WHITE PAPER

Where Global Science Meets Playful Learning: Implications for Home, School, Cities and Digital spaces

A special focus on China

By Hirsh-Pasek, K., Masters, A. S., Christie, S., Gibbs, H. M., Evans, N. S., Fletcher, K. K. , Pesch, A., Yang, H., Fan, W., Todaro, R. D., Golinkoff, R. M , Xu, F.

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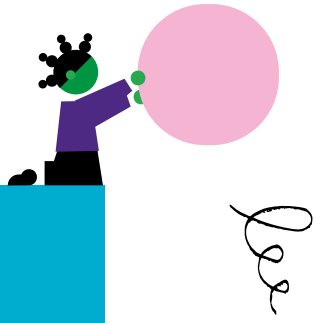
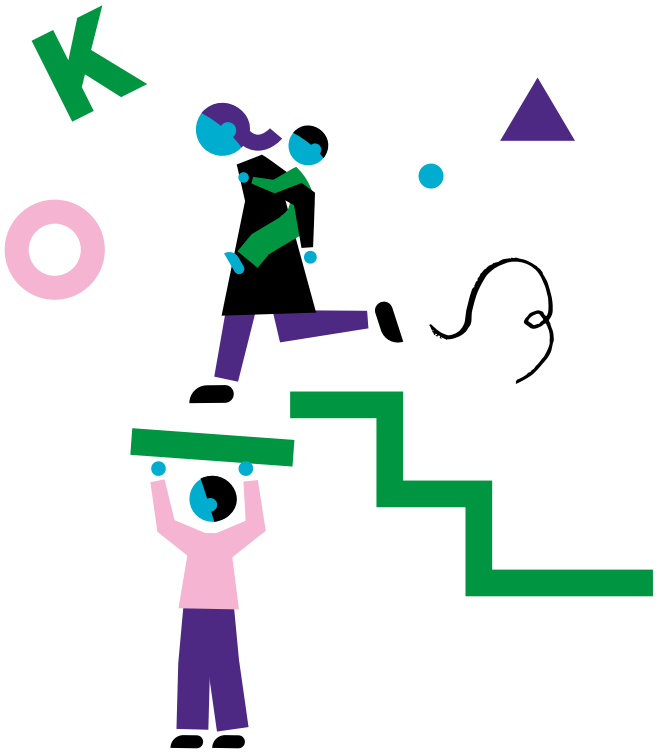




Preface

How do we educate children today for a world of tomorrow – for a world filled with new technological tools that can port them to diverse realities, for a world where innovators and leaders will face uncertainties in geographic boundaries, climate change and the workforce? Success in that new world order will require that children outsmart the robots. They must master basic skills in reading, writing and science – but computers will be faster at doing calculations and digesting paragraphs than their human counterparts. To succeed, our children will need to be strong collaborators, critical thinkers and creative innovators. The science of learning offers a roadmap to this type of education in which every child thrives amidst these global changes. Playful learning holds the key to turning that roadmap into reality in contexts as diverse as school, digital platforms and in Child-Friendly Cities.

Playful learning consolidates a suite of characteristics that capture how the brain learns best, through active, engaging, meaningful, socially interactive, iterative and joyful experiences. Playful learning policies are appearing from Ministries of Education around the world including in India, Canada, Singapore, Finland, and China. To better align these policies with implementation, however, governments will need to concentrate on three levers: societal attitudes, educational policy and implementation and city policy.

This white paper on the global landscape in playful learning articulates ways we can (1) help parents understand the connection between playful learning and their children's academic and developmental outcomes; (2) promote continued momentum in education policy that embraces a breadth of skills approach rather than a narrow focus on content in school settings; and (3) scaffold city designs that centre children's learning in everyday inter-generational spaces.

CHAPTER 1

Introduction

"Play is often talked about as if it were a relief from serious learning. But for children, play is serious learning... Play is the work of childhood."

– Mr. Rogers

Children learn every day in every context. They experiment with toys and other materials (Dag et al., 2021), seek out stimulation in their environments (Kuo et al., 2019), and tap into their social relationships to support their learning (e.g., Meltzoff et al., 2009). Their brains come ready to take in information and sort that information into usable knowledge. The most organic way that children leverage opportunities for their learning is through play (Kosner, 2019). During play, children test theories about the physical, biological and social worlds, expand on their communication skills, and build foundational confidence in their abilities. By creating spaces that support children's learning through play, we foster a generation of children who see opportunities for learning in everyday life, who make connections and think critically, and who grow into enthusiastic lifelong learners.

For too long, play has been shunted to the role of frivolity. In 2009 well-known Yale University psychologist Ed Zigler proclaimed that "play was under siege" (Zigler & Bishop-Josef, 2009). Surely a behaviour seen throughout species like dogs, cats, goats and octopuses and that surfaces in children even in war-torn countries, must have deeply important roots. But somehow the rush of advanced society created what Professor David Elkind of Tufts University called the "hurried child" (Elkind, 1985). Determined to help children succeed, parents filled children's time with 'purposeful' activities in science, literature and mathematics. In the United States, schools began to drop recess time in favour of increased time in class (Pellegrini & Bohn, 2005). Test outcomes became intellectual currency around the world, leaving little time for curiosity, exploration and innovation.

More recently, play has experienced a global renaissance (Hirsh-Pasek & Golinkoff, 2003; Sahlberg & Doyle, 2021; Yogman et al., 2018). Today, Professor Pasi Sahlberg, the acclaimed Finnish author who is credited with propelling Finnish schools to the top of the international test score comparisons, writes that the secret to Finland's success is not in academic drilling, but rather in play and playful learning (Sahlberg & Doyle, 2021). This white paper uses the accumulated scientific evidence from around the world to demonstrate why play – a seemingly simple, joyful, and natural behaviour – might be key to healthy brain development and to nurturing precisely those skills that children need to thrive in the 21st century.

The animal literature gives us a first glimpse into the important role of play throughout evolutionary time. Cats, monkeys, squirrels, dolphins, rats and many other animals all play (Bekoff, 1984; Caro, 1988; Fagen, 1981; Janik, 2015; Takahashi & Lore 1983). Professor Panksepp, an Estonian neuroscientist from Bowling Green State University, was among the most prolific writers on animal play and its molecular, cellular and behavioural impact on activity in the brain (Bell et al., 2010; Gordon et al., 2003; Panksepp et al., 1984). Most of Panksepp's research was conducted with rats and demonstrated that when rat pups play they have permanent changes in brain areas used for thinking, relating and emotional coping (Burgdorf et al., 2010; Gordon et al., 2002). Two hours of play per day affected a rat's problem solving, synaptogenesis and neural pruning. Indeed, rats in more socially enriched cages with ramps and running wheels develop different brain structures than those in less richly furnished cages (Bell et al., 2010). This in turn promoted increased problem-solving ability and lower levels of impulsivity (Baarendse et al., 2013; Einon et al., 1978; Hol et al., 1999). Cross-species comparisons further suggest that animals play more if they have previously been deprived of the opportunity to play (e.g., Jensen & Kyhn, 2000; Wood-Gush et al., 1990).

The animal literature further reveals that play is related to the reward centres in animal brains. Neurotransmitters, such as dopamine made by cells in the substantia nigra and ventral tegmentum, activate dopamine receptors and increase play behaviour in rats (Vanderschuren et al., 1997). Finally, and relatedly, high amounts of play are associated with low levels of cortisol, suggesting either that play reduces stress or that unstressed animals play more (Yogman et al., 2018). These animal studies hint at the potential role of play in attention, working memory and problem-solving skills that are often nested under the term *executive function skills* – skills that, in humans, are situated in the frontal lobe areas of the brain (Miyake et al., 2001). In fact, one study showed that 7- to 9-year-old children who took part in an active play after-school intervention demonstrated better executive control than those randomly assigned to a non-play condition (Hillman et al., 2014). And executive control is linked to later school readiness (Gibb et al., 2021).

Research also suggests that the amount of play noted in a species is related to the size of the brain in that species. The most playful animal species tend to be those that mature more slowly, and have larger brains, increased intelligence, and good learning abilities (Gopnik, 2016). Thus, humans play even more than our evolutionary cousins, the apes. Evidence of human play has a long history. Anthropologists have found evidence of play throughout prehistory, suggesting that play is one of the most important means of cultural transmission in human societies (Lancy, 2015). One of the earliest examples of a wheeled vehicle was a small coyote toy found in an Aztec tomb south of Mexico City (Charnay, 1887). Miniature tools found in Bulgaria (Marangou, 1991), model carts and constructions in the Indus Valley in South Asia (Rogersdotter, 2006), infant rattles in the Czech Republic, Siberia and Austria (Turek, 2013), small clay pots and animal figurines in the Czech Republic (Turek, 2013) and Death Valley, USA (Wallace, 1965) all point to play occurring throughout time and across cultures.

Evidence of sports and games also supports the existence of play throughout human history. In Ancient Mesoamerica, the earliest known version of a ball game was played as early as 1650 BCE (Blomster & Chávez, 2020) and is well documented in the Popul Vuh, the sacred book of Ancient Mayans transcribed in the 16th century. Although a board from the Levant (the present-day Eastern Mediterranean) thought to be used for game play dates to 7,000 BCE (Masukawa, 2016), the earliest known evidence of a board game being played was in Egypt around 3500 BCE (Janssen & Rosiland, 1996; Piccione, 1980). Indeed, board games appear throughout the world in prehistory on almost every continent (Masukawa, 2016). Other game artifacts such as marbles, balls, dice and chess were used during the European medieval period, as well as devices like teeter totters (seesaws) and swings (Hanawalt, 1993; Orme, 2001). Before colonialism, Native Americans had sports as varied as the tribes themselves, and their children played a variety of circle games, singing games, imitating animal games, and chasing games (Stow, 1924). The early evidence of sports, games and other play indicates that play is not only universal but is an activity that adapts and manifests in a variety of ways across cultures.

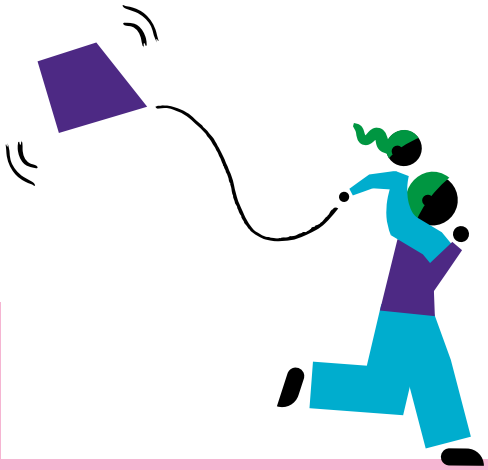
Perhaps most striking is not merely that play unfolds across human history, but that it permeates each generation. Child's play is found on fabricated playgrounds, in natural forests, in the aftermath of tornadoes and hurricanes and amid the strewn remnants of war. Its universal appearance across species and human history suggests that play should be central to human competence and resilience.

In the modern era, theories about the importance of play were guided by the Swiss psychologist Jean Piaget and the Russian scientist Lev Vygotsky. For Piaget, play represented what he called pure *accommodation* – or the fitting of the real world into symbolic representation. Through a prolonged process over the course of the first two years of life, Piaget argued that children learn that one object or symbol can stand for another – as in sticks representing swords or magic wands. **The ability to think symbolically is central to human thought – found in our understanding of number, causality, logic, and learning to read, among others.** Vygotsky saw two distinct roles for play that were both evident in make-believe play. First, as in Piaget's theory (1962), a child pretending to be something or someone else divorces their internal reality from the concrete reality. Symbolic representation is born. Second, Vygotsky (1967) added that fantasy play allows children to internalise social rules and move from external regulation to the ability to control impulses from within. This surfaces in the modern literature as a key feature of executive function skills like attention and memory.

In the 1970s, 1980s and 1990s scholars like Brian Sutton-Smith, Doris Bergen and Vivian Paley offered more comprehensive descriptive and correlational accounts about the merits of play. They noted that play teaches critical life skills (Bergen, 2015; Fromberg & Bergen, 2006; Paley, 1992, 2009; Sutton-Smith, 1997). Robert Fagen (1981) posited six overlapping hypotheses about the benefits of play: play (1) develops physical strength, endurance and skill; (2) regulates developmental rates; (3) yields specific information; (4) develops cognitive skills necessary for behavioural adaptability, flexibility, inventiveness and versatility; (5) provides a set of behavioural tactics used in competition; and (6) establishes or strengthens social bonds in a dyad or social cohesion in a group.

Since then, many others have developed theories of play (e.g. Burghardt, 2005; Fisher et al., 2011; Hirsh-Pasek & Golinkoff, 2003; Zosh et al., 2018) and written reviews of the research on play (e.g. Johnson et al., 2016; Pellegrini & Nathan, 2011; Smith & Roopnarine, 2018), and there are now journals focused specifically on play – most notably the *American Journal of Play*. A seminal paper by Angeline Lillard of the University of Virginia and colleagues (2013) challenged the field to do even more stringent research on the role of play and, in particular, the benefits of make-believe play. Published in the high-impact journal *Psychological Bulletin*, this work prompted a resurgence of interest in both play and playful learning with high-quality data. This new batch of research reflects many of the recurrent themes: play seems to have enormous social (e.g., Hirsh-Pasek & Golinkoff, 2003; Smith, 2010; Vygotsky, 1967; Zigler & Bishop-Josef, 2004) and academic (e.g., Alfieri et al., 2011; Hirsh-Pasek et al., 2015) benefits for young children.

The evidence relating play and learning also inspired curricular approaches to education. Jerome Bruner's spiral curriculum, Piagetian schools, the Open Classroom movement, Waldorf schools, and many others, emphasise active learning through play. There is also considerable data that tests playful learning approaches to education. Montessori Schools and the Tools of the Mind curriculum are perhaps the most noted examples. Maria Montessori was the first woman to graduate as a medical doctor in Italy, but then gave up practising medicine to start a school in Rome to serve underserved children. She based



her principles of teaching on her observations of children and believed strongly that educators and parents should "follow the child" (Montessori, 1964; see also Lillard, 2021). The Montessori curriculum capitalises on intrinsic motivators of learning by allowing children to freely explore and learn in semi-structured learning environments, where adults guide rather than direct the learning process. In a strong test of the Montessori approach, Lillard and Else-Quest (2006) evaluated 3–6-year-old children who had been randomly selected by an existing lottery system to attend a Montessori school. If the children were not admitted, they attended other more traditional schools in their area. They found that children who attended Montessori preschools had superior outcomes on standardised tests of reading and mathematics, wrote more complex creative essays, and showed more prosocial behaviour, advanced social cognition and executive control.

Similarly, Tools of the Mind, a curriculum developed for early childhood classrooms by Drs. Elena Bodrova and Deborah Leong (1997; 2007) uses guided play as a means to cultivate executive function, self-regulation and academic skills. In Tools of the Mind classrooms, children learn critical academic and self-regulatory skills through play and hands-on learning activities which are guided and facilitated by teachers, rather than directly taught. When compared to children attending traditional schools, those attending Tools of the Mind schools demonstrated stronger academic performance in both reading and writing, better socio-emotional outcomes, and improved executive function skills (Blair & Raver, 2014; Diamond et al., 2019, but see Nesbitt & Farran, 2021).

The data emanating from these programmes demonstrates that playful learning offers a viable pedagogical approach which augments but does not dampen traditional curricular learning. That is, playful pedagogy can support rich curricular goals. Professor Bruce Fuller noted the benefits of playful learning approaches in his longitudinal study of underserved children, writing "If you can combine creative play with rich language, formal conversations and math concepts, that's more likely to yield the cognitive gains" (Goldstein, 2017, p. 2; see also Hirsh-Pasek & Golinkoff, 2011; Hirsh-Pasek et al., 2020; Weisberg et al., 2013).

The LEGO Foundation has likewise embraced play in educational contexts. Playful learning appears in even familiar pedagogical models, such as project-based learning, thematic learning and flipped classrooms (Hirsh-Pasek et al., 2020; Rice, 2009). These educational modes create opportunities for children to engage with curricular material in ways that endorse meaningfulness, encourage children to be actively engaged, to iterate and build on their own learning, and to engage collaboratively with their teachers and peers (Parker & Thomsen, 2019). Having acquired the relevant skills, children learn in the moment and create a bedrock for all future learning. Rice (2009) sums up best what is most impactful about play for children's learning: it is experiential; process- rather than goal-oriented; is supported by intrinsic motivation; and requires a fundamental active engagement (see also Henricks, 1999). These ingredients, together, create the ripest conditions for children's knowledge-building.

More recently, the work on play and playful learning has even prompted communities to consider the implications for children's learning in everyday environments. Several cities are invigorating public spaces with opportunities for enriched playful engagement. In Playful Learning Landscapes (**playfullearninglandscapes.com**; see **Chapter 6**), a joint initiative of the Playful Learning Action Network and the Brookings Institution, bus stops morph into public spaces where children can participate in the type of puzzle play that sparks STEM learning in science, technology, engineering and mathematics (Hassinger-Das et al., 2020). Sidewalks prompt storytelling, libraries become hubs for community and intergenerational learning (Hassinger-Das et al., 2020), and public parks offer human-sized board games that encourage executive function skills in attention, memory and impulse control (Bustamante et al., 2019; 2020).

Finally, evidence is mounting that playful learning is a key component of digital learning through intentional app design and gaming. Recent research investigating the literature on screen time use demonstrates that playful learning principles can be adapted to educational television, ebooks and app development and even the metaverse (Etta & Kirkorian, 2019; Hassinger-Das et al., 2020; Hirsh-Pasek et al., 2015; Hirsh-Pasek et al., 2022). Importantly, many popular educational apps do not yet employ playful learning. For example, Meyer and colleagues (2021) found that many commonly downloaded apps in the US do not engage principles designed to optimise learning even when they are labelled 'educational apps'.

Taken together, data from the animal literature, human history, laboratory research, educational interventions and digital learning all suggest that play should feature centrally in future educational approaches, both in and out of school. Play has been implicated in growing **collaboration**, **communication**, **content**, **critical** thinking, **creative** innovation, and the **confidence** to persevere and learn from failure (see **Chapter 5**). These 21st-century skills are not only those that characterise optimal developmental outcomes, but are also those that are mentioned in surveys by CEOs about workplace skills for the jobs of tomorrow (Golinkoff & Hirsh-Pasek, 2016). In short, play is serious business. As Albert Einstein rightly noted, "Play is the highest form of research".

Project Introduction

The pages that follow define play and playful learning from a global perspective. Play is a topic of interest that spans traditional disciplines – from developmental psychology to educational science to game theory. In **Chapter 2**, we examine the history of play and definitions of play, including a definition of 'learning through play' or playful learning that is respectful of the history in the field and adaptable to these varied sectors. **Chapter 3** examines the child's environment and how proximal and distal ecologies shape each child's experience of play. **Chapter 4** brings together the data supporting the role of children's social relationships in their learning through play. **Chapter 5** focuses on the academic and socio-emotional outcomes of learning through play and identifies a suite of skills needed for success in the 21st century – the '6 Cs'. **Chapter 6** dives into the varied settings in which children can learn through play, be it at home, at school, on the playground, or in other public spaces, such as Playful Learning Landscapes. **Chapter 7** reviews digital play and both the benefits and limitations it presents to children. Here we also demonstrate how with proper design, digital learning can be even more effective in promoting a broad suite of skills. Finally, **Chapter 8** discusses the future of playful learning and how policymakers can change policies and social attitudes to create a playful learning society in which children learn the skills they need to be successful in the 21st century.

CHAPTER 2

Defining Playful Learning

"Play is our brain's favorite way of learning"

– Diane Ackerman

"Play is fun for children, but it is also essential for their development and well-being"

– OECD, 2021

Far from being a frivolous activity, researchers realise that play fosters skills like curiosity, problem solving, creativity and innovation – skills that are central for the workplace and for the growth of society. While there is enormous interest in the study of play, the concept itself remains difficult to define. It looks different across cultures and serves a variety of purposes – ranging from simple joy to practising basic skills (Gopnik, 2016) to supporting learning of advanced concepts (Golinkoff & Hirsh-Pasek, 2016; Hassinger-Das et al., 2017; Sim & Xu, 2017). Biologists and developmental scientists accept a definition of play that characterises it as a spontaneous child-led activity with no extrinsic goals (Garvey, 1990; Gray, 2013; Smith & Pellegrini 2013). However, as the OECD report, *Play, Create, and Learn* testifies (OECD, 2021), play can serve as the most organic conduit for particular goals as in knowledge-building. Play thus serves as a fertile proving ground for children to capitalise on opportunities to learn, to generate a relatively stable "change in behavior brought about by practice or experience" (Lachman, 1996, p. 477).

History of Playful Learning

The struggle to converge on a definition of play has roots that extend for millennia from Ancient Greece and Rome, through Plato, Aristotle and Quintilian. Plato, for example, considered play essential for helping children train for later careers. "He who is to be a good builder, should play at building children's houses... The most important part of education is right training in the nursery" (Plato 1952, p. 649). As this quote illustrates, centuries ago it was clear that play and learning were inextricably related (Plato, 1952). Writing in the 1700s, French philosopher Jean-Jacques Rousseau added that the way to teach children, particularly before age 5, was to adapt children's games and play to teach specific learning goals (Rousseau, 1779). It was these words that inspired Johann Pestalozzi, in the early 19th century, to establish the first schools for young children in Europe where he cautioned against learning through memorisation and endorsed 'learning by doing' (Sellars & Imig, 2021). This sentiment has been carried over time, through Montessori, Reggio, and Anji Play schools, among many others (Coffino & Bailey, 2019; Froebel, 1887; Montessori, 1964).

Contemporary Attitudes toward Play

During the last century, play and learning were somehow divorced from one another. Academic curricula were to be learned through rote memorisation aimed at success on achievement tests that became favoured over 'deep' learning that was generalisable and retainable (Heckman & Kautz, 2012). Play was relegated to what Nobel laureate and economist Heckman (Ibid.) termed 'soft skills' that were viewed as fundamentally non-academic. Only recently have scholars rekindled the age-old connection between play and learning in their definition of this key human behaviour. A book edited in 2011 by noted developmental psychologist Ed Zigler (Zigler et al., 2011) of Yale University featured an article by Hirsh-Pasek and Golinkoff titled 'Optimizing core curricula through playful learning', in which they write, "Playful pedagogy offers a model for how we can better prepare students to be lifelong learners who will enter a world that is increasingly relying on global, socially sensitive and creative thinkers" (Hirsh-Pasek & Golinkoff, 2011, p. 114).

More recently, this sentiment has been echoed in a consensus report arguing that we must move toward an academic curricular approach that is integrated with a playful learning pedagogy. Jade Jenkins and Greg Duncan write that developmental researchers should aim to "provide teachers with lesson plans to follow in which playful activities are strategically organised to present children with learning opportunities" (Phillips et al., 2017, p. 39). The pendulum is swinging towards an approach that favours academically rich environments delivered through playful learning. Play and learning are again bound together.

