Design Thinking for Preschoolers: Encouraging Empathy through Play

Coorey, Jillian; Caldwell Rinnert, Gretchen

School of Visual Communication Design, Kent, United States

Over the last two decades, we've seen an emphasis on math and science education, along with standardized testing, a direct result of legislation and educational reforms meant to improve education for children. The Common Core (CCSS) moved educational decision making out of the hands of local school systems and moved that power to a national level (McCluskey, Rebarber, & Wolf, 2018). Funding for art education was removed, minimized or relegated to the extra-curricular activities. Art and Design programs in the United States are seeing the results in higher education as these children have now matriculated to the college level. Recent graduates are showing less aptitude for creative thought and critical thinking (Land, 2013). Attention and focus have turned towards the reintroduction of art and design in K-12 education with the recent STEAM initiatives (STEAM = Science, Technology, Engineering, Mathematics + Art+ Design) that also emphasize *art and design*.

Many programs and research within this area focus on older children, but preschool curriculum is inherently playful and curious, as such provides a well-suited context for introductory design education. This study seeks to explore how might design be integrated effectively into a Pre-K classroom. Through the integration of design methods, do students begin to display design thinking tasks such as empathy, creative thinking, empathy, and collaboration? To answer these questions, we worked with a preschool summer program to develop design curriculum based on play and inquisitive making. We explored critical thinking and creativity through visual tools and popular children's literature as a starting point, helping to ground the design activity.

Keywords: design thinking; design pedagogy; preschool learners; design thinking; empathy

1 Introduction

Over the past couple of decades, specifically within the United States, there has been a rise in educational standards which prioritize science and math over other subjects. Education reforms, such as the No Child Left Behind (NCLB) Act, signed into law in the US in 2002, focused on an effort to ensure no child would be overlooked. NCLB prioritized core subjects and standardized testing within school systems as a measurement of success. To meet needed scores, "teachers drove their students, often eliminating subjects such as social studies and the arts, in pursuit of student success" (Wexler, 2014). Eight years later in 2010, the Common Core State Standards (CCSS) state-wide initiative for reform was launched. CCSS emphasized the skills students need for college and career success through a set of

K-12 standards. Similar to NCLB, CCSS "aligned national curriculum and standardized testing to the degree that testing inexorably drives curriculum" (Wexler, 2014). In response, numerous schools allocated funds for math and language courses, at the expense of art education (Metla, 2015). Along with these educational reforms, the STEM (Science, Technology, Engineering, Mathematics) movement, emphasizes the importance of these areas in education for a future of global competitiveness and innovative ideas (Land, 2013).

While they vary slightly, these reforms accentuate core subjects of science, math, language—subjects that are testable and quantifiable. This curriculum emphasizes standardization, a nod to an earlier era of faculty systems with mass production, centralized decision making, and passive compliance (Strauss, 2014). At the heart of the CCSS initiative was that decisions and flexible maneuvering by educators eliminated.

> Common Core is the logical endpoint of nearly three decades of Congressionally-mandated centralization through 'standards-based reform' that has moved key curriculum content, sequencing and pedagogical decisions away from local school systems and educators to the state and national levels. Instead of the promised accountability for results or informed school choice, the outcome at the local level has been a culture of compliance ("alignment") that has intruded into the core function of curriculum and teaching. (McCluskey, Rebarber, & Wolf, 2018)

As a result, recent college graduates are lacking creativity and innovation (Land, 2013). The current education system instructs students how to execute tasks, "but rarely fosters curiosity and self-motivation" (Land, 2013, p. 548). Focusing on innovative problem solving, communication, and critical thinking is critical (Carrol et al., 2010, p. 38).

As we look to the future, some educators are beginning to see value in the STEAM (Science, Technology, Engineering, Mathematics + Art+ Design) platform. "Art + Design are poised to transform our economy in the 21st century just as science and technology did in the last century" (http://stemtosteam.org/). Initiated by Rhode Island School of Design, the STEAM movement advocates for the integration of Art and Design within K-20 education (education from kindergarten through university), as a response to schools removing or significantly reducing art offerings in public education.

