WHITE PAPER

Learning Through Play and the Development of Holistic Skills Across Childhood

Jennifer M. Zosh, Brenna Hassinger-Das & Margaret Laurie

The LEGO Foundation

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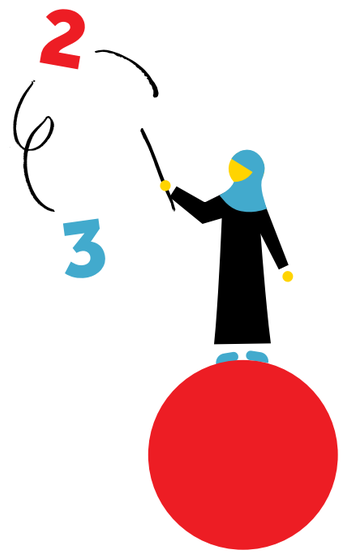
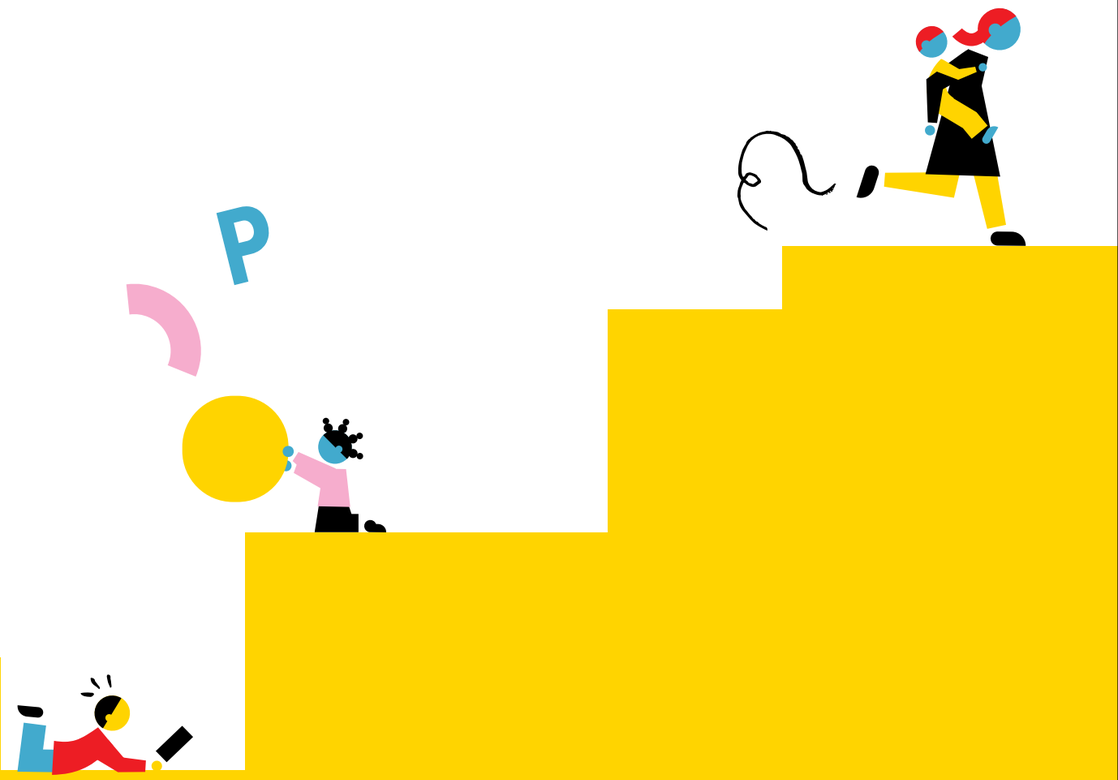
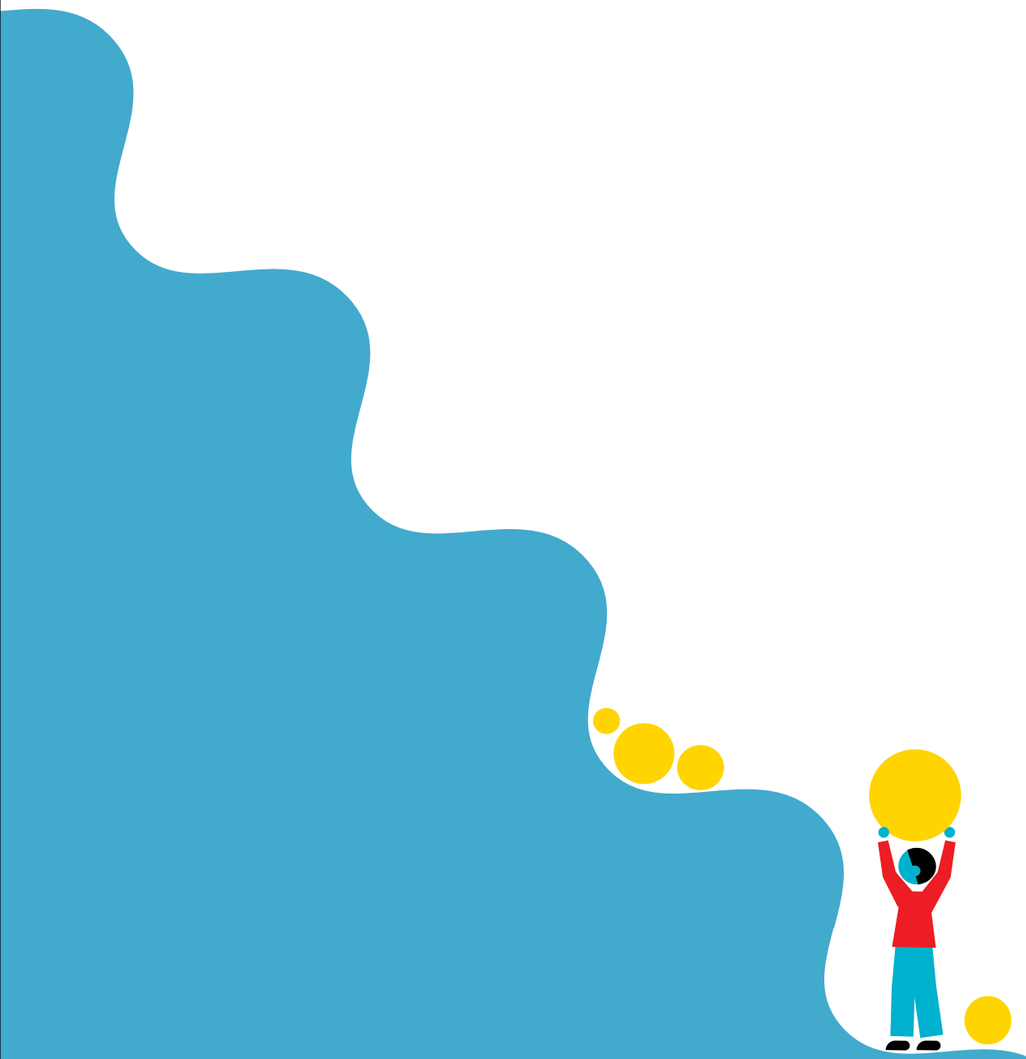


Abbreviations

ASPI	Adjustment Scales for Preschool Intervention
CCQ	California Child Q-Sort
DCCS	Three-Dimensional Change Card Sort
ECE	Early childhood education
EF	Executive functioning
HIFTO	How I Feel Toward Others
HTKS	Head-Toes-Knees-Shoulders
IDELA	International Development and Early Learning Assessment
SCT	Scientific Creativity Test
TCI	Test de Creatividad Infantil
TEAM	Tools for Early Assessment in Mathematics





Foreword

What does it mean to prepare children for the future? Growing inequality, increased uncertainty and a need to repair our systems have emphasised the need for children to develop a more holistic set of skills for their present and future thriving.

Play is acknowledged by many as the fundamental mechanism for children to develop, and it is increasingly being perceived among caregivers and educators as critical for engagement, positive relationships and learning. We have begun to realise what we have always intuitively understood: that play, development and learning are not to be separated.

This review pulls together over 300 studies from more than 40 countries that have demonstrated a positive relationship between learning through play and holistic skills. It gives a clear profile for decision-makers to articulate the key relationship between playful learning and children's skills, and it provides a vocabulary, examples and future opportunities to expand our understanding further.

The work serves as an acknowledgement to the research community, which has invested time and effort to investigate this topic, which is critical for the development of human civilization, but still lacks the full attention and resources it deserves.

Thank you to the authors for bringing forward a more nuanced view and stronger examples of the link between learning through play and holistic skills. With this work, we not only have stronger confidence in the value of play, but also a starting point for exploring this relationship more systematically, and with a stronger focus on diverse groups of children around the world.

Bo Stjerne Thomsen
Chair of Learning Through Play, LEGO Foundation

About the authors

Jennifer M. Zosh

There is nothing quite like seeing a child's eyes light up with the thrill of insight. Ever since I was young and corralled the neighborhood children to play school and complete my "lessons", I have been engaged with exploring how children learn. From doing research in my own lab, partnering with local museums and community groups, supporting the work of organizations such as the Playful Learning Landscapes Action network, and engaging in translating science for the public, business leaders, non-profits, educational organizations, policy makers, and even companies, I am honored to see how we can help make the world better for children and families by supporting playful learning for all – across contexts, across learning domains, and even across settings (e.g., electronic vs. traditional play).

PhD, Professor of Human Development and Family Studies, The Pennsylvania State University, Brandywine; Director of the Brandywine Child Development Lab

Brenna Hassinger-Das

As an Assistant Professor of Psychology at Pace University, I am particularly interested in exploring how playful learning can be incorporated into all areas of children's lives. For example, my work explores the effects of both play and digital media on caregiver-child interactions and on child development and learning. I also am committed to translating my research and the research of others for use by the public through community-based research projects transforming everyday spaces into hubs of playful learning and also through other outreach activities.

PhD, Assistant Professor of Psychology, Pace University; Director of the Science of Development Lab

Margaret Laurie

Margaret is a researcher specialised in child development, education and learning technologies, particularly for children who think and learn differently. She completed a PhD at the University of Edinburgh looking at social play and digital technologies in autistic children. Her current work focuses on social and emotional development, play, and neurodiversity.
PhD, Research and Evaluation Lead at Play Included C.I.C

Executive summary

Background and rationale

Today's children will need to adapt to a constantly changing world: a world of climate change, economic and global crises and developing technology. To deal with this changing world, learning needs to be more than just a matter of memorising facts: children need to acquire a wide range of skills to prepare them for the uncertainties that lie ahead, and be equipped to create a better world.

While much attention has been focused on supporting children's understanding of cognitive concepts such as literacy and numeracy, it is critical to understand children's development holistically. The LEGO Foundation takes such an approach to children's learning, looking at the development of the whole child, and focusing on five key holistic skills (LEGO Foundation, 2017; Zosh et al., 2017b). It is important to better understand how we can scaffold children's **social** relationships and skills, support their **emotional** development and regulation, help children build strong and capable **physical** bodies, help them learn and acquire new knowledge as part of their **cognitive** development and support their curiosity and **creative** skills.

Over the past decade, research has focused on what supports children's deeper learning (e.g., Hirsh-Pasek, Zosh et al., 2015), and on the power of learning through play throughout childhood (Zosh et al., 2017b). This body of research has shown that effective learning through play is actively engaging, meaningful, socially interactive, iterative and joyful for children. But this research tends to focus primarily on links between learning through play and a single cognitive skill or sub-skill (e.g., literacy or mathematics), leaving us with an incomplete understanding of how learning through play is related to children's development *across* the holistic skills.

In this report we provide an **overview of the evidence** supporting **an association between learning through play and children's holistic skills**. This builds on previous work by the LEGO Foundation, as well as by other educators and researchers, showing the benefits of learning through play for children aged 0–12 years, across different settings (including homes, schools and communities), geographies and cultural contexts.