Scientific Approaches to Studying Play

Among the first scientific definitions of play were those provided by Piaget and Vygotsky. In many ways, these scholars set the foundation for current theories and thinking about the constructs of play and playful learning. In Piaget's classic 1945 book, *Play, Dreams, and Imitation in Childhood*, he outlines how children need an environment where they are free to explore and discover the world around them. Play is the natural context in which exploration takes place. Through exploration of their environment, children actively construct knowledge (Mayer, 1992). Vygotsky's (1978) *Mind and Society* lays forth a cultural historic view of playful learning that is centred more on early social learning. Through dramatic play – a symbolic representation of the 'real' world – children inherit social mores and cultural values. When a child plays house they are acting out social roles they see adults inhabiting and learn skills, self-regulation and social scripts.

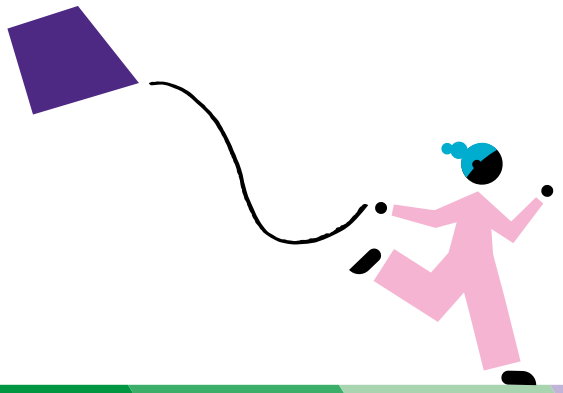
Together, these approaches set the stage for serious inquiry around, and educational application of, play. Over the last century, several schools of education have begun to use the work of Piaget and Vygotsky to design curricula that view play and learning as inseparable (e.g., Montessori, 1964; Tools of the Mind by Bodrova & Leong, 2007). A more recent example comes from the Anji Play schools in China, which use specifically designed play materials and environments to inspire exploration and learning (Coffino & Bailey, 2019). The success of educational programmes such as these have contributed to the resurgence of theories and studies attempting to define and understand play from a scientific perspective.

Defining Play Today: From Free Play to Guided Play or Playful Learning

Much of the initial research examined so-called stages and categories of play. Building on the work of Piaget, for example, Mildred Parten (1932) first described stages of play that children pass through from birth to age 5, ranging from the unoccupied solitary play of very young infants, to the complex, collaborative play of the young child. Belsky and Most (1981) linked the early exploration of object play to pretend play and offered a 12-step-sequence of play that offered insight into the development of the advanced capacity to infuse imagination into play. Other scientists conceptualised play in terms of categories rather than all-encompassing definitions. Describing categories of play provides a framework to explore the benefits that play can offer children. Smilansky (1968) and Brian Sutton-Smith (1995) fall into this camp in writing about children's functional play, conditional play, games with rules, and dramatic play.

More recently, researchers including Zosh, Hirsh-Pasek, and colleagues (2018), Yu and colleagues (2018), and Weisberg and colleagues (2013) argue that there are multiple types of play. Free play, where a child plays without constraints, has no extrinsic goal. However, other forms of play, including games, sports and guided play can have extrinsic learning goals that can be scaffolded and supported either by a prepared environment or an adult. Doris Bergen (1988) was the first to suggest that play might lie on a continuum in this way. Zosh, Hirsh-Pasek and their colleagues (2018) built on this research and other prior frameworks to expand on the notion of play as a multifaceted spectrum that is bookended on one end by free play – a child-initiated and child-directed activity with no learning goal (when the cushions on the couch become a fort) – and on the other end, by direct instruction – an adult-initiated and adult-directed activity with an adult-directed learning goal (traditional school, which does not constitute play even if playful).

As we see in Figure 1, playful learning or *guided play* is marked by being adult-initiated, but child-directed with a specific learning goal (e.g. children's museums, Montessori schools). It lies midway between the extremes, encompassing both guided play and games. When adults both initiate and direct play – even if it is in the context of a fun flashcard game – it is not really play. By *initiated*, Zosh, Hirsh-Pasek and their colleagues (2018) refer to the way in which the adult curates the environment to target specific learning outcomes and coaches the child within that environment without co-opting the child's engagement. By *directed*, they refer to the way in which the child interacts with the adult and the environment. A room or centre can be designed for STEM learning with well-constructed blocks and models of what can be built that get progressively more difficult. As the child moves through the space, the adult can prompt learning or coach (e.g., asking questions; using spatial language like *above*, *through*, *under* or *beside*), but not direct the learning.



	Free Play	Guided Play	Games	Co-opted Play	Playful Instruction	Direct Instruction
Initiated by	Child	Adult	Adult	Child	Adult	Adult
Directed by	Child	Child	Child	Adult	Adult	Adult
Explicit Learning Goal	no	yes	yes*	yes	yes	yes

*Here, we refer to 'serious games' as outlined in Hassinger-Das et al., 2017 in which the game has a learning goal

Figure 1: The play spectrum (Zosh et al., 2018)

Guided play provides opportunities for child-initiated and child-directed activities while *also* integrating the support of teachers, caregivers and parents in pursuit of a learning goal that can be embedded into the activities and in the environment. In other words, guided play epitomises what we call **playful learning**.

Playful learning, as mentioned previously, manifests all of the key characteristics of a learning exchange best suited to what we know about how brains learn best – when the activity is **active**, **engaging**, **meaningful**, **socially interactive**, **iterative** and **joyful**. When these characteristics or pillars are present, in addition to an embedded learning goal either in the environment or in the activity itself, children are best poised to build new, enduring knowledge and skills.

Active

Children who actively construct their own knowledge learn more than children who passively receive information. Studies with children as in Whitehurst and colleagues (1994, 2003) find that when adults ask questions during book reading, children learn more than when they are simply being read to. In fact, Kersey and James (2013) found greater activity in brain areas associated with letter perception when children wrote letters rather than when they watched someone else write. Children who are active participants in their own playful learning are more likely to encode, recall and generate new connections because their minds are 'on'; they are not just passive recipients of information imparted by an adult. Indeed, active learning is a key element in how humans learn efficiently (Hirsh-Pasek & Golinkoff, 2021).

Engaging

Children need to be motivated or invested in what they learn (Fredricks et al., 2004). Disruption, distraction and extraneous information all result in shorter attention and engagement times. From preschool through adolescence (Barriga et al., 2002; Razza et al., 2012) a child who is engaged is more academically successful. A child who is distracted by background noise (Schmidt et al., 2008; Ribner et al., 2021), pop-up books (Tare et al., 2010) or even cluttered classrooms (Fisher et al., 2014) does not learn as well. When children are engaged in what they are doing, they are invested in the outcomes, and will persist with the activity even in the face of challenges.

Meaningful

Meaningful activities build on a child's current knowledge by connecting new information to past experiences, resulting in more effective learning (Novak, 2002; Shuell, 1990). When fractions are taught by cutting pizza or sharing slices of cake (Clements & Sarama, 2007) – experiences which children may have had previously – children learn more. They remember stories and learn vocabulary when they are centred in familiar events rather than unfamiliar ones (Hudson & Nelson, 1983). When children's playful learning is connected to their own lived experiences, children are better equipped not only to relate their learning to existing knowledge but to see opportunities for learning in everyday life.

Socially Interactive

Socially interactive activities provide opportunities for children to learn from others – whether they are parents, teachers or peers. Many studies reinforce this finding, from those in infant imitation (Meltzoff & Moore, 1977) to language learning (Adamson et al., 2004, 2017; Hudson et al., 2015; Kuhl, 2007) to vocabulary building and literacy (Whitehurst et al., 1994; Zevenbergen & Whitehurst, 2003). In fact, 4- to 5-year-olds who engage in more conversations with adults have increased connectivity in the language centre of the brain (Romeo et al., 2018). When social interaction is stilted, as it is in television, children learn less (Kuhl et al., 2003; Madigan et al., 2020). Social interactions are the bedrock for learning and development, from early in infancy throughout life.

Iterative

As Piaget described in his theory of early development, children grow from examining a new problem, discovering and exploring aspects of the problem, creating hypotheses about the problem and how to solve it, and then reinforcing or debunking those hypotheses through testing their theories and refining them with new 'data' (Piaget, 1945). Work by Baillargeon and DeJong in 2017 suggests that this is even true for infants as they explore their world (e.g., Gopnik et al., 2001; Schulz, 2012). Learning comes from iterative exposure and exploration.

Joyful

Finally, Zosh and Hirsh-Pasek's model overlaps with other definitions in claiming that fun is a key part of what it means to learn through play. At a neuroscientific level, positive affect and surprise are related to learning (Betzel et al., 2017). When learning is fun, children are more motivated and less stressed (Bisson & Luckner, 1996; Zosh et al., 2018) and are better able to overcome frustrations and obstacles (Hirsh-Pasek et al., 2015; Zosh et al., 2018) to persist in their pursuit of learning.

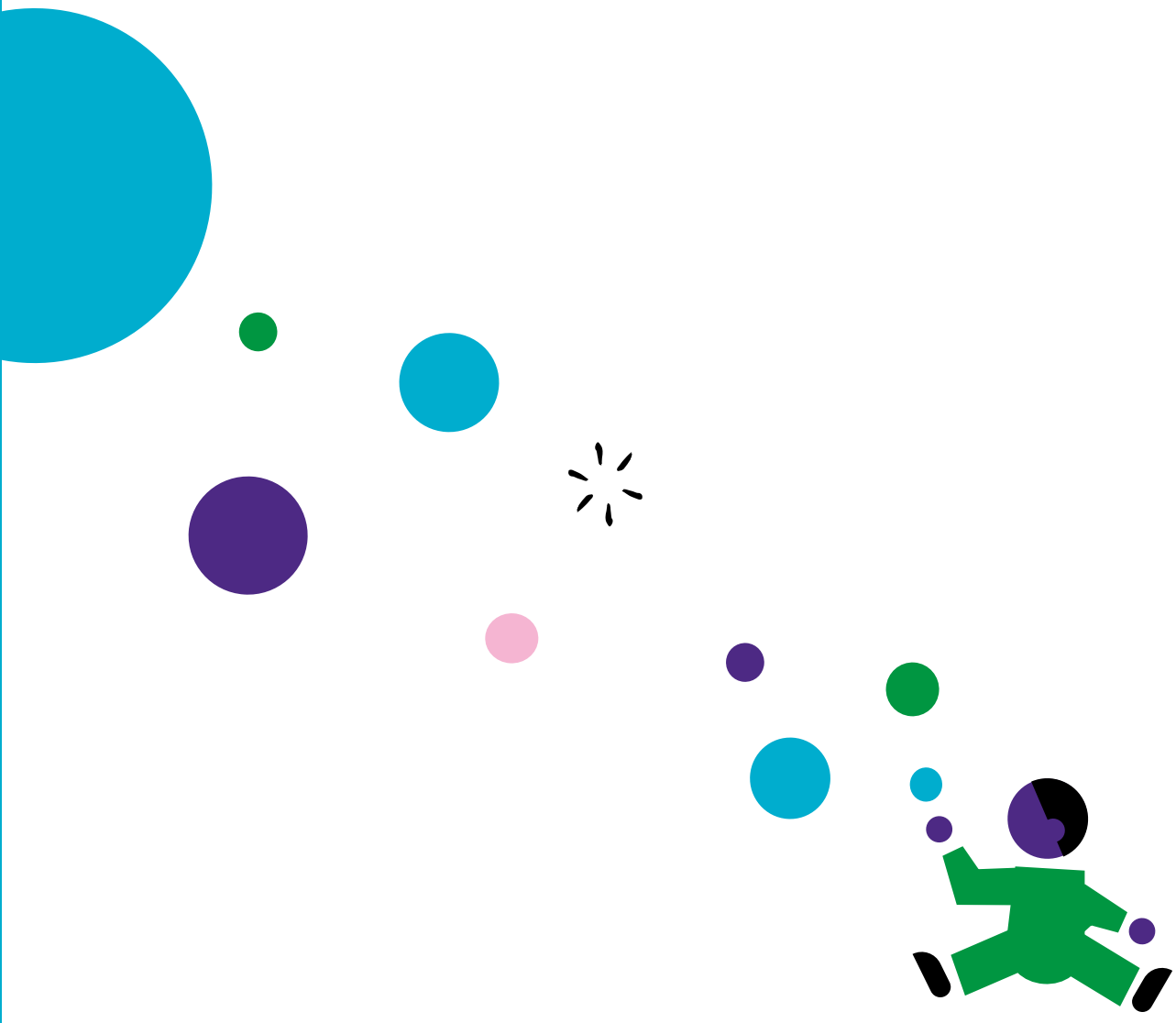
How the Pillars Support Learning

Drawing on past research and definitions of play, Zosh, Hirsh-Pasek and their colleagues (2018) suggest that the key pillars of playful learning described above (active, engaging, meaningful, socially interactive, iterative and joyful) collectively lead to a suite of systematic outcomes that Golinkoff and Hirsh-Pasek (2016) call the 6 Cs: **collaboration**, **communication**, **content** (math, science, attention, memory), **critical** thinking, **creativity** and **confidence** (growth mindset, learning through failure) (see **Chapter 5**). Each of these characteristics of effective learning builds on and reinforces the others. Play, and guided play in particular, is an effective way for children to learn because they encompass these characteristics of learning that mirror how brains learn, and generate more robust academic achievement outcomes, as well as a more transferable breadth of skills.

Conclusion

The definition of 'play' has gone through a number of iterations in the last 50 years. Yet, the field is beginning to reach a consensus. Play is not a singular construct, but rather is best represented by a spectrum that moves from free play, to guided play (playful learning and learning through play), to games, to more playful direct instruction (which is, however, not play). The characteristics of playful learning overlap with the characteristics of *how* children learn best. If children learn best when they are active, engaged, when material is meaningful, when they are socially interactive, and when the learning is iterative and fun, then playful learning should be an optimal pedagogical strategy, especially in the context of meeting a specific learning goal.

Taken together, the characteristics of play offer a rubric for creating dynamic systems that foster learning in and out of school, and in digital and live environments. Moreover, when these characteristics of learning are present, they promote not only the traditional academic outcomes typically thought of as relevant for children's learning, but also a host of transferable skills that children can use to achieve success in any context throughout their lifespan. In Hirsh-Pasek and colleagues' 2020 *Big Ideas* piece for the Brookings Institution, they flesh out this model and present the evidence to support it. Hirsh-Pasek and Golinkoff now call the use of the two rubrics together the Ultimate Playbook$_{TM}$ for learning as they create a formula for creating optimal learning curricula and spaces that engage children and adults in intergenerational, educational, equitable and fun ways. The learning embodied in the Ultimate Playbook$_{TM}$ helps children develop the breadth of skills needed to thrive in a global world.



CHAPTER 3

The Ecology of Play

Children play. They play at home, in the park, in the library, in the museum and even at school. Children have many opportunities to discover their world and to become little scientists who uncover mysteries in local parks and households. A child in a home filled with blocks will learn about the kinds of spatial skills that foster mathematical learning. A child with a paucity of books will not be as likely to jump into the imaginary worlds that allow them to shape the possible or to create what we once thought of as impossible. To fully understand the impact of play on learning, it is imperative that we explore the many contexts and ecologies that surround the child and that influence who they will become.

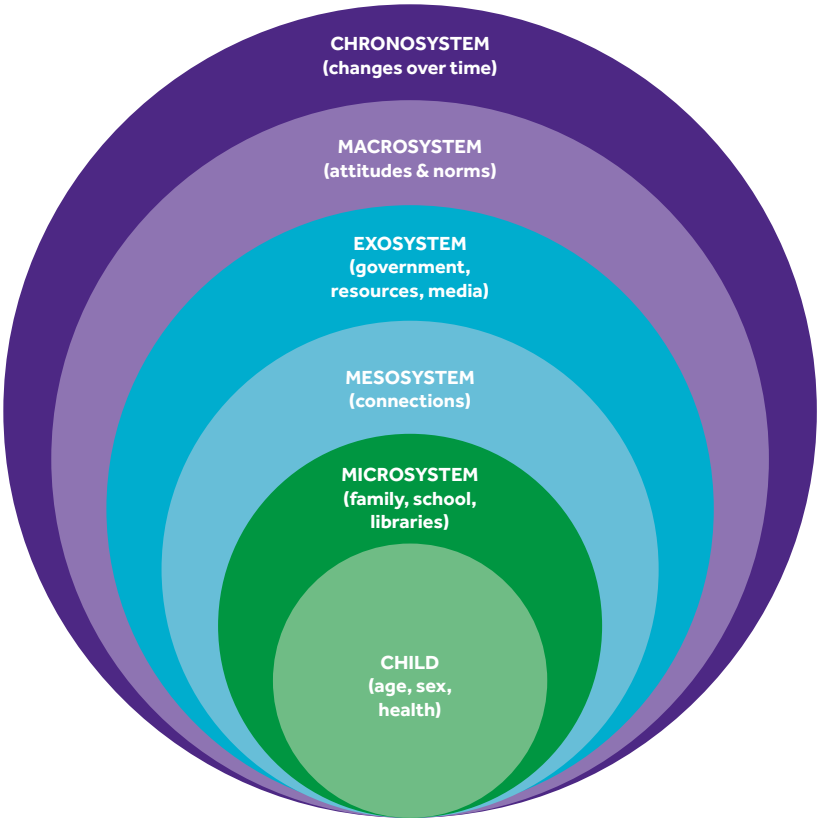


Figure 2: Bronfenbrenner Ecological Systems Theory

A useful way of thinking about how various contexts shape playful learning is to understand the *nested* relations among the contexts – the Bronfenbrenner *ecological systems theory* (Figure 2; Bronfenbrenner, 1979; Bronfenbrenner & Morris, 2007). Bronfenbrenner's model allows us to understand that, for example, when communities have fewer playgrounds and libraries, children are limited in their ability to engage in gross motor play or reading (Hassinger-Das et al., 2018). Similarly, to understand why girls play with dolls and pink objects more than they do with construction toys and blocks (Davis & Hines, 2020), we should not look at home context alone, but at society's attitudes and norms – at what Bronfenbrenner called the macrosystem. As such, any effort at shaping and increasing playful learning opportunities must strategically consider changes at each contextual level – whether this is the microsystems of home, schools and libraries, the exosystem of government and media, or the societal attitudes and norms that change over time (the chronosystem). In the following sections we review the trends in the global literature that shed light on these nested contexts.

Contexts with Direct Influence on the Child

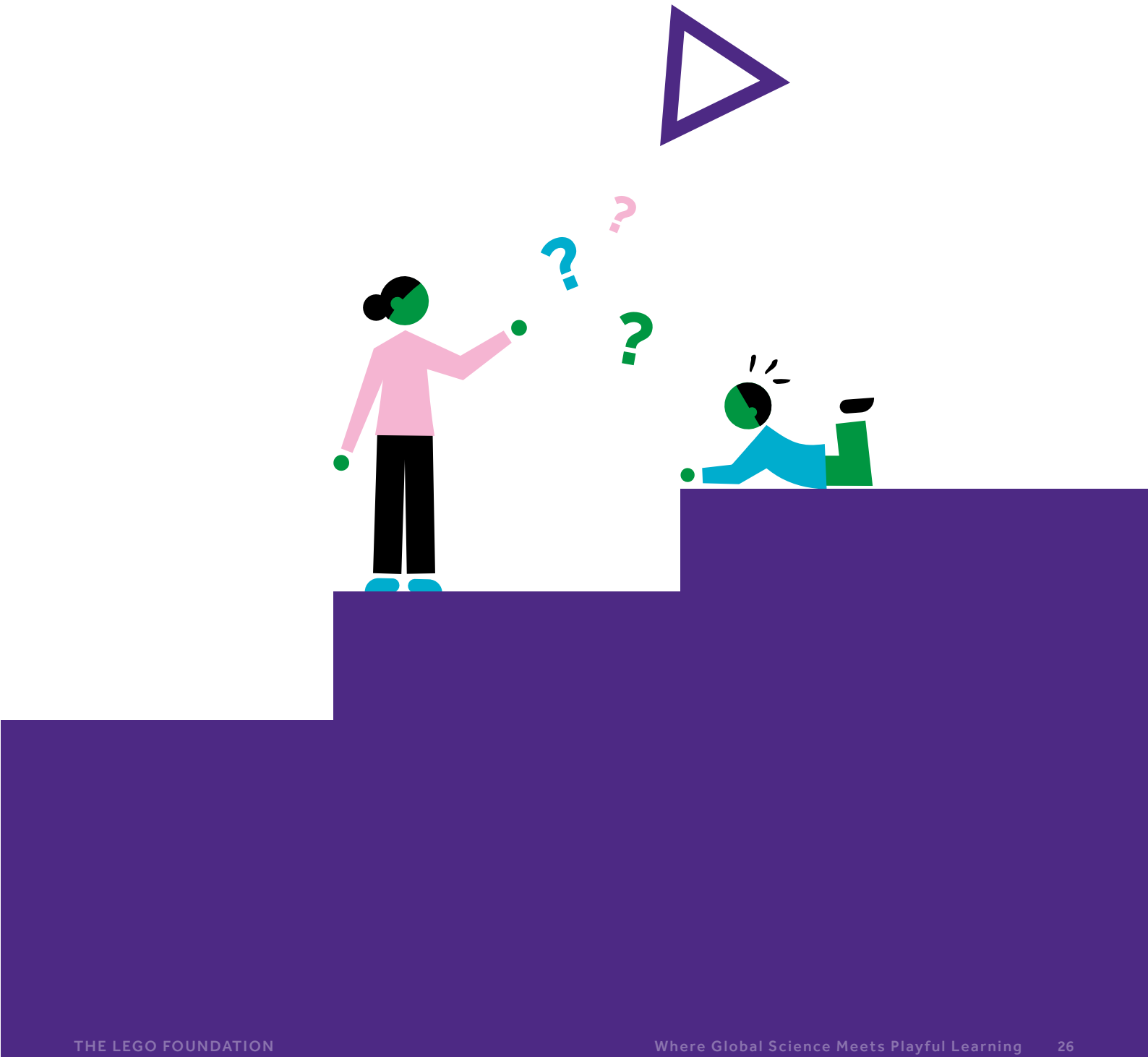
Home

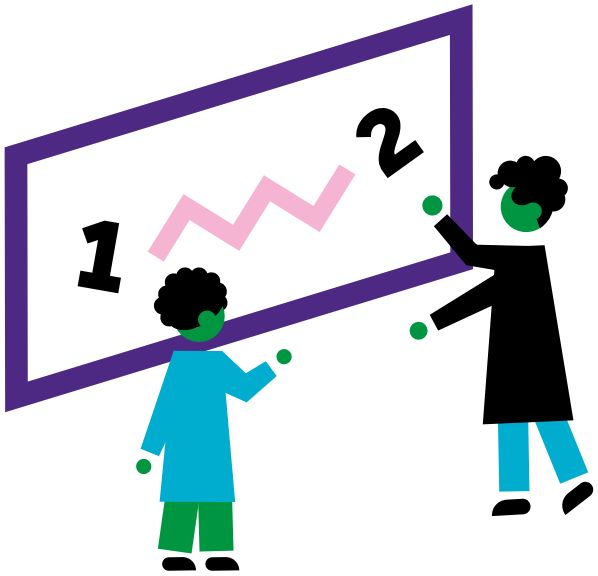
Children worldwide spend 80–90% of their waking hours outside of school (OECD, 2018). Thus, caregivers play a significant role in determining how and whether playful learning will unfold for their children. There is three times as much published research on mothers playing with children as there is on fathers (Cabrera & Roggman, 2017). While mothers and fathers play with children in different ways, both parents can be equally playful (Menashe-Grinberg & Atzaba-Poria, 2017) and support children's learning and development (Tamis-LeMonda et al., 2004; Robinson et al., 2021). John and colleagues (2011) found mothers were more likely to guide and teach their preschoolers during play, whereas fathers were more likely to follow the child's lead, engage in physical rough-and-tumble play, and challenge the child (John et al., 2011). The same study found no differences in emotional availability between mothers and fathers, indicating that both types of play were equally likely to bond the child to the parent. Fathers also speak to their children differently, and are more likely to use open-ended *what*, *when*, or *why* questions, yet both mothers and fathers contribute to children's language development (Rowe et al., 2004, 2017).