This paper presents qualitative research as a case study that explores how design can provide new learning experiences, encourage empathy, and creative thinking at the pre-kindergarten (Pre-K) level. Our goal is to introduce the problem-solving methods used by visual communication designers in a Pre-K learning environment. We choose to focus our investigation with 3-to-5-year-olds as "the quality of children's learning environments prior to age 6 has an influence on later academic success" (Tippett and Milford, 2017, p. 68).

2 The Design Process

First, it is important to define the type of 'design' we are using when approaching designing curriculum for Pre-K students. The author's degrees and expertise are in graphic design, also referred to as visual communication design, with a specific focus on typography, interaction, and motion design. Design "encourages participants to think outside the box in the pursuit of creative or innovative solutions" (Wolniak, 2017, p. 247). While exact definitions and processes vary slightly, the general design process involves research, ideation, iteration, prototyping, testing, and refining until a solution is reached. This problem-solving process is cyclical, with designers often repeating steps along the way. Dubberly

Design Office (DDO) has produced several information graphics regarding the design process, breaking the design process and people-centered research into the following steps: observe > reflect > make > socialize > implement (Chung J. et al., 2009). They define the creative process as iterative and recursive (Figure 1).

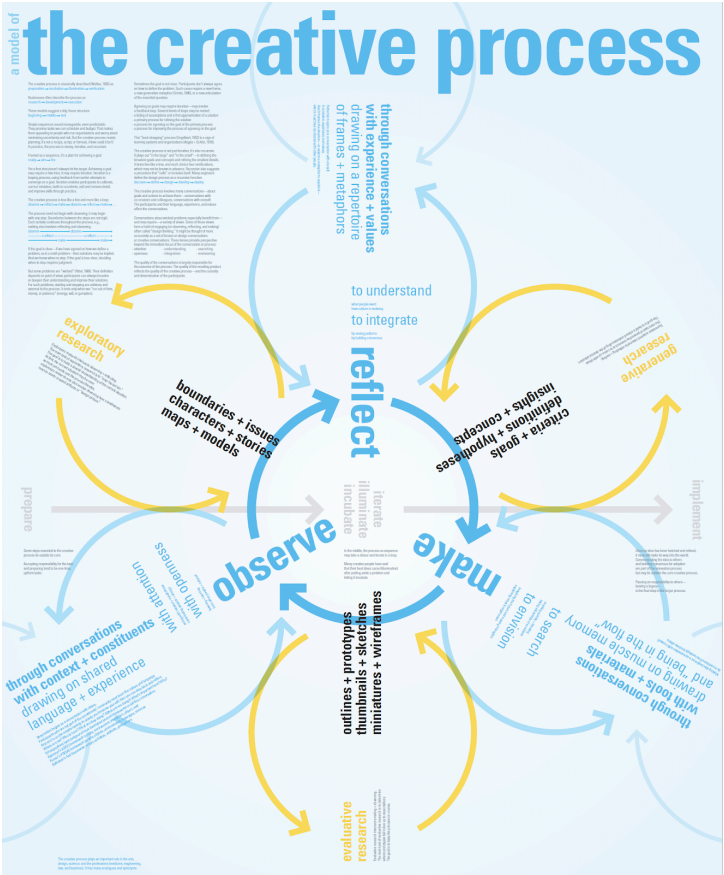


Figure 1. This concept map depicts the creative process. Source: Chung J., Evenson S., and Pangaro, P. 2009.

2.1 Design Thinking

While designers have been utilizing this process for many years, it has recently been popularized by IDEO founder, David Kelley. Design thinking is a methodology which has grown immensely over the years as it is integrated into education and business. Design thinking builds upon the creative strategies that designers use, applying these principles to a range of disciplines from business to social issues (Wolniak, 2017). Along with IDEO, Stanford's d.school uses design as a foundation for learning. According to their website (dschool.stanford.edu), their process involves building upon 'methods from across the field of design to create learning experiences that help people unlock their creative potential and apply it to the world.' The five steps of the d.school's Design Thinking process are: 'Empathize, Design, Ideate, Prototype, and Test'. Similar in nature, the steps in the IDEO Design Thinking model include: 'Discovery, Interpretation, Ideation, Experimentation, and Evolution'.

