behaviors, with a total of 15 cases. These included 8 instances of rule deviation and 6 instances of low confidence.

Examples of rule deviation included misusing the exhibit features—such as hitting the windows with magnifying glasses, pulling on the speaking tube, or hanging from the prism mirror. Low confidence was usually observed when children quickly gave up on activities or showed a lack of focus. For instance, some children gave up after failing to find the correct end of the speaking tube, which may suggest a loss of interest or momentary frustration.

In the Fishing Pond, a newer exhibit, the Breakthrough score was only 40%, which was relatively low. There were 13 instances of challenging behavior, including 5 cases of low confidence and 5 cases of rule deviation. Low confidence often appeared when children gave up quickly after failing to catch a fish once or twice. Rule deviation included using fishing rods as swords to play-fight with others, or taking the fish props out of the area.

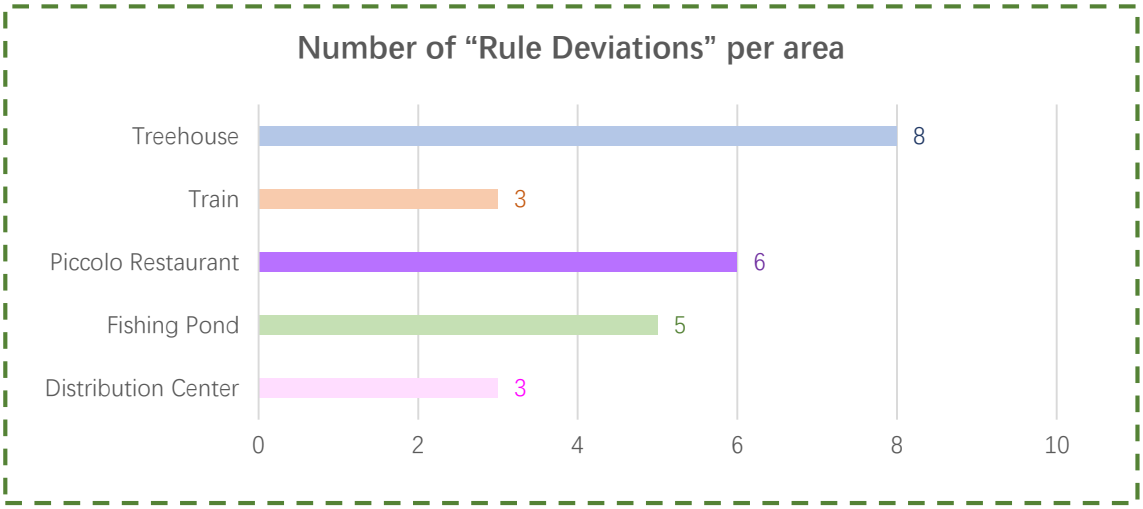
However, not all rule-breaking behavior should be seen as negative. Some may reflect creative exploration. For example, one child who took a fish out of the Fishing Pond later brought it to the nearby camping area, where she used it as pretend food for grilling. This kind of behavior suggests she was extending the play narrative in her own way.

These patterns show that the level of engagement is not determined by whether an exhibit is new or old, but more by how accessible the interaction is, whether tasks offer enough challenge to build on, and how clearly the exhibit communicates what to do. When children cannot experience small moments of success early on, they are more likely to lose focus, feel frustrated, or act out, which affects the overall quality of interaction and learning.

While some exploratory behavior should be encouraged, it can also lead to shortages of props in the original area. For this reason, it may be helpful to add more pretend food options to the camping area, such as fish or vegetables, in addition to the existing sausages and marshmallows.

✦ *Finding 3: Rule deviation is the most common type of negative behavior.*

Figure 5



As shown in Table 3, rule deviation was the most frequently observed type of challenging behavior across all five categories. It occurred 25 times, accounting for 10% of the 250 children observed. As shown in Figure 5, the Treehouse recorded the highest number of rule deviations at 8, followed by Piccolo Restaurant with 6 and Fishing Pond with 5. In contrast, the Distribution Center and Train had lower frequencies, with only 3 instances each, indicating more consistent behavioral patterns in those areas.