What children play with can be just as influential as *who* they play with. In the United States a stroll down through toy aisles in stores reveals a stark divide between pink dolls and kitchen playsets on one side and blue cars and pretend tool kits on the other. Reviews of the scientific literature find that both girls and boys largely gravitate toward gender-typical toys (Davis & Hines, 2020), and this divide in gender preference has been found consistently over the last 50 years (Davis et al., 2021). This difference is consistent throughout the world. Although the idea that pink is for girls and blue is for boys is rooted in Western ideas, a study found that Chinese children were just as likely to assign these colours to a certain gender (Wong & Yeung, 2018). This divide in what toys children play with concerns many researchers as it may lead to an increase in gender stereotypes and differentiation in skills and abilities (Brown, 2014; Cherney, 2008; Weisgram & Dinella, 2018; Kung, 2021; Li & Wong, 2016; Liben et al., 2018). For instance, boys are more likely than girls to gravitate toward spatial toys, such as blocks and puzzles, that contribute to the development of spatial skills that are in turn foundational for later math reasoning and performance (Jirout & Newcombe, 2015).

Children's play is also shaped by the ubiquity of the internet and availability of portable devices. Indeed, children born after June 2007 never lived in a world without an iPhone. In 2020, the Pew Research Center reported on the digital engagement of US children under 11 years of age, and found that 67% use or interact with a tablet, 60% a smartphone, 44% a computer, and 44% a gaming device (Auxier et al., 2020). These devices create new opportunities for companies to promote 'edutainment' to young children (Lewis, 2017). The word edutainment, first coined by Walt Disney in 1954, refers to media that intend to make learning fun and engaging. With modern technology, edutainment often takes the form of smartphone and tablet applications or apps. Worldwide, nearly one billion educational apps were downloaded from the Apple App Store and Google Play store during the first quarter of 2020 (Ceci, 2021). Despite the prevalence of these apps, few of them are *truly* educational (Hirsh-Pasek et al., 2015; Meyer et al., 2021). Several studies also suggest that parents and children interact differently when playing with digital devices compared to traditional toys (Barr, 2019; Hiniker et al., 2015). Parents spoke more and used

more varied language (Ewin et al., 2020), used more spatial language (Zosh et al., 2015), and more consistently responded to children's bids for attention (Hiniker et al., 2015), when engaging with a traditional toy compared to a digital toy or application.





School

Outside of the home, schools and teachers play the most influential role in children's learning. The pressures of standardised testing, based on outdated educational values that prioritise only reading, writing and arithmetic, led many schools to adopt a "teach to the test" or "drill, kill and bubble fill" (Goyal, 2012) method. This approach favours direct instruction, and students are encouraged to memorise and then regurgitate information. Overemphasis on academics has led to a reduction in playtime in schools. As of 2019, only 40% of states in the US had a recess policy in place, with only 12% requiring daily recess (Chriqui et al., 2019). Even when recess is required, it can be for as little as 20 minutes a day (Reilly, 2017). This places recess time in the US behind countries like China and Finland, which give children an average of 60 and 75 minutes of recess respectively (Chang & Coward, 2015). Reduction in playtime in favour of test time created alarms that we were "endangering childhood" (Miller & Almon, 2009), and that kindergarten is becoming "the new first grade" (Bassok et al., 2016). Playful learning offers a path through which children can learn their basic curricular content while also acquiring the broader set of skills necessary for success in the 21st century (Brookings, 2020). Golinkoff and Hirsh-Pasek (2016) identify these 21st-century skills (Hirsh-Pasek et al., 2022) as the 6 Cs: **collaboration**, **communication**, **content**, **critical thinking**, **creative innovation** and **confidence** (see **Chapter 5**).

Libraries

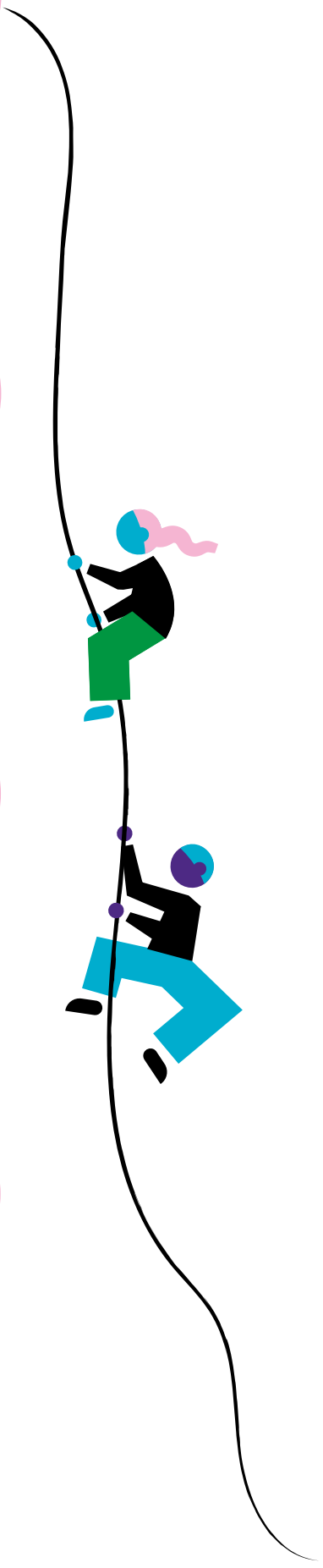
Children's libraries are found in many countries; they exist in Singapore, Norway, Mexico, Burma and Columbia and range from state-of-the-art facilities to bookshelves strapped to the backs of donkeys. In the US, the first children's reading room was opened in 1904 (Aller, 2020), and has since evolved into a plethora of children's programming that ranges from more traditional offerings such as story time and summer reading programmes, to playful learning activities often provided in collaboration with children's museums such as music, art making, computer programming and science experiments. Some libraries are even including more explicitly play-based activities, such as sensory play (Hickey et al., 2018). This movement is gaining such currency in North America that authors are encouraging children's programming even within university libraries (Carliner & Everall, 2021).

Children's programmes in libraries offer a concrete example of how sub-contexts within Bronfenbrenner's model – in this case the microsystem – interact to create playful learning opportunities. Families living in small spaces, without the luxury of having dedicated playrooms in their own homes, often need to find space alternatives. Library programmes not only provide the needed space, but also offer engagement and activities, allowing children and parents to seamlessly participate in playful learning events. This is probably why in major cities in China, where most people live in small apartments, private children's libraries have become extremely popular. In 2020, there were only 147 children's libraries in all of China (Chinese National Bureau of Statistics, 2020), a very limited number considering that there are 252 million children under the age of 14 years. Since public libraries cannot satisfy the needs of many families, affluent parents resort to private children's libraries (huiben guan 绘本馆). These private libraries serve mostly children ages 1–8 years, and function like many libraries in the US or Europe, including offering children's programming like story times or art making. However, while they do offer great playful opportunities, they only serve those who can afford it, creating gaps of playful learning opportunities between families of different incomes.

Museums

Access to children's museums provides even greater opportunities for children to engage in playful learning with caregivers. Children who interact with an exhibit with a caregiver are more likely to explore and learn more than those who play alone (Crowley & Jacobs, 2011). When parents ask questions (Borun et al., 1997) or engage in science talk (Callanan et al., 2017), their children learn from the exhibit. Children also explore more when a caregiver is present to help generate explanations about the phenomena they encounter (Callanan et al., 2020; Van Schijndel & Raijmakers, 2016). Children's museums are found in most major cities in the United States and lists of the best worldwide museums include countries all over the world, such as England, Belgium, Sweden, Portugal, Mexico, Croatia, Canada, South Korea and Turkey (Beaven, 2018).

Around the globe, however, children's museums are more the exception than the norm. For example, in China, currently there are only four children's museums, located in Beijing, Shanghai and Hohhot (Children's Museum Research Center, China, 2022). Of course, other public museums (non-children specific) can offer programmes, exhibitions and activities geared for children's playful learning. In fact, we see a trend in this direction. For example, in 2015 and 2020 the China Ministry of Education and the National Cultural Heritage Administration issued a guidance that museum learning should be fun, interactive, experiential, and appropriate for children of different ages (Ministry of Education of the People's Republic of China, 2022). Such guidance from the exosystem may have a trickle-down effect on the mesosystem, the microsystem, and all the way down to the child. For example, the national guidance may increase the number as well as the quality of museum learning programmes (Zhao et al., 2021), encouraging schools and individual families (the microsystem) to visit museums. As discussed above, these museum visits provide opportunities for interactive as well as social learning, increasing children's sense of exploration and curiosity.



Outside Influences on the Child

National government policies also influence school curricula and children's education. In the United States, for example, No Child Left Behind, and more recently the Every Student Succeeds Act, prioritised mathematics and reading assessment through standardised testing. Around the world, societies are rethinking the reliance on standardised testing and elevating their focus on playful learning. Finland led the way in deprioritising standardised testing and increasing play within education. Other countries such as Sweden, Singapore, Chile, Canada and India are following Finland's lead, which has powerful positive implications for young children's education (Hirsh-Pasek et al., 2020). For example, India's Ministry of Human Resource Development states in its National Education Policy (Government of India, 2020), "certain subjects and skills should be learned by all students to become good, successful, innovative, adaptable, and productive human beings in today's rapidly changing world. In addition to proficiency in languages, these skills include ... creativity and innovativeness."

In fact, the Programme for International Student Assessment (PISA) run by the Organisation for Economic Cooperation and Development (OECD) assesses students' abilities to apply and analyse information, not just regurgitate acquired facts, and is growing in popularity – the most recent version in 2018 was used by 79 countries. Such changes in governmental priorities will undoubtedly change the way schools operate and what parents prioritise. Government policy also shapes the support children and families receive prior to formal schooling – the US, for example, ranks third lowest in preschool enrolments (OECD, 2020), last in rankings of family-friendly governmental policies (Chzhen et al., 2019), and at the bottom of a list of industrialised nations on a battery of child wellness markers (Strauss, 2020). When governments fail to provide foundational support to children and families, the ramifications echo through development and have a multiplicative effect on children's later life outcomes.

Affordances in the physical environment are also affected by government policy. Public playgrounds, for example, are part of the infrastructure of cities and towns, and therefore the value placed upon them by the society and government impacts each child's access to public play spaces. Playgrounds were first conceived in Germany, where Henry Barnard first sketched his idea for an outside space for children to interact with blocks, swings and toy carts. The first playground was built in 1859 in England, and the first American playground was built in 1887 (Hart, n.d.). There were many hiccups as playgrounds were seen by some to be unsafe, but most American and European towns now have playgrounds. However, this is not true worldwide. In China, the first playgrounds were built in the early 1900s (Zhang et al., 2011), and today playgrounds in China are more common for the elderly than they are for children. A recent movement toward bringing nature back into the cities has increased the popularity of natural play spaces for all citizens (Wang et al., 2018).

Access to community resources influences how children and parents interact with playgrounds. A recent study found that although community members from both lower- and higher-resourced areas freely shared play memories, responses differed between the two communities (Schlesinger et al., 2019). Those from the lower-income neighbourhoods, as compared to their higher-income peers, more often shared experiences of playful learning; describing a rarely acknowledged strength of lower-resourced communities. This study has implications for community engagement and supporting play as a vehicle for community learning across diverse communities.

The Impact of Societal Norms and Cultural Values

Cultural differences are evident in attitudes about how parents should interact with their children (Metaferia et al., 2021; Shneidman & Goldin-Meadow, 2012). These differences include beliefs regarding an infant's role in interaction, their ability to communicate, their autonomy (e.g., Roopnarine, 2011; Weber et al., 2017), and the value parents place upon specific activities, such as homework, music or play (e.g., Chen & Stevenson, 1989; Conkling, 2018; Roopnarine, 2011). For instance, Luo and colleagues found that parents in the US with cultural backgrounds from Europe, Africa, the Dominican Republic, Mexico and China had culture-specific book-reading styles (Luo et al., 2013).

It is important to note that cultural differences bring unique strengths. For example, the quantity and quality of language spoken to and with a child is a strong indicator of language learning in Western countries where parents are encouraged to speak frequently with their children (Hirsh-Pasek et al., 2015; Masek et al., 2020). In the Tsimane village of lowland Bolivia it is the cultural standard that parents do not speak directly to their infants (Cristia et al., 2019). However, these children still learn language. Evidence from a Mayan village, where children are also rarely spoken to, suggests that children in these cultures learn from the conversations they witness between their parents and with other adults (Shneidman & Goldin-Meadow, 2012). This evidence suggests that there are culturally appropriate and distinct pathways to achieve the same outcomes.

Parent attitudes toward play vary widely across the world. One study found that German and Chinese parents vary in their views of the educational value of structured play time (Wu et al., 2018). Studies noted a wide range in parents' views of the value of educational video games, with parents in Israel and Southern Europe holding largely positive views (Amzalag, 2021; Sousa et al., 2017), and parents in Malaysia holding largely negative views (Yong et al., 2016). In a series of interviews and home recordings of parents in Shanghai, China, Lin et al. (2019) found that even when parents held positive views of playful learning, they did not always implement those views due to conflicting cultural pressures. These attitudes toward play and learning affect how parents play with their children and how much their children play. As an example, Chinese parents think of themselves more as teachers, rather than as playmates, when spending time with their children (Lin et al., 2019). Such attitudes may restrict child-led activities and, consequently, opportunities for active exploration. In another example, Fisher and colleagues (2008) studied beliefs about the relationship between play and learning of mothers in the US. They found that mothers differed in both what they defined as play and how much learning value they ascribed to free play and structured play. Interestingly, how much their children played also varied by how their mothers conceptualised play; mothers who did not make distinctions between the playfulness of structured and unstructured play had children who played more overall and who engaged in more structured play.

Similarly, teachers hold contradictory ideas of the role of play in education which impacts the effectiveness of playful learning strategies. Kangas et al. (2020) found that in Finland, the success of a playful learning technological interface for a class depended on each teacher's confidence with implementation. McInnes (2019) found that in the UK children and early years practitioners differed in what they considered play – children considered the presence of an adult to be the difference between play and not play, while practitioners did not make this distinction (McInnes, 2019). Bulunuz (2015) found that pre-service teachers in training showed more positive attitudes toward playful learning when they believed it made learning

easier or helped to relieve students' boredom. This work suggests that teachers' and parents' perceptions of, and confidence in their abilities to support, learning through play impacts children's opportunities to engage in and benefit from playful learning.

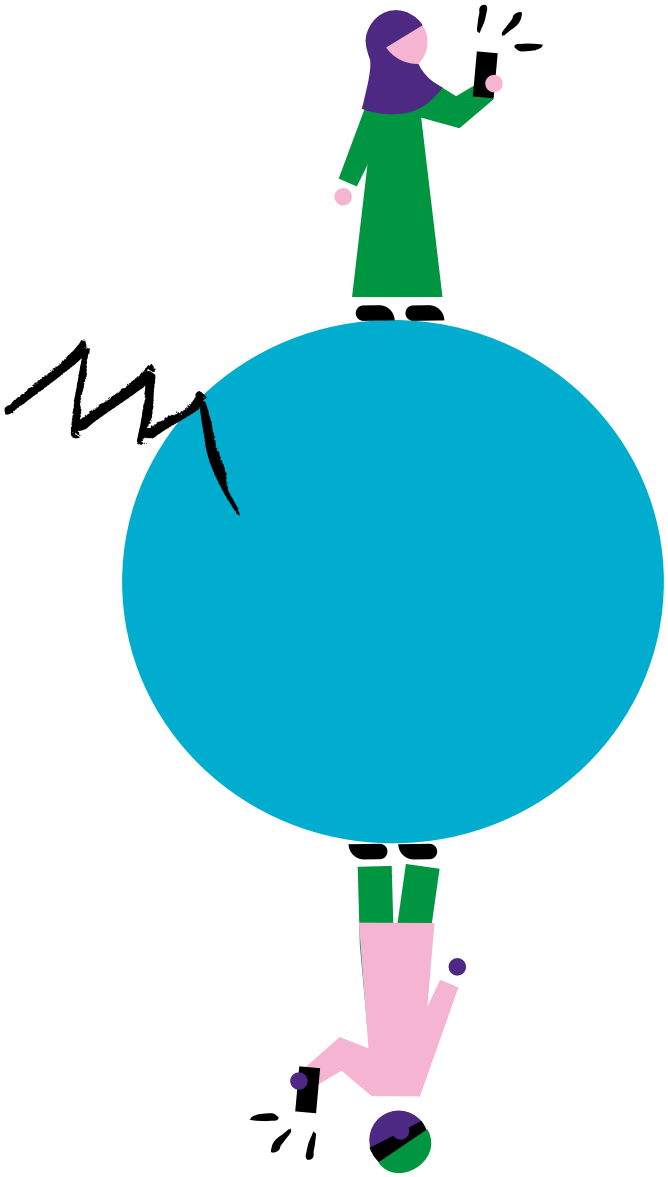
As predicted by Bronfenbrenner's model, societal norms and cultural values interact with other contexts, directly and indirectly impacting children's play opportunities. To get a glimpse of this complex interaction, take the case of early childhood care and education in China. As there are relatively few policy regulations for childcare services for 0–3-year-olds (Qi & Melhuish, 2017), the majority of daycare services are private, rather than public, commanding relatively high enrolment fees. Daycare services in cities like Beijing and Shanghai typically charge between RMB 7,000 and 10,000 ($1,106 to $1,540), an astronomical cost considering that the average salary of white-collar workers in 2019 was RMB 8,050 (Huifeng & Xin, 2019). To save this cost, unlike the trend in the US where mothers give up their jobs to fully care for the young, in China, families resort to grandparents instead. There is a strong cultural norm that grandparents are expected to fully care for their grandchildren; one study estimates that the proportion of grandparents co-living with grandchildren is as high as 45% (Chen et al., 2011). This cultural norm of grandparents providing early childhood care also interacts with other policies such as maternity leave. China's national statutory maternity leave is 96 days, and in late 2021 many provinces increased the maternity leave period to encourage childbirth. However, many women decide to return to work earlier, partly because they fear that they may miss promotions or lose their job altogether, and partly because they can rely on grandparents to provide full childcare. Where do all these interactions between societal norms and policy leave us? In China, young children's playful learning opportunities may actually be shaped more by grandparents than by parents. It might be supposed that grandparents would be more lenient and indulgent than parents concerning play, but the opposite tends to be the case. Bounded by a sense of responsibility to their children (the parents) and not wanting to be accused of providing inadequate care, grandparents may in fact be stricter – limiting play and exploration so as not to expose children to any risks.

The Times we Live in

The child, the parent, the government and the culture all change over time. This can be clearly observed in schools and educational policy. Early education in the United States was reformed in the 1950s when the 'Space Race' and Russian Sputnik launch prompted an increased emphasis on reading, writing and arithmetic (Zigler, 1984; Zigler & Bishop, 2004). In the 1970s and 1980s a whole-child perspective returned, with such books as David Elkind's *The Hurried Child* supporting the movement. However, there was a resurgence of the emphasis on teaching to tests, epitomised by the US educational policy No Child Left Behind. Lately, there has been a worldwide movement toward valuing skills needed for success in the 21st century, and these skills are not as easily measured through standardised tests. Other countries also experience these influences and changes over time, impacting societal views and educational policies. As an example, China, a country with a long tradition of rote learning and exams, in 2021 implemented a 'Double Reduction' policy: eliminating after-school tutoring and reducing homework load for primary school children.

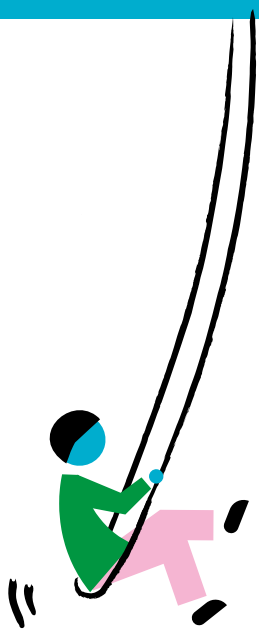
We now live in a cultural era in which the world has become more compact and interdependent, where technology has sped developmental inquiry, and where most people have a computer in their pocket. To thrive in this new world, children need to learn a suite of skills that are evidence-based, malleable, and measurable (Golinkoff & Hirsh-Pasek, 2016; Hirsh-Pasek et al., 2020; Hirsh-Pasek et al. 2022). Which countries will be able to change their educational missions to meet these needs? Finland, Norway, Sweden, Singapore, Chile, China, Ireland, India and many others recognise that reading, writing and arithmetic are important and that play might prove a perfect pedagogy for helping children learn these skills as well as the breadth of competencies that they will need beyond that basic curricular content.

The economy and business community often drive the cultural context. Thus, as technology changes, family institutions and opportunities change. Today, the industrial age is largely gone and, with it, factory jobs that require assembly line workers. We are entering the knowledge age, where curiosity, exploration, discovery and entrepreneurial thinking will be prized. Looking at the many ecologies that impact the child both directly and indirectly will help us to better understand how play can be used to develop the 'breadth of skills' mindsets required for success in the future.