2.2 Design and design thinking at the PK-12 level

Along with the rise in design and design thinking now practiced in business and higher education, there has been a rise in educators integrating these methods into the PK-12 classroom. At the K-12 level, there are numerous resources and studies (Noel and Liub, 2017; Cook and Bush, 2017; Carrol et al., 2010) of how to integrate design thinking in the

curriculum and classroom activities. “As children move from kindergarten to middle school, and then to high school, instruction shifts from stories to facts, from speculation to specifics, and imagination fades from focus. Design thinking is an approach to learning that focuses on developing children’s creative confidence” (Carrol, 2010, p. 38). Involving an interactive and dynamic approach to problem-solving, design thinking can enhance the learning experience among preschool and kindergarten students (Lynch, 2018). Not solely related to the subject of design, design thinking used as a learning tool can support a diverse range of interdisciplinary content (Carrol et al., 2010). In contrast to the education reforms involving standardized testing, the design process helps “students develop as deep thinkers and doers, not just as test takers” (Wise, 2016).

The study ‘Taking Design Thinking to Schools Research Project’ (Carroll et al., 2010), completed in the United States, contributes to research on design thinking within the K-12 classroom. The qualitative study centered around the questions: how did students express an understanding of design thinking, how did affective elements impact design thinking in the classroom, and how is design thinking connected to educational standards and learning (Carroll et al. 2010). The study found that students grasped the design process evident through the vocabulary they used and the artifacts students designed displayed attention to human needs. Through utilizing collaboration, a key element of the design process, they worked together to think creatively and take risks.

In addition to the aforementioned initiatives, there are several organizations looking to reshape the way design is integrated into PreK-12 education. One such example is DESIGN-ED. Established in 2012, the DESIGN-ED coalition’s goal is to “develop policies of support for design education at the international, national, state, and local school district levels” (design-ed.org). The organization, which consists of educators, administrators, practitioners and institutions, supports PreK-12 initiatives through resources, events and conferences, and publications.

2.3 Learning Styles and Design Process

The design process may offer a way to engage different learning styles. Kolb’s experiential Learning Theory (ELT), based on the work of Dewey, Piaget, and Lewin, provides a “holistic integrative perspective on learning that combines experience, perception, cognition, and behavior” (Kolb, 2014, part 1, section 2, para. 2). Kolb argued that learning is a unique process for each individual “formed and reformed through experience” (Kolb, 2014, part 1, section 2, para. 21).

Kolb identified four modes of learning that provide new experiences and require different abilities: Concrete experience abilities, Reflective Observation abilities, Abstract Conceptualization, and Active Experimentation (Kolb, 2014, part 1, section 2, para. 38). Kolb further explains;

> “Learning requires abilities that are polar opposites, and the learner, as a result, must continually chose which set of learning abilities he or she will bring to bear in any specific learning situation. More specifically, there are two primary dimensions to the learning process. The first dimension represents the concrete experiencing of events at one end and abstract conceptualization at the other. The other dimension has active experimentation at one extreme and reflective observation at the other. Thus, in the process of learning, one moves in varying degrees from actor to observer, and

from specific involvement to general analytic detachment" (Kolb, 2014, part 1, section 2, para. 38).

Kolb compared ELT to various models of problem-solving process (Kolb, 2014, part 1, section 2, para. 46). The problem-solving process shares many of the same activities as design thinking, from selecting a problem/goal, evaluating options, selecting and deciding on a way to proceed, executing a final solution and then refining that solution.

Learning theorist Bernice McCarthy summarized learning theories by Kolb and other leading theorists to define 4 unique learner types in her book The 4Mat System:

1. Type 1: Imaginative Learners enjoy developing ideas and brainstorming (McCarthy, 1980, p. 37)
2. Type 2: Analytical Learners create concepts and models. They are abstract thinkers and enjoy summarizing findings. (McCarthy, 1980, p. 39)
3. Type 3: Common Sense learners enjoy practical application and hands-on activities. (McCarthy, 1980, p. 41). These learners would enjoy prototyping.
4. Type 4: Dynamic Learners, who enjoy action, testing and learn by trial and error (McCarthy, 1980, p. 43). These students would enjoy beta testing ideas, and the discovery process that transforms design ideas to verified solutions.