We first explore the most essential sub-skills that make up each of these main skills. We then present the results of a scoping review of over 300 pieces of research, examining the association between learning through play and the development of holistic skills. Finally, we make recommendations for future work, based on the evidence.

To summarise, our main findings are:

Learning through play and children's holistic skills go hand-in-hand. We found more than 300 studies across over 40 countries that demonstrated a link between learning through play and children's skills.

The sub-skills for which there is the most supporting evidence are:

- → Cognitive skills: literacy, mathematics, executive functions, spatial skills
- → Social skills: pro-social skills and social engagement/interaction
- → Emotional skills: supporting positive emotions/affect/enjoyment.
- → Physical skills: gross motor skills
- → Creative skills: general measures of creativity.

The review's main findings are:

- → Among the holistic skills, cognitive skills are by far the most studied in relation to learning through play.
- → Guided play is a promising facilitation method. The reviewed studies demonstrated that adults have an important role in supporting children's play and development.
- → The research on learning through play and children's skills focuses primarily on preschool children from western cultures.

The review suggests we need to learn more about:

1. How to understand and measure holistic skills and sub-skills in a more integrated way
2. The role of adults in children's learning through play
3. The impact of learning through play on children in less studied groups, including those who are of primary school age and older, as well as across different cultural and social contexts
4. The connection between learning through play and skills development over time, which must be explored using longitudinal research.

Learning through play: a focus on holistic skills

The mission of the LEGO Foundation is to elevate and implement the growing evidence base to empower children to learn through play. In previous white papers, it has been shown that:

- Learning through play harnesses five characteristics of deeper learning experiences (Zosh et al., 2017b)
- Adults have an important role in supporting learning through play (Jensen et al., 2019)
- Learning through play can be applied effectively in schools (Parker and Thomsen, 2019) and with digital technologies (Gray and Thomsen, 2021)
- Learning through play can help to reduce educational inequalities (Dowd and Thomsen, 2021).

In this white paper, we expand on this evidence by exploring the evidence on the breadth of skills that are associated with learning through play.

Below, we briefly review what we mean by "learning through play" before describing the main holistic skills and their component parts, and showing (through our scoping review) what is currently known about the relationship between each holistic skill and learning through play.

What we know about learning through play

The characteristics of learning through play

Zosh et al., (2015, 2017, 2018) suggest that learning through play may be particularly powerful when it is:

→ **Actively engaging:** minds-on learning in which children participate in discovering new knowledge through play

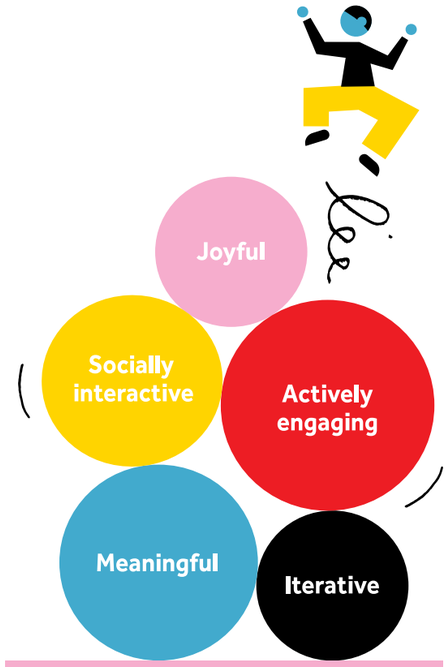
→ **Meaningful:** true learning happens when learners connect with content that they care about, and are able to relate new experiences to things that they already know

→ **Social:** social interaction enables children to learn from others and learn from communicating with others, increasing their interest and intrinsic motivation

→ **Iterative:** by supporting children's active exploration, learning through play enables children to repeat and vary their experience, testing ideas about the world through trial and error

→ **Joyful:** an important ingredient in a learning journey is the 'a-ha moment' – the sense of enjoyment in learning something new, or excitement in trying out different solutions to a problem. These positive emotions associated with learning are key to increasing motivation during the learning process.

At the core of these five characteristics of learning through play is the notion that if we can understand what motivates children to learn, we can create learning experiences in which children are fully engaged. We can provide spaces where children test out different ideas and feel safe in taking risks and exploring different solutions. If we understand how positive and meaningful memories are created, as well as how they can be reinforced within the learning process, we will be in a better position to create an environment for children where deeper learning takes place.



The role of adults in supporting high-quality learning through play: a spectrum

To support learning through play, enabling children to have rich experiences that lead to deeper learning, we can think of adult involvement as taking place along a spectrum of different degrees of involvement.

Free play, whether with objects or pretend or physical play, is fun and voluntary, involves active engagement, is without extrinsic goals and often incorporates make-believe (Fisher et al., 2013; Johnson et al., 1999). During free play, children can discover, learn and practise social and other skills without the constraint of adult involvement (Singer and Singer, 1990). One study of free play time in school found that children who engaged in more peer play demonstrated higher levels of emotion regulation, social skills and initiation, as well as self-determination and receptive vocabulary. These same children who engaged in more free play with their peers showed lower levels of aggression, shyness and adjustment problems (Fantuzzo et al., 2004).

Guided play retains most of the characteristics of free play, especially its enjoyable nature, but adds an additional focus on a developmentally appropriate learning goal (Weisberg et al., 2013, 2016). Guided play involves children exploring their environment with adults through interactions that are focused on implicit learning goals (Toub et al., 2018; Weisberg et al., 2013, 2016), for example, by commenting on and asking open-ended questions about children's ideas (Bergen, 1988; Weisberg et al., 2013, 2016), fostering the back-and-forth interactions that are critical for development. Guided play is uniquely suited to helping children reach content-based learning goals, outperforming both free play and direct instruction (Raikes and Davis, 2021). Dusabe et al. (2019) found that access to high-quality learning environments, which included appropriate materials and teachers trained to provide responsive pedagogical approaches, had benefits for children's cognitive, social, emotional and physical development. The ability of guided play to support the wider holistic skills is an important area for investigation.

Games are enjoyable and set apart from the real world (Caillois, 1961; Hassinger-Das et al., 2017). They are unique in that players compete according to rules for the purposes of achieving a predetermined outcome within the game's system (Caillois, 1961; Garvey, 1990; Huizinga, 1955; Prensky, 2001; Salen and Zimmerman, 2004). While games have a beginning and an outcome that might be the same every time they are played, the route taken may change, depending on some combination of choice or chance or both (Caillois, 1961). Games can be created either by children themselves or by adults, with the rules of the game more or less restrictive, allowing varying amounts of child

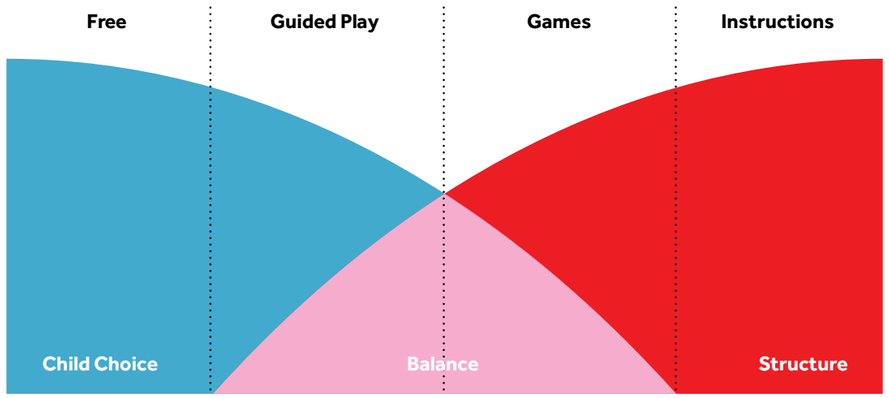


Figure 1. The spectrum of playful learning (Jensen et al., 2019)

agency. Games that weave content into the course of the gameplay can be used for particular learning goals. The active elements of games increase children's intrinsic motivation to learn (Habgood and Ainsworth, 2011). An innovative example is the Building Brains and Futures curriculum (Coelho et al., 2020), designed to nurture cognitive skills and executive functions in preschool children. An evaluation found that children who played the games included in the curriculum showed significant improvements in a range of skills, including language and literacy, gross motor and fine motor skills, executive functioning and problem-solving.

In direct instruction, the adult plays more of a role in initiating and directing the activity. Adults provide the structure, the environment and perhaps some materials in line with an intended learning goal, while children have less choice than elsewhere on the spectrum. In addition, adults direct the activity by guiding and scaffolding children's engagement, and provide support when children struggle to master the intended learning outcome. Well-planned and intentional instruction can lead to improved academic outcomes and socio-emotional skills (Lee and Anderson, 2013). For example, Diazgranados et al. (2016) reported that children who attended an enhanced preschool programme in Bangladesh, which incorporated good quality direct instruction, improved their literacy and numeracy skills, as well as their social development and fine and gross motor skills.

Free play, guided play and games place child agency at the forefront. In all of these, children are given the ability to direct their play, but what varies is the level of adult support and whether or not an adult helps to guide children towards achieving a learning goal. Different children thrive with different mixes of adult involvement, and different levels of involvement can be appropriate at different times. For example, sometimes direct instruction or rote learning is necessary to begin with, before children are introduced to opportunities to learn through guided play or games.

Play happens within a larger context

The focus of this review is on children from birth to 12 years. When thinking about play and learning in childhood, it is important to consider the child at the core but also the people, settings and contexts surrounding that child.

From caregivers offering materials to children, to teachers encouraging children to discover their own passions and interests, to cultures that place value on children's opportunities to discover and play, no child exists in a vacuum untouched by the people and communities around them. These contextual factors play a critical role in both supporting and shaping children's developmental potential. There is significant evidence that these factors have important roles in supporting learning through play (National Scientific Council on the Developing Child, 2004; Zosh et al., 2017b). While there is also much potential for children to learn through solitary play, in the coming sections we explore how other people can help support children in building a wide variety of skills and sub-skills, as they facilitate different types of play.

Globally, approximately 80% of a child's time is spent outside school (Meltzoff et al., 2009; Dowd et al., 2012). Thus, it is critical to note that learning, and learning through play, also happens outside formal learning environments – in the community, in the home and online. We must think about opportunities for learning through play across different settings (in homes, schools, neighbourhoods, playgrounds, communities and digital worlds), different contexts and different geographies to support children's deeper learning.

Exploring the holistic skills

The LEGO Foundation (2017) defines the key holistic skills as follows[1]:

- → **Cognitive skills:**concentration, problem-solving and flexible thinking, learning to tackle complex tasks and building effective strategies to identify solutions
- → **Social skills:** collaborating, communicating and understanding other people's perspectives through sharing ideas, negotiating rules and building empathy
- → **Emotional skills:** understanding, managing and expressing emotions by building self-awareness and handling impulses, as well as staying motivated and confident in the face of difficulties
- → **Physical skills:** being physically active, understanding movement and space through practising sensory-motor skills, developing spatial understanding and nurturing an active and healthy body
- → **Creative skills:** coming up with ideas, expressing them and transforming them into reality by creating associations, symbolising and representing ideas and providing meaningful experiences for others.

[1] We acknowledge that there are different labels to describe holistic skills, including 'breadth of skills' (Care and Anderson, 2016), '21st-century skills' (e.g., Fadel, 2008), the '6 Cs' (collaboration, communication, content, critical thinking, creative innovation and confidence) (Golinkoff and Hirsh-Pasek, 2016), and others (see Winthrop and McGivney, 2016, for a discussion). Likewise, we also acknowledge that there are a number of different frameworks for understanding holistic skills (for a review, see Jones et al., 2019).

Just as child development cannot be described as a single concept, all the holistic skills explored here consist of many sub-skills that a) develop with different trajectories and timelines, and b) interact with one another, over time and with practice, to form higher-order or more complex skills.