CHAPTER 4

Relationships in Playful Learning



Navigating social relations is one of the hardest skills to learn. Yet, it is taught the least in school. Its immense complexity makes it almost impossible to be taught as a subject, as its rules and repercussions are subject to great variations. Trusting a stranger may save your life at one point while costing you trouble in another; negotiating with logic may be met with success in one culture but disapproved of in another for the lack of 'human touch'. Yet children have to *learn* to navigate the social environment. Those who master social relations tend to be happy and successful people. How can we learn something that cannot be taught? Through play.

In Chapter 1 we noted that the Russian scholar Vygotsky and his students were among the first to recognise the importance of play for social and mental development. Vygotsky argued that instinctual behaviours meet up with social relationships and culture through play, and it is play that allows children to restructure basic biological responses into thoughtful, culturally relevant behaviour. In his terms, in play, children move from being "slaves to the environment" to being "masters of their own behavior" (Bodrova & Leong, 2015). A six-month-old has the instinct to smile, but it is through playing peek-a-boo that she learns to laugh at the reappearance of a familiar face. A three-year-old naturally picks up objects, but when he pretends to be a doctor a common object turns into a stethoscope. Play is a conduit for learning about social relationships and cultural norms, for using those relationships to control natural impulses, for practising socio-cultural scripts, and for learning to act in concert with others.

Children spontaneously *want* to play with different social partners – whether parents, siblings, peers, or even teachers. Sometimes, parents and teachers may be hesitant to play, thinking that time is best used for something else, delegating play to siblings or peers. But research has shown that the *variety* of social play – playing ball with Dad being different from playing catch with friends – is necessary and beneficial not only for social learning, but also for other types of learning. This is because playing with different social partners affords a range of 'practice' and benefits: pretend play with Mom allows the child to learn new words, sharing and arguing about toys with peers gives insight to the art of negotiation, while constructing a block tower with a teacher lends confidence and new knowledge of geometry. In this chapter, we highlight how each relationship in play is unique. Combined, they produce powerful social learning, which then bootstraps language learning, emotional development, and even academic performance. As a social partner to a child – whether you are a parent, a teacher, or a school principal deciding whether or not to put playtime in the curriculum – the research gathered here can provide guidance on whether, why and when to play socially.

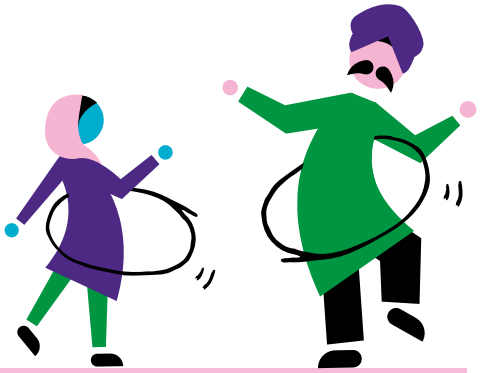
Playing with Parents

Parents are the child's first playmates – the ones with whom they learn the 'rules' of conversational turn-taking, new words, emotion regulation skills, social norms and culture; the trusted source of information (Harris, 2019). During infancy, face-to-face play dominates the baby's life (apart from feeding and other physical cares) and these synchronous, affective interactions create neural synchrony (Piazza et al., 2021) – shared brain activities between parents and infants (Feldman, 2012; Wass et al., 2018). Importantly, these live "conversational duets" (Hirsh-Pasek et al., 2015; Tamis-Lemonda et al., 2019) also predict language development. This is because parent–child play, more than other settings, affords high-quality *interactions* that are advantageous for language learning (Golinkoff et al., 2015). As such, for parents who waver between playing and teaching their babies words – e.g., showing flashcards repetitively – the choice is clear: playing is better because it provides more social interactions, which are critical for language learning (Kuhl, 2007).

The parental dilemma between playing and providing direct instruction continues as children grow and become more active play partners. On the one hand, it is even more fun now to play with the preschooler, as they can talk and do so much more. But on the other hand, shouldn't they be learning? Fortunately, research evidence offers an answer to this dilemma: guided play (see **Chapter 2**) results in good learning. One study found that preschool-aged children who played a math-based tablet game talked about math more when parents were instructed to supplement the game with guided, math-based talk compared to parents who did not engage in math-related talk during the play activity (Zippert et al., 2019). Not only do the children learn, but the *parents* are happier during guided play. When teaching preschoolers fractions, parents who used guided play reported just as much math talk and more joy compared to those who used a formal instruction approach (Eason & Ramani, 2018). Likewise, mothers who were trained to play with their toddlers such that the *child* directs the play session, showed more positive emotional reactions and behaviours when responding to their toddler's bids for engagement (Brock & Kochanska, 2016). It is no secret that when the parents are happy, the children learn better.

Parents of different cultures may experience the dilemma of deciding between playing and teaching differently. Perhaps this is one reason why mothers tend to engage in more didactic play activities compared to fathers (Roggman et al., 2007). In China, while mothers tend to play with toddlers more than fathers do, both genders engage more in educational play than in other types of play (Lin et al., 2019). Interestingly, although mothers have been the focus of research on parent–child play, fathers are often viewed by children as their primary adult playmate (Roggman et al., 2007). Fathers do in fact play with their children nearly every day and engage in play more frequently as children progress from infancy to toddlerhood (Amodia-Bidakowska et al., 2020). While both mothers and fathers engage in pretend play, object play and symbolic play (see **Chapter 2**) at similar rates (Amodia-Bidakowska et al., 2020), father-play tends to be more gender-differentiating. For example, fathers play in more 'rough and tumble' ways with boys than with girls (Leavell et al., 2012). But regardless of the types of play – or perhaps thanks to the variety – they all bring benefits for children. Here is a critical finding: the play preschool-aged children engage in with their parents – both mom and dad – *uniquely* predicts later cognitive and language outcomes (Tamis-Lemonda et al., 2004; Amodia-Bidakowska et al., 2020; Rowe et al., 2017). There is also evidence that father-play, in particular, relates to later peer competence, self-regulation skills, and emotion regulation skills (e.g., the ability to

manage emotions and control impulses) (Amodia-Bidakowska et al., 2020). Parents all over the world know that it is extremely difficult to teach children to manage emotions (at times it is even difficult for adults), so it is encouraging to learn that research suggests that play can serve as emotion management training.

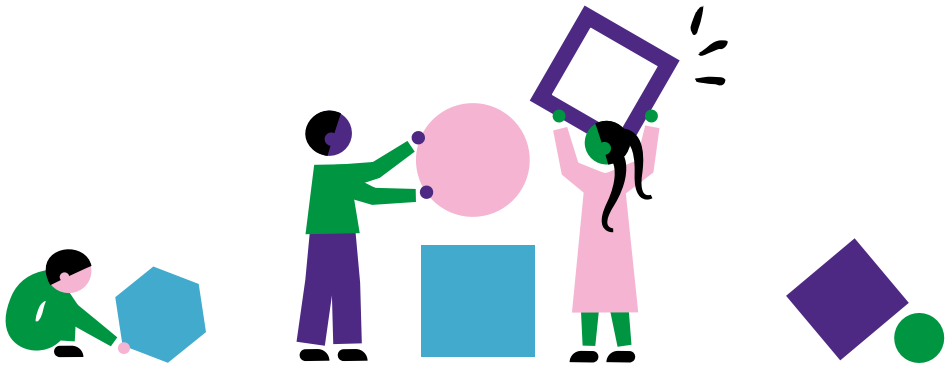


Playing with Siblings

For many children, siblings are perhaps their most influential and consistent play partners. Siblings learn important social and cognitive skills from each other within the boundaries of a relationship that endures throughout life. It is a special relationship, one that opens space to 'test the waters' when it comes to important skills like conflict resolution, collaboration, emotion regulation, and relationship building and maintenance.

As siblings play together, they experiment with different social and relational dynamics, delving deeper into an understanding of the social world. Siblings must master the art of figuring out how to play with a toy they both want. They wrangle with social disparities, including age and gender differences, such as a younger sibling learning from their 'teacher' – the older sibling. When preschool-aged children play with their younger, toddler-aged siblings, the older is more likely to initiate protest, creating conflict that siblings must work together to resolve (Vespo et al., 1995). On top of age disparities, gender difference adds a layer of complexity. Perhaps rather surprisingly, preschoolers and their toddler siblings had significantly *more* conflict when in same, rather than mixed, gender dyads (Vespo et al., 1995).

Other than conflict resolutions, sibling play is marked by activities that involve sharing, cooperation and collaboration, allowing children to practise and establish foundations for later social skills. In fact, siblings who engage in more frequent play sessions together, such as sociodramatic or pretend play, show greater emotional skills, perspective-taking skills (the ability to see the world through the eyes of others), emotional regulation and higher-level negotiation strategies (Lillard et al., 2012; Howe et al., 2005).



Playing with Peers

Much like sibling relationships, peer relationships are conduits for learning important social and cognitive skills. Supportive peer relationships are linked with positive academic trajectories and motivation, and are contexts in which children can explore collaboration and emotion regulation, and learn the ins and outs of social interactions (Li & Yu, 2020). On the flip side, just as in the adult world – where someone who lacks social connectedness may experience discomfort with colleagues or an atmosphere of distrust at work – children who lack social connectedness in school may suffer academically. Indeed, when play interactions with peers are positive, preschool-aged children show more motivation and engagement in the classroom (Coolahan et al., 2000). Put simply, children who develop connections with their peers through play are also more excited to learn.

Play with peers manifests in the classroom, at recess and outside school. In the classroom, group-based work offers children opportunities to play in ways that stimulate learning and foster relationships and social skills. We often think of group-based work in the context of older children, even university students. But in fact, preschool dyads who engaged in more collaborative math play (with shapes and patterns) explored more advanced math concepts and discussed these concepts verbally (Zippert et al., 2019). At recess, children are together in a space free of the constraints imposed on them in the classroom. The playground is open territory for exploration and learning through play. There are joyful screams as children chase each other in a game of tag. There are coordinated efforts to craft new games, like one where the ground is 'lava' and cannot be touched.

Navigating the rules and perspectives of others while playing at recess is the prime arena for establishing relationships (Li & Yu, 2020). In the early elementary and primary school years, peer play fosters relationship building, supports social competence, and cultivates 21st-century skills such as collaboration and cooperation (Pellegrini & Bohn, 2005; see **Chapter 5**).

Playing with Teachers

Here, it is reasonable to begin with the question: Why should teachers play at all? Isn't a teacher's role to teach? Indeed, teacher interviews produced two distinct profiles: teachers who think that play and learning are separate, and those who think that play and learning are integrated (Pyle & Danniels, 2016). The simple answer to the question is that not everything can be explicitly taught: how to instil confidence, motivation, prosocial behaviour, and even a good student–teacher relationship itself.

And yet we want to instil all these in children, as there is solid evidence that they are instrumental to children's academic performance, not to mention their benefits for mental health. Relationships with teachers are central organisers of experience (Collins & Repinski, 1994; Laursen & Collins, 2004). In the early elementary years, students who feel more emotionally connected to teachers demonstrate positive trajectories in both social and academic domains (Hamre & Pianta, 2001; Roeser et al., 2000; Silver et al., 2005). For example, teachers who make an effort to form personal connections with students from the ages of 8 to 12 years – such that the students feel known and understood – enhance student motivation and engagement in school (Skinner et al., 1998). Children who have better relationships with their teachers have more positive *peer* play interactions (Griggs et al., 2009), resulting in an overall feeling of social connectedness and support.

But often, the big challenge for teachers is how to build good relationships in the first place. Unlike mathematics or history, there is no dedicated class time for building the teacher–student relationship; it has to be done 'on the go'. This is where play, in particular guided play, comes in. In guided play, teachers have opportunities to develop activities that increase conversations between students, teachers and peers, allowing for more social interaction in the classroom. Further, by developing activities that are *guided* by teachers, students exercise agency and independence, seeking guidance from their teacher as needed. Importantly, this style of teaching does not take away students' learning time. In fact, as highlighted in **Chapter 2**, mounting evidence shows that guided play results in better learning outcomes when compared to other forms of pedagogical instruction (İman et al., 2017; Lillard et al., 2017). In classrooms that adopt a guided play curriculum, children have more positive emotional outcomes, peer relations and prosocial behaviour (İman et al., 2017). For example, students aged 6–13 from Finland and the Netherlands were more satisfied in their learning and gained better academic outcomes when their teachers engaged in playful learning (Kangas et al., 2017).

The upshot is that teachers can confidently embrace guided play, because it enhances rather than diminishes academic and social learning. Guided play can also complement direct instruction: with good teacher–student relationships, teaching hard subjects may feel more effortless. The challenge of course is how to do this concretely in the classrooms. We encourage teachers to delve into **Chapter 2** and **6** of this white paper, as well as recent teacher 'guides' for designing and implementing guided play activities in early childhood classrooms (Loizou, 2017).

Playing with Social Partners in Media: Is it Good Enough?

The influx of digital technology, including computers, laptops, iPhones and iPads has become commonplace to children growing up in the 21st century (see **Chapter 7**). As noted in **Chapter 2**, the 'edutainment' industry is fast making inroads in the digital world. At the same time, the science strongly suggests that social interaction is the bedrock of learning, in particular language learning (Adamson et al., 2012; Adamson et al., 2019; Hoff & Ribot, 2017; Hudson et al., 2015; Kuhl, 2007; Kuhl et al., 2003). We care about language learning because it is the single best predictor of later mastery in social skills, mathematics and reading (Pace et al., 2019) – i.e. doing well at school. But since much social interaction takes place during play with various (live) social partners – as reviewed in this chapter – it is right to ask: does playing socially online give the same learning benefits?

The answer is both yes and no: it depends on how much social interaction is afforded by the online interaction. Studies show that toddlers learn language better from a parent alone than from watching an educational video with the parent (DeLoache et al., 2010). Infants also learn better from interacting live with a stranger than from watching the same stranger on a screen (Kuhl et al., 2003). However, children show learning when parent–child interactions are supported through a live-video app, such as Skype or FaceTime (Roseberry et al., 2009; Roseberry et al., 2014), most likely because there is enough social interaction, enough back-and-forth, despite the digital medium. In both human and digital venues, social connectedness and social relationships are central to children's motivation to engage and learn. Indeed, toddlers learned more from a digital character when they felt socially connected to the character (e.g., Elmo) (Calvert et al., 2014; Lauricella et al., 2011). Lastly, a piece of cautionary scientific evidence to parents who think that *live* interactions are necessarily social: they are not. When live, in-person conversations between a child and their caregiver are interrupted by a phone call to the caregiver, language learning is hindered (Reed et al., 2017).

In sum, if there is a choice, socially engaging, live interactions are more likely to give greater learning benefits than digital interactions. But parents, teachers and students in this world of COVID-19 should not lose hope: even online interactions can be made socially engaging so that students learn. The easiest way to do this is most likely through playful learning.

Learning Cultures from Social Play

Vygotsky shows us that when children are in playful social relationships they can learn more quickly and efficiently than when they tackle learning alone (Vygotsky, 1967; Fiese, 1990). In his famous quote, he suggested that in play a child is "a head taller than himself". Thus, play not only enables children to form strong trusted relationships, but enables them to use those relationships to buttress social, cultural and academic learning. Because the human brain itself is built through social relationships (Meltzoff & Kuhl, 2016), social skills are not 'soft' but rather the hard skills that support the development of cognitive capital.

Science tells us that play offers a positive activity through which human relationships are built and sustained – be it with parents, teachers or friends. But Vygotsky also taught us that play is a vehicle through which these relationships foster the internalisation of culture. Children who play doctor or architect are practising and internalising the roles of adulthood. They are following the 'rules' of a profession and creating a social narrative within which to explore and discover different social perspectives. This in and of itself is a monumental achievement, as children who are no longer tied to the reality before them learn to interpret the world through their cultural lens. This, in turn, fuels how children think about everything from parenting to gender to ethnic differences. As they play with others, children take on roles and embody the nature of these roles, learning how to socially engage with others, and crafting a blueprint of the social norms and expectations surrounding different positions (Bodrova & Leong, 2015). This addresses an important concern about playful learning: that it is culturally specific, and therefore not appropriate in some contexts. In fact, the opposite is true: the cumulative acts of play, done with various social partners, is what shapes children's understanding of culture. Becoming a cultural player cannot be done without play.

CHAPTER 5

Learning and Social Outcomes Through Play

The 2-year-old making a tower out of blocks is developing their spatial skills that support STEM (science, technology, engineering and mathematical) learning. The 3-year-old pretending that a stick is a sword or a wand is engaging abstract symbolism, which underpins later language and math skills. The 4-year-old who examines how fast feathers and marbles fall to the ground is learning about cause and effect and other basic STEM principles. The 6-year-old playing basketball is learning how to follow rules and grow from their mistakes, in addition to learning how to coordinate and communicate with teammates. If we only described what each child was learning – spatial skills, abstract symbolism, cause and effect – would you ever guess they were playing?

Many adults discount the role of play in children's learning, mistaking play for a frivolous activity, unrelated to the serious considerations they associate with academic outcomes. In reality, play provides an access point to children's growing intellects as they assimilate their mental models with the real world around them (e.g., Hirsh-Pasek & Golinkoff, 2011; Weisberg et al., 2016; Weisberg et al., 2015). By understanding the connection between play and children's learning outcomes, educators, parents, policymakers and other thought leaders can reshape children's early educational experiences and build a foundation for lifelong learning.

The Power of Playful Learning

Playful learning marries the best of direct instruction with children's natural proclivities for play. Children's engagement in playful activities creates a space ripe for adult scaffolding toward particular learning goals. As noted in Chapter 2, children are **active**, **engaged**, extracting **meaning** from their activity, are interacting **socially** and **iteratively**, and are having **fun**. In short, they are using the very characteristics that prime learning. Playful learning functionally creates contexts in which children can exercise cognitive and social muscles, and therefore has significant impacts on multiple dimensions of their social, emotional and academic well-being. Playful learning interventions also show a marked impact on children's academic outcomes, including literacy (e.g., Bellin & Singer, 2006; Bergen & Mauer, 2000; Golinkoff et al., 2013; Pellegrini & Galda, 1990) and STEM skills, as well as social skills and learning-to-learn skills like executive function (EF) and emotion regulation (e.g., Berk et al., 2006; Singer et al., 2010; Skene et al., 2022), in addition to the interconnected competencies known as the 6 Cs.

→ Literacy Development.

Neuman and Roskos (1992) found that when they added literacy materials – such as signs – to play environments – such as a pretend house or store – more literacy-supporting activities like reading and writing occurred during play. Bergen and Mauer (2000) noted that literacy play, such as rhyming games and pretending to read to a stuffed animal, predicted reading readiness in kindergarten. Nicolopoulou et al. (2006) realised that preschoolers who engaged in storytelling and dramatisation of those stories created more elaborate stories and increasing grammatical complexity over time. Parent behaviours during play and daily life activities, including responsiveness (Hudson et al., 2015), sensitivity (Baumwell et al., 1997; Tamis-LeMonda, 1996) joint attention (Adamson et al., 2019; Tomasello & Farrar, 1986) and child-directed speech (Golinkoff et al., 2015; Weisleder & Fernald, 2013) show benefits to children's vocabulary development, an essential building block of reading ability (e.g. Cunningham & Stanovich, 1997; Dickinson & Porche, 2011; McCardle et al., 2002).

Parents are well versed in their child's current language skills and spontaneously adapt their language use to that level (Gros-Louis et al., 2006; Kondaurova & Bergeson, 2011; Ramírez-Esparza et al., 2017). Toub et al. (2018) demonstrated that adult-supported play presents a unique opportunity for adults to scaffold children's language development. And importantly, language development is the single best predictor of later literacy and mathematics learning (Pace et al., 2018) Interestingly, Creaghe and colleagues (2021) found that not all types of play support language equally. Children spoke more, their language was more complex, and conversations with their parents were more dynamic, interconnected and content-rich during parent–child symbolic play (such as pretending to have a tea party) compared to parent–child functional play (such as assembling puzzles or hitting pegs with a hammer).

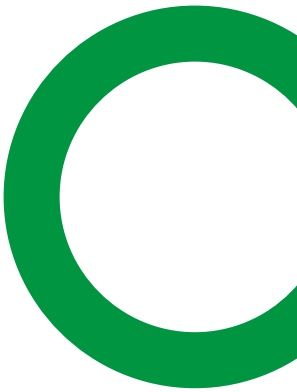
→ STEM Development.

A recent meta-analysis found that documented effects of **guided play**, a subtype of playful learning, are more consistent when teaching math skills, as opposed to literacy or social skills (Skene et al., 2022). Related STEM skills also appear to be richly supported in guided play contexts. For example, in a study with 4- to 6-year-old children, Hollenstein and colleagues (2022) found that children's digital problem-solving strategies were more complex (e.g., ability to identify a problem and trouble-shoot solutions) after a guided play intervention. Several studies of playful learning, more broadly construed, show that playing with blocks, puzzles and other spatial and geometric toys can improve children's spatial and math skills (Bower et al., 2020; Jirout & Newcombe, 2015; Verdine et al., 2014; 2017; Wexler et al., 1998). One mechanism through which play supports spatial skills is through increasing spatial language; for instance, when a parent and child play together with blocks and the parent uses language such as 'above', 'on', or 'under' (Ferrara et al., 2011; Verdine et al., 2019). When children hear more spatial language, they perform better on spatial tests (Pruden et al., 2011) and on later math tests.

Hands-on playful approaches also benefit spatial and early engineering skills. For example, a recent study found participating in spatial training, such as completing tangram puzzles and engaging with blocks, improved math performance for children in first through sixth grade (Mix et al., 2021). In a study with 4- to 5-year-old children, numerical knowledge increased after playing a card game that illustrated principles such as numerical magnitude (the ability to understand and compare the sizes of numbers) and number identification (recognising symbolic and non-symbolic number representations; Ramani et al., 2012; 2019; Siegler & Ramani, 2009; Scalise et al., 2018; 2020). Preschool children took part in a shape learning intervention in either a guided play, free play, or direct instruction condition. When given a test of shape knowledge, children in the guided play condition performed better than children in the other conditions on both an immediate and delayed post-test, indicating that their knowledge persisted over time. Moreover, children in the guided play condition were better able to identify atypical variations of shapes, such as isosceles triangles, and to hold on to the knowledge over time (Fisher et al., 2013).

→ Executive Function.