When comparing theories on learning preferences and styles, there is an overlap with the design process, where each learning style is engaged during the act of designing (Figure 2). In a group setting, hypothetically, each child would be able to exercise in their preferred method of learning by using design thinking, therefore taking part and being an active and engaged member of the learning community.

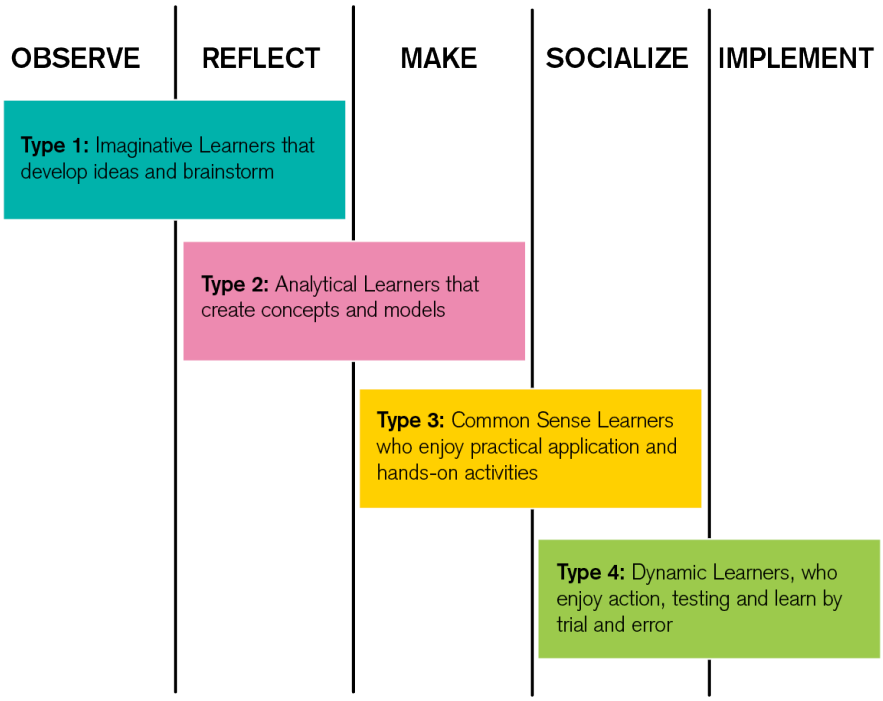


Figure 2: Comparing the creative process to McCarthy's Four Learner Types. Source: Caldwell Rinnert, 2019.

2.4 Skills for the 21st century

With pedagogies involving problem-based learning, human-centered creativity, prototyping, and user testing; most designers would testify to the benefits of introducing children to a design education (Noel and Liub, 2017). “The learning outcomes of design education are consistent with what experts agree are necessary skills, knowledge, and attitudes for individual success and the nation’s global competitiveness in the next century” (Davis, 1998, p. 7). According to Meredith Davis, a design educator, the ‘problem-solving process’ of design affords strategies of use within the K-12 classroom. Since the 1960s, small groups of designers have been working with K-12 educators to demonstrate how design can be used to teach other subjects. The goal is to educate through design by expanding the pedagogical repertoire of teachers in the delivery of content, and, to advocate for creative problem solving within the classroom (Davis, 1998).

In 1997, the National Endowment for the Arts (NEA) published a study titled *Design as a Catalyst for Learning*, which examined how design is being used in K-12 schools. From the case studies teachers cited student benefits including:

- enhances flexible thinking skills
- promotes self-directed learning and assessment
- develops interpersonal and communication skills
- develops responsible citizens
- applies learning to students’ lives
- increases student comfort with uncertainty

(Davis, 2004, p. 15)

As shown, research attests to the benefit of an arts and design education. However, within the United States, there has been a decrease in arts education, the effects are especially noted in lower-income and minority populations. Based on a study done by *Americans for the Arts*, in 2008, “African-American and Hispanic students were two times less likely to have access to art programs in their school districts in comparison to their white peers” (Metla, 2015). The National Endowment for the Arts (NEA) reports that low-income high school students who earned few or no arts credits were five times more likely not to graduate from high school than low-income students who earned credits in art, music and design (Metla, 2015).