While the rule-related issues in the Treehouse and Fishing Pond were discussed in the previous section, this finding highlights the patterns observed in Piccolo Restaurant.

The Restaurant is one of the most popular areas in the museum, where children can take on roles such as ordering, cooking, and serving food. However, its high popularity often leads to crowded conditions and competition for props, which were major triggers for rule-breaking behaviors. During observation, children were frequently seen hoarding large amounts of food props (such as piling all the pasta or pizza toppings in their "kitchen"), throwing utensils at each other, or banging on the tables with excessive force.

These behaviors may not stem entirely from a disregard for rules. Contributing factors could include a shortage of props, delays in resetting used items, or limited adult supervision during busy hours. It's worth noting that the Restaurant also scored highly in Breakthrough engagement, which shows that even highly engaging and immersive areas can face behavioral challenges if intense interaction is not well managed. High-traffic exhibits require thoughtful design and consistent guidance to maintain a positive and respectful play environment.

✧ Summary 2

A comparison of behavior patterns across the five exhibit areas reveals that the age of an exhibit does not determine how deeply children engage or how often negative behaviors occur. Table 4 shows that as engagement levels increase, so does the variation between exhibits. The Breakthrough category had the largest variation in scores, with a standard deviation of 0.76. This makes it a useful indicator for assessing both the quality of visitor engagement and the effectiveness of exhibit design.

As the analysis shows that areas with lower Breakthrough scores, such as the Treehouse and Fishing Pond, often made it more difficult for children to engage meaningfully. These spaces also saw more frequent behavioral issues like rule-breaking and signs of low confidence.

Such challenges often stem from unclear task design, mismatched difficulty, or lack of guidance. In the Treehouse, for instance, the speaking tube activity requires two participants and is difficult to complete without clear prompts or adult help. As a result, many children gave up after a single failed attempt, and even those who were interested struggled to maintain engagement.

The Fishing Pond, while easy to start, lacked progression or challenge. Children often lost interest within a few minutes, as there was little incentive to stay or re-engage.

By contrast, exhibits like Piccolo Restaurant and the Distribution Center, which had higher engagement scores, typically provided clearer objectives, structured interaction paths, and immersive experiences. These elements encouraged deeper participation and were associated with fewer behavior-related issues. Still, even the more successful areas had their challenges. For example, in the Restaurant, crowding and a shortage of props led to noticeable rule deviation. This highlights that high-interest exhibits need strong management and well-planned support systems to prevent conflicts arising from competition or uneven access to resources.

In summary, this section shows that the quality of children's engagement is not related to whether an exhibit is new or old. It depends more on the structure of interaction, the progression of task difficulty, the clarity of prompts, and the availability of props. Exhibits with lower engagement scores, such as the Treehouse and Fishing Pond, also had more challenging behaviors, which highlights the importance of these design factors.

Some rule-breaking behaviors were not just about ignoring rules. In some cases, children were expanding the experience in creative ways. For example, bringing a fish to the camping area for pretend play showed an effort to build their own story. While this may lead to missing props, it also offers ideas for improving the flow between exhibits. Adding more pretend food or providing simple guidance across zones could help support continuous engagement and deeper learning.

✧ Section 3：Analysis of Engagement Depth and Alignment with Educational Goals.

✦ *Finding 1: All exhibits show a "declining trend" in engagement depth, but the degree of decline reveals differences in interactive quality.*

