SCIENCE IN INFORMAL LEARNING SPACES: TINKERING SPACE AT SCIENCE WORLD

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Abstract

Creating tinkering spaces in informal learning places requires research, testing, prototyping, and evaluation. Designing the space and programming can be an iterative process and could take years to create something that works. Science World takes on the approach of creating and designing a tinkering space by using the design process and collaborating with partners. We evaluated the process and took observations to ensure the tinkering space met the criteria we set forth. The creation of the Tinkering Space was thoughtfully created and designed with the visitor's experience at the forefront.

Introduction

Aside from unique architecture, Science World has become iconic for families in Vancouver to explore hands-on exhibits and galleries that nurture their process of discovery and inspire connection with their natural, physical, and built environments. Our value of inquiry-rich, play-based, cross-disciplinary learning is embedded in every aspect of design, from fun interactive exhibits, engaging stage shows, and unique school programs. Throughout Science World you will discover that each gallery focuses on different themes and topics. Gallery spaces have their own narratives, learning goals, and outcomes. One of the newest galleries at Science World is our Tinkering Space: The WorkSafeBC Gallery.

Tinkering can be thought of as something similar to that of maker activities (Bevan, 2014). We can think of these activities to help build a maker mindset in visitors and to get them to do activities that support a different mindset.

The Tinkering Space has daily tinkering programming where you can solve problems, make new things from existing parts, create something cool and imaginative, and learn through experimenting and making mistakes. You'll also learn about the science behind safety and how important it is to choose the right tools for the job. This informal learning environment captures the playful spirit of Science World all in one place. Creating the Tinkering Space is an iterative journey, and we continue to work hard to build out the visitor experience and pedagogical practice we have today.

The Tinkering Experience

After many years working at Science World, I still experience the wonder and joy of seeing visitors and staff engaging with the interactive exhibits in the building. The eyes of delight and curiosity as families bring their children into the building for the first (or hundredth) time is incredibly rewarding. Designing captivating experiences is our goal and our mission, as we research the current and most relevant practices in the museum industry.

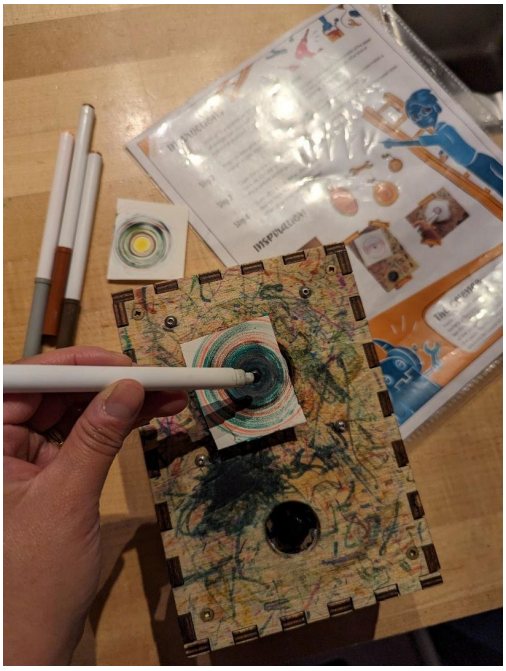
Whenever visitors enter the Tinkering Space, they get hit with its colourful and fun aesthetic, its welcoming space, and hands-on tinkering experiments. When you enter you are greeted by a science facilitator asking if you would like to participate in today's activity. As you look around the room, tools and equipment adorn the walls. You get a sense of wonder and excitement like you are meant to create and build something of your own in the space. The front half of the gallery contains wooden KEVA building blocks. The displays show a variety of different KEVA structures to prompt creativity and design. The backspace is intended for facilitated activities and school workshops. In between the two spaces are interactive exhibits that focus on workplace safety. The emphasis on safety is important in this gallery as it builds skills for future scientists, engineers, and artists.