Play not only provides a context for children to exercise academic competencies, it is also effective in supporting the development of social and learning-to-learn skills. Early executive function and social skills, like attention, memory, impulse control and socio-emotional regulation are highly predictive of children's later socio-emotional, as well as academic, outcomes (Howard & Melhuish, 2016; Rhoades et al., 2011; Sabol & Pianta, 2012; Wolf & McCoy, 2019). Play provides a setting for children to hone their abilities to sustain attention, engage in problem-solving and symbolic representation (as with the earlier example of a child using a stick as a sword or a wand), build memory, and test hypotheses about how things function (e.g., DeLoache, 2002; Newman, 1998; Kagan & Lowenstein, 2004; Ruff & Capozzoli, 2003; Ruff & Lawson, 1990). White and colleagues (2021) found that when under-resourced Spanish-speaking preschoolers engaged in more social pretend play, they gained greater EF skills than when they engaged in non-pretend social play, solitary pretend play, or non-pretend solitary play. Gibb and colleagues (2021) found that incorporating EF-supporting games (such as red light, green light) into class time also increased preschoolers' EF skills. Through playful interactions such as these, children learn to collaborate and communicate with teachers, parents, siblings and friends, learn social scripts, behaviour regulation, and even the ability to manage their own emotions (e.g., Cabrera & Roggman, 2017; Diamond, 2015; Hirsh-Pasek et al., 2020; Jones & Doolittle, 2017; McClelland et al., 2019).



The 6 Cs Framework

Proponents of traditional pedagogical approaches, even to the exclusion of broader socio-emotional learning, might wonder what else developmental researchers think that children need to learn. Why not just literacy, STEM and EF skills? What more do children need to know? As the world gains in complexity, so too must children acquire the breadth of skills necessary for success in the 21st-century global society. These skills go beyond the familiar academic and learning-to-learn skills taught in schools today that supported success in a world economy that no longer exists. The 6 Cs provide a framework for understanding these skills, how to support their development, and how they build on and grow from one another. Playful learning pedagogies lead to a host of developmental outcomes that underpin several key academic and socio-emotional skill sets that are learned through play in ways that are malleable, teachable, and rooted in the science of learning.

These foundational skills include curricular **content**, but also go beyond the basic academic competencies to include a wide range of abilities necessary for success – such as **collaboration**, **communication**, **critical thinking**, **creative** innovation and **confidence** – that CEOs of top companies today point to as the most desirable qualities in the workforce of the future (Davis, 2020). Moreover, the 6 Cs framework provides an integrated developmental overview of how these skills develop and can be supported, and does so in a way that is supported by the science, demonstrates malleable skills and offers a set of skills that can be measured.

→ Collaboration.

Collaboration is rooted in the relationship building that we saw in Chapter 4. Even in infancy, babies begin to understand that other people are capable of intentional actions (Leong et al., 2017; Meltzoff, 1995; Tomasello et al., 1993). Contingent interactions, when a caregiver responds to an infant's behaviour in meaningful ways, provide the foundation for attention, which ultimately helps infants learn language (Masek et al., 2021). Neuroscientific research shows that mother–child dyads who participate in collaborative play display synchronised brain activity (Piazza et al., 2020), which supports the development of self-regulation (Schmitt et al., 2015; Walker & MacPhee, 2011) and empathy (Levy et al., 2019). By age 2, children begin to work together collaboratively to solve problems and behave altruistically (Barragan et al., 2020; Warneken et al., 2006). Children's understanding of joint goals continues to develop well into the school years (Paulus, 2016; Young et al., 2019).

Over time, children transition from using solitary, non-social play to parallel play around age 2 or 3 in which children work side by side on independent play activities (Bakeman & Brownlee, 1980). Later, children advance to associative play, in which they interact with other children about their activities, and finally to cooperative play, in which children work together toward a shared goal (Parten, 1932; Rubin et al., 1978). The development of prosocial skills in kindergarten, such as sharing and empathy, is positively associated with later academic outcomes, such as reading performance (Cooper et al., 2000). From the playground to the classroom to the international boardroom, being able to engage, collaborate and build relationships with others is a part of being human.

	Collaboration	Communication	Content	Critical Thinking	Creative Innovation	Confidence
LEVEL 4	Building it together	Tell a joint story	Expertise	Evidence	Vision	Dare to fail
LEVEL 3	Back and forth	Dialogue	Making connections	Opinions	Voice	Calculated risks
LEVEL 2	Side by side	Show and tell	Wide breadth / Shallow understanding	Truths differ	Means-end	Where do I stand?
LEVEL 1	On my own	Raw emotion	Early learning / Situation specific	Seeing is believing	Experimenta-tion	Barel on

Figure 3: The 6 Cs Framework

→ Communication.

Communication is dependent on the ability to form relationships. It encompasses the smiles of an infant, the back-and-forth conversation of a parent and toddler, and the literacy skills discussed above, that help children transition from learning-to-read to reading-to-learn (Hirsh-Pasek & Golinkoff, 2018). Infants communicate with their caregivers in meaningful ways even before the development of formal language skills through gaze, gestures, facial expressions and vocalisations (Brooks & Meltzoff, 2005; Bruner, 1983). Back-and-forth conversations between parents and children lay the foundation for communication and are associated with the development of language skills across different cultures (Hirsh-Pasek et al., 2015; Ramírez-Esparza et al., 2017). These conversational turns even help develop connections across language regions in the brain (Romeo et al., 2018).
Language ability in kindergarten (i.e., vocabulary, syntactic knowledge, expressive language skill), which is built on earlier language development throughout infancy and the toddler years, is the single best predictor of academic trajectories (Pace et al., 2019). Later in school, the vocabulary that children learned as a foundation allows them to identify and understand the words as they learn to read (Cunningham & Stanovich 1997; Dickinson & Porche, 2011; McCardle et al., 2002). As children build reading competency, textbooks, the internet, and other written resources become critical tools for learning. Success without reading becomes impossible.

→ Content.

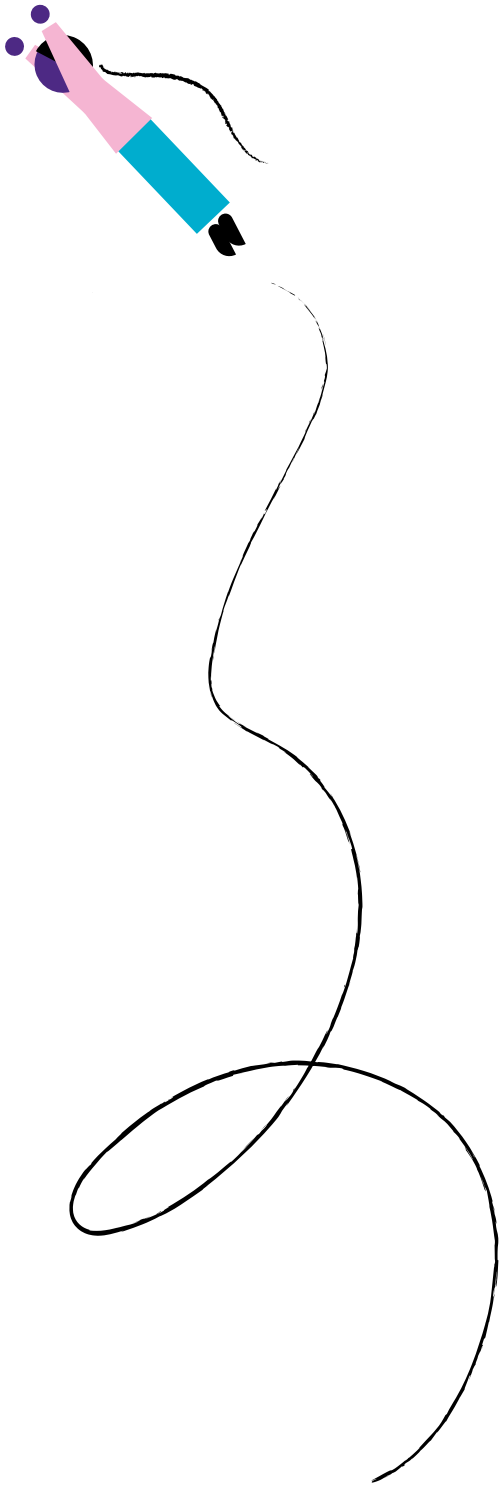
Content is acquired through collaboration and communication. It encompasses the 'traditional' learning areas such as STEM and literacy. When children in kindergarten create literacy games through guided play, they show greater gains in measures of basic literacy skills and executive function skills over children in typical teacher-led activities (Cavanaugh et al., 2017). Children of parents with less education who participated in a semi-structured block play intervention experienced greater gains in numeracy, cognitive flexibility, and executive function than did their peers with parents of higher education (e.g., Finders et al., 2021; McClelland et al., 2019; Schmitt et al., 2018). Playing with blocks and other activities that strengthen spatial awareness have been linked to increases in math skills (Fisher, 2013; Schmitt et al., 2018; Verdine et al., 2017). Additionally, preschoolers who played numerical card games showed improvement in their numerical knowledge (Scalise et al., 2020). Informal STEM learning experiences as early as preschool "may help establish a habit of STEM engagement" (Hurst et al., 2019, p. 19), elevating children's interest which may lead to increases in educational and career pursuits in STEM. Research has found that several aspects of parents' playful interactions with children relate to the development of executive function including autonomy, support, scaffolding (Bernier et al., 2010; Hammond et al., 2012) and parental responsiveness (Merz et al., 2017).

The strength of the 6 Cs model is that it includes these core content areas, and seeks to foster development in them, but also goes beyond in supporting a host of other skill areas that promote and subsequently draw on content mastery.

→ Critical Thinking.

Without content, there can be no critical thinking. Playful learning supports children's critical thinking by encouraging them to test hypotheses to solve problems or generate explanations. It allows children to bring the evidence to bear on their discoveries and findings. Successful critical thinkers navigate a world full of growing and changing information. They evaluate information through comparing and contrasting, analysing and synthesising (Ennis, 2015). Critical thinkers examine whether new evidence supports or contradicts their existing beliefs (Facione & Gittens, 2016; Zosh et al., 2017), and change their minds when the evidence no longer supports them (Miele & Wigfield, 2014). Children also learn to assess the quality of their information. By age 4, children understand that some sources are more reliable than others at providing accurate information (Afshordi & Koenig, 2021; Koenig & Harris, 2005; Koenig et al., 2019; Pesch et al., 2018), though they still often struggle with tasks that require them to reason about unverified or unreliable sources of information (Butler et al., 2018; Butler et al., 2020; Danovitch & Mills, 2014; Heyman, 2008; MacDonald et al., 2013; Taylor, 2013).

In a study with 4- to 6-year-olds, Elizabeth Bonawitz and colleagues (2011) found that children persisted in exploration and discovered more operations on a multi-function toy when engaged in a guided play context than when the function was explicitly demonstrated for them. In this study, and in other similar work by Kittredge and colleagues (2018) and Yu and colleagues (2019), children are given the opportunity to engage in a playful learning scenario, scaffolded by an adult either through hinting at other ways to explore or asking probing questions. These contexts show more robust outcomes for children because they are given autonomy in their learning and are supported in their playful interactions with their peers, as opposed to being required to passively take in the content of direct instruction. Children engage in playful exploration when their expectations are violated, and they explore more in an effort to test out their hypotheses about how things work (e.g., Bonawitz et al., 2012).



→ Creative Innovation.

Creativity is also dependent upon having enough content with which to create. In 2010, a survey of international CEOs listed creativity as the most sought-after attribute of an employee (IBM, 2010). Creativity was first defined by Guilford (1950) as a combination of divergent thinking, the ability to generate multiple ideas or solutions to a problem, and convergent thinking, the ability to hone in on one idea or solution. Curiosity refers to a desire to close gaps in knowledge and understanding (Jirout & Klahr, 2012; Loewenstein, 1994; Kidd & Hayden, 2015). Adults can nurture critical and creative thinking in children by fostering and modelling curiosity (Jirout, 2020). Curiosity, in turn, can lead to exploration where children act as 'little scientists' and learn about the world around them through their own investigations (Gopnik & Wellman, 2012; Stricker & Sobel, 2020). It is through exploration that individuals are able to investigate and generate ideas that ultimately lead to a creative outcome (Carr et al., 2016). In fact, the number and variety of preschoolers' exploratory behaviours predict whether or not they will accomplish a creative problem-solving task (Evans et al., 2021). In a study with 4- to 9-year-old children, Tougu and colleagues (2017) found that children who engaged in creative play at home were more likely to successfully solve an engineering problem following a demonstration than their peers who engaged in less creative play. Furthermore, 4- to 6-year-old children who built a LEGO structure in a guided play condition, as opposed to free play or direct instruction conditions, subsequently generated more original ideas on a creativity task (Evans et al., 2021).

→ Confidence.
Finally, confidence or perseverance is a result of the critical thinking and creative innovation which were in turn nurtured through the learning of content, communication and collaboration. Confidence allows children to take calculated risks, engage in unfamiliar experiences, and recover after experiencing failure. Children's mindsets about their own abilities can influence the development of their confidence (Claro et al., 2016; Gunderson et al., 2013; Leonard et al., 2017), and play gives parents opportunities to build their children's confidence by using growth-mindset language that focuses on learning as a process (Gunderson et al., 2018; Haimovitz & Dweck, 2017). When children try something new, there is always a chance that they will fail. Couching those new experiences in a playful context gives children a safe space to persist in their efforts, exercise their passion for reaching a goal, and learn to take calculated risks to build on what they know (e.g., Hirsh-Pasek et al., 2020). Children of all ages can take what they learn from their mistakes and calibrate new approaches, building on their abilities to collaborate, communicate, and think critically and creatively (Hirsh-Pasek et al., 2020). In a community-based playful learning programme known as Play Streets, even adolescents trained to support playful learning activities among younger peers saw positive impacts on self-confidence (Schlesinger et al., 2020).

In infancy, children begin to **collaborate** with their caregivers, as contingent interactions set the stage for basic cognitive processes such as attention and self-regulation (Masek et al., 2021). These cognitive processes in turn allow for the development of **communication**, as back-and-forth conversations build children's language skills. Collaboration and communication then scaffold children's learning of **content**. As children learn more content, they are able to engage in **critica**l thinking to evaluate the information they encounter and later to **creatively** innovate and generate new, original ideas. Creative innovation forces children to take risks and make mistakes, which ultimately bolsters their **confidence**. Each of the Cs build on one another over the course of development, forming an interrelated roadmap showing the foundational skills young learners today will need for success.

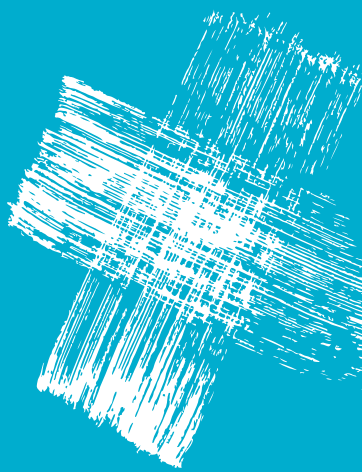
What Makes Playful Learning so Effective?

Playful learning, in particular **guided play** (e.g., Zosh et al., 2018), provides a unique opportunity for children to contend with complex concepts, drawing from their interactions with others to build deep and enduring learning. It represents a discovery approach that increases children's knowledge through their natural engagement with the world using opportunities to assimilate meaningful input. When children engage in playful learning, they improve their existing skills, experiment with their developing knowledge, and build confidence in their own abilities. Children can learn and generalise complex concepts more readily when they are introduced in a playful medium (e.g., Cavanaugh et al., 2017; Critten et al., 2021; Fisher et al., 2011; Peterson & Rajendram, 2019). Play also increases motivation for learning and hence not only allows children to learn more deeply, but also to learn in a way that is more 'sticky' so that the knowledge is retained over time.

The interactive and dynamic nature of playful learning gives children an opportunity to generate hypotheses, and to seek out opportunities for new, more complex learning (e.g., Gopnik, 2020; Walker & Gopnik, 2013; Letourneau & Sobel, 2020; Medina & Sobel, 2020; Yu et al., 2018). This can be illustrated in a study with 4-year-olds by Sobel and Sommerville (2010). They asked children to determine how a box lights up by having them test a series of activating buttons. When they were allowed to explore freely, as opposed to first observing the experimenter demonstrate how to play with the box, they naturally tested out higher-order scientific principles such as hypothesis generation and variable estimation through play, and they were more likely to solve the problem and to figure out which buttons activated or did not activate the lights on the box.

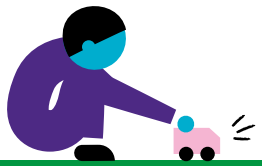
Guided play also provides a context for children to communicate with others about materials or activities that are meaningful to them. In play, parents communicate in rich ways that spark diverse and higher-level linguistic interactions, which have cascading effects on children's later language development (e.g., Masek et al., 2020; Weisleder & Fernald, 2013; Panscofar & Vernon-Feagans, 2006), and support developmental outcomes for children, including literacy, STEM skills, and other learning-to-learn skills (e.g., Bergen & Mauer ,2000; Creaghe et al., 2021; Lillard et al., 2013; Massey, 2013; Pellegrini & Galda, 1990; Wasik & Jacobi-Vessels, 2017; Weisberg et al., 2013).

During play, children talk more, with their peers, teachers and caregivers, providing ample opportunities to learn new vocabulary, and build their capacity for narrative. They are likely interacting with something that interests them, and the experience is therefore meaningful and engaging, reducing the likelihood that the child will be distracted and their learning consequently interrupted. For the young child, learning through play is the most organic means to access high-order concepts, experiment with them, build new knowledge, and forge new social connections – all foundational to building each of the 6 Cs in turn: **collaboration**, **communication**, **content** mastery, **critical** thinking, **creativity** and **confidence**.



Three-year-old Li Mei collects toy cars. She has fire trucks, small sedans, and even a city bus. She sorts them by colour and size with her mother and challenges her father to see who can push their car the farthest. In each of these activities, Li Mei is **actively** involved, **engaged** in the cars and their well-being as she **creates** a padded box to store them, **socially interacting** with her parents, **collaborating** and **communicating** her strategy as she and her mother decide how to organise her toys, engaging in **critical** thinking to decide which is bigger: a longer or taller car? Her interest in the cars gives **meaning** to the activities she's engaged in, the activities are **iterative**, building in **content** complexity (perhaps next she will make a grid, sorting the cars by size from top to bottom and by colour from left to right, using vocabulary to describe her cars and math skills to measure the distance they have driven), and she finds joy in her treasured toys and builds **confidence** through each successful task accomplished.

Eight-year-old Tom loves to help his mother bake. Today, he is going to help bake a cake for a family celebration. He helps his mother decide which type of cake to bake (carrot, his sister's favourite), and how it will be decorated. His mother helps him as he measures out each ingredient, and she pours in the wet ingredients while he stirs. Tom shows his mother the correct setting for the oven and stands back as she puts the cake inside. When it is baked, Tom mixes blue and green food colouring into the white icing to make his favourite colour and assesses whether the cake is cool enough to ice before spreading the teal icing and adding decorations. Tom is **active**, using math **content** skills to understand measurements and his **critical** thinking to assess when he has mixed ingredients sufficiently, and he is **socially interacting** by **collaborating** with his mother and **communicating** when he needs assistance. He is **engaged** as he contributes his ideas to the design and experiments **creatively** to mix the perfect colour of icing. The activity is **meaningful** as he uses his **joy** of baking to make his family happy. Finally, it is **iterative**, as he can tackle new baking projects of varying degrees of difficulty, and as he improves in ability and **confidence** he will need less and less scaffolding.



Conclusion

When children are **actively engaged** in a playful activity, particularly with a caregiver or a peer, they have intrinsic opportunities to **collaborate**, to **communicate** about **meaningful** elements of the activity, and to build critical knowledge that will help them apply their learning to new contexts. Each new skill, moving from **content** to **critical** thinking and **creative** innovation, to intellectual **confidence**, is **iteratively** built on the previous skill and scaffolds the child to acquire more advanced and deeper competencies. Playful learning gives caregivers unique access to children's natural orientation to the world and creates a space for them to embed specific skill development opportunities in a context best suited to how children's brains learn and retain new information. Early playful experiences are important, not only for the immediate transfer of knowledge or domain-specific competencies, but because they model for children the notion that learning opportunities exist everywhere, in their everyday lives. This orientation broadens the scope of what the child may hope to learn over the course of their lifetime, and helps them to develop the habits of mind that will perpetuate those attitudes well into adulthood.

Why is Lifelong Learning Important?

As the global economy continues to grow progressively more interconnected, digitised and postindustrial, the learners of today will face incredible demands in terms of innovation, **critical** and **creative** thinking, and the **confidence** to navigate a complex and dynamic workforce (Woetzel et al., 2021). Cultivating the habits of lifelong learning early will enable today's learners to adapt to these changing demands more readily. The McKinsey Global Report finds that leading up to 2030, nearly one third of the Chinese workforce, for example, may need to transition between occupations – particularly those that demand greater socio-emotional and technological skills. Around the world, a greater proportion of occupations will become progressively more automated and digitised. Training a workforce that can go beyond the basic competencies easily replicated in a machine learning context will help prepare the next generation to stake a competitive advantage over these innovations. Since the onset of the COVID-19 pandemic, the nature of the workforce, and the context in which work happens, has shifted even more in the direction of a hybrid model. These shifts in worker dynamics place even greater pressure on today's workforce to **creatively** adapt their **collaborative** and **communicative** strategies to a new workforce reality (e.g., Work Trend Index, 2021).

At every phase of societal evolution, the stage for new innovations is fundamentally changing the way in which people participate in their growing economy (e.g., McKinsey & Company, 2021). Helping young learners build a repertoire of skills that prepare them for the uncertain demands of a future workforce is critical to keeping pace with these changes. Playful learning pedagogies present a futuristic educational model that can be applied today, that builds on existing educational curricula while supporting the rich skill sets children will need for 21st-century success.

CHAPTER 6

The Physical Environment and Learning Through Play

Children play on a parent's bed, at the local playground, and even, in wartime, amidst the war-torn remnants of their neighbourhood. The environments that they inhabit shape the kind of play children engage in and, subsequently, the lessons and skills they learn. The features of children's play environments – including noise, space, and the objects that fill them – all contribute to children's opportunities to explore, take risks and learn. Given that all environments can become play environments researchers, city developers, parents, educators and policymakers all benefit from understanding how children adopt and adapt play to various contexts, spaces and cultures.

A comparison of play spaces makes this clear.

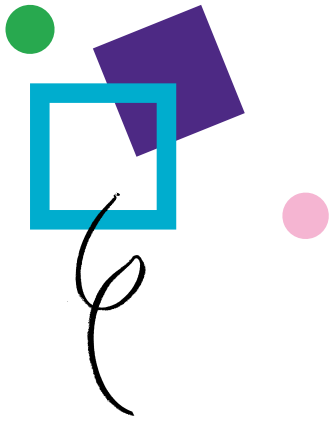
The Adventure Playground movement, which has its roots in the early 1940s, advocated for riskier outdoor spaces for young children. Carl Theodor Sørensen, a Danish landscape architect, is credited with starting the movement when in 1931 he suggested that we should create "a junk playground in which children could create and shape, dream and imagine a reality" (Chown, 2014). Where children have access to playgrounds, the physical features of that space have everything to do with their confidence and risk-taking. In New Zealand, for example, it is even commonplace for children to climb trees on their school playgrounds. The United States, by contrast, forbids the climbing of trees at school, out of concern for children's safety and even more concern for the litigation that might follow if someone is hurt.