Figure 6

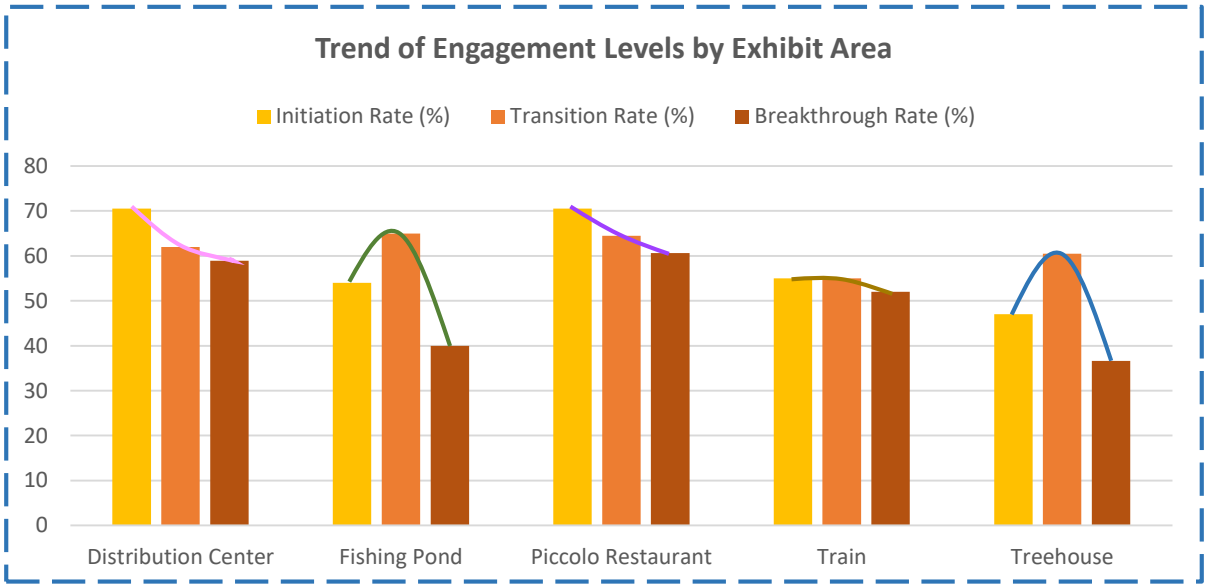


Table 5：Slope of Engagement Trajectory Curve

Area	Slope
Distribution Center	-5.8
Fishing Pond	-7.0
Piccolo Restaurant	-4.95
Train	-1.5
Treehouse	-5.2

As shown in Figure 6, connecting the midpoint of the tops of each bar creates what we call an Engagement Trajectory Curve. This curve is used to analyze how well each of the five exhibit areas supports progression through the three levels of engagement: Initiation, Transition, and Breakthrough. The slope of this curve, shown in Table 5, indicates how deeply children tend to engage within each exhibit. A steeper downward slope (a more negative value) suggests that children are less likely to move from initial attempts to more sustained, deeper forms of interaction. In other words, it reflects weaker continuity and progression in engagement.

From the chart and the slope data, we can see that the Train exhibit has the shallowest slope (–1.5), which means that although its overall scores are not particularly high, children's engagement remains relatively stable across all three levels. This suggests that the Train area is better at maintaining children's attention and interest over time.

In contrast, the Fishing Pond has the steepest decline, with a slope of –7.0. This indicates that while it may successfully attract children to begin exploring (Initiation), it struggles to guide them into more complex or meaningful engagement, such as collaboration, creative expression, or deeper problem-solving.

It is also important to note that all five exhibits have negative slopes. This means that even in high-performing areas, there is room for improvement in designing experiences that help children stay longer, explore more deeply, and move progressively from basic actions to more advanced forms of participation. In most cases, children remained at the level of simple interaction or repetition, and relatively few reached the deeper Breakthrough level.

✦ *Finding 2: Each exhibit area shows distinct strengths in supporting different educational goals.*