3 Methodology

This research is a qualitative case study. Our goal was to introduce problem-solving methods used by visual communication designers into a Pre-K learning environment. The following questions directed our research:

1. How might design thinking be effectively integrated into a Pre-K classroom?
2. Through the integration of design methods how will students visually and physically display design behaviors such as creative thinking, empathy, and collaboration?

3.1 Site and participants

Located on a state university campus, the Child Development Center (CDC), is a child care facility primarily used by university employees and cares for children from two through six-year-olds, in toddler, preschool, and kindergarten classrooms. The school’s curriculum applies a variety of teaching methods and strategies, and children are exposed to various

ways of learning and play. According to their website, part of the CDC's mission includes, "offering an education based on meaningful relationships and, engaging in ongoing inquiry into our own practices". The educators are at the forefront of pre-K pedagogic methods, directly reflective in how they run their individual classrooms. One of the instructors is currently pursuing her PhD, where she has taken courses on how to integrate design in education. Within the current curriculum, the CDC employs learning techniques utilized in design including brainstorming, peer collaboration, prototyping, and experimentation.

During the summer, STEAM camp (Science, Technology, Engineering, Arts, and Mathematics) focuses on weekly themes which introduce various ways of problem-solving to students. The camps are for children ages three, four, and five with each week centering around a different theme. The summer camp attendees are a mix of students, some attend the CDC throughout the year, while others only come for summer programming. Camp sessions last one week and run from 9 AM until noon.

Our involvement consisted of developing the curriculum for a one-week session, detailing supplies, meeting with the instructors prior to the start of the week, and conducting observations. Our curriculum centered on various aspects of design, with each day focusing on a different theme. For this initial research, observational field notes were used for data collection along with photographs of artifacts (prototypes, text, drawings) produced by the students. We rotated between the three different classrooms, which were divided into the age groups of three, four, and five. While daily attendance varied, the average weekly attendance throughout the week consisted of 15 three-year-olds, 8 four-year-olds, and 15 five-year-olds. The students who attend during our session included a mix of races (African American, Caucasian, and Asian), with the gender division between male and female balanced. Additionally, informal conversations with the teachers and students provided supplemental insight into student's comprehension and working methods.

3.2 Curriculum

Each day began with a morning meeting where the weekly theme of design was discussed. Discussion of the design process provided a framework for the children to begin making throughout the week, connecting play and discovery to the design process. Students were read a story that was related to the problem they were going to solve. The stories provided context and information, presented in a familiar and welcoming format. Table 1 is an example of the daily theme along with learning objectives and in class activities.

Table 1 CDC example curriculum chart

MONDAY	
Topic	*Creating Spaces*
Order	Read story, The Black Dog Discussion about the story and locations In class activity Outside activity
Learning objectives	Space and location, scale and contrast
In class activity	Map making of the black dog house, playground, and yard
Outside activity	Hide and seek.
What are they prototyping?	Map poster

While each classroom (3, 4, and 5-year-olds) had the same daily theme, projects varied slightly to account for the students' ages and learning abilities. Within the three-year-old classroom, clear instructions were given and project examples were shown. In contrast, the four and five-year-old activities were open-ended, providing freedom for exploration and inquiry-based learning. The role of the instructor shifts within this environment, evolving from the sole distributor of information to one who designs educational experiences, engaging learners with one another and the material (Love et al., 2014).

To encourage playful interaction and making, everyday recyclable objects, along with general art and craft supplies, were used for most of the projects. A 2017 study by Tippett and Milford conducted research integrating science learning in the Pre-K classroom. Regarding integrating science and STEM learning they state, "Children's early STEM experiences should be hands-on and allow them to experiment and explore with safe everyday materials in meaningful ways; these types of experiences are related to later academic and social success" (2017, p. 69). Our approach was similar and objects ranging from paper towel rolls to rubber bands, and tin foil provided a platform for creativity (Figure 3). Working with materials is central to art and design education, which is based on doing and making (Noel and Liub, 2017).