Child development does not follow a static, simple, incremental path.

In some areas of development, such as language, we can see much greater progress at one stage of child development compared to another: in the first two years of life, infants gain language skills very quickly. Similarly, we can see particularly rapid progress in physical development during infancy and early childhood. Certain cognitive skills, however, such as executive functioning, begin in early childhood and continue to develop over the course of our entire lives.

Skills and sub-skills interact in important ways as they develop.

As children grow, they weave a wide range of skills and sub-skills together in complex ways. For this reason it can be very difficult to consider each skill on its own. Take cognitive development as an example: in infancy the child develops the pincer grasp to manipulate an object to explore its different colours, textures and functions. Then, during early childhood, the child may begin to throw the object and understand depth and distance in relation to their own body. Over time, this contributes to learning about quantity and comparisons of near and far or short and long, providing a foundation for emerging numeracy. And, as understanding of numeracy evolves, children can begin to look for different solutions to mathematical problems. Over time, the understanding that there are multiple ways to approach a problem builds up a child's repertoire for problem-solving and critical thinking. The physical and cognitive skills are very clearly intertwined in this scenario, However, as children practise and build these skills, they are also certainly balancing interactions with others, managing and expressing their emotions and finding creative opportunities. In play and in many meaningful, daily activities, children are constantly braiding a strong rope of flexible holistic skills.

Children weave together higher order skills from many different basic skills, both within and across the holistic skillset. They do this over time with exposure to different experiences, practice and continuous adjustment in their daily lives. Although there is still a great deal that we must learn about how children develop complex skills, we have also made tremendous advances in the understanding of sub-skills and the dynamic interplay between them.

Consider Stella, a toddler who is learning to walk. Stella must develop the gross motor skill of locomotion, and she must develop the necessary muscle strength in her torso and her legs. She must learn to move her legs in an alternating pattern. She must use depth perception to navigate changes in terrain. She must process the emotional challenge of being separated from her caregiver. She must also process her own emotions – fear and excitement – as she takes this new step, and she must develop the self-confidence even to attempt it. She has to develop the metacognitive skills to know when she will be able to successfully navigate an obstacle and when she will not (for example, walking down a steep hill).

This dynamic intertwining of holistic skills continues across children's development and into adulthood. Consider Angharad, aged 11, who is excited as she prepares for the annual science challenge. She must manage these feelings of excitement because she knows that

she needs to be thinking clearly as the science games begin. As she works with her teammates, she must follow the social expectations of the school while also balancing her social relationships with her teammates. She must regulate herself because she knows that she tends to take over when she gets excited, and a teacher will disqualify anyone that does not work well in teams. She must think adaptively as she is presented with a scientific concept she has not heard of before. She must practise her fine motor skills as she works to measure closely and write down her data. She must use critical thinking as she evaluates the evidence she collects.

As children navigate challenges in their play, and as they work on controlling their emotions, thoughts and behaviours, they are not just gaining knowledge and experience; they are practising and interweaving cognitive, social, emotional, physical and creative skills to form a rope that can be used across many scenarios in their lifetime.

The scoping review

This scoping review examines the following central question:

What evidence exists to support a positive association between learning through play and children's holistic skills from birth to 12 years, across settings and geographies?

To answer this question, we reviewed the literature surrounding learning through play across ages (from birth to 12 years), settings (such as home, school, the community, formal and informal settings), cultural contexts, geographies and holistic skills (cognitive, social, emotional, physical and creative).

This review aims to:

1. Explore the sub-skills that make up each holistic skill
2. Compile the studies that demonstrate a positive association between learning through play and holistic skills in children from birth to 12 years, across settings and geographies
3. Identify areas where many studies exist, as well as areas where there are fewer studies.

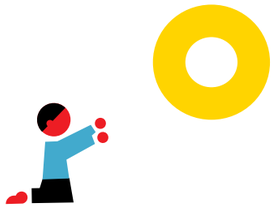
To locate relevant literature, a number of electronic databases were searched, including Academic Search Complete, APA PsycArticles, Health and Psychosocial Instruments, PsycINFO, Education Resources Information Center, Education Source and Google Scholar. As this is a scoping review, there may be studies that fall outside our specific search parameters that were not captured. Appendix 2 provides more detail about the search terms and how we conducted the review.

Below, we bring out some of the insights provided by our review of more than 300 empirical studies of learning through play. The conclusions of this white paper are shaped by the review of empirical studies presented in primary journal articles and secondary sources, as well as grey literature sources (such as assessment and programme reports, book chapters). It is important to stress, however, that empirical evidence (rather than theory or conjecture) was the focus of this review.

We begin by reviewing the evidence regarding the sub-skills that have been linked to learning through play. We highlight each holistic skill (cognitive, social, emotional, physical and creative) and provide an overview of the studies linking learning through play to each of them. We concentrate on highlighting the sub-skills that have the highest number of studies supporting a positive link between learning through play and that sub-skill. To do this, we specifically looked for studies that found a positive link between a learning through play approach and one of the sub-skills. While we do not present an exhaustive list of sub-skills, their selection is based on the sub-skills that are typically associated with a holistic skill in the literature (for example, mathematics as a sub-skill of cognitive skill), and skills that governments across the world are looking to address in education and workplace systems (Roth et al., 2017; World Economic Forum, 2021). Also, owing to the interrelated nature of the sub-skills, some could reasonably be categorised under multiple different skills (for example, executive function was classified as a cognitive skill, but requires social and emotional regulation – see Footnote 1 for an overview of frameworks which classify skills).

In the final section, we outline a number of conclusions, highlight existing gaps in our understanding and suggest next steps to advance the study of this subject.

It is important to note that this review does not address the strength of the existing evidence, nor does it reveal the *process* by which learning through play may support the development of holistic skills. Rather, it identifies and collects the studies that have so far demonstrated a positive association between learning through play and children's holistic skills.



Overall profile of the reviewed studies

We found a total of 369 examples of a positive relationship between **learning through play and children's holistic skills**.

This relationship was demonstrated for each of the five key holistic skills (cognitive, social, emotional, physical and creative skills), with the highest number of studies in the cognitive domain.

We see that **literacy and mathematics** have the greatest number of studies positively linking learning through play and the sub-skills. There is also a higher number of studies cxonnecting **executive functions** (which include capabilities such as working memory, flexible thinking, attention and self-control/ regulation) to learning through play. Social skills are also linked frequently to playful learning, especially **social engagement and interaction**, social competency and **pro-social behaviour**.

Learning through play has also been connected with **children's positive affect and enjoyment**. Similarly, it is linked, albeit in fewer studies, to **emotional self-regulation and self-control**.

Within the physical domain, most of the links were between learning through play and **gross motor skills**.

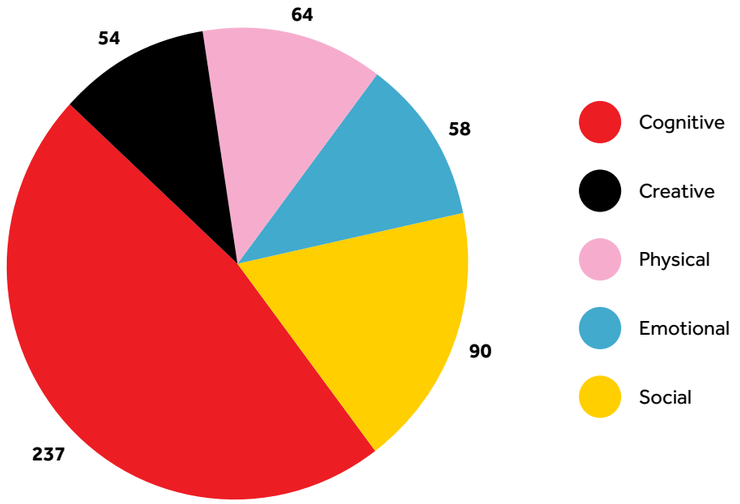


Figure 2: Number of instances where a study found a positive link between learning through play and the five key holistic skills (some studies include multiple pieces of evidence, which can fall across multiple categories)

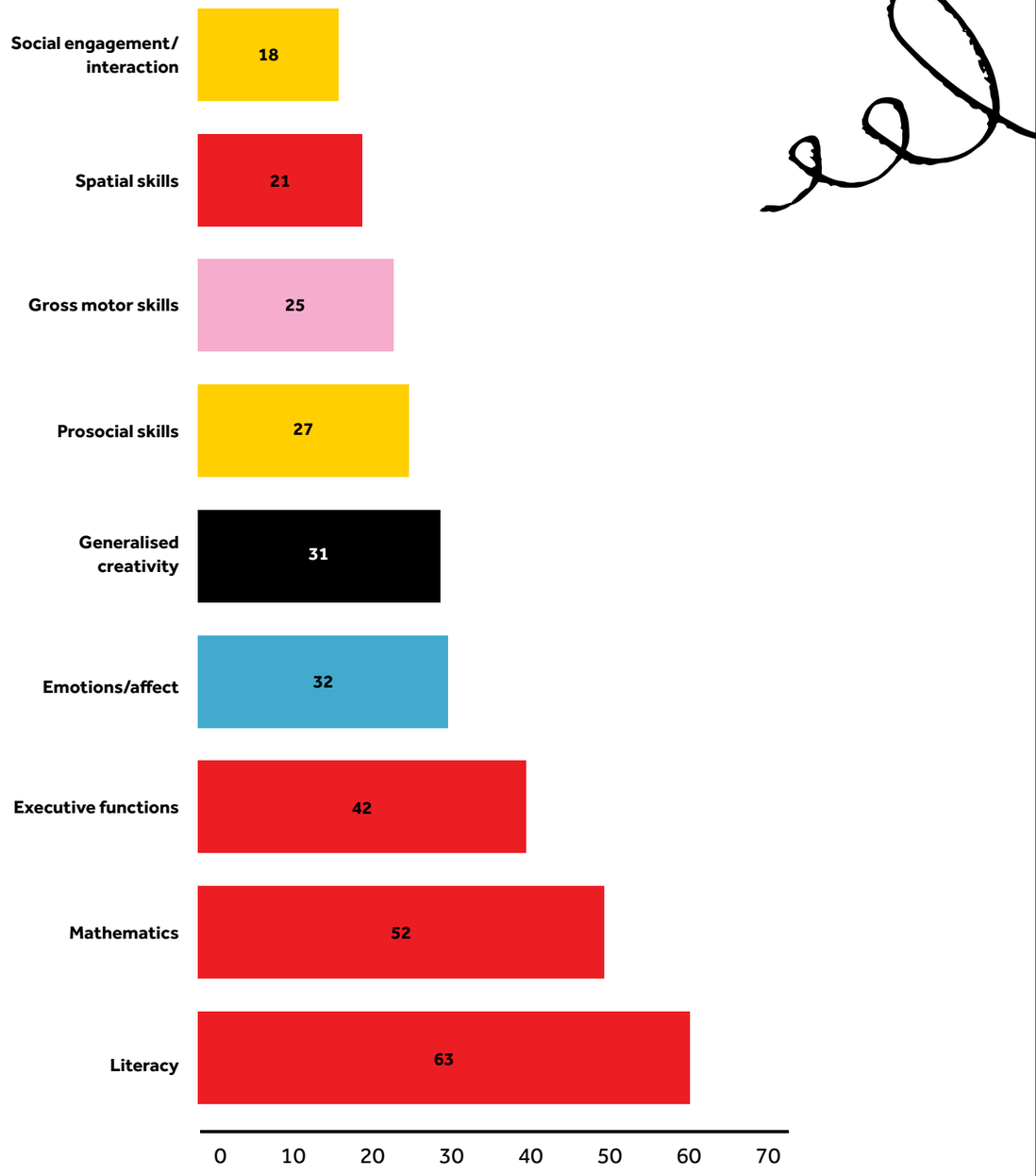


Figure 3: Top sub-skills (>15 instances where a study found a link between learning through play and this sub-skill), categorised into holistic skills by colour