What is the Physical Environment and Why Does it Matter for Development?

Directly observable characteristics of a setting, such as the objects and materials it contains, the sounds, the housing design, and density of people (e.g., Frost et al., 1998) all impact the way in which people behave and children play (Audrey & Batista-Ferrer, 2015; Wolf, 2007). Drawing from a range of other fields, such as health science, architecture and environmental science, coupled with more recent psychological findings, allows us to examine how embedding opportunities for playful learning in physical spaces can support cognitive well-being and social and cognitive outcomes (e.g., Evans, 2004).

Research on the connections between the physical environment and children's play and development first appeared in the scientific literature around the 1960s. Building on Bronfenbrenner's approach to harnessing the role of a child's broader environment (see **Chapter 3**), Super and Harkness (1986) originated the Developmental Niche Theory – one of the first psychological theories to integrate physical setting characteristics with culture and caregiver characteristics to understand child development in context. More recently, Gary Evans, an environmental and developmental psychologist at Cornell University, conducted research at the forefront of the movement to integrate the physical environment with our understanding of psychological and social processes (Evans, 2004, 2021).

What has become clear in this research is that changing an environment can profoundly affect behaviour – even for adults (e.g., Evans, 2006). For instance, in 2014, a Johns Hopkins University robotics club found that by redesigning the stairs in their department so that they played like piano keys, they could encourage more people to use the stairs rather than an elevator (De Nike, 2014). Indeed, even small changes to physical environments, when delivered on a large scale to many people, can be the most effective use of resources. This theory aligns with public health models (Frieden, 2010) and is evidenced by the effort to increase the amount of physical exercise people take in public spaces. By reimagining physical spaces to capitalise on the specific features most supportive of children's well-being and positive developmental outcomes, caregivers can enjoy opportunities to engage their children's learning everywhere they go.



Which Physical Features Matter for Play and Learning?

A growing body of evidence connects children's learning with their physical environments (Sumerling, 2017). For example, the availability of toys and books relates to infants' language skills as early as 6 months (Tomopoulos et al., 2006). By age 3, research finds that chronic and loud ambient noise exposure relates to low pre-reading skills (Maxwell & Evans, 2000), crowding relates to poor cognitive skills (Evans et al., 2010), and physical housing type relates to social skills (Oda et al., 1989). A vital pathway by which the physical environment shapes early development is through play. The scientific literature even provides some consensus on the features of spaces and the things in them that drive human interaction and behaviour.

→ Objects to Touch.

Both solitary and collaborative play with objects such as blocks, crayons, stuffed animals and books represents an important element of infant development. Manipulating objects allows infants to learn their properties and functions (e.g., Evans et al., 2021; Rachwani et al., 2020). During play with objects, children have rich opportunities to develop social, cognitive and language skills, especially during interactions with caregivers who scaffold children to higher levels of play (e.g., Suarez-Rivera et al., 2019). A large body of research has linked the availability of enriching toys and other learning materials in the home to children's cognitive and language development (Tomopoulos et al., 2006; Raikes et al., 2006; Rodriguez & Tamis-LeMonda, 2011; Rodriguez et al., 2009).

It is not the number of toys available, or the price of toys purchased that impacts learning; it is the specific features of toys, such as their geometric properties and their ability to be combined and recombined that spark enriching playful interactions (Verdine et al., 2019). For example, children use more overall spatial language, a behaviour known to relate to later mathematics skills, when they play with tangible toys that come in a variety of shapes. Relatedly, when commercial geometric toys lack atypical representations of shape (e.g., isosceles and scalene triangles), children struggle to identify these more complex shapes (Resnick et al., 2016). Children also produce more words, engage in more conversational turn-taking with their caregivers, and produce more content-specific vocabulary when they play with books compared to when they play with electronic toys (e.g., Sosa, 2016; Zosh et al., 2017). More recent research even points to toy design and parent–child interactions around those toys as factors influencing children's developing emotion regulation (Iskanderani & Ramírez, 2021). Play objects that can be used iteratively, in different ways, to enrich children's play experiences – as opposed to simply an overabundance of play objects – are particularly beneficial for children's learning and development.

→ Sounds To Hear.

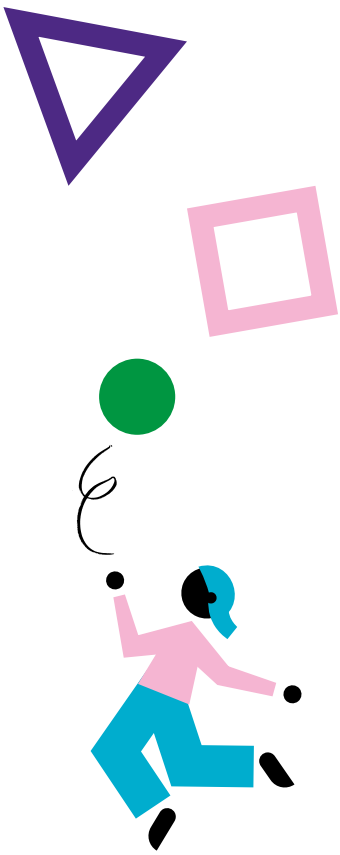
Children's everyday environments are replete with sounds, including from music, television, phones, home appliances, transportation, construction, and even bird chirps and dog barks. The importance of music as a key feature of children's soundscapes begins early. Even as young as infancy, children may be predisposed to attend to the contours, pitch and rhythmic patterning of music, especially in maternal singing (Nakata & Trehub, 2004). Research suggests that lullabies share similar structures across cultures and languages, and that they foster a sense of calm and safety. There are also studies to suggest children develop brain areas associated with processing language by listening to and making music (e.g., Carr et al., 2014; 2016), and there is some evidence that understanding music is related to the development of the spatial skills (e.g., Brown, 2012) that we discussed in Chapter 5.

Musical play represents a rich context for the development of academic and social skills throughout childhood (e.g., Berger & Cooper, 2003; Kemple et al., 2004; Marsh, 2017; Tarnowski, 1999). During musical play, children can manipulate instruments, move their bodies rhythmically, and vocalise. When children's musical engagement is embedded in a guided play context, children can express their individuality while also learning to coordinate with a social group. Sounds can be meaningfully incorporated into playful spaces and activities, such as in musical staircases, as mentioned earlier, or installations that are musically interactive (e.g., Peeters et al., 2013; St Clair & Leitman, 2009). Children even see benefits in their learning and academic outcomes in more typical school domains, such as mathematics, when they generate music through instruction; musical education is associated with transferable cognitive skills, including spatiotemporal reasoning skills, motivation, and the ability to sustain focus (Črnčec et al., 2006).

Sounds arise from many sources, and certain types or combinations of sounds may be more disruptive than others, spilling over into what may be considered 'noise', which can be defined as sounds that are annoying, or otherwise negatively impact human behaviour or well-being (World Health Organization, 2018). Sounds in the environment may disrupt language interactions that occur spontaneously during play at home. For example, there are reports that adult television viewing that occurs as background noise can deeply affect parent–child interactions by decreasing both the quantity and quality of those interactions (Kirkorian et al., 2009). Despite the fact that most children, at least in the United States, are media users by age 3 (Kirkorian et al., 2008), research suggests that exposure to television, particularly without adult supervision or interaction, is implicated in negative effects on children's toy play, parent–child interaction, and broader cognitive development (Pempek & Kirkorian, 2020). In classrooms, noise might disrupt children's attention and interfere with instructional time, which negatively impacts early school experiences and outcomes (e.g., Dockrell & Shield, 2013). Sounds that are used intentionally to enrich children's play experiences, such as music or other socially embedded or interactive mediums – rather than background noise or as a solitary activity – are particularly beneficial for children's learning and development.

→ Space to Move.

Children with regular access to spaces to play and explore have better health and developmental outcomes (e.g., Dyment & Bell, 2007; McCracken et al., 2016). Ample open physical space provides opportunities for children to develop motor skills as they jump, run and climb. In classrooms, open-plan designs (designs with few interior walls) can promote social interactions and idea-sharing among children (Brogden Head, 1983; Hickey & Forbes, 2011).



However, open-plan designs are not suited to every teaching style or activity as they have also been linked to increased noise and off-task behaviours (Mealings et al., 2015). Furthermore, physical spaces that are cluttered with objects, are unsafe, or are overcrowded, may inhibit play and learning (e.g., Evans, 2006; Ferguson et al., 2013; Fisher et al., 2014). Crowding is typically defined as the person-density of a house (i.e., number of people living per room) or classroom. In the United States, crowding in schools is also thought of relative to student–teacher ratios and whether there is a need for mobile and extended classrooms (e.g., McMullen & Rouse, 2012). Previous research in WEIRD (western, educated, industrialised, rich, democratic) communities suggests a home is 'overcrowded' if it contains more than one person living per bedroom (Evans, 2006), though this is not representative of every living arrangement, where caregiver-couples or siblings share rooms. The metric used to determine what constitutes 'overcrowding' in a physical space is therefore sensitive to cultural and historical context. When considering how the density of a child's physical environment may impact their general well-being, this is something to keep in mind. Physical environments that are largely open and sparse but populated with enriching features or opportunities for children to play with and discover are particularly beneficial for their playful learning. When arranging a space for children to play, it is important to consider walking areas, functional spaces with designated purposes, and inviting opportunities for children to explore (e.g., Biddle et al., 2012).

→ Nature to Explore.

Children thrive when they have opportunities to connect with their natural surroundings (e.g., Chawla, 2001; Hart, 1978). Regular access to parks, gardens and other green spaces promotes children's mental and physical health and enhances their academic skills (e.g., Dadvand et al., 2015; Hattie et al., 1997; Kaplan & Kaplan, 1989; Kaplan & Talbot, 1983), a phenomenon supported and popularised by the Montessori, Waldorf, Reggio and Anji educational models (e.g., Aljabreen, 2020).

Schools infusing nature and learning are growing in number across the world. Nature schools in California incorporate nature into the everyday learning experiences of young children. Forest kindergartens – in which school is conducted in a forest setting, without a classroom, in all weather – are born out of pedagogical practices common in Scandinavia and are now embraced in other countries, including the UK and Canada. These schools offer unique opportunities for young children to have direct access to the natural world while engaged in active learning (Knight, 2011). The Adventure Playground movement showcases playgrounds that are designed with stimulating and variable physical structures that encourage creative and adaptive play (e.g., Chilton, 2018). Tim Gill, at the forefront of the Urban Playground Movement – which proposes designing child-focused cities – advocates for environments in which children can take 'manageable risks' in their play which enable them to explore wilder physical environments. Forest Schools, which also allow for these types of risks, require children to make meaning from their direct experiences, and several themes arise from their pedagogies, including observed increases in children's confidence, social skills, language and communication, motivation and concentration, physical mobility, and a developing understanding of ecology and the physical world (e.g., O'Brien & Murray, 2007).

'Anji Play', a preschool programme in China, offers another progressive 'manageable risk' approach to education in which children use minimally structured, natural materials for play such as wooden climbing structures and large-scale blocks. In interacting with these more simplistic structures, children have an opportunity to engage in creative play with a degree of risk built into the physical space. When children navigate this risk effectively, they are bolstered by the feeling of joy that comes with being engaged in their own learning (e.g., Coffino & Bailey, 2019). Adventurous, semi-structured play and learning environments that are imbued with features of the natural environment have been shown across pedagogical approaches and cultures to uniquely support children's playful learning and development.

→ A Well-Organised Environment.

Chaotic environments characterised by disorganisation, unpredictability and instability – those that are noisy, crowded, or lack physical structure – are linked with a range of negative outcomes, such as lowered child IQ and greater risk for conduct problems in first grade (see Berry et al., 2016; Matheny et al., 1995). Conversely, when a play environment is well organised, it promotes playful interactions (Field, 1980; Frost & Dempsey, 1990; Moore, 2001). In classrooms that use Anji Play, where children have access to relatively simple sets of materials and know where materials are and how they are organised, they participate in more meaningful shared learning experiences.

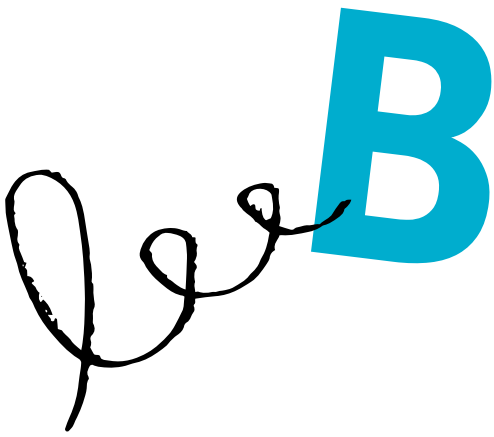
In this way, play is also guided by the environment – a 'third teacher' to complement the roles of parent and educator (e.g., Darragh, 2006) by spurring and facilitating rich interactions between children and their friends, teachers and parents or caregivers. Montessori classrooms, likewise, capitalise on an organised and predictable physical environment to which children have all manner of access; they are designed for children, grouped appropriately by age, to explore and independently correct their mistakes (e.g., Lillard, 2013). In fact, the core tenets of Montessori education – grouping by developmentally sensitive periods, allowing for sensory play, encouraging spontaneous, but repeated activity, and fostering a 'prepared environment' – have recent empirical support in the neuroscientific literature (e.g., L'Ecuyer et al., 2020).

→ A Safe Space where Children can Gather and Explore.

The initial impetus for the playground was a focus on children's safety – to get children off the streets and into secure areas. As noted in Chapter 3, the idea of a playground was conceived in Germany by Henry Barnard in 1848, followed 11 years later by the first playground in England. Surprisingly, playgrounds were not mass-produced in any way until the 1960s, and with them came a host of regulations designed to prevent injuries. It is only in the last two decades that pop-up, temporary playgrounds – in areas where permanent play structures are not available – became commonplace in cities around the world as city officials and other partners closed off streets to make special places for children to play safely. While the concept of playgrounds has been around for 150 years, the variability in playgrounds continues to grow to include climbing structures, swings, and even more adventure and risk.

Playgrounds differ across cultures not only in their makeup but in their availability. In China, for example, the first playgrounds appeared at the turn of the 20th century (Zhang et al., 2019), but are today less commonplace. More recently, Wang and colleagues (2018), from the University of Sheffield, examined a movement in China to incorporate more of the natural environment in city design and construction, thereby increasing the popularity of natural play spaces for children (see also Bradsher, 2021). In the US and other Western countries, playgrounds have such general popularity that they even appear in airports: Chicago's O'Hare Airport, for example, houses a playground called 'Kids on the Fly' in Terminal 2 (Poirot, 2018). In an airport in Milan, Gate A17 is situated near a themed play area containing interactive games and activities for children waiting with their families for their flights. In Russia, some popular restaurants have children's spaces and nannies to watch children while their parents eat (Moscow Living, 2020). Some countries are still reshaping their perceptions and acceptance of public play spaces for children. In Taipei recently, a small group of mothers fought for the conservation of a playground originally built to commemorate the moon landing, and ultimately influenced the Ministry of Health and Welfare to preserve that playground and to provide protection to children's public play spaces (Hsin-Yin, 2021).

Though there is still wide variability in the availability of high-quality public playgrounds, these recent developments point to a pronounced and increasing concern from researchers and top government officials, as well as caregivers, city designers and even entrepreneurs about the importance of high-quality physical play spaces for children.

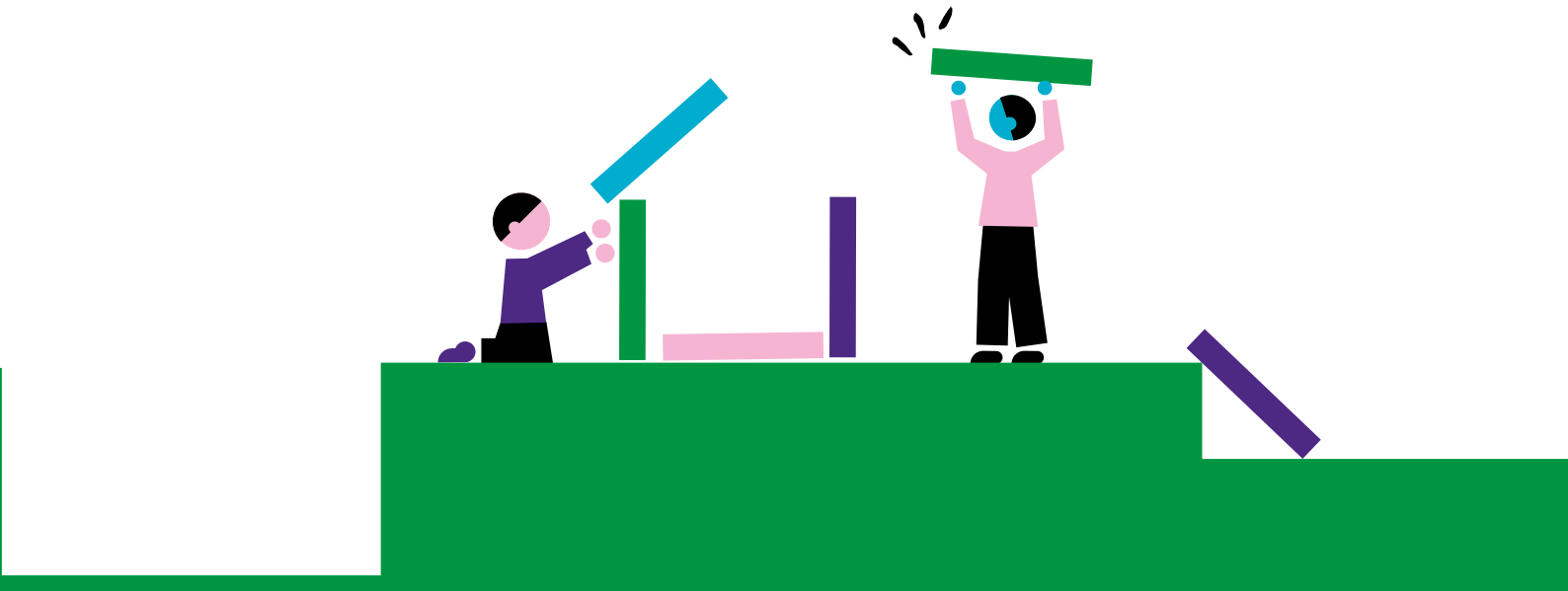


→ A Place to Stay.

Not every community has the luxury of installing expansive or outdoor play spaces. For many, it is the home that serves as sleeping, dining, working and play space. Physical homes represent a major financial and personal investment for families. American infants spend much of their waking time at home (~60%) playing with toys and other household objects (Herzberg-Keller et al., 2021). Prior to school or preschool entry, very young children spend more time playing at home than during any other developmental period. In some countries, as household ownership increases, and space comes at a higher premium, access to outdoor spaces, community centres or other venues for children to play and explore is limited. In China, for example, Zhan Hu and Xizhe Peng from Fudan University have studied the past four censuses and found a staggering increase in homeownership, coupled with simplification of the housing structure and shrinking of household size, moving away from the traditional multi-generational housing model (Hu & Peng, 2015). Both housing type and quality have powerful influences on children's opportunities for playful activities and social interactions that shape their social and cognitive developmental outcomes (e.g., Coley et al., 2019; 2021; Votruba-Drzal et al., 2021).

Housing type and housing quality (e.g., the presence of any structural deficits in the home) are important spatial characteristics of the physical environment (see Evans et al., 2003 or Gifford, 2007 for reviews of housing type and child development; Leventhal & Newman, 2010). There are also standardised housing scales to assess home quality. The HOME scale, for instance, has been widely used in a broad range of cultural contexts to assess the quality of the home environment, including the housing type and availability of resources for children in the home, such as books and toys (Bradley & Caldwell, 1984; Bradley et al., 1992). In a cross-cultural retrospective evaluation of the availability of modern playful learning resources in the home (e.g., tablets, books, radio, television), researchers have identified a positive correlation with children's cognitive growth, perspective-taking abilities, and degree of exploratory play (see Gauvain & Munroe, 2009).

Research in high-income areas in the United States has found an association between several features of housing type and children's behavioural outcomes, such as the development of later conduct disorders (e.g., Ferguson et al., 2013). Work from previous decades has also shown associations between children living in high-rises and their parents' concerns about the availability of physical play spaces (see Levi et al., 1991), as well as parents' observations of more restrictive and hesitant play in their children when they do play outdoors (see Churchman & Ginsburg, 1984). Children's living conditions have broad-ranging impacts on how they play, not only in the home but also in their immediate surroundings. Capitalising on the features of the home environment that best support children's playful learning, as well as complementing that environment with public play spaces outside of the home, helps to create well-rounded environments that support children's learning and development.



How Scientists Can Transform Children's Public Spaces

Taken together, the work on the role of children's physical worlds in their learning and development underscores the important opportunity researchers, educators and policymakers have in shaping positive influences in those physical spaces and in re-thinking Child-Friendly Cities. Well-curated spaces can drive parent–child interactions and child outcomes in the same ways that nudges have been used to drive behaviour in adults (Kwan et al., 2020). It is within this context that Drs. Kathy Hirsh-Pasek and Roberta Golinkoff launched a new take on traditional play spaces that they called **Playful Learning Landscapes** (see playfullearninglandscapes.com).

In the Playful Learning Landscapes initiative, public and 'trapped' spaces like bus stops, supermarkets and parks become infused with activities that are inspired by the science of how children learn. With objects to touch, sounds to listen for or to generate, and a safe space to move, think, and play, Playful Learning Landscapes is a unique community-centred initiative that inspires the kinds of adult–child interactions that build social and mental capital. Using the science of learning as a framework, Playful Learning Landscapes is an optimal example of integrating the critical elements of children's physical spaces described above – not too much clutter; a safe, designated space to play and interact; stimulating and enriching sounds, activities, and prompts to promote conversation – to extend children's learning beyond the classroom and into the public sphere in an intergenerational way.

In the conception and design of Playful Learning Landscapes, scientists, designers, corporations and non-profit groups, educators and children's museum leaders, and community members (including parents and their children) work together in a human-centred co-design process to fuse the interests, strengths and values of each respective community with science-backed activities. The reimagined playful learning spaces that result are culturally relevant, engaging, joyful and developmentally stimulating. In a series of papers derived from Playful Learning Landscapes data, Hirsh-Pasek and Golinkoff have outlined the benefits of infusing the science of playful learning into public spaces – from enhancing caregiver–child interactions, to generating meaningful improvements to learners' **collaborative** skills, **communication** skills, **content** mastery, **critical** and **creative** thinking and **confidence** (e.g., Bustamante et al., 2019; Hassinger-Das et al., 2021). Several key examples of Playful Learning Landscapes sites below illustrate how the science of learning can be successfully applied in the broader community. Further, they illustrate how the principles of play and of the 6 Cs can be used in design to create Child-Friendly Cities.