Figure 7

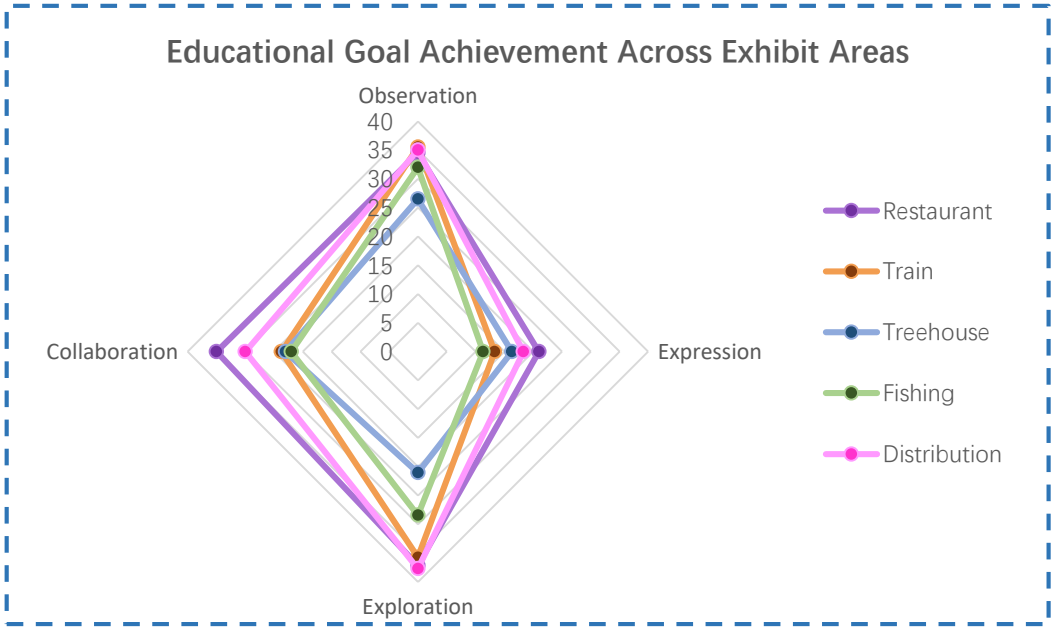


Table 6：Average Scores by Educational Dimension Across Exhibit Areas (%)

Area	Observation	Expression	Exploration	Collaboration
Restaurant	34.5	21	37.14	35
Train	35.5	13.3	35.7	23.7
Treehouse	26.5	16.3	21	23
Fishing	32	11.3	28.4	22
Distribution	35	18.3	37.7	30

Based on Imagine Children's Museum's learning framework, I mapped the observed child behaviors to four key educational dimensions: Observation, Expression, Exploration, and Collaboration. I then reclassified the behaviors recorded in the observation tool according to these four categories, as follows:

Observation:
4. Watch other children or parents interact with the exhibit, showing interest.
11. Independently reading labels or learning.

Expression:
8. Stronger signs of enjoyment, e.g laughing; verbally mention the enjoyment.
9. Asking questions to staff, other children, or family members.
12. Sharing or discussing experiences and information with others.

Exploration:
2. Touching or trying to operate the exhibit, exploring its functions.
3. Partially completing the activity.
5. Repeat 2-3 times, achieve the desired result/master the exhibit's functions.
6. Changing variables leads to different outcomes (beginning to engage).
13. Engage in exploration,e.g repeat activities, read labels, ask questions(2-3 mins)
14. Deep focus, interact for long period (3-5 mins), achieve the activity's purpose.
15. Experiment and test different variables to seek varied outcomes (more than 5 mins)

Collaboration:
9. Asking questions to staff, other children, or family members.
10 .Responding to others' suggestions (verbally or through actions).
12. Sharing or discussing experiences and information with others.

After reclassifying the behaviors, I calculated the average score for each category (Table 6) and compared how each exhibit performed across the four learning goals. The results are shown in the radar chart in Figure 7.

Overall, the Restaurant had the strongest and most well-rounded performance across all four dimensions, especially in collaboration and expression. This is largely because children often take on the role of chef, which involves extensive verbal interaction during pretend ordering and cooking activities. The limited availability of props such as plates, utensils, and food items helped promote turn-taking and teamwork during peak hours. In many cases, children had to negotiate with others, share tools, or divide tasks to achieve their play goals. These moments not only

fostered social and communication skills but also likely offered children meaningful opportunities to practice collaboration.