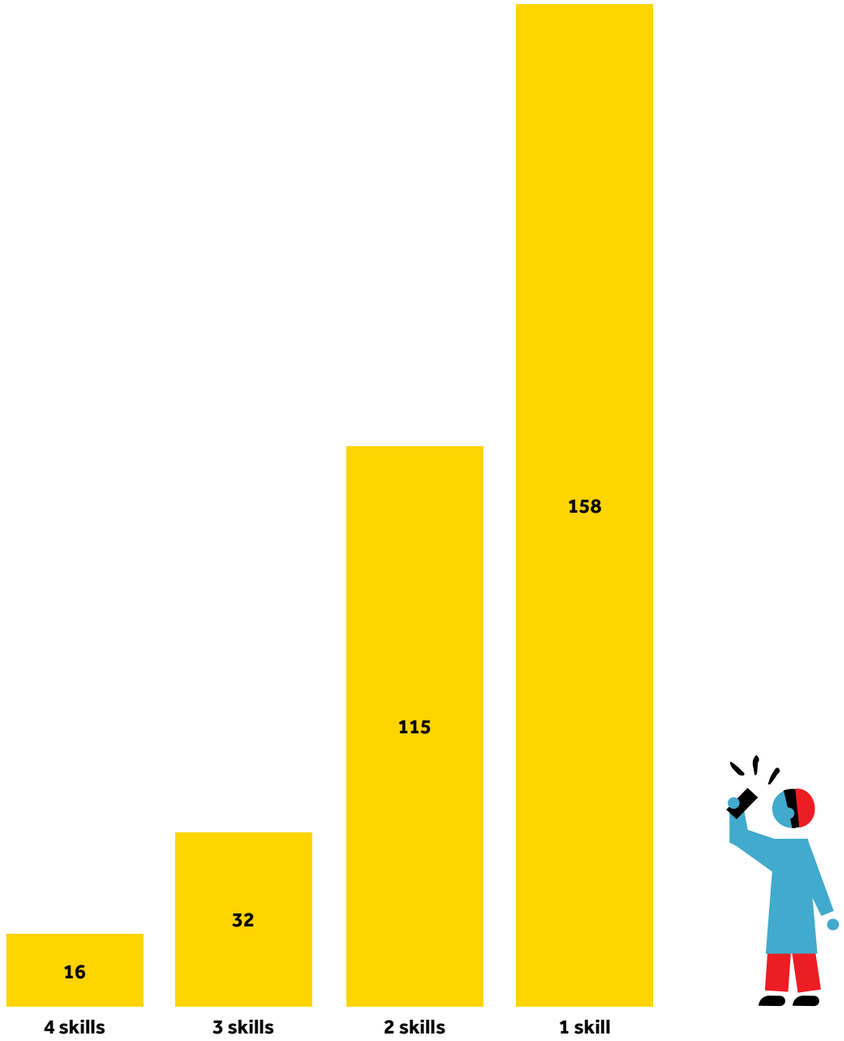


Figure 4: Number of holistic skills investigated in parallel

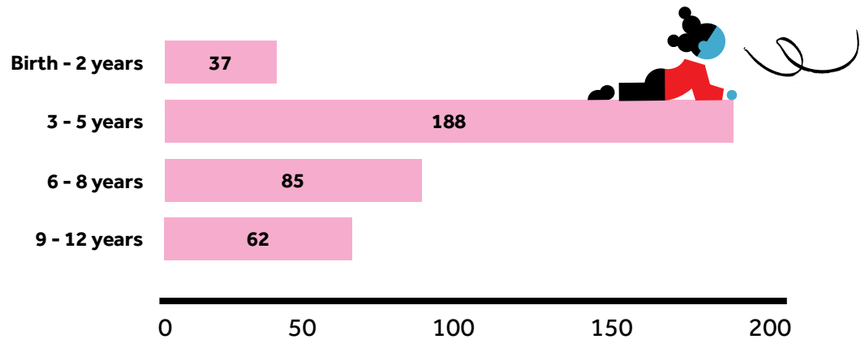


Figure 5: Learning through play: Age distribution of evidence linking learning through play to children's holistic skills

Finally, learning through play has been connected to creative thinking as well, **especially between pretend play and divergent thinking**. None of the evidence that was reviewed examined all five holistic skills within a single study. Instead, the majority of studies (49%) investigated only one holistic skill. For example, De Lisi and Wolford (2002) examined the relation between playing the computer games *Tetris* and *Where in the World is Carmen Sandiego?* and children's ability to picture how objects will look when they are rotated. Compare this single-skill approach with that of Walsh et al. (2006), who compared play-based and formal curricula for children aged four and five in Ireland on a measure of overall learning experience, and found that those in play-based programmes demonstrated greater levels of emotional, social and physical well-being. Only 5% of the evidence that we reviewed took a similar approach, investigating four holistic skills (see Figure 4). In future, it will be important for research to continue to examine development across holistic skills in parallel. However, including measurements across multiple holistic skills, including their sub-skills, takes more resources and requires teams made up of researchers across multiple areas of expertise. There are also limitations to such an approach, in terms of drawing strong conclusions about cause and effect between interventions and outcomes.

The evidence spans age groups, but the largest number of studies focused on **children aged 3–5 years. Less evidence was available on learning through play and children's holistic skills for children aged six and up**.

The majority of these studies (83.3%) used a **direct test of learning through play**. This means that play was isolated as a variable in the study design, and perhaps compared to an alternative condition (such as a different play activity or a non-play activity). Direct studies of play took place in laboratories, schools, early childhood education (ECE) settings and community settings. For example, Stagnitti et al. (2015) followed two groups of children: one group attended a school implementing a play-based curriculum, and the other group attended a traditional school. Both groups were tested on cognitive skills including literacy and non-verbal intelligence. The group who attended schools implementing more play showed statistically significant improvement in cognitive skills compared to the group who attended the traditional school. Other studies treated play as an incidental variable – play could be identified but it was not manipulated (scientifically) in the same way, or play was considered alongside other factors in child development, such as nutrition and parental support. As an example, Wolf (2019) reported an evaluation of a training programme for preschool teachers in Ghana. The programme focused on the importance of play-based learning, parents' role in children's learning and encouraging engagement between school and parents. Engagement with the programme was associated with positive impacts on children's literacy levels. Therefore, we can infer that teachers who engaged with the programme engaged in more learning through play approaches, resulting in positive child outcomes, but teachers' actual implementation of playful teaching approaches was not directly reported. Therefore, while the training module contains play-based approaches, it was not investigated in a way that allows us to draw conclusions about its effect on children's outcomes.

Finally, much of the research that is reviewed in this report was carried out in the United States and other high-income contexts (for a breakdown of countries covered by the literature, see Appendix 3). There is a growing evidence base from other countries, however, and we highlight promising examples of research from across the globe.

Next, we look at each of the five key holistic skills in more detail, and summarise the current evidence linking each to learning through play.

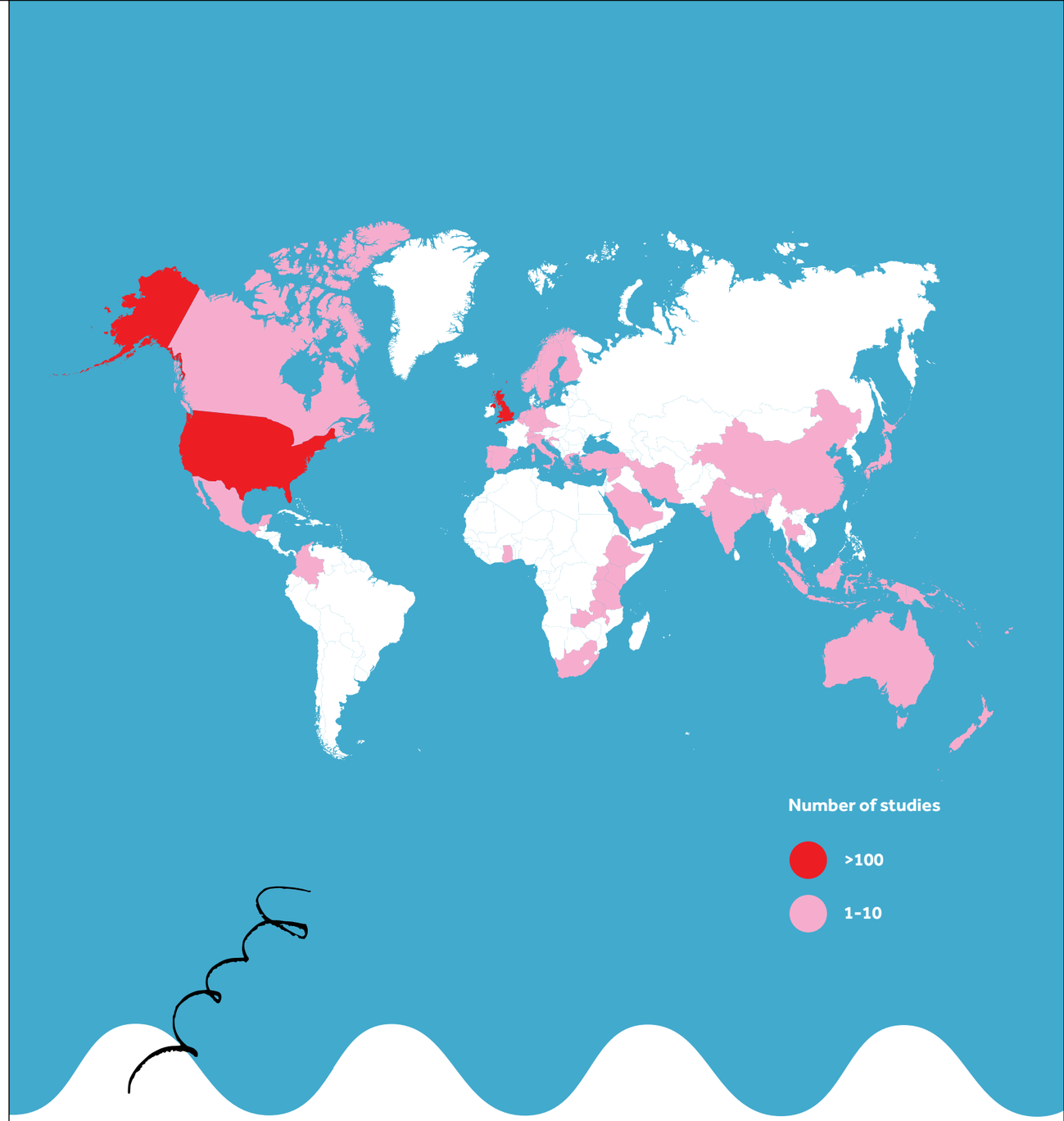
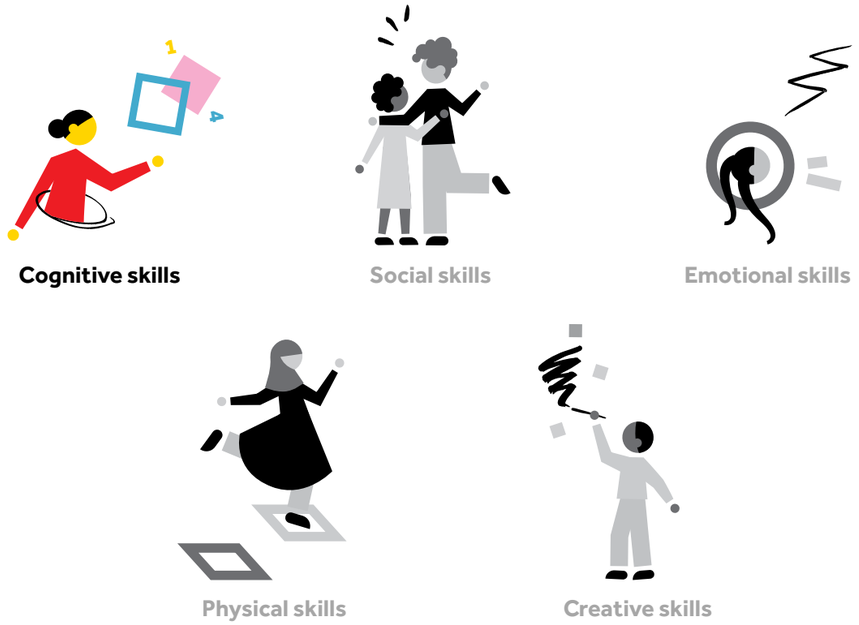


Figure 6: Global distribution of studies examining the connection between learning through play and children's skills



Cognitive skills

From gaining subject-specific knowledge to learning how to concentrate, from problem-solving based on what children already know and new information coming their way, to flexible thinking, tackling complex tasks and building effective strategies to identify solutions, the amount of cognitive development that occurs during childhood is astounding.