Figure 4. Images from the Ultimate Block Party (photo copyright: The Ultimate Block Party)

The Ultimate Block Party.

In New York City, the team expanded the notion of a traditional block party by infusing it with elements specifically related to playful learning, with the first 'Ultimate Block Party'. More than 50,000 parents and children engaged in 28 semi-structured activities (targeting science, technology, engineering, math (STEM), and literacy skills) across 8 play domains (e.g., adventure, construction, physical, creative, the arts, make-believe, technology and language play; Zosh et al., 2013). The research suggested that parents showed a marked increase in their perceptions of play as a pathway to their children's learning, reflecting a greater understanding of the role of playful learning in imagination, creative thinking, and later success in adulthood (e.g., Grob et al., 2017). Similar results emerged in later installations in Toronto and Ontario, Canada, and in Baltimore, Maryland.

Supermarket Speak.

Supermarkets are not typically child-friendly or focused but are simply large one-stop-shopping centres for families to purchase food and other basic necessities. In 'Supermarket Speak' (*see Figure 5*) grocery stores in three under-resourced communities were reimagined and outfitted with visual prompts encouraging parents to ask their children questions like, "where does milk come from?" or "what is your favorite vegetable?" (Ridge et al., 2015). Both the amount and quality of parent–child interactions increased significantly after the prompts were installed. A replication of this work demonstrated the same findings with prompts that encourage discussions around STEM (Hanner et al., 2019). 'Supermarket Speak' and related studies illustrate ways to support the critical role of meaningful conversational input from parents and caregivers in daily life, which have later positive impacts on children's language development (e.g., Rowe & Goldin-Meadow, 2009; Rowe, 2012).

Urban Thinkscape.

A final example is 'Urban Thinkscape' (Hassinger-Das et al., 2018), which transformed a bus stop and an adjoining disused street-corner into a hub of playful learning (*see Figures 6 and 7*). This installation joined functional architecture with tasks designed to tap into children's developing spatial skills (e.g., a lattice with searchable hidden numbers, letters and shapes in the structure and in its shadows; Hidden Figures), language development (e.g., a many-levelled walking trail with pictures along to inspire narrative-building; Stories), and executive functioning skills (e.g., hopscotch designed for jumping with one foot on a two-footed space and two feet on a one-footed space; Jumping Feet). By reshaping the physical environment to capitalise on children's space to move and objects to touch, all within an area adjacent to the bus stop, children were given a venue to explore higher-order concepts in a playful medium while engaged in a daily task, like waiting for the bus.

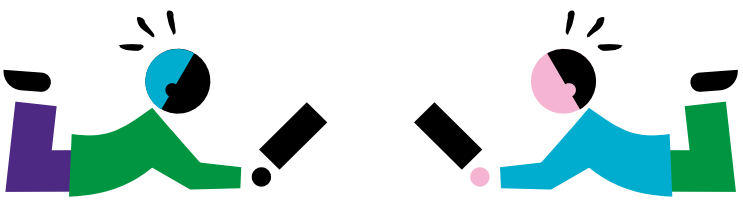


Figure 5. Supermarket Speak
(Photo credit Saxum, courtesy of PLLAN)

Figure 6. Urban Thinkscape
(Photo credit Sahar Coston-Hardy courtesy of PLLAN)

Figure 7. Urban Thinkscape
(Photo credit Sahar Coston-Hardy courtesy of PLLAN)

The Future of Playful Learning in the Physical Environment

As cultures and communities learn about the role of redesigned physical spaces in sparking positive developmental outcomes, increasing numbers of initiatives to support play in neighbourhoods have arisen around the globe. In the Netherlands, the Bernard van Leer Foundation's Urban95 initiative seeks to design city landscapes from the point of view of 95cm – the average height of a 3-year-old. Urban95 partners with urban leaders, planners and designers to ensure cities support frequent, high-quality interactions between children and caregivers and provide safe and stimulating physical environments to explore. While Urban95 does not build in the playful learning aspect, a lot can be learned from this initiative in how it uses the design aspects of objects to touch, sounds to hear, space to move, and nature to explore to support safe parent–child interaction outside the home. In the United States, KABOOM! emerged to end play space inequity through thoughtfully designed playgrounds targeted in communities with historically limited access. They are currently working with Playful Learning Landscapes to embed learning into their designs. Finally, Playful Learning Landscapes adds the science of learning to a mix of playful opportunities by embedding targeted activities that stimulate STEM, literacy, and 21st-century skills in children's everyday spaces. A 2018 UNICEF report further emphasised the role of a well-organised, supportive environment in children's playful learning: "*A supportive enabling environment is conducive to recognising the importance of learning through play, and it can further strengthen this emphasis by fostering coordination with other sectors such as health, nutrition and social protection, which together can create a unified voice for play in children's lives*" (p. 16).

All of these initiatives shape our conceptions of what is possible in communities of the future – from the city square to the centrepiece of the rural town. This redefinition of the way people live and raise children melds urban and rural design with the science of playful learning and is sure to write a new chapter on the ways in which play influences our spaces and our spaces influence human interaction. By infusing the scientific principles of learning into play spaces, children's playful learning is elevated from ordinary to extraordinary.

Photo credits: João Pires / FotoJump courtesy of PLLAN

CHAPTER 7

Learning Through Digital Play

In June 2007, the first iPhone appeared. Three years later, the iPad entered the digital marketplace. Together, these inventions would forever change the landscape of play. In 2018, 95% of Chinese citizens owned a smartphone (Deloitte, 2018), and by 2021 the same was true for 80% of adults in the US (Perrin, 2021). Ninety-seven percent of 0–4-year-olds use these mobile devices, 90% of whom start before the age of one. In 2019, more than 200 billion apps were downloaded (Ceci, 2021) – many of which targeted children under the age of 5, and of those, many were mis-classified as 'educational' (Meyer et al., 2021). The ubiquity of digital devices, and the degree to which they permeate infants' and children's daily lives, raises the question: How can digital technology meet the criteria for playful learning?

Given such wide accessibility of digital technology, it is no wonder that children are spending a lot of their discretionary time using screen-based media. Common Sense Media (Rideout, 2017) reports that American children under the age of 8 spend an average of 2 hours per day engaging with digital sources. The National Center for Education Statistics holds that 94% of American children between 3 and 18 years had a computer at home in 2015 (US Department of Education, 2018), and a vast majority of elementary-aged students reported using digital resources for schoolwork (McFarland et al., 2019). Some research even suggests that young children become familiar with digital technologies before they are exposed to books (Hopkins et al., 2013).

As digital media become increasingly common in our societies, technology and software developers have likewise increased their efforts to target younger audiences – including infants and children. Further, digital offerings are no longer just available on phones and iPads but are ever-present in toys (Clifford, 2012; Druga et al., 2018; Healey et al., 2019; Marsh, 2017) and in household accessories and smart speakers like Google and Alexa, which readily answer children's questions or play a favourite selection solely through a voice prompt (see Wiederhold, 2018).

Given the ubiquity of digital offerings, scientists, parents and paediatricians are asking questions about the *amount of time* children spend with digital media and the *content* that is best suited to children of different ages. A third and important off-shoot of this work concerns adults' preoccupation with digital media in the presence of young children. Research finds that use of mobile devices by parents is related to lower levels of responsiveness and verbal interaction with their children (Radesky et al., 2014; Radesky et al., 2015; Konrad et al., 2021), a phenomenon dubbed 'technoference' (McDaniel & Radesky, 2018). Indeed, there is a relation between children's problem behaviours and caregivers' technoference (McDaniel & Radesky, 2018). Children learn less when their social interaction is disrupted by a parents' cell phone call (Reed et al., 2017).

Amount of Time on Screen

Issues surrounding the amount of time on screen motivated much of the earlier scientific discussion about television watching. Practitioners and parents were also concerned (Hassinger-Das et al., 2020) that digital media would displace other enriching activities such as book reading, socialising and non-technological play (Christakis et al., 2004; Foster & Watkins, 2010; Schmidt et al., 2008). What we know from the television literature is that children under the age of two do not profit from screen media (Anderson & Pempek, 2005; Lee et al., 2018). As early as 1999, this finding prompted commentary from the American Pediatric Association, which issued guidelines restricting children under two from watching screen media (American Academy of Pediatrics, 1999). China was so concerned about the amount of use by its citizens that in 2021 it restricted all children under 18 to only 1 hour a day of digital gaming time on Fridays and weekends (Goh, 2021).

Why is screen time considered a problem, particularly for young children? At the heart of all early learning is social interaction. Interactions between caregivers and children are immensely important for the development of social and cognitive competencies. Interactions that provide contingent, back-and-forth exchanges set the foundation for later life, even from infancy (Adamson et al., 2014; Hirsh-Pasek et al., 2015; Konrad et al., 2021; Masek et al., 2021; Radesky et al., 2014; Reynolds & Burton, 2017). These socially contingent interactions are important for later language development (Masek et al., 2020; 2021; Ramírez-Esparza et al., 2017), brain growth (Romeo et al., 2018), and potentially for the development of basic executive function skills like attention and memory (Masek et al., 2021). Studies demonstrate that when a child hears a person talking on a screen without these contingent interactions, they fail to learn – be it word learning in the child's native language (Roseberry et al., 2014) or learning a foreign language (Kuhl et al., 2003). Young children simply need social interaction to build cognitive and social skills (e.g., Lytle et al., 2018).

Play provides exactly the opportunities for the types of social interaction that best support mental and social growth (see **Chapter 5**). Several studies demonstrate that when toys have digital components, parent interaction is displaced, and child–caregiver play is disrupted. Sosa (2016), for example, asked whether socially interactive behaviour was more likely to occur when 18-month-olds play with electronic vs. traditional toys. She found that play with etoys was associated with decreased quantity and quality of language and interaction, as parents tended to treat the etoy as a replacement for their own verbal interactions with their children. A study by Zosh and colleagues (2015) noted similarly that when digital characteristics were added to a shape sorter, parents were more likely to become observers, rather than partners, in their children's play.

It is possible to build socially contingent interactions into screen time and many platforms do just that. Video calls (e.g., Skype, Facetime, Zoom) support early social relationships and subsequent learning because of the opportunity for a back-and-forth exchange (Kuhl et al., 2003; Roseberry et al., 2014; Strouse & Samson, 2020). Lauricella and colleagues (2011), discovered that social interaction overcame the difficulty young children have with transferring knowledge acquired in a 2D to a 3D context (Barr, 2010). They found that toddlers who played an interactive computer game were just as likely to successfully find a hidden object as children who watched the item being hidden in real life, and more successfully than children who simply watched the item being hidden on a screen. As has been noted in other studies (Kirkorian et al., 2016), social interaction facilitated the children's transfer of knowledge between screens and real life. The use of some technology, such as ebooks and apps, with sufficient parental or teacher involvement and structure, promotes children's attention, word learning, mathematics learning and reading comprehension (e.g., Christopoulos et al., 2020; Courage, 2019; Parish-Morris et al., 2013; Smeets & Bus, 2014; Hassinger-Das et al., 2016).

A related concern about screen time is left over from the television era. Many hypothesised that the introduction of children's television would rob children of opportunities to read or do activities with others. Research suggests, however, that although television did change how children spent their time, it did not lead to major reductions in the time spent doing activities like homework or reading books (Schramm et al., 1961). In fact, most research finds no definitive, causal effects of television viewing – either positive or negative – on children's behavioural outcomes (e.g., Barr, 2010; Christakis et al., 2004; Foster & Watkins, 2010; Huston, 1992; Mistry et al., 2007; Schmidt et al., 2009; Stevens & Mulsow, 2006; Zimmerman & Christakis, 2005; Zimmerman et al., 2007). The jury is still out with respect to how much interactive digital and social media is too much, although it is generally recommended that media be limited for children under the age of 5 (Hill et al., 2016; Levin & Rosenquest, 2001; Radesky, 2020). However, associations have been documented between children's screen time and an unhealthy diet, poor quality sleep, damage to eyesight, cyberbullying, and poor mental health (Chindamo et al., 2019; Haripriya et al., 2018; Lee et al., 2018; Stiglic & Viner, 2019; Wang et al., 2020). It is also clear that even at older ages, screen time should not usurp human interaction time.

During the COVID-19 pandemic, school moved from a live to a virtual context and, around the globe, the results were underwhelming (Dorn et al., 2020; Garcia & Weiss, 2020; Herold, 2020). In fact, China outlawed all online for-profit educational services aimed at providing additional tutoring to students during the pandemic (USC US-China Institute, 2021). Time spent on digital media has the potential to be both more playful and more educational, yet it must be a supplement, not a substitution, for learning in a social context. Playful learning *can* incorporate socially interactive components within digital technology. It merely has to have the commitment to do so.

The Question of Content: What counts as playful learning in digital media

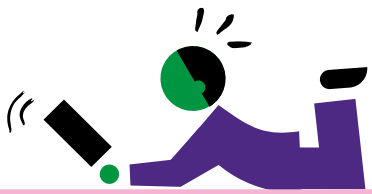
Much of the digital media available for young children is dubbed as 'educational', and the share of the online education market is greatest in the US (42.9%) and China (21.4%) (Markets Insider, 2020). What counts as 'educational' in digital technology, however, is less clear. To be sure, the digital world offers children a number of games that are meant exclusively for entertainment, not educational entertainment, or edutainment (American University School of Education, 2020; Prasad, 2020). Because of the proliferation of so-called educational apps and programming, and because our focus here is on playful learning, we restrict our discussion to issues surrounding educational play in the digital realm.

In 2015, Hirsh-Pasek, Zosh and colleagues sought to describe a consensus view on the characteristics of learning. In so doing, they asked how these characteristics could become part of the digital design process that produced playful learning content. Their review articulated five characteristics that we have mentioned for playful learning: that learning should be

1. **active and minds-on** rather than passive (not swiping),
2. **engaging** rather than distracting,
3. meaningful rather than disjointed, suggesting that it should use a context familiar to children with a coherent narrative,
4. **socially interactive** where possible rather than solo, and
5. **joyful** so that children were motivated enough to want to continue in the game play (see **Chapter 2**).

Finally, the designers should use these characteristics in the context of a game or activity that has a clearly defined learning goal – when these conditions are met, we call this guided play (see **Chapter 2**). Importantly, this definition aligns with the latest research on how children learn through play, with a focus on preserving child agency even while engaged in learning.

A 2021 study by Meyer and colleagues asked whether apps that were designated as educational actually met the standards of the learning science put forth by Hirsh-Pasek, Zosh et al. (2015). Sadly, very few did. They analysed the most downloaded 124 children's educational apps, and when evaluated against the criteria for playful learning, a full 58% of the apps were deemed low quality – many because they violated the characteristic of engagement, distracting from the narrative of the game or story to add unnecessary features. Despite this disappointing result, seven of the apps did meet the criteria as high quality – suggesting that digital games and activities can be imbued with the core characteristics of playful learning to support children's knowledge-building across a variety of domains, including reading, STEAM (STEM + art), and executive function.



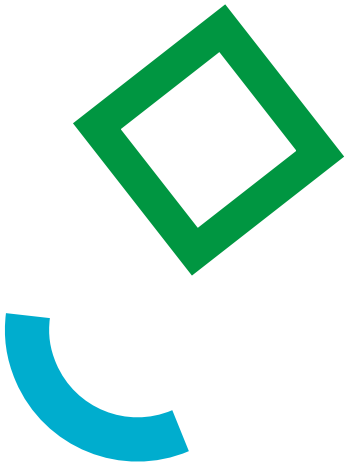
Reading. One of the most contentious areas in the digital literature concerns whether ebooks are as good as traditional books for young children. Work conducted on an early version of digital books called console books suggested that young children did not learn well from these digital devices alone (Parish-Morris et al., 2011). Later work shows that social interaction is the key ingredient that moderates what and how much children learn from ebooks. Interactive ebooks promote parent–child dialogue, which in turn supports children's reading comprehension (Choi & Kirkorian, 2016; Kirkorian et al., 2016; Parish-Morris et al., 2013). For example, when an ebook includes touch-based pop-up activities designed to define target words, kindergarten children's vocabulary learning was greater than when they used an ebook without these tools (Smeets & Bus, 2014).

Dore and colleagues (2017) likewise found that ebooks supplemented with audio narration can help preschoolers' developing reading comprehension, and their retention of book content is even better when their interactions are supported by a parent. Finally, Tsuji and colleagues (2020) found increases in learning when they programmed cartoon characters to respond to an infant's eye gaze. As the child looked at the objects and the character on the screen, the character responded appropriately. This interaction with the character – which not only spoke to the child but also responded to the child's eyeline – resulted in increased learning of new word-object associations.

Taken together, these findings point to a common thread in the literature on children's learning from digital sources – they function well when there is an interactive element, but best when they are supplemented by real-life social interactions.

STEAM. A problem for digital media sources seeking to support children's math learning is that many math-focused apps have no parent-facing component that would enable them to support their children's engagement. And those apps that do encourage parent interaction often lack a specific focus on math. However, there is some evidence that digital media can serve to support children's early science, technology, engineering, arts and math (STEAM) learning.

Since one of the best predictors of later STEAM performance is early math skills (Wai et al., 2009), much research has focused on understanding how digital technology can enhance children's developing math competency. Christopoulos and colleagues (2020) conducted a study with elementary school students in Dubai using technology to provide real-time responses to math exercises. Instead of filling out worksheets that then need to be graded by the teacher, children received immediate responses to their answers. Teachers could, in real time, see what activities children were struggling with and modify their individualised learning plan.



Calvert and colleagues (2019), in a study with 217 preschoolers, found that children could more accurately transfer math concepts from digital to physical objects when they engaged in math talk with a *parasocial* digital character – a character that appears to interact with the viewer and give the impression of personal relationship or familiarity. Bower and colleagues (2021) found similar performance results across both concrete and digital training on a spatial puzzle task – a skill area that is known to strongly predict later math abilities. 'Bedtime math' in which parents and their first graders answered interactive math questions on an iPad app at bedtime, was associated with increases in children's math achievement compared to a control group (Berkowitz et al., 2015). For older students and adults, researchers also report that children learn spatial skills when playing games of Tetris (Bediou et al., 2018).

Omo Moses, CEO of an early math education lab known as MathTalk, best summarises the pressing issue of today's math education: "As you learn and see math around you, and you're able to interact and engage with it, a world opens up" (Beckner & Minn, 2021). Beyond early math and spatial skills, some research addresses the role of technology in science, engineering and arts skills. Digital media offers an opportunity to expand upon children's basic skills, by encouraging intrinsic interest in music (Hirsh-Pasek et al., 2015), computer coding (Kaplancali & Demirkol, 2016), and other science skills, like the engineering of a stable bridge (Christensen et al., 2020).

Executive Function Skills. In other cognitive areas, including learning-to-learn skills dubbed executive function (EF), the research is mixed. In a longitudinal study with toddlers, McHarg and others (2020) found no concurrent association between screen media and executive function, but after a year a negative association between the two emerged, even when controlling for other capacities, like verbal ability. Jusienė and colleagues (2020) noted no significant relation between screen time and executive function in preschoolers. Other studies, like one conducted by Huber and colleagues (2018) find that preschoolers are more likely to delay gratification and show improvements in working memory (both skills associated with EF), after playing an educational app compared to passive cartoon viewership. Yang and others (2017) showed in a study with Chinese preschoolers that television viewing, specifically through child-directed content, was positively associated with EF, and that content was a significant mediator of the relation between viewership and EF. Rossignoli-Palomeque and colleagues (2019) found that elementary schoolers' executive function skills could be trained via the use of an educational app, particularly when the app was interactive and responded to the children's performance.

While this research suggests that there is indeed an impact of digital learning, there are also several caveats. First, digital material must be created in concert with the five characteristics of playful learning and with a clear learning goal. Second, a review of the adult 'brain training' literature by Simons and others (2016) finds that the effects of cognitive training are narrow: training in attention does not benefit a person's speed at responding. Further, and importantly, the training rarely goes beyond improving performance in the task at hand. That is, there is no transfer from speed on one game to speed on another task. These findings thus suggest that training performance in a singular digital task does not have transferable benefits for the learner – particularly when that engagement is solitary and lacks the crucial social interactions known to be critical for young children.

Work by Jan Plass from New York University captures this idea best with the 'Zone of Optimal Engagement'. Digital technologies must strike a balance of cognitive engagement – not too difficult and not too boring – for maximum benefit (Plass et al., 2019). Understanding these limitations of technology and media is crucial for shaping the future of digital learning. In the following sections, we describe the lessons learned from the digital world and point to the science of learning as a touchstone for reshaping digital education for the 21st century.

Lessons Learned from the Digital World for Playful Learning

1. Not all apps that are labelled 'educational' are really educational

Digital games are an increasingly popular activity for children. Common Sense Media (Rideout, 2017) reports that US children from infancy to age 8 play interactive games for approximately 25–40 minutes every day. Some computer games have been linked to short-term performance gains on certain tasks, while others fall short. One way to test the educational value of computer games is to assess whether or not children learn transferable skills from playing them.

Near transfer refers to extending improvements on a new task learned in a specific context to other contexts that require the same method to solve (Meyer, 2021). When a child learns to tie the shoelaces of their favourite shoes, and then can generalise this skill to all shoes, they are achieving a near transfer of their knowledge (Matthews, 2018). Near transfer effects have been documented in games like Tetris and online chess (e.g., Sala & Gobet, 2020). Far transfer refers to improvements in solving novel problems (Meyer, 2021) and generalising to contexts outside of the original learning episode (Smid et al., 2020). An example of far transfer would be learning about fractions and percentages and applying that knowledge to calculate sales tax. Little research has addressed far transfer from digital learning, although some work has been conducted on gaming platforms such as Lumosity and it has been found that they have limited effect on improving far transfer of cognitive ability (Bainbridge & Mayer, 2017). Studies of other cognitive training programmes like video games, music, chess and exercise games show small or null effects on far transfer (Sala, 2019).

Training in a digital game improves performance on that game. However, there is limited research to suggest that digital training transfers and improves performance in other tasks. Even the transfer of emotional understanding – the ability to recognise expressions of emotions on others' faces – is impacted by the use of digital media. Uhls and colleagues (2014) conducted a study with middle school students and found that, after a five-day 'nature' retreat without digital devices, children were able to identify emotional expressions more accurately in video-recordings of peers.