The Distribution Center also performed strongly, particularly in the areas of exploration and observation. Children repeatedly experimented with the conveyor belts, transported packages, and designed delivery routes. I observed several instances where children watched others interact with the digital screen before attempting to plan their own routes. Many also engaged in trial-and-error to figure out the best timing to place boxes onto moving belts. These behaviors reflected strong observational and exploratory engagement.

The Train area scored highest in observation. In addition to the interactive tracks and toy trains, this area includes a detailed miniature train landscape. This feature drew children's attention, leading them to spend time studying how the trains worked, how buttons controlled the engines, and how others interacted with the exhibit. In the toy area, children often paused to figure out how to move train parts or adjust tracks to make sure the trains could pass, showing sustained attention and curiosity.

The Fishing Pond scored lower across all dimensions. As discussed earlier, this area involves a simple interaction that lacks sustained challenge. Most children engaged briefly before moving on, with little opportunity for deeper interaction. That said, the simplicity of the task does offer some value. The Fishing Pond is especially suited for younger children, ages 3 to 5, as its low barrier to entry makes it easier for them to participate. The straightforward design can help build confidence and comfort, especially since the exhibit is located near the entrance and often serves as a gentle introduction to the museum experience. More complex tasks at this early stage might overwhelm younger visitors.

The Treehouse had the lowest scores across all four educational dimensions. While the space includes exploratory tools like a speaking tube and magnifying glass, many children were unable to recognize or fully engage with these features due to a lack of clear instructions and limited adult support. For instance, the far-end speaking tube was often overlooked, and children who failed to use it on their first try tended to give up quickly. Low parental involvement in this area also limited opportunities for cooperative and exploratory behavior.

✧ Summary 3

This section analyzed differences across the five focus exhibits in terms of engagement depth and progress toward educational goals, based on observational data and coded behaviors.

First, using the *Engagement Trajectory Curve* and the slope comparisons between behavioral levels (Figure 6 and Table 5), I found that all exhibit areas showed a certain degree of decline in engagement as children moved from Initiation to Breakthrough. This suggests that most exhibits lack a strong structure for guiding deeper interaction. Children often stopped at initial exploration or repeated simple actions, with relatively few progressing to deeper levels of engagement as defined in the observation rubric. The Train area showed the most stable engagement across all levels, while the Fishing Pond had the steepest decline (–7.0), indicating significant room for improvement in sustaining children's attention over time.

Second, in terms of progress toward educational goals (Figure 7 and Table 6), the five exhibits demonstrated clear differences. This reflects the original intention behind selecting these areas, as each was designed to support a distinct learning focus. Most of the exhibits generally fulfilled their intended educational roles. The Restaurant and Distribution Center performed particularly well across all four learning dimensions, showing strong multidimensional support. The Train was especially effective at fostering observation skills, while the Fishing Pond and Treehouse showed limited support for deeper exploration, extended interaction, or social collaboration.

Overall, the findings from this section highlight a direct link between exhibit design and children's behavior, as well as progress toward learning goals. Exhibits with clear task progression and opportunities for cooperation are more likely to encourage sustained participation and generate positive outcomes. In contrast, areas with limited challenge These moments not only fostered socials or unclear guidance are more prone to disrupted interaction and weaker educational impact.

Study Limitations

➢ Age estimation errors

Although estimated ages were recorded for all observed children, these were based on visual and contextual cues, not direct inquiry. Due to differences in physical appearance across individuals and cultural backgrounds, it was not always possible to make accurate judgments. In a few cases, I spoke with parents and asked about their child's age directly, and the answers were sometimes unexpected. For example, a child who appeared to be around six or seven was actually almost ten. As with adults, children of the same age can look and behave quite differently. This means that the age groupings used in the analysis carry a certain margin of error.

➢ Observer bias

All observations in this study were conducted by myself. For subjective measures, such as rating the level of adult involvement, I followed a detailed rubric to stay consistent. Still, personal interpretation likely influenced the results. While consistency was maintained across the data, the lack of a second observer meant there was no opportunity to cross-check scoring or compare perspectives. This may have affected the objectivity of certain judgments, especially in areas involving interaction quality or behavioral context.