While it is perhaps easiest to associate the cognitive domain with content knowledge (such as numeracy and literacy), it is essential to recognise that cognitive development includes **both** content and the broader skills involved in 'learning to learn'. Beyond traditional academic content, cognitive development also includes how children think critically, how they solve problems, make decisions, reason using evidence, evaluate what they know and do not know (metacognition), store items in working memory for active processing, and exert top-down control on their thoughts, behaviours and actions (also known as executive control, part of social and emotional learning).

Below, we highlight a number of sub-skills that are involved with the development of cognitive skills during childhood and offer examples of how learning through play has been linked to them.

Summary of study findings

As noted earlier, there is a much larger number of studies investigating the link between learning through play and children's cognitive skills: in 237 instances a study found a positive link between learning through play and one of the cognitive sub-skills, with literacy, mathematics, executive function and spatial knowledge being the sub-skills for which there is most evidence.

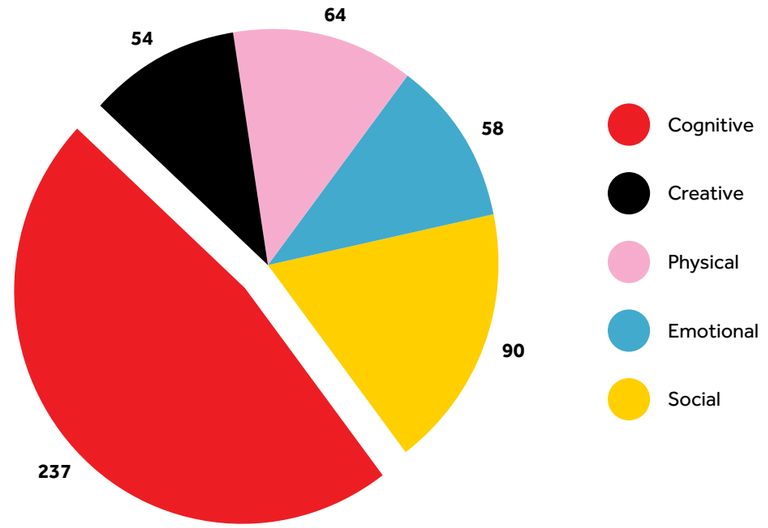


Figure 7: 237 instances were found in which studies demonstrated a link between learning through play and cognitive skills

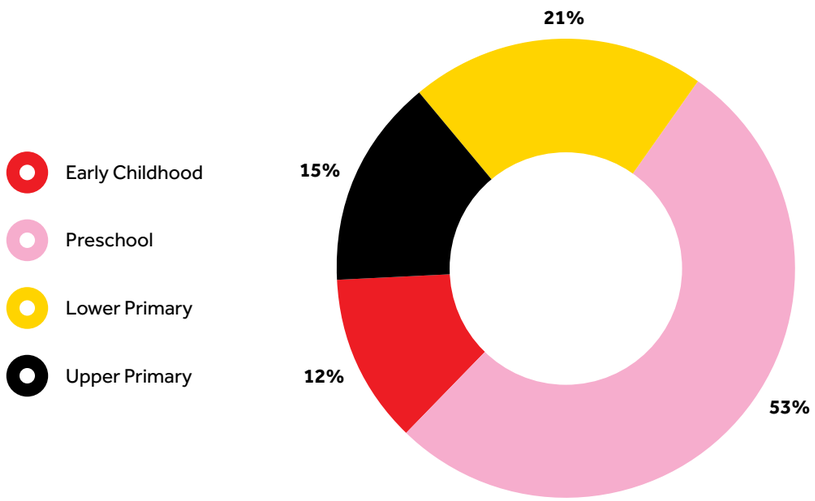


Figure 8: The age distribution of evidence linking learning through play to children's cognitive skills

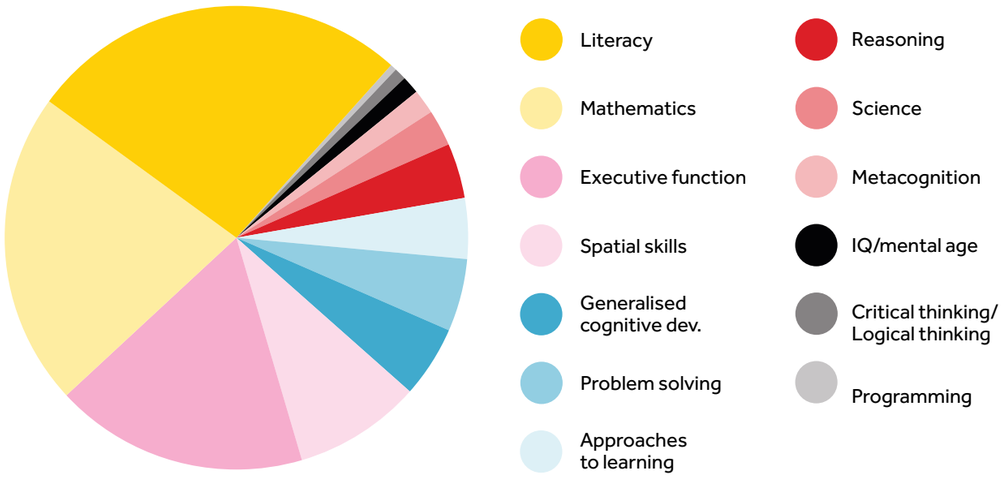


Figure 9: The distribution of cognitive sub-skills represented in the literature review

Literacy

Literacy is the cognitive sub-skill that has the largest amount of evidence linking it to learning through play. The relationship between play and the components of literacy, including language, storytelling and reading comprehension, has been evident for decades. Symbolic play has been found to relate to language development (Casby and Corte, 1987; Lewis et al., 2000; Tamis-Lemonda and Bornstein, 1994; Ungerer and Sigman, 1984); enhanced copying and the mimicking of what others do during play is related to later expressive vocabulary ability (Charman et al., 2000); and symbolic play and vocabulary production at 14 months is linked to language skills (among others) at two years of age (Lyytinen et al., 1999). Positive relationships have been demonstrated between play, storytelling and language abilities (Holmes et al., 2019). Fantuzzo et al. (2004) found that children who played more frequently with their peers had greater receptive vocabularies. Even something as simple as block play relates to improved language abilities in toddlers in the United States (Christakis et al., 2007).

When play is combined with more directive teaching methods among US preschoolers (Han et al., 2010), or with a shared book-reading activity (Hassinger-Das et al., 2016; Moedt and Holmes, 2020; Nicolopoulou et al., 2015; Pellegrini and Galda, 1982; Toub et al., 2018), children's receptive and expressive vocabularies can benefit. Guided play appears to be uniquely beneficial: when it is included in literacy-rich play, preschool children's language skills improve (Cavanaugh et al., 2017). Evidence is also beginning to mount that digital apps that use a game-based approach may also help US preschoolers to develop their vocabulary (Dore et al., 2019).

Play-based curricula are another source of benefits for children's language skills. High-quality ECE programmes tend to incorporate play, and studies show that these types of programmes improve language and literacy outcomes across high-, middle- and low-income countries (e.g., Aboud and Hossain, 2011; Blair and Raver, 2014; Coelho et al., 2020; Donahoe and Flaten, 2016; Dowd et al., 2016; Nores et al., 2019; Reynolds et al., 2011; Roskos and Burstein, 2011; Stagnitti et al., 2016; Weiland and Yoshikawa, 2013; Wolf, 2019). For example, Baumer found that the Scandinavian Playworld practice, which uses a guided play pedagogy in which adults engage in pretend play with children, along with discussion, free play and art creation, supports the development of children's narrative abilities. The Tools of the Mind curricula have been shown to improve writing ability among Canadian kindergarteners (Diamond et al., 2019). Similarly high-quality, play-based ECE programmes in Colombia and Ghana also showed promising effects on language development, among other skills (Nores et al., 2019; Wolf, 2019). In many studies the use of play is not measured directly, however, so we cannot determine whether it is the play component itself that makes these programmes effective, nor the exact processes by which learning through play may affect children's outcomes.

Mathematics

Some research suggests that free play (Sumpter and Hedefalk, 2015), symbolic play (Edo et al., 2009), peer play (Ivrendi, 2016) and pretend play (Worthington and van Oers, 2016) provide opportunities for children to engage in play with mathematical concepts. Guided play and games also seem to provide benefits in supporting mathematical thinking in childhood.

Several studies show that block play, such as building stacks and structures, supports children's early mathematical development, including their numeracy, patterning, spatial skills and understanding of mathematical language (e.g., Park et al., 2008; Pirrone et al., 2018; Schmitt et al., 2018; Trawick-Smith et al., 2016). Structured curricula using playful methods has also been shown to support early mathematical development in western contexts (Clements and Sarama, 2007; Opel et al., 2012; Piper et al., 2018; Schmitt et al., 2015; Vogt et al., 2018). As with language skills, some evidence suggests that educational apps and computer games may support elementary school students' numeracy development in higher-income countries (Habgood and Ainsworth, 2011; Hung et al., 2015; Miller and Robertson, 2009; Pareto, 2014; Riconscente, 2013).

There is also evidence that structured games that incorporate mathematical content can support children at the preschool and elementary school level, in higher-income countries, in their understanding of mathematical concepts (Núñez Castellar et al., 2015; Laski and Siegler, 2014; Miller and Robertson, 2009; Pareto, 2014; Ramani and Siegler, 2008, 2011; Siegler and Ramani, 2009; Whyte and Bull, 2008; Wolfgang et al., 2001). For example, when US preschool children from poor backgrounds regularly played a linear number board game – The Great Race Game – with an adult over a two-week period, it resulted in increased skills in numerical comparison, number line estimation, counting and numeral identification, compared to a group of children who played the game without integrated numerical content. These gains held when the children were tested again nine weeks later (Ramani and Siegler, 2008).

Adults play a key role in supporting mathematics: studies show that US preschoolers' mathematical knowledge is improved by hearing teachers (e.g., Klibanoff et al., 2006) and parents (e.g., Eason and Ramani, 2020; Ramani et al., 2014) talking about maths – for example, discussing quantity and the counting sequence. In the US, the involvement of teachers (Trawick-Smith et al., 2016) and parents (Braham et al., 2018) in facilitating play also plays a major part. For example, even in informal settings (such as children's museums), when parents are supported in providing guided, number-based play with their preschool children, their preschoolers pay greater attention to numbers afterwards (Braham et al., 2018).

Additionally, adults enjoy implementing guided play more than providing direct instruction. Eason and Ramani (2020) found that US parents reported enjoying a guided play maths game more than more direct instruction, despite viewing them as equally beneficial for

preschool children's learning. Similarly, in a life-sized board game installation in a US children's museum, caregivers and preschool and elementary-aged children used more STEM-related language, such as discussing measurement using a rule, relative to a more traditional museum exhibit (Bustamante et al., 2020).