I am captivated by seeing families engaging with the tinkering activities. Adults and science facilitators explain the activities to the kids and their young faces light up with the

thought of creating and learning something new, or even building on skills they already know. Carefully chosen open-ended challenges in the programming space allow visitors to "think with their hands" and prompt them to "think outside the box". Tinkering challenges are inherently cross-curricular, or Science, Technology, Engineering, Arts, and Mathematics (STEAM) activities. For example, folding and modifying origami models incorporates math, art and engineering, while building "wiggle bots" is an exercise in circuitry, sculpture and structural design. Wiggle bots are simple robots that can shake, wiggle, and dance.

Many of these activities and challenges use common and familiar materials and are designed to invite inquiry as well as artistic creativity. For example, the "spin art" activity adds a motor to felt-tip pens and paper to invite visitors to play with rotational physics and math.

Figure 1. *Spin Art activity in the Tinkering Space*



Note. This image shows the Spin Art Activity. We want to make sure that these tinkering explorations draw the interest of a variety of visitor demographics. Used with Permission. Photo credit: Kristin Lee

Tinkering activities are designed to have "low floor, high ceiling, wide walls"; in other words, they are easy to start, are rich in inquiry potential, and appeal to a broad demographic of learners.

To provide a design experience for the widest possible age spectrum, the front part of the Tinkering Gallery is filled with wooden KEVA planks.

The name "KEVA" stands for "Knowledge – Exploration – Visual Arts," reflecting the educational and creative aspects the building blocks encourage. Each planks measures ¼" thick,

¾" wide, and 4 ½" long. A box of KEVA plans offers builders an opportunity to explore mathematical relationships, structural stability and problem-solving. Armed with an instruction card, visitors can build their skills by copying the designs on the card, and then get creative and let their imaginations go wild. The versatility and open-ended nature of the blocks encourage visitors to return again and again to try new experiments.

Figure 2. *KEVA building blocks are simple wooden planks but can hold tremendous amounts of value. Playing with the blocks can facilitate visitor learning about design, engineering, and inventing.*

Note. KEVA Planks exhibit at Science World. Used with permission. Photo credit: Science World.

As visitors walk in today, they are drawn into our newest program called the Maker Studio, a brand-new program that allows our guests to create and design using industry tools such as 3D printers, Cricut smart cutting machines, and sewing machines. This is the most elaborate manifestation at Science World of "constructionism" – Seymour Papert's description of the learning that happens while making something that is meaningful to the maker (Stager, 2016). Maker Studio is a safe and facilitated space to be introduced to new skills and tools, while working through a design cycle. A high ratio of facilitators to participants means that Maker Studio experiences are individualized and responsive to visitors' different levels of expertise. Participants feel ownership throughout the design process as they design and make something for themselves.

The Design Process

The Tinkering Space did not always exist in the space that it is today. It was a dream to create a space where we could allow visitors to make and tinker with tools and materials. The gallery took many years to develop, and it is a continuous project to make sure we are practicing and using the most current tools, methodology, and museum practices.

Science World has always had "loose parts" exhibits and areas that allowed for some level of tinkering and creating. For example, Contraption Corner offered games, puzzles, table activities and inventor kits. Each inventor kit contained tools and materials that allowed a visitor to create and build an "invention" such as a ball launcher, a flashlight, or a motorized cart. However, the step-to-step instructions made the activity feel more like an assembly than an open-ended tinkering task.

Over the many years, Contraption Corner ceased to exist. As the years went by, we wanted to create a dedicated space with tools and materials and fill it with open-ended activities that could be used for facilitation. Science World decided to create a tinkering space, inspired by the Tinkering Studio at the Exploratorium in San Francisco and Fabrik at the Montreal Science Centre.

When we first came up with the concept of the Tinkering Space, we really wanted to expose our visitors to the idea of design thinking and using the iterative design process (Question-Imagine-Create-Test and Repeat). This process is the foundation to our exhibits, facilitation, and programming. Thus, the Tinkering Space has become a living and evolving hub for tinkering and implementing the creative process. The design process is similar to NASA's Engineering Design Process that helps engineers solve problems (STEMOnstrations, n.d.-b).