2. Not all screen interactions are created equal (Hirsh-Pasek et al., 2015)

To the extent that digital experiences can prompt social interaction while exploring, discovering, or even reading, they will be more effective for children's learning. As in the television literature, children learn more when parents and children co-view, or watch side by side while jointly engaging with the content (see Bus et al., 2020; Calvert et al., 2019; Zack & Barr, 2016 for more on socially interactive media). During co-viewing, caregivers can support children's viewing experience by asking questions or pointing out what is happening to the characters on the screen. Passive engagement with digital media does not yield higher learning outcomes for children, even with multiple exposures (Richert et al., 2010; Robb et al., 2009). Indeed, when engaging with others around digital content, children up to age 8 have been found to demonstrate higher levels of word learning (Kuhl et al., 2003; Myers et al., 2016), better content comprehension (Fisch et al., 2008; Parish-Morris et al., 2013), and sustained attention (Barr et al., 2008; Nussenbaum & Amso, 2016).

3.When digital media embodies playful learning, children's outcomes are supported

The five characteristics of playful learning, from the science of learning literature, provide the framework for how to create optimal digital material and activities for young children. When these criteria are met, children are best prepared to achieve their learning goals – in particular, the development of the suite of 21st-century skills that Golinkoff and Hirsh-Pasek (2016) describe as the 6 Cs (see **Chapter 2**).

Recent work has demonstrated the power of digital media in promoting these skills – what the LEGO Foundation refers to as 'holistic skills' (Gray & Thomsen, 2021). In a study with almost 120 elementary school students, Karsenti and Bugmann (2018) found that the gaming platform Minecraft helped increase student motivation and engagement (**communication, collaboration, content**), as well as computer coding and troubleshooting skills, imagination and creativity (**creative innovation, confidence**). Alawajee and Delafield-Butt (2021) also found that Minecraft has been associated with language development (**communication**), academic learning in subject areas like science and history (**content**), and even communication and student leadership (**communication, collaboration, confidence**). During the COVID-19 pandemic, similar open-source digital 'sandboxes' (Gray & Thomsen, 2021, p. 29), like Roblox and Fortnite Creative, have generated online interactive spaces for children and adolescents to collaborate, problem-solve, and cultivate 'digital civility' (Ibid.). Physical technology, likewise, can enhance children's inherent curiosity: Shiomi and colleagues (2015) found that when a 'social robot', or interactive robotic character named Robovie, was embedded in an elementary school science class, children showed individual increases in curiosity and the number of science-related questions they asked. The theme here is evident: When digital media is imbued with the core tenets of playful learning – particularly a socially interactive component – children benefit far more and across a wider range of cognitive and content areas.

Conclusion

The technology industry is on the cusp of a new revolution. Over time, technology has become increasingly advanced, embedding more and more supplemental tools that encourage social interaction. At first, books and content were merely converted into a digital format. The second wave of digital advancement saw dramatic improvements by advancing the interactive components; for example, vocabulary tools that map target words to their definitions. Industry developers also created Osmo, a digitised magnetic building set, that enables children to meld manipulable physical elements with screen use (Fowler, 2016). Most recently, developers have begun adding more features that prompt social interaction and that allow children to apply what they learn in their digital worlds to the real world. Finally, the technological revolution is poised to share the metaverse with young users. If activities in the metaverse are designed with playful learning characteristics and with the 6 Cs, it might offer even more pathways for the digital world to support guided playful learning (Hirsh-Pasek et al., 2022).

Playful learning is the pedagogical ideal for early childhood education, and digital technologies will play an increasingly central role (Bird & Edwards, 2015). The next wave of advancement can see apps and augmented reality software that enables children to walk into a historical landscape, explore outer space, or visit the bottom of the ocean. If we build digital technologies with the science of learning in mind, children can learn 21st-century skills in ways that use the full power of the internet.


Motion
Visuals
Sounds
Functions
Variables
Flow
play sound
led 1
255
255
0
10
button 1
released
Attempts
by
32.23
button 1
pressed
pick random
1
Magic Number
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pick random
22.66
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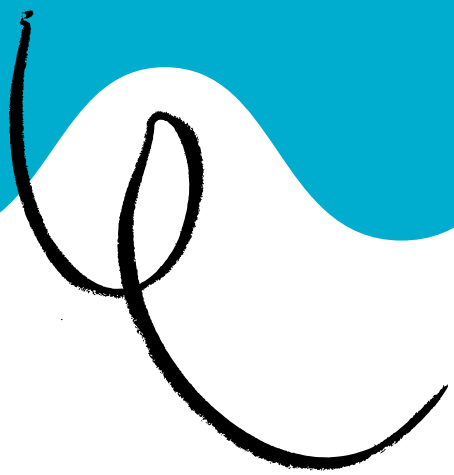
CHAPTER 8

Blueprint of Future Learning through Play



The growth of human civilisation relies on *new* discoveries – from fire, to the wheel, to the printing press, to rockets. Humanity cannot move forward without the makers, the creators, the orators, the believers – those who persistently play in the sandbox of ideas. New knowledge requires exploration, trial and error, testing of a vision, development of a design, and finally, the drive to take that spark into the marketplace of ideas. How do we create an environment that nurtures the drive for exploration and discoveries? How does one learn to be a maker and creator of new knowledge, whether in schools, in public spaces within the broader community, or in informal digital platforms?

Throughout this white paper, we suggested that models of playful learning offer a perfect way to introduce the science of learning to educators, businesspeople, and the population at large. We demonstrated the power of play as an exploratory and social behaviour that is ubiquitous among the species and that exists across cultures and over time. Egyptian children were playing over 3,000 years ago (Janssen & Janssen, 1996) and today, children play as refugees, in the aftermath of war, during a pandemic, and on an average seemingly mundane day. Children explore and cope with the many challenges of the world in front of them through play. Playful learning is not a model of learning imported from the West; it is a model of how the brain learns best.

Despite the compelling scientific case that can and should be made for playful learning, schools around the globe remain dominated by pedagogies that favour rote memorisation of subject material. This is the case in countries like the United States and China. In the final chapter of this white paper, we look to the future of children's playful learning. We home in on the benefits of learning through play – specifically through adult-facilitated, collaborative guided play – in modern education in and out of school anywhere in the world. This model of learning would create a world in which children have opportunities to learn in the way we know works best. Moving instruction from 'sage on the stage' (direct instruction) to 'guide on the side' (guided play) requires personal, cultural and political attitudinal change about the benefits of playful learning. And with that mindset change, it offers a pipeline of learning that can carry children from cradle to the workforce.

The scientific review in these pages offered evidence supporting the view that playful learning is an optimal way to learn for both children and adults around the globe. It is among the first white papers to assemble the current evidence to reinforce a new pedagogical approach for the future. It also integrates newly collected data that highlight how parents in the US and China think about play and learning. **Chapter 1** gave us an overview and introduction to the topic of play. **Chapter 2** explored the historical backdrop behind the idea of 'learning through play' providing foundational definitions for different types of play. **Chapter 3** examined play in the context of the child's broader ecosystem, taking Bronfenbrenner's Ecological Model as a framework for focusing on the interactions between the child's immediate and distal environments. **Chapter 4** asked how playful learning might support the development of social relationships, while **Chapter 5** reviewed the data on how play impacts socio-emotional learning and the suite of 21st-century skills known as the 6 Cs. **Chapter 6** took us to the role of the physical environment as the 'third teacher' in children's playful learning experiences. **Chapter 7** reframed playful learning in the context of the digital world.

The question that remains is how we put a playful learning agenda into action in our homes, schools and in our society. The chapters detail a kind of formula that can serve as a guide. If we think of playful learning as the *how* of learning – the pedagogical approach that we can follow to achieve deeper, engaged learning, then the 6 Cs become the *what* of learning or the suite of skills that we develop as part of the 21st Century 'toolkit.' Adding the cultural context and values points the way towards a checklist for bringing a playful learning approach to fruition. The challenge for leaders who want to realise this approach is threefold. First, they must engage in attitude change that enables parents to understand the connection between playful learning and their children's academic and social outcomes. Second, societies will need to engage in educational policy that supports playful learning approaches by embracing a breadth of skills approach rather than a narrow focus on content in school settings. Third, societies need to think beyond the school as a context for playful learning as they scaffold city designs centred on children's learning in everyday intergenerational spaces.

On Attitude Change

There is a gap between parents' views of how play and learning align. John List and others from the University of Chicago found evidence that changing parents' beliefs about responsive parenting and parent – child interactions has measurable impacts on children's developmental outcomes across vocabulary, math, and socio-emotional skills a few years later (List et al., 2021). This finding suggests that parental attitudinal change early in the course of development can have drastic positive downstream effects on children's well-being. A similar intervention comes from the Harvard Center for the Developing Child. The center's Filming Interactions to Nurture Development (FIND) intervention, in which parents practise science-based strategies for engaging children in back-and-forth interactions, has also been linked to children's attachment security, early learning, and school achievement (Fisher et al., 2016; Liu et al., 2021).

These studies show that we can change parents' attitudes and implementation of scientifically backed practices to generate positive outcomes for children. Applying the methods used in this white paper can support implementation of playful learning. This is particularly important in the face of political and societal adherence to outdated models of instruction. However, persistent beliefs among caregivers and educators that play has little overlap with learning complicate efforts to infuse playful learning principles into education policy and practice.

Our team proposes that attitudinal overhauls are effectively accomplished through community cultivation and engagement as a first step (Schlesinger et al., 2020; Hassinger Das et al., 2021), be that at the neighbourhood level or at the school level. The Playful Learning Landscape initiative (see **Chapter 6**) provides singular insight into the success of this approach. Engaging

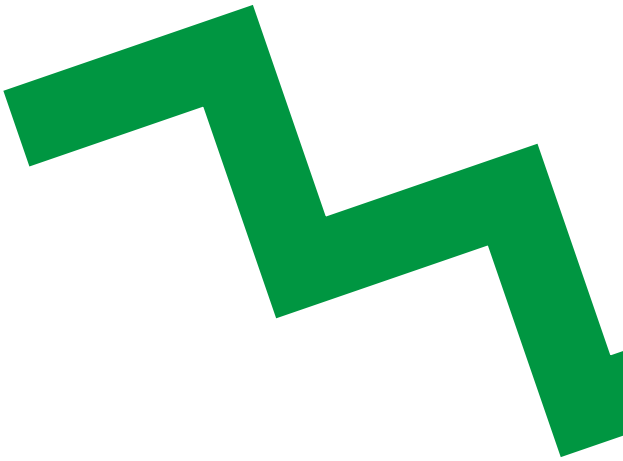
communities in the co-creation of public spaces designed to support children in achieving specific learning goals helps their members learn about the principles of learning. In addition, community members gain a sense of autonomy and ownership over the spaces that are reimagined for their children.

This 6 Cs approach through playful learning is also being applied in schools with great success. Several schools in the US and in Japan have used the system and report strong outcomes in the early grades.

How to Change Attitudes: Reevaluating Success

As society has evolved, so too have our conceptions of success. If success means being fully equipped to meet the demands of working life and sustain meaningful careers, then we need to update our education systems accordingly. In the 20th century, a period when many people worked in assembly lines and all products looked the same, a straightforward, passive education suited the demands of the workplace. That is, education served the economic purpose of preparing children to join that mental assembly line. Current demands of the workplace in the 21st century no longer fit this mould. How do we reverse engineer what success looks like for our time and design educational systems to meet these demands? How do we redefine early childhood education for the 21st century?

A number of scholars have tackled these important questions. For example, the International Early Learning Study (IELS) was recently developed by the Organisation for Economic Cooperation and Development (OECD) to compare the 21st century skills held by 5-year-olds around the world (e.g., Auld & Morris, 2019). To support the development of these skills and prepare children for positive pathways into adulthood, we must take a "whole child" approach (Darling-Hammond et al, 2020) that builds the science of learning into our educational models. Similarly, McKinsey Global Institute's new report, 'Reskilling China: Transforming the World's Largest Workforce into Lifelong Learners,' also urges integrating economic trends with education reform (Woetzel et al., 2021). In the service of this goal, Golinkoff and Hirsh-Pasek (2016; see also Hirsh-Pasek et al., 2020) created an actionable checklist framework derived from years of scientific study – detailing the 6 Cs and the playful pillars of learning that help students master them. They suggest that using this approach will lead to a definition of success that includes but goes beyond test scores and holds the promise of creating "happy, healthy, thinking, caring, and social children who become collaborative, creative, competent, and responsible citizens of tomorrow."



On Educational Policy

If the ultimate goal for the future is to arm the next generation with the skills they need to be successful as human beings today and to prepare them for the workplace of tomorrow, then we need to rethink our current educational policies and instructional practices. A few countries are leading the movement following this science and incorporating playful learning principles, to great success (Kangas et al., 2020). Among them are Finland, Singapore, Canada and India.

In Nordic countries like Finland, a "learning through play" model promotes "balanced growth" (Finnish National Agency for Education, 2021). The stated goal for the Finnish Agency for Education (2021) is "to support pupils' growth toward humanity and ethically responsible membership of society and to provide them with the knowledge and skills needed in life." By the time Finnish children enter basic education at age 7, they are accustomed to flexible testing requirements, evaluations of their progress, and malleable daily and weekly timetables established by their teachers – aimed to meet the needs of the class (Dickinson, 2019; Kangas et al., 2020).

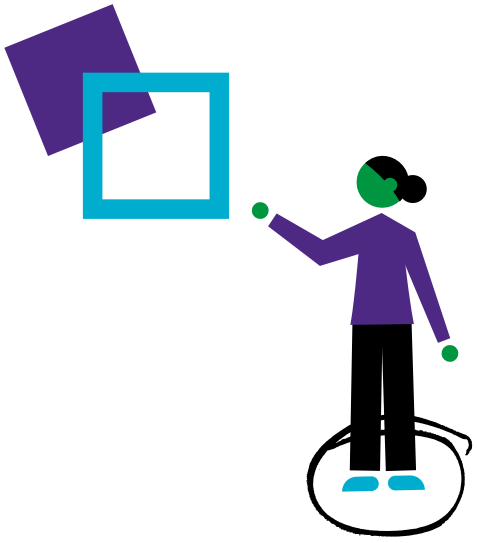
In Singapore, the 'Teach Less, Learn More' initiative was adopted nearly 20 years ago, in 2004 (National Center on Education and the Economy, 2021). This education policy shifted pedagogy in this island nation away from the rote education model common in the United States to programme that encourage "deeper conceptual understanding and problem-based learning." As a result, students are among the top-performing in the Programme for International Student Assessment (PISA) – an international comparative assessment of performance in reading, math, and science. The benefits of this shift do not end there – the same students are more well-rounded as well. As of 2020, Singapore announced plans to extend this pedagogical approach, including more skills-based training and increased work-study placements as well as higher education, offering financial credit for adults aged 40-60 to pursue further education under the SkillsFuture program (National Center on Education and the Economy, 2021).

In Canada, The Council of Ministers of Education transformed early learning programmes – including full-day kindergartens – to encourage purposeful play nearly a decade ago. At that time, a statement about play-based learning

declared, "educators should intentionally plan and create challenging, dynamic, play-based learning opportunities" (Grieve, 2012). This "play ethos" can be seen throughout studies of teachers', daycare workers', and parents' perspectives about playful learning, reflecting the view of play as an engaging, natural -and enjoyable tool for learning and discovery (Carolan et al., 2021; Peterson et al., 2017). In 2018, Ontario's Ministry of Education released a brief detailing their mission to "enable students to develop the competencies they will need to thrive as citizens in an increasingly globalized world" – a mission founded on the idea that the skills students need today make them the learners of tomorrow – what we call 21st century skills (e.g., Manion & Weber, 2018). Indeed, the January 2021 report from the Elementary Teachers Federation of Ontario is entitled 'Ontario's Kindergarten Program: A Success Story.'

In India in 2019, the Delhi government launched a comprehensive early education programme, emphasising the importance of community-based preschool centres and childcare (Subramanian, 2019). Amidst these changes, Samyukta Subramanian, of the Brookings Institution in Washington, DC, notes that the digital landscape is increasingly becoming a third sphere of the average child's learning and care ecosystem, along with their caregivers and educators. India's National Education Policy (NEP), the blueprint for their early education infrastructure, emphasises the development of 21st century skills, specifically compassion, critical thinking and motivation (Government of India, 2020). Along with these more institutional changes came the development of an India collaborative with Sesame Street: Galli Galli Sim Sim is a Sesame Street branded early childhood programme founded on the idea of play as a pathway for social change (Borzekowski et al., 2019). The show encourages increases in the frequency of play and parent – child interactions, both known to be beneficial for children's learning and development.

Not only are play-based educational models fruitful for children's learning, but in countries that embrace these principles, students are more globally competitive. There is considerable international movement suggesting that whole-child, play, and inquiry-based approaches are becoming recognised as effective educational models.

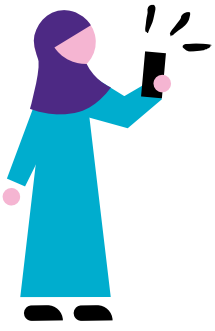


These recent shifts in educational policy across the globe in the direction of playful learning signal an opportunity to reimagine how we teach and evaluate the successes of the next generation. Some of these changes include reduced homework for primary school children, restrictions on access to online gaming, and increased emphasis on vocational training. In this sense, China is already leading the modern world in creating a climate that is ready to embrace an updated, playful learning approach to lifelong learning. In this future, a child can start their school day walking through classroom doors that are painted to look like book binding to signal they are entering into a reading-rich environment. In science classes, children can participate in thematic learning by taking turns presenting weather reports while studying the weather, rolling and tumbling their way through science of gymnastics, or building a rainforest to understand ecology. A playful learning approach allows children to think through math problems together while measuring and designing a garden for their school, all while building collaboration, communication, content and critical thinking. As these examples demonstrate, problem-based pedagogies, inquiry-based curricula, and project-based learning are the kinds of playful learning models that will advance the 6 Cs.

The message from CEOs and entrepreneurs is already loud and clear. Many of the graduates from our schools are simply not employable; their jobs can often be done by robots. It is the society's responsibility to now ask what skills we hope our students will have when they graduate from our schools. We must then put policies in place to encourage the pedagogical and curricular approaches that will support those skills and ensure lifelong learning.

On Education beyond School Settings through Child-Friendly Cities

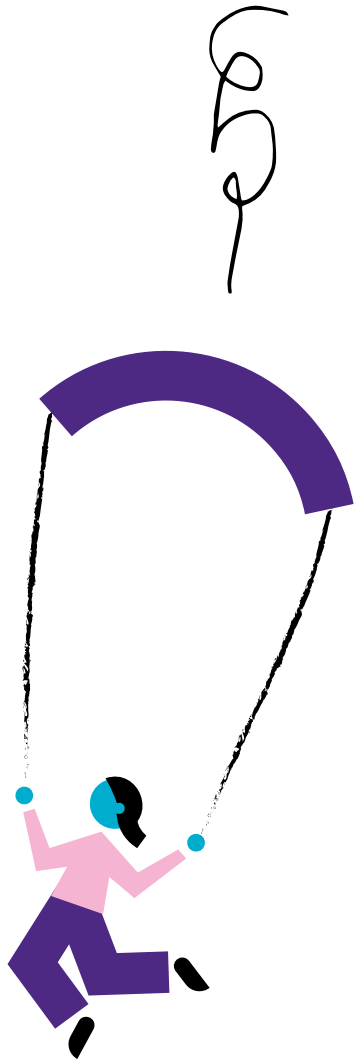
China has already committed to a National 5-Year Plan to create Child-Friendly Cities, 十四五”儿童友好城市创建. City policies can direct communities to design installations from parks to public transportation to libraries that extend and enrich lifelong learning models in community spaces. Playful Learning Landscapes is among the first initiatives that demonstrates the scientific value of extending learning outside of the school setting, where children spend the vast majority of their time (80% in the United States, 60% in China). Through playful learning, we can expand the knowledge children are already acquiring to include the breadth of skills that children (and adults) need to flexibly solve the puzzles and problems before us, and we can do this within the context of the city scape. Around the world we are working with communities and training local designers to meld the science of playful learning into everyday spaces. These city governments, charged with scaling and maintaining streets, parks and community settings, already have budget lines that can support this work if it is mandated. Further, we are training local designers who can implement the structures in culturally rich and inclusive ways for members of their communities.



Playbrary credit Halkin Mason courtesy of PLLAY

A Thriving Future Through Playful Learning: Transforming the 'Whole Child' Approach into a 'Whole Society' Approach

Educational systems that have failed to keep pace with the technological, globalisation and demographic changes that characterise today's international economy will not prepare students with the skills to thrive. For today's children to make a mark on the marketplace of the future, they must be equipped with more than the familiar reading, writing and arithmetic skills. It is critical that we, globally, reimagine how to equip students with the skills they need to meet the challenges they will face. Rebecca Winthrop, of the Brookings Institution, reported in 2015 that if we stay the course in our current educational goals, it will take learners from the most marginalised communities around the world another 100 years to reach the levels already achieved in developed countries (Winthrop, 2015). We simply must adopt a better way forward.



As shown throughout this white paper, the best way to support development of the 21st century skills so often named as essential by international leadership, industry CEOs, and researchers is through learning that is **active**, **engaged**, **meaningful**, **socially interactive**, **iterative**, and **joyful** (see **Chapter 2**) – playful learning (Hirsh-Pasek et al., 2020; 2022; Mardell et al., 2021; Taylor & Boyer, 2020). Playful learning is an umbrella term that harnesses the way human brains learn and the way children engage with the world – "being active and minds-on, finding meaning and joy in an experience, trying out ideas and interacting with others" – and optimises them for specific learning goals (Jensen et al., 2019, p. 4; see **Chapter 2** and **5**). Today's learners – tomorrow's leaders – have access to overwhelming amounts of information amidst a complex and changing digital landscape (Jensen et al., 2019). To navigate this landscape effectively, children must go beyond passively retaining information. They must sift through information to engage with it meaningfully, draw connections between new and old knowledge, generate new solutions, and assess and take calculated risks. Until we, collectively, begin to see play as a potential liberal arts education for children, encompassing target academic skills as well as broader learning-to-learn skills, we will never make the kinds of advancements in education policy that learners need.

Children who entered formal schooling in 2021 will be young adults in our workforce in 2040, entering a workforce populated with professions that may not exist yet and technologies we have only begun to imagine (OECD, 2018). Implementing instructional practices that align with the science of learning, creating playful spaces, and enculturating communities with playful learning can optimise what the learners of today will need to be able to build that world of tomorrow. The science of learning with research from around the globe offers a vision of what tomorrow can be. To reach this goal, however, we will need to change attitudes around play and learning, to create educational policy (and strategies for implementation) that is consistent with our goals, and to foster the creation of playful learning societies as child friendly cities. When we commit to these goals, we will not only support whole-child learning, but will elevate the whole society as a learning community committed to lifelong learning.

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Chapter 1

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