Executive functioning

Research predominantly from higher-income countries suggests that young children with more unstructured play time have stronger executive function (EF) skills than those with more structured time (Barker et al., 2014). Further studies show connections between EF and pretend play (Carlson et al., 2014; Slot et al., 2017; White et al., 2021), fantasy play (Thibodeau et al., 2016), block play (Schmitt et al., 2015) and symbolic play (Kelly et al., 2011). Overall, the evidence is mounting that EF and play are connected and may complement each other in important ways.

Some studies show that play-based preschool curricula, such as Tools of the Mind (Solomon et al., 2018), Building Blocks (Clements and Sarama, 2007) and Second Step Early Learning (Upshur et al., 2017; Wenz-Gross et al., 2018), can support the development of EF skills. The Tools of the Mind curriculum, in particular, weaves together holistic skills by focusing on improving children's socio-emotional skills and EF skills simultaneously. It is notable, however, that certain studies of the Tools of the Mind programme have demonstrated negative child outcomes and are, thus, not included in this review. Further research is required to understand why there is inconsistency in the results across studies of the programme.

Games provide important opportunities for children to practise EF in a variety of ways. For instance, there is evidence that using board games supports visuo-spatial working memory among Thai preschool children (Sriwilas and Wisessathorn, 2020); circle-time games improved the EF of US children who started the school year with low levels of EF (Tominey and McClelland, 2011); playing a cognitively engaging video game supported US children's EF abilities (Flynn and Richert, 2018); and digital-based training games, which are designed to improve children's EF, have been shown to be partially successful (Goldin et al., 2014).

Again, teachers and parents appear to play key roles in helping to support EF in playful contexts in higher-income countries (Kangas et al., 2015; Walsh et al., 2006). Playing with peers (Ivrendi, 2016), particularly those who have shared learning goals (Qu, 2011), also effectively improves the EF abilities of children from higher- and middle-income countries.

Spatial knowledge

Recent research supports the idea that spatial knowledge and mathematics are fundamentally linked (Verdine et al., 2017) and, as with mathematics, guided play is found to be related to children's learning of spatial knowledge (e.g., knowledge about shapes, Fisher et al., 2013). But guided play is not the only type of play that is linked with the development of STEM skills. For example, research in higher-income countries suggests that pretend play may allow children to practise STEM skills (Matthews et al., 1980), that block play can help support children's spatial knowledge (Casey et al., 2008) and that the play materials provided for children affect their spatial learning (Vander Heyden et al., 2017). Playing certain digital games is also related to children's spatial skills (De Lisi and Wolford, 2002; Subrahmanyam and Greenfield, 1994; Yang and Chen, 2010).

Informing play partners (e.g., mothers) about the importance of spatial thinking has been shown to increase not just US mothers' use of spatial language during block play, but also young children's use of spatial language (Borriello and Liben, 2018). Similarly, simply providing US parents with picture cards that demonstrated how they could build a structure in a guided play context increased their 'spatial talk', relative to free play or playing with pre-assembled structures (Ferrara et al., 2011). Installing games in more informal contexts

(e.g., a life-sized board game in a children's museum) provides another way to target spatial thinking by increasing play and high-quality conversation and interaction between children and caregivers (Bustamante et al., 2020).

Social skills

Social skills are critical for success inside and outside school (e.g., Golinkoff and Hirsh-Pasek, 2016; Price, 2015). For a child to participate in the social world, they must be able to identify themselves as individuals with their own wants and needs, develop and understand other people's wants, needs and perspectives, develop the ability to share ideas, negotiate rules and respond flexibly when things do not go as intended. Similarly, children must develop the ability to feel empathy for others and exhibit pro-social skills – the desire and ability to do things for the benefit of others. Gaining social skills is a key piece of socio-emotional development, and it is helpful to view them as acting in concert with the emotional skills covered later. Below, we explore a number of sub-skills that are involved in the development of children's social skills. We also offer examples of how learning through play has linked to them.

It is important to note that, of all the holistic skills explored in this white paper, social skills are the most variable across settings, cultures and geographies. Different cultures and contexts respect different social and community values and have different ideas of what is considered acceptable or unacceptable for children. Similarly, these social sub-skills overlap and intersect with one another in critical ways (e.g., a child's theory of mind is directly related to their ability to have perspective and empathy, which then affects their social skills and interactions) and each consists of a number of additional sub-skills (e.g., socio-emotional learning involves a suite of skills including

perspective-taking, emotional regulation, self-awareness, cognitive flexibility), making the measurement of these skills particularly challenging.

Summary of study findings

The spectrum of social development is vast. At one end are very specific skills and abilities (e.g., understanding 'theory of mind'), while at the other are broad abilities, such as understanding social and community values. There is more evidence at this 'broader' end of the spectrum for the development of pro-social skills and social engagement, rather than for more specific social sub-skills.

Our scoping review found 90 instances in which a study showed a positive link between learning through play and social skills across childhood, again with most of the studies focusing on the 3–5 years age group.

Pro-social skills

Much of the evidence for the links between social development and learning through play comes from general studies of pro-social skills. Earlier work in western contexts suggested that social pretend play is related to young children's theory of mind (Youngblade and Dunn, 1995). It has also linked fantasy play to social skills and competence (Connolly and Doyle,

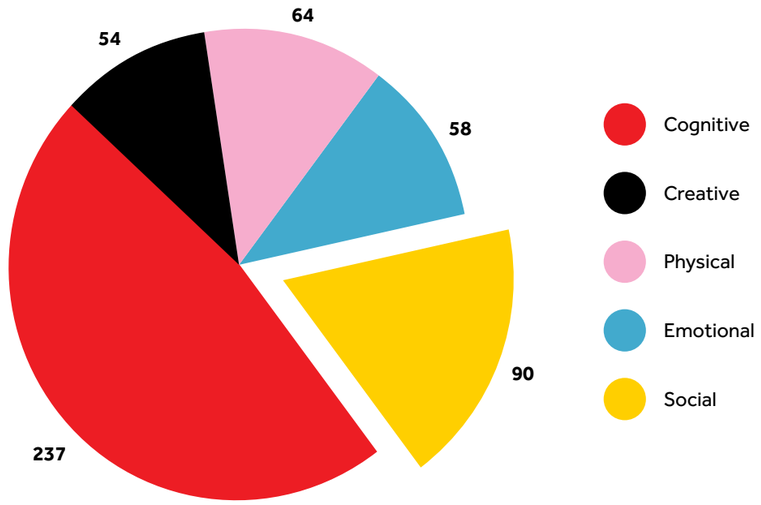


Figure 10: 90 instances were found in which studies demonstrated a positive link between learning through play and children's social skills

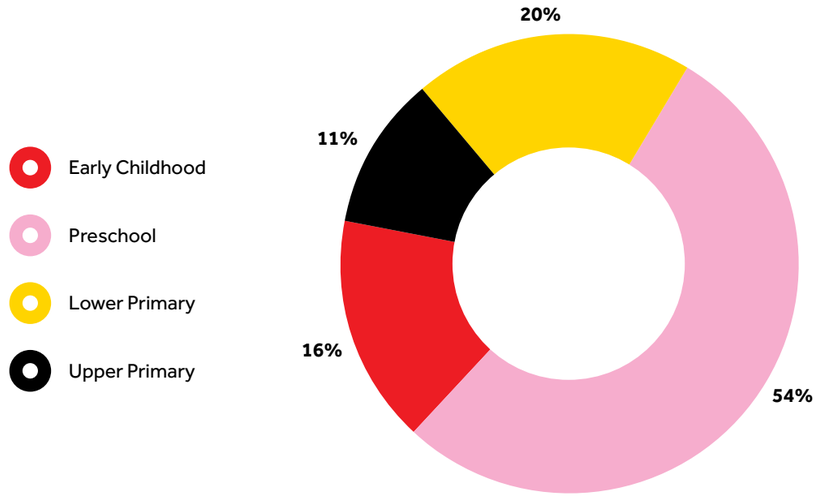


Figure 11: The age distribution of evidence linking learning through play to children's social skills

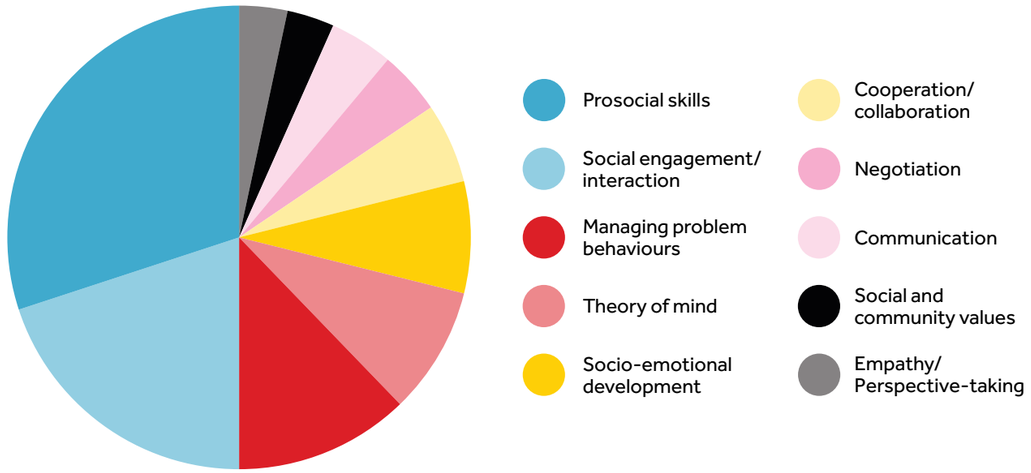
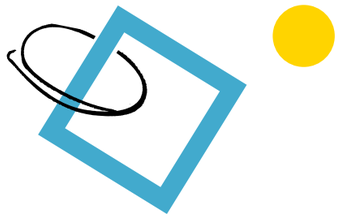


Figure 12: The distribution of social sub-skills represented in the literature review

1984), and suggested that structured imaginative play helps support children's imaginativeness and their understanding of social relationships (Fink, 1976). More recently, studies have suggested that play is beneficial in helping children to develop social skills and act for the collective (Adair et al., 2017), and shown that play is linked to children's social competence and school-readiness in high-, middle- and low-income countries (Pellegrini et al., 2002; Pisani et al., 2017; Save the Children, 2017; Wolf et al., 2019; Yousafzai et al., 2014). For example, play competencies (such as being cooperative and helpful during play) that children demonstrate when playing at home with peers are associated with positive behaviours in the US preschool setting, such as having motivation, persisting in tasks and having autonomy (Fantuzzo and McWayne, 2002). In addition, children who play with others more often exhibit greater social skills such as positive cooperation and social interaction (Newton and Jenvey, 2011), although social pretend play has mixed results between genders, in terms of its influence on social skills (Choi and Ohm, 2018; Colwell and Lindsay, 2005).

Not all studies point to a direct positive link between play and social skills. One reason for this may be hinted at by a Dutch study that suggests that support and scaffolding may be needed to help preschool children when they are engaged in social play – especially those who are less able to self-regulate (Broekhuizen et al., 2017). Similarly, research conducted among Spanish and Ghanaian preschoolers suggests that the reason why play may be important for social development is that it helps to support executive functioning (Romero-Lopez et al., 2020; Wolf et al., 2019).

Importantly, play-based curricula and interventions provide avenues through which we can support the development of social skills. This is not limited to the classroom, however, with pilot results from a wide-ranging family learning programme in Tanzania showing promising results in building new positive habits and increasing parent-child play-based learning activities (among other results), according to parents (Airbel Impact Lab, 2019). The intervention targeted refugee parents in Tanzania, who were shown videos and encouraged via social media to play with their children (aged six to 14 years).

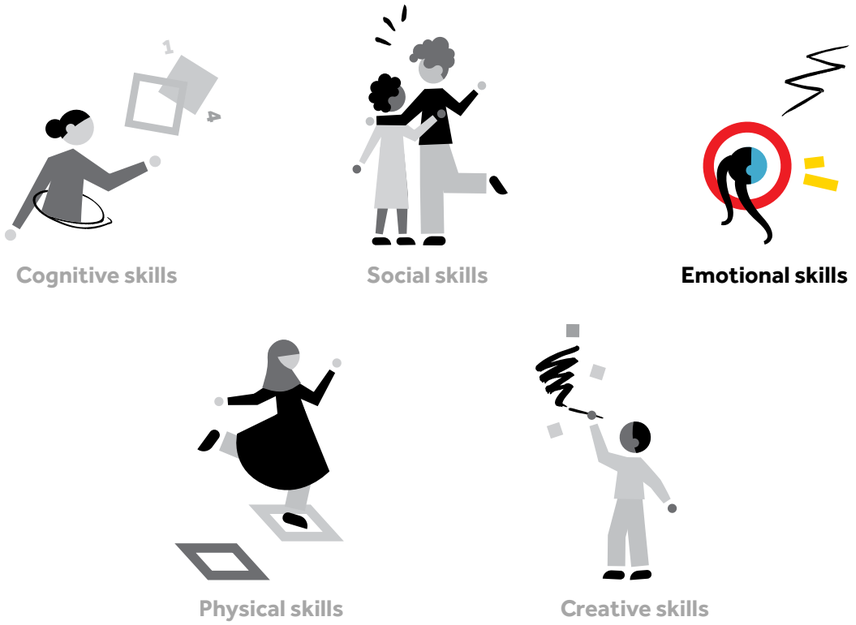


Social engagement/interaction

Play also gives children opportunities to develop their ability to interact and engage with others. For example, social pretend play seems to be more enjoyable for children than social non-pretend play, increasing the amount of time that children play with one another and the size of the group that children play with, and involving greater engagement and reciprocity among their peers (Connolly et al., 1988). There are some hints that these positive outcomes are linked to children's ability to exercise negotiation skills in addition to engaging in pretend play (Doyle and Connolly, 1989). Pretend play develops in its complexity over time, with even two-year-olds in the US showing the fundamentals of beginning to understand pretend play (Ma and Lillard, 2017).

There appear to be ways to help support positive interaction through play, as shown in an intervention for fourth- and fifth-grade students in the US. In this study, physical activities at recess increased positive interactions, decreased conflict and even improved in-class behaviour (Massey et al., 2017). Play-based curricula also seem to support social connection among Australian preschoolers (Reynolds et al., 2011). Another way to support the development of social interaction and engagement skills comes from thoughtful design and installations. Purposely designed community installations can help support positive engagement among caregivers and children, as shown in a study of children aged from birth to10 years in the US (Bustamante et al., 2020; Hassinger-Das et al., 2020; Hassinger-Das et al., 2020). Further, even something as simple as playground design can affect social interaction, as evidenced by a study of second-graders in the US (Barbour, 1999).

Part of the work of childhood is learning what behaviours are socially acceptable, depending on time and place. Play also appears to be helpful in addressing problem behaviours: a lack of time for free play has been associated with increased problem behaviours among Portuguese preschoolers (Veiga et al., 2016). Conversely, a school-based playful curriculum in which children take part in group games and structured play sessions has helped increase appropriate classroom behaviours among preschoolers in Jamaica (Baker-Henningham et al., 2009). There is even preliminary evidence that a game-based intervention carried out in first grade, and designed to help teach good behaviours, may reduce later risk of drug use, smoking and antisocial personality disorder among US young adults who are most at risk (Kellam et al., 2008). US-based programmes such as Playworks (Fortson et al., 2013) and Second Step (Low et al., 2015) have also been shown to be effective in elementary school in reducing problem behaviours.



Emotional skills

Emotional skills allow us to manage our thoughts and feelings in ways that are accepted culturally. Children must learn to handle disappointment, misunderstandings, frustrations, rejections and limitations to their wants and needs. They must learn what is and is not acceptable to do in a wide variety of settings and relationships, and must also learn to become self-aware, motivated and confident in the face of difficulties. Emotional skills also work in tandem with social skills to support socio-emotional development. Below, we explore a number of sub-skills that make up the suite of emotional skills that develop over childhood. We also offer examples of how learning through play has been linked to them.

Summary of study findings

The evidence base includes many studies that link learning through play to a wide variety of emotional sub-skills, and Figure 14 shows the relative distribution of this evidence by age group. Over half of the instances which we found relate to early childhood (0 to 2 years) and pre-primary (3 to 6 years) age groups. The majority of the evidence is also focused on how learning through play supports emotions/affect in children.

Emotions/affect

As early as infancy, games between mothers and infants, which are designed to keep infants engaged, are linked to children having more positive and less negative affect. 'Positive affect' is the propensity to experience positive

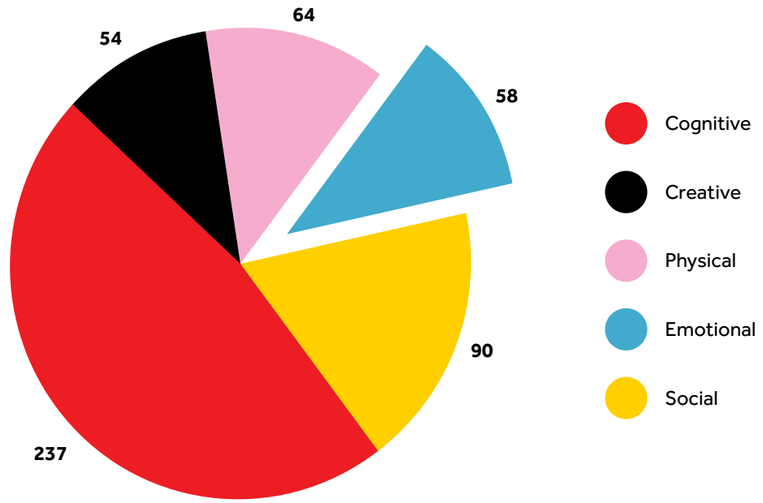


Figure 13: 58 instances were found in which studies demonstrated a positive link between learning through play and children's emotional skills

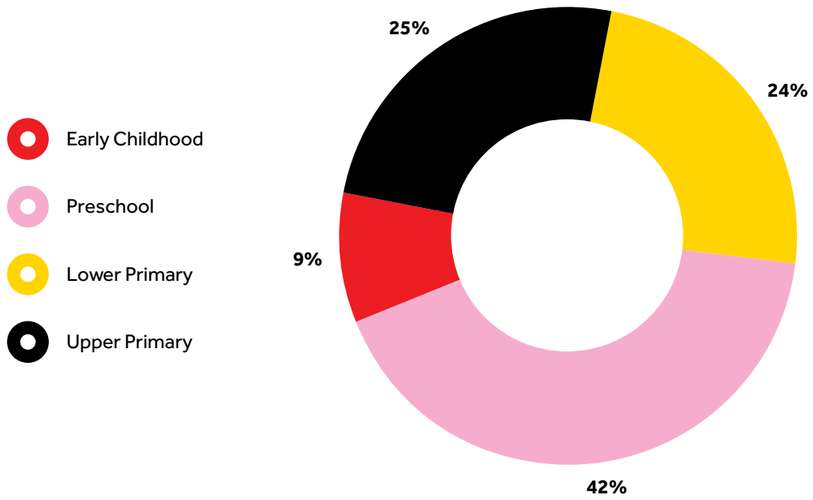


Figure 14: The age distribution of evidence linking learning through play to children's emotional skills

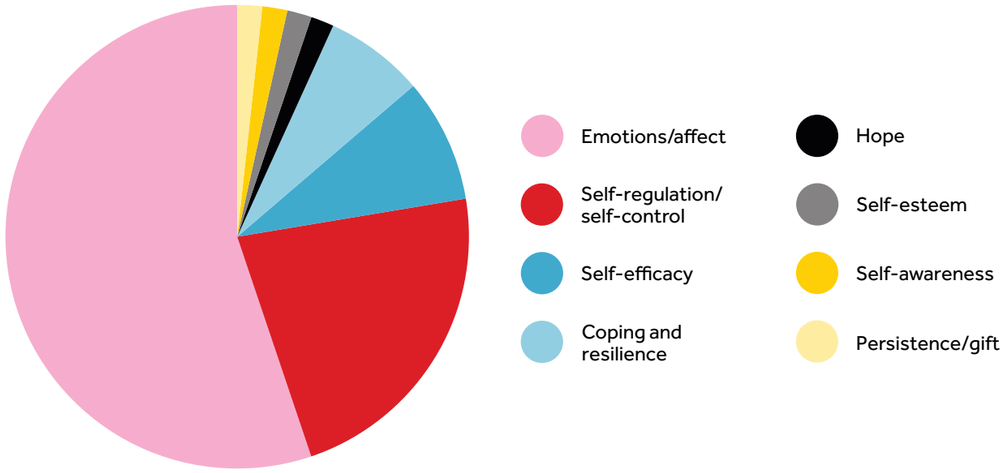
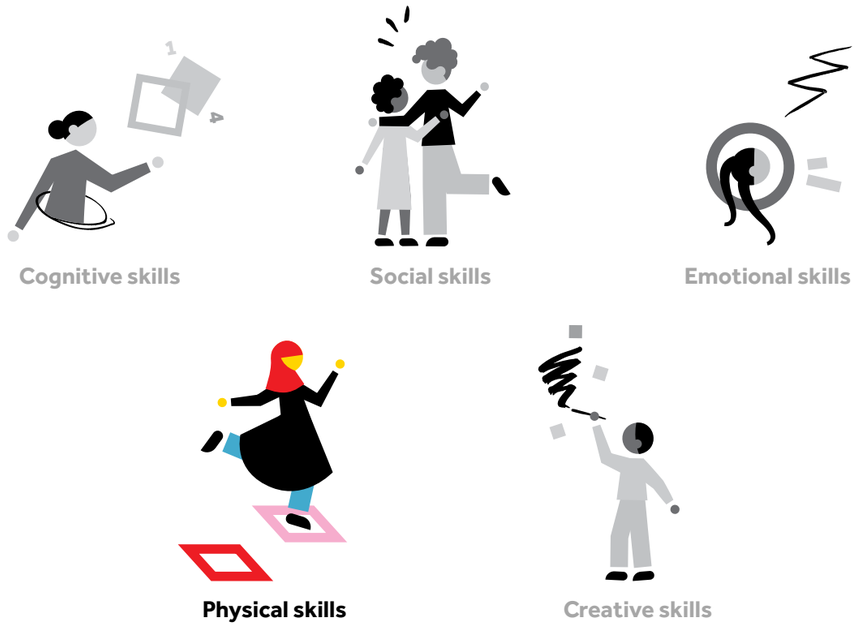


Figure 15: The distribution of emotional sub-skills represented in the review

emotions, and the ability to interact with others and deal with life's challenges in a positive way (Markova, 2018). As they get older, the way in which children perceive and experience activities – for example, if they experience the activity as playful or not – has an effect on their emotional state. In one study, children enjoyed the same activity more when it was presented to them 'like play' (the child was given a choice, the activity took place on the floor and an adult was nearby but not directly involved) versus 'not like play' (the child was asked to take part, the activity took place at a table and an adult was directly involved) (Howard and McInnes, 2013).

Additionally, with first- and second-grade children in the US, Russ and Kaugars (2001) found that children who were placed in an 'angry play' group (using puppets to express something that makes them angry or upset) reported more negative emotions than those in a 'happy play' group (using puppets to express something that makes them happy). Similarly, Fiorelli and Russ (2012) found that pretend play with emotion-related themes related to positive mood in everyday life, suggesting that learning through play is linked to children's feelings of positive emotions.

Evidence is also mounting that computer-based gameplay has the potential to affect elementary school children's emotional states (e.g., Núñez Castellar et al., 2015; Hung et al., 2015; Hwang et al., 2015). For instance, in a computer game for children aged 8 to 10 years in the Czech Republic, children were either shown an animation of a biology-related topic, or they interacted with a plant character. Those children who were playing the interactive game had higher ratings of enjoyment and children chose that option more, despite the two options having the same learning outcomes in terms of biology-related content (Tetourová et al., 2020).



Physical skills

Over the course of childhood, most children build the fine and gross motor skills that allow them to hold up their own heads, crawl, feed themselves, stack blocks, write, run and navigate through time and space with their bodies. They quickly and flexibly respond to sensory stimuli, adjust their motor responses and, when possible, begin to develop body awareness and a sense of how to nurture an active mind and body. These skills continue to be refined as children age and engage in physical play that requires more coordination, flexibility, complex spatial thinking and stamina. Below, we highlight a number of physical sub-skills that develop during childhood and offer examples of how learning through play has been linked to them.

From the fine and gross motor skills that are the hallmarks of the first few years of life, to physical activity that can help prevent the lifelong challenges of childhood obesity, physical holistic skills are among the most easily observable aspects of a child's development. Physical development includes being physically active, understanding movement and space through sensory-motor skills and nurturing an active and healthy body.

Summary of study findings

Our scoping review found 64 studies that found a positive link between learning through play and the development of physical skills.

As with the other holistic skills, the majority of studies took preschool children as their targeted age group. Figures 17 and 18 show the distribution of evidence linking learning through play to physical skills by children's age, and by the sub-skills that were identified.

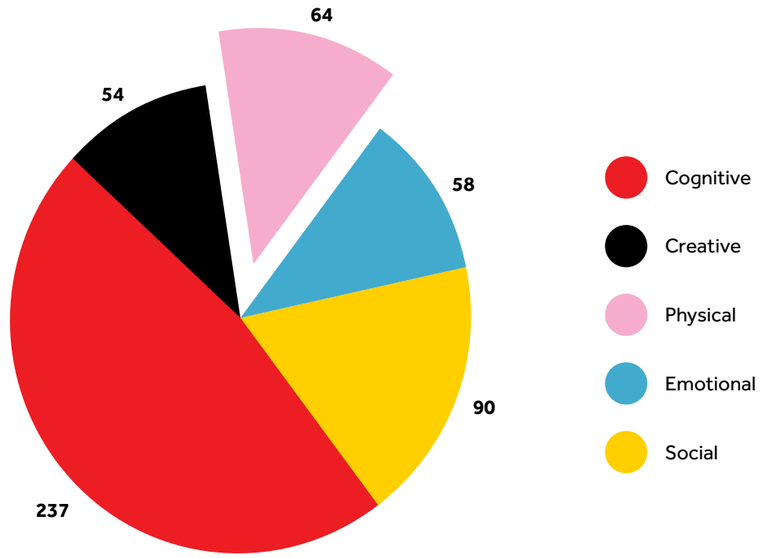


Figure 16: 64 instances were found in which studies demonstrated a positive link between play and children's physical skills

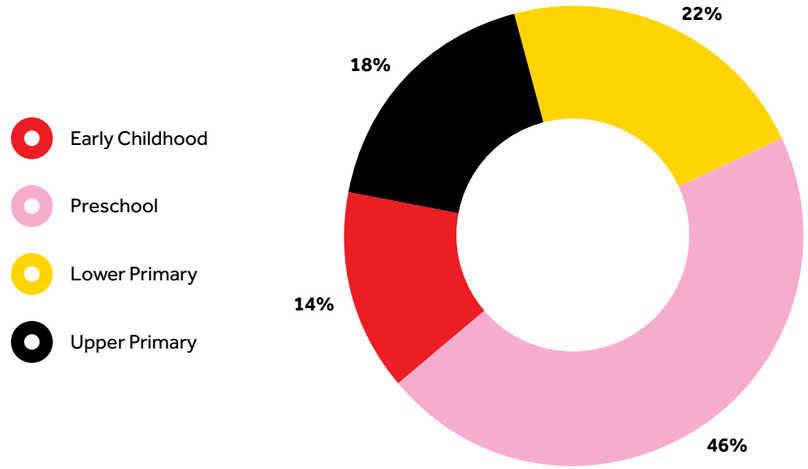


Figure 17: The age distribution of evidence linking learning through play to children's physical skills

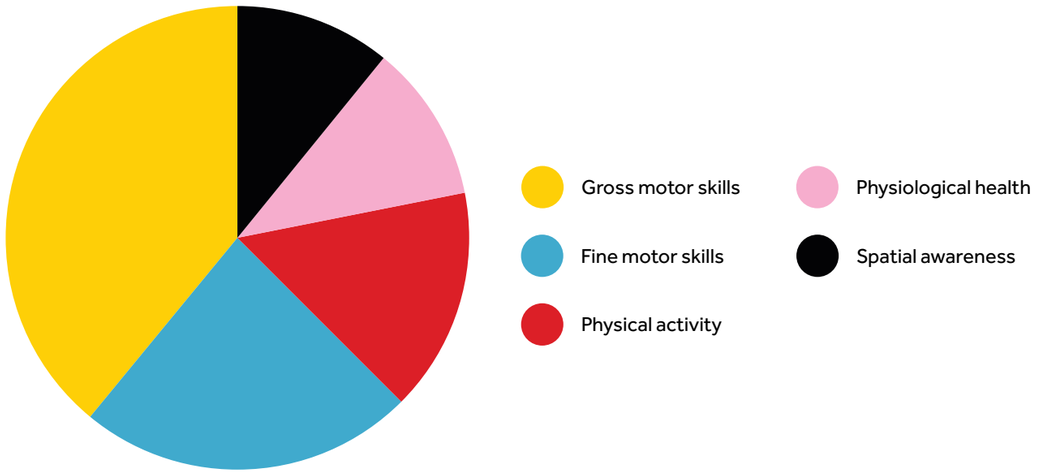


Figure 18: The distribution of physical sub-skills represented in the review

Given the link between physical activity and later health outcomes (Poitras et al., 2016), researchers have been interested in determining how to promote increased physical activity in children. Curricula such as Go2Play (Johnstone et al., 2017) have been shown to increase physical activity among Scottish primary school students. Furthermore, programmes designed to use physical structured play have even been posited as a way of helping to increase physical activity and protect emotional well-being among US children experiencing poverty (Madsen et al., 2011). A natural time when physical activity and play is expected is during recess. Frank et al. (2018) carried out an investigation of how recess type (for example, involving free play or structured play) in a US preschool classroom affected physical activity levels among preschoolers. They found that learning through play (with children involved in structured and free play during recess) resulted in increased physical activity compared to the control group. It is important to note, however, that individual differences affected this finding: specifically, those children who were most active during free play showed decreased activity during structured play, while those who were not at their highest level of activity during free play showed an increase in physical activity during structured play. This suggests that there can be no one-size-fits-all approach in increasing physical activity among preschoolers (Frank et al., 2018; Luchs and Fikus, 2018).

Adults have also been shown to have an effect on children's physical activity during play. For example, in a family active play intervention in England, reductions in preschool children's sedentary time and increases in their physical activity levels were affected by parents' own levels of physical activity (O'Dwyer et al., 2012). Finally, it is worth noting that outdoor physical activity preceding preschool classroom instruction has been found to help children in the US (including children experiencing poverty) to work on tasks (Lundy and Trawick-Smith, 2020).

Gross motor skill development

Physical games have been repeatedly shown to help improve children's gross motor skill development (Akbari et al., 2009). The evidence also suggests that children's agency (e.g., their ability to choose different activities and the levels of activity that they engage in) is positively linked to gross motor skill development among Canadian preschoolers (Butcher and Eaton, 1989). Again, curricula in schools that are game-based seem to be associated with development in the physical domain (e.g. De Oliveira et al., 2019; Piek et al., 2013; Mostafavi et al., 2013; Draper et al., 2012; Johnstone et al., 2017), and high-quality early childhood care helps children to develop both fine and gross motor skills (Nores et al., 2019). Again, digital technology games appear to be linked to motor skills for children in early primary school (Vernadakis et al., 2015).

External factors also affect the efficacy of learning through play and its impact on gross motor skill development. Teachers play a key role in facilitating physical play: in a study comparing guided play and free play in an enriched environment (with the same materials and

space, but with adult facilitation) among Brazilian kindergarteners, children improved more in their motor development through guided play, relative to children without teacher facilitation (Palma et al., 2014).

Where children play can also affect their physical skill development. Studies in Norway have found that playing in a natural outdoor space (e.g., a forest) results in a wider variety of play activities compared to playing in a built playground, resulting in greater gains in motor skills for young children (Fjørtoft, 2001, 2004). Other studies in Germany, however, have found that the type of outdoor play area does not significantly affect physical activity – measured as the number of gait cycles per minute – among preschoolers (Luchs and Fikus, 2018). Other work suggests that the space that children play in has a different impact on the play activities of Australian boys aged between 8 and 11 compared to girls of the same age (Harten et al., 2008).

There is some evidence, although not as much, that learning through play also supports children's development of fine motor skills. The benefits of learning through play in this respect have been captured in direct interventions in countries such as Iran (e.g., Dadkhah, 2004), and in German caregivers' reports of young children's fine motor skills (Suggate et al., 2017). Block play has also been linked to positive outcomes in the development of fine motor skills among Indonesian preschoolers (Islammeiliani, 2017).

Creative skills

Creativity is a difficult concept to define, but for decades researchers have explored the question of how we come up with novel ideas, how we think of new uses and applications for existing materials and how flexible we are with our thinking. Play allows children to exercise their creativity – from the materials that are used (e.g., an upside-down bicycle as an ice cream truck), to the roles that they play (e.g., a doctor on Mars) – and play enables children to try out new solutions to problems. Below, we highlight a number of sub-skills that are involved with the development of creative skills during childhood and offer examples of how learning through play has been linked to them.

Summary of study findings

Our scoping review found 54 studies that demonstrated a positive link between learning through play and creativity. The difficulty in defining and measuring creativity, however, means that there is little agreement on common metrics for creativity, and many studies conflate creative sub-skills (such as divergent thinking) with creativity generally. This makes it difficult to interpret the findings across studies. As with other holistic skills, the majority of the evidence comes from studies investigating creative skills within the preschool population.

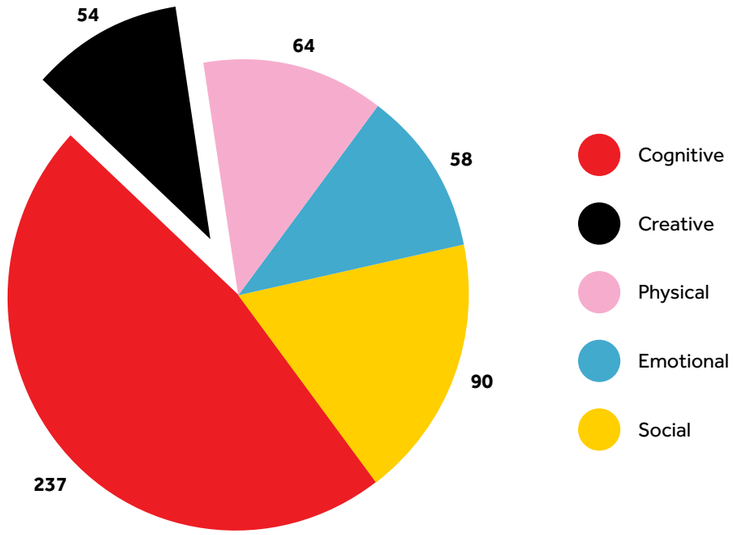


Figure 19: 54 instances were found in which studies demonstrated a positive link between learning through play and children's creative skills