➢ Sample representativeness

During the observation period, I noticed that external factors such as time of day, crowding levels, and family composition had a clear impact on children's behavior and dwell time. On two of the ten observation days, large school groups were visiting. On two other days, poor weather led many families to visit the museum for indoor activities. These situations caused temporary spikes in crowd density, which significantly influenced how children used certain spaces. Some children left areas quickly or avoided interaction when they felt overwhelmed. During crowded periods, adult engagement also tended to drop due to noise and space constraints. While each exhibit area included 50 observations, this sample may not fully reflect the broader, day-to-day visitor patterns at Imagine Children's Museum.

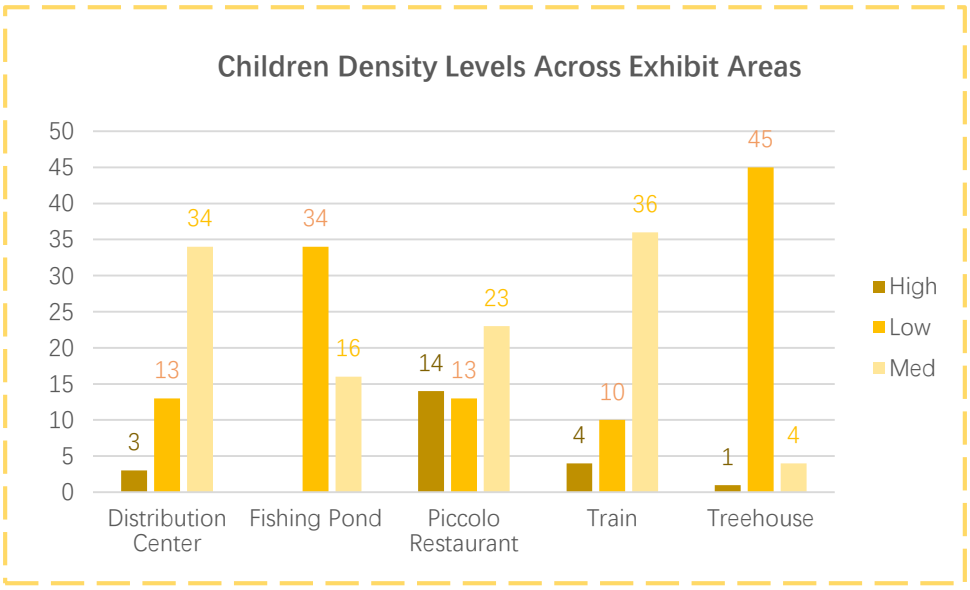
Recommendations and Conclusion

Based on the observation and analysis of the five focus areas at Imagine Children's Museum, this evaluation found that children's dwell time, activity type, and depth of engagement are influenced by a combination of factors. These include the structure of the exhibit, the level of task challenge, the clarity of instructions and prompts, the availability and management of props, and the degree of adult involvement.

In response to the key issues identified in each area, I have developed a set of targeted recommendations. These suggestions are intended to support the museum's future development and improvements, helping to enhance both visitor engagement and educational impact.

✧ Piccolo Restaurant

Figure 8



Issue:

As shown in Figure 8, the Restaurant is the most heavily visited area among the five exhibits. Its high popularity creates a number of challenges, such as limited availability of props and delays in resetting materials. Some children were observed engaging in rule-breaking behavior. For example, some hoarded props or got into conflicts with others over items, which affected the experience of other visitors.

Recommendations:

- **Add a visible reminder for caregivers.** Place a friendly sign in a noticeable spot within the Restaurant area to gently remind parents to help children clean up props after playing, or encourage children to do it themselves.
- **Introduce a "cleanup time" during peak hours.** Currently, staff typically enter the Restaurant to reset props once most children have left. While this helps preserve the immersive experience, it also leads to periods of disorganization during busy times. I suggest adding a mini activity every two hours during peak times called "Little Organizers," inviting children to help tidy up the space. Small rewards, like stickers, can be given as encouragement. This not only keeps the area clean but also teaches children responsibility and organizational habits.
- **Expand the Restaurant space.** If future renovations are considered, this area would benefit from physical expansion. The Restaurant is one of the museum's most popular spaces, but because it's located in the older section, it is relatively compact. The room can comfortably hold about four families at a time; with more participants, the space becomes overcrowded. Future upgrades could include enlarging the room, adding more food props, and diversifying them with items from global cuisines. This would enhance both role-play and cultural learning, helping children explore the world through food.

✧ Fishing Pond

Issue:

The interaction pattern is limited, and the task is highly repetitive, which can cause children to lose interest quickly. There are not enough props, and the existing ones are somewhat difficult to use. In addition, some instances of rule deviation suggest that children are trying to extend their play across different areas, but the current prop setup does not support this kind of engagement.

Recommendations:

- **Redesign the fishing rods. The current fixed handle and reel do not match children's natural** hand movements. A rotating design that better fits how children grasp and turn objects would improve usability.
- **Add more props to the pond.** This could include more types of fish in different sizes and colors. Keeping the interaction simple while increasing variety would make the experience more exploratory and appealing. The visual diversity would also help attract attention and keep children engaged.

- **Create a cooperative link between the Fishing Pond and the Camping area.** Use signs or prompt cards to encourage children to bring the fish they catch to the campsite for pretend grilling or picnic activities. This approach would give the fish props multiple uses and help connect the two exhibits with a shared storyline, encouraging deeper and more continuous engagement.

✧ Treehouse

Issue:

Children' s dwell time is short. The far-end speaking tube is rarely used due to insufficient signage. Caregiver involvement is generally low. Since the speaking tube activity requires cooperation, the lack of clear guidance limits full interaction.

Recommendations:

- **Add clearer prompts.** Currently, the only instructions are located in the small upstairs room within the Treehouse. Because the space is tight, many caregivers stay at ground level and may not see the prompts or realize when a child has completed an activity. Additional prompts should be placed downstairs and next to the far-end tube, with messages such as: "Find the second tube to start the talking game!"
- **Provide cue cards for caregivers.** Add small signs near the speaking tube labeled "Parent Tip" or "Try this together," encouraging adults to join the interaction. This can help caregivers better understand the activity and increase their willingness to participate.

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Appendix 1: Observation Form

UNIVERSITY of WASHINGTON — Imagine Children's Museum Observation Form — Date: _____

Child No._____

Enter time: _____

Exit time: _____

Duration:_____mins

*Reason to **stop** the activity:*

Observation Area: *Original side:* Piccolo Restaurant | Treehouse | Train

New side: Fishing Pond | Distribution Center

Crowding Level: *Low* *Med* *High*

Child Age: 3-5 6-8 9-12 Child Gender: ♂ ♀ Group composition: #adults _____ #children _____

Adult Engagement:

Supportive Behavior: Actively supports the child's participation through words or actions.支持 _____

Assisting Behavior: Directly helps the child complete the activity (e.g.demonstrating).协助 _____

Distracting Behavior: Interrupts the child's sustained participation (distracted or urge leave).干扰 _____

Accompanying Behavior: Plays or interacts with the child without interfering.陪伴 _____