We also recognise that the context of the learning matters, designing visitor experiences around collaborative learning models and using physical design principles drawn from the Reggio Emilia philosophy, where the learning environment is seen as the 'third teacher'. The walls of the Tinkering Space are decorated with tools and with sample KEVA structures, and the tables are designed for groups to gather around with some materials displayed in the centre – and other materials in a common area to encourage cross-group collaboration. The design cycle is made concrete by a rotating overhead sign that reads "Question Imagine Create Test".

Tinkering is an engaging way to provide our visitors with creative thinking skills. It offers a fun means to learn by doing and to think with your hands. We wanted to make sure that we were capturing these skills to allow visitors to repair, adjust, and improve their creations without barriers.

We hope that when visitors explore the space, they can take home these key messages:

- I am creative.
- I need to know how to use tools properly and safely before I use them.

- Thinking about safety is part of my everyday life.
- I like to create with my hands.

Throughout the gallery development, we learn and observe from our visitors. They teach us how to develop and design innovative exhibits with clear learning objectives. Observing visitors' learning in the space and while they are programming allows us to practice and evolve our science communication. It allows us to make sure we keep current and use emergent learning practices. These practices come from teachers, educators, museum industry, and classrooms. To keep up with all these practices we must make sure to be flexible and agile. We want to make changes quickly to ensure the visitors are getting the best experience.

Working with Community Partners

During our design processes we collaborate with community partners, content experts, and Science World members. Through collaboration, we can ensure that we present the most accurate, up-to-date, and relevant information.

In creating the Tinkering Space, we worked with WorkSafe BC as content experts on workplace safety. Working with partners like WorkSafeBC taught us about communicating effectively and efficiently with partners. It is important to identify the key learning messages, and outcomes together. Once we have our key messages, we can use this information to determine how we will implement them into the balance of experience across the exhibition. These messages are brought to our Exhibits Design team to create exhibits and experiences that can capture and communicate the learning outcomes.

As well as their expertise, community partners also bring in different perspectives to the museum setting. Often, as museum educators we forget that we are not content experts in every field and sometimes the message incorrectly gets translated to the visitors. There is often specific vocabulary that is used in different subject matter or certain topics that may have more current and accurate information. To make sure that we are getting this information correct we ask our partners to review and vet our content.

We often work with local community partners to help educate and inform our visitors about different initiatives and messaging. Along with presenting useful resources within our exhibits and galleries, Science World can help provide an avenue to pass on important messaging to our visitors. Our collaboration with WorkSafe BC in the Tinkering Space made sure to highlight the importance of safety in the workplace and to get visitors to critically analyse their perspectives on safety.

When working with community partners we make sure that both parties' benefit and learn from each other. Partnering only makes sense if we share common goals or missions. We want to make sure we choose what we design and present as well as making sure that our partners are the right ones to work with. Mutual collaboration is ideal for a good working relationship.

Inquiry-rich Programming

The Tinkering Space is about "thinking with your hands". Visitors can make mistakes and experiment in a welcoming, safe environment, and are encouraged to take part in the iterative design cycle. They generate their own questions and are provided with the tools and materials to answer those questions.

Safety is crucial to good tinkering. Providing visitors with the opportunity to learn how to use new tools properly and safely allows them to expand their creative boundaries. In the Tinkering Space, we scaffold visitor's learning based on their prior experience, so they can feel comfortable taking risks by trying new skills or by putting materials together in new ways.

Facilitators encourage visitors to work collaboratively with one another. This builds skills essential for teamwork, communication, and critical thinking.

Facilitators are trained not to jump in and "fix" visitor projects, but to ask questions and offer just-in-time tips. We don't offer step-by-step assembly instructions, but general guidelines and inquiry questions.

Conclusion

Keeping up to date with current and emerging informal learning practices involves connecting with other museums, industry educators, science facilitators, educators, and community partners. We attend webinars, conferences, and workshops to get the important information, trends, and technology. We find experts to help us identify holes, provide us with correct information or even point us in the right direction. We are active participants in our hope to inspire lifelong learning in our visitors.

References

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