Figure 3: Children working with recycled materials. Source: Author, 2018.

4 Observations and results

We began with an analysis of the qualitative data that was collected through our observational notes, photographs, and artifacts of the work produced. Field notes and photographs of the student's artifacts were used to identify behaviors that were indicative of the design process. Observational notes, consisting of classroom activities and student discussions, were organized by the authors into categories, with evidence of their behaviors noted. From these categories, the authors noted several themes. Students exhibited an understanding of the design process as various themes emerged from their behaviors, displayed in Table 2.

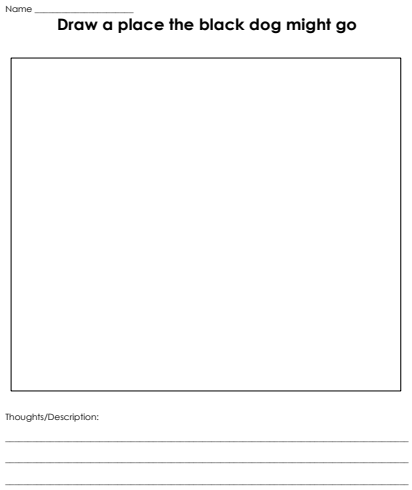
Table 2 Categorizing student behaviors

Category	Behaviors Exhibited	Theme
Student working habits	Two students joining together on a project	Collaboration
	Inventing new aspects of a project, students determined what direction the project would take	Innovation, Creativity, Problem Solving
	Sketching ideas and building plans	Brainstorming, Ideation, Sketching
Exploration of materials	Students were comfortable using a variety of materials with the imaginations to build and construct	Creativity, Innovation
Student discussions	Recognizing others differences and similarities	Empathy
	Defining characteristics of others and characters	Empathy
Student Comprehension	Displaying an understanding of design with how they use terminology. “Design is to create”, “Design is to build”	Design discourse

4.1 Theme: Brainstorming, Ideation, Sketching

Brainstorming is a type of ideation usually used within a team setting to rapidly compile ideas to solve a problem in a non-judgemental and safe space (Dam & Siang, 2018). Brainstorming has been around for a long time and should inspire a group. Brainstorming frequently begins with a problem to solve (Dam & Siang, 2018). Sketching is tightly coupled with brainstorming as people sketch and draw their ideas as they work in order to communicate their thoughts to the group. Sketching can communicate more quickly than text or verbal communication as it gives the participants a mental model to discuss. Sketching can come naturally to children as they often draw ideas and stories for their family and friends. Sketching provides an easy way to communicate complex ideas and thoughts for children who are learning language skills and struggle to express themselves. For children with special needs or experience a speech delay, it may be their preferred method of communication. Brainstorming and sketching activities can help children generate ideas for critical thinking and problem-solving.

Within each classroom three to four learning activities were organized at different stations, as suggested by the CDC educators. Although given a choice with where to begin, the students were instructed to try all activities, even if they might not like something. Within the older classrooms, students were provided with pencils and paper to sketch their ideas prior to making (Figure 4). Terminology such as building plans and brainstorming related this step back to the design process. Upon completion of their sketch, students could begin prototyping.


Name _____

Draw a place the black dog might go

Thoughts/Description:

Figure 4: Brainstorming paper provided to students. Source: Authors, 2018.