Overall interaction index: 1 2 3 4 5

No.	Type of behavior	Behavior Description	(0=No, 1=Yes)	Note(frequency)
		Initiation Behaviors		
1	Doing the activity 参与活动	Free play without completing the activity. 自由玩耍，没有完成活动。		
2		Touching or trying to operate the exhibit, exploring its functions. 触摸或尝试操作展品，初步探索展品功能。		
3		Partially completing the activity. 在一定程度上完成了活动。		
4	Observing others interact 观察他人互动	Watch other children or parents interact with the exhibit, showing interest. 观察其他儿童或家长与展品互动，表现出兴趣。		
		Transition Behaviors		
5	Repeating Activity 重复活动	Repeat 2-3 times, achieve the desired result/master the exhibit's functions. 进行 2-3 次活动，以达到预期效果，掌握展品的功能		
6		Changing variables leads to different outcomes (beginning to engage). 一旦改变变量，结果就会不同。（开始参与/投入）		
7	Expressing Positive Emotions 积极情绪表达	Smiling and enjoying the exhibit. 面带微笑，欣然参展。		
8		Stronger signs of enjoyment, e.g laughing; verbally mention the enjoyment. 更强烈的享受迹象，如大笑；口头提及享受。		
		Breakthrough behaviors		
9	Sharing/Seeking Information 分享/寻求信息	Asking questions to staff, other children, or family members. 向工作人员、其他儿童或家属提问		
10		Responding to others' suggestions (verbally or through actions). 能够对他人的建议做出回应（口头/行为）		
11		Independently reading labels or learning. 独自阅读标签或学习		
12		Sharing or discussing experiences and information with others. 与他人分享/讨论经验和信息		
13	Engaging/Involved 参与/投入	Engage in exploration,e.g repeat activities, read labels, ask questions(2-3 mins) 有探究性行为。如多次重复活动、读标签、提问。保持 2-3 分钟		
14		Deep focus, interact for long period (3-5 mins), achieve the activity's purpose. 展现高度专注，互动时间长。达到活动目的。保持 3-5 分钟		
15		Experiment and test different variables to seek varied outcomes (more than 5 mins) 进行实验，测试不同的变量，寻找不同的结果。超过 5 分钟		
		Negative behaviors		
16	Lack of Confidence 缺乏自信	Gives up after the first or a few attempts. 在初次或几次尝试后放弃		
17	Displays Frustration 表现沮丧	Negative emotions, e.g. difficulty understand tasks or feelings of failure (e.g., frowning or hitting objects). 表现出负面情绪，例如无法理解操作、产生挫败感，（皱眉或拍打）		
18	Rule Deviatio 规则偏离	Does not complete the activity according to the rules (e.g., improper use of tools). 未按规则完成活动（不正确使用道具）		
19	Distracted Attention 注意力分散	Easily disturbed by external stimuli, losing focus. 容易受到外界干扰，分心		

Appendix 2: Observation Tool Guide

Imagine Children's Museum Observation Tool (How-To Guide)

Purpose of the Evaluation

To conduct a comprehensive evaluation of 3 to 12-year-old children's engagement with both new and old exhibits at the museum, focusing on dwell time, activity types, and engagement levels.

How to Collect Data – Tracking and Timing

1. **Observation Duration**:
   Each data collection will last 2 hours/per area, once a week for 5 weeks (estimated 2-3 children per hour). This means a total of 10 hours of observation per area.
2. **Preparation**:
   Gather an iPad and a timing tool. Before starting, fill in the top section of the observation form, including the date and the observation area.
3. **Positioning**:
   Stand at the entrance of the designated observation area and randomly identify target children (aged 3-12).
4. **Selecting a Target Child**:
   When families enter the museum, they will be informed at the ticket counter about the observation and evaluation activity in specific areas of the museum. If parents don't consent to participate in the observation, their children will be given a specific wristband to wear. Therefore, the target children will be any child not wearing the wristband.
5. **Recording Details**:
   Once the target child is identified, record their entry and exit times, the caregiver's involvement status, and make an approximate estimation of the child's age.
6. **Interpretation of crowding level:**
   Low: Very few other children/families; most materials are readily available.
   Medium: A moderate number of children/families are present, but materials are still accessible without delays.
   High: The area is crowded, and children/families need to take turns using the materials.
7. **Following the Child**:
   Follow the child's activities, keeping a close but non-intrusive distance to observe both the child's and the caregiver's actions (if applicable). Provide enough space to ensure they do not feel scrutinized or monitored.
8. **Recording Observations**:
   Observe the target child's engagement, interactions, and caregiver involvement. Fill in the behavior observation form, marking each behavior as 0 (No) or 1 (Yes).
9. **Data Storage**:
   At the end of the observation day, input the data recorded on paper into an Excel spreadsheet for archival and analysis.