4.2 Theme: Collaboration

Collaboration was evident during the week's activities. Collaboration is a natural part of the design process, as teams work together to solve a problem. A study by Pino-Pasternak, Whitebread, and Neale found that "productive collaborations were marked by demonstrations of positive affect (i.e., smiles, physical proximity, and encouragement); the provision of assistance in the face of challenges; and the presence of interspersed humor and play. These positive behaviors seem to have provided a fertile ground under which students felt confident to engage in cognitive and social challenges" (Pino-Pasternak, Whitebread and Neale, 2018, p.57). They went on to conclude that "dialogue is an extremely powerful tool through which students not only learn content, modes of thinking, or strategies to solve a task, but very importantly, they exert social positions that facilitate or preclude group participation (Pino-Pasternak, Whitebread and Neale, 2018, p.60) They advocated for early childhood collaborative experiences, as even children as young as 5-years-old found it beneficial, but they also expressed a need for curricular planning that managed collaboration and interaction. Collaboration in the classroom can be difficult, and can cause anxiety for everyone involved. Luckily, preschoolers enjoy their peers, and find collaboration to be a social activity. Preschoolers' teachers must play the role of facilitator and note-taker. The maps and "dog traps" the children sketched show the work by multiple children with notes from the teacher, taken as the children discussed their ideas (Figure 5). The design process offers a means to facilitate productive collaboration as children define problems and solutions together, testing and making design prototypes.

Figure 5: Collaborative maps by children and teacher. Source: Author, 2018.

4.3 Theme: Creativity and Innovation

Creativity, linked to problem-solving, is an essential skill which will be needed to generate new solutions to complex problems in the future (Wong and Siu, 2011). Students displayed creativity and innovation throughout the week as they designed solutions to the project prompts. On the first day the teacher read aloud, *Black Dog* by Levi Pinfold, an illustrated children's book about assumptions, fear, and bravery that centers around a black dog in the family's yard. Following story time, the students created maps of the dog's journey throughout a neighborhood as he chases a little girl. Designing a map was part of the project, however, the students took this project a step further as they began to design traps and objects to help catch the dog. Their behaviors display additional complex thinking, and self-initiated exploration. They demonstrated problem-solving behaviors, creativity, and self-directed learning as they used found materials to build and explore.

4.4 Theme: Empathy

The theme of empathy emerged from classroom discussions. After reading the book, *Same, Same But Different* written by Jenny Sue Kostecki-Shaw, which focuses on how humans having similar and contrasting lifestyles, the three-year-olds had a discussion about where they lived and how things were similar but different. Throughout the reading of the book, students were quick to interject with their own comments about how they were alike or different from the characters in the book. At the conclusion when asked about what makes us the same as others, a student stated, 'we all live on earth'. At the heart of these discussions, the students displayed empathy as they began to compare and contrast their lives with each other. "Empathy is a learned skill that is needed not just in design, but in many professions, and therefore empathetic children who grow into empathetic adults are likely to perform better in general and be more successful in life" (Noel and Liub, 2017, p.8). Focusing on empathy through design-based learning is beneficial to all students.

5 Conclusion

Research attests to the importance of a design-based education. However, the creative fields are often overlooked in preference to STEM-based learning. As an alternative to STEM, educators are advocating for the integration of art and design, resulting in STEAM. The STEAM curriculum engages students in cross-disciplinary learning in PK-12 settings and informal education (Bequette and Bequette, 2012).

In response to this challenge, we approached this from early childhood education, beginning in the Pre-K classroom. This initial study engaged Pre-K students in design activities during a weeklong summer program. Through the artifacts created and observations collected, we've begun to see how design can enhance the learning experiences at this level. This study is transferrable to preschool and kindergarten curricula. Since story time is a frequent early learning activity used in both classrooms and libraries, it would be easy to model this strategy in a variety of ways. Story time usually has a focus on literacy. By pairing it with design activities, for instance map making, children are engaged in deep thinking that truly shines when one has a narrative to base ideas on. The narrative provides the children with context and application of the design process connecting literacy with science, math and art/design. By allowing children use story time as the precipice of their exploration, the teachers can engage the class and initiate a conversation, and the activities allowed the children to be makers, creators, artists and designers.

As this was an initial study, further research is needed to fully understand what the best practices are for integrating design at the Pre-K level. Additionally, we acknowledge the limitations of this study. The study was completed during a one-week period and students were not monitored following the program to see if they continued to exhibit design behaviors. The developed curriculum was given to all students, thus there was no control group. Future research could involve developing questions for the parents about their children's use of design terminology outside the classroom, along with conducting follow up interviews with the students and instructors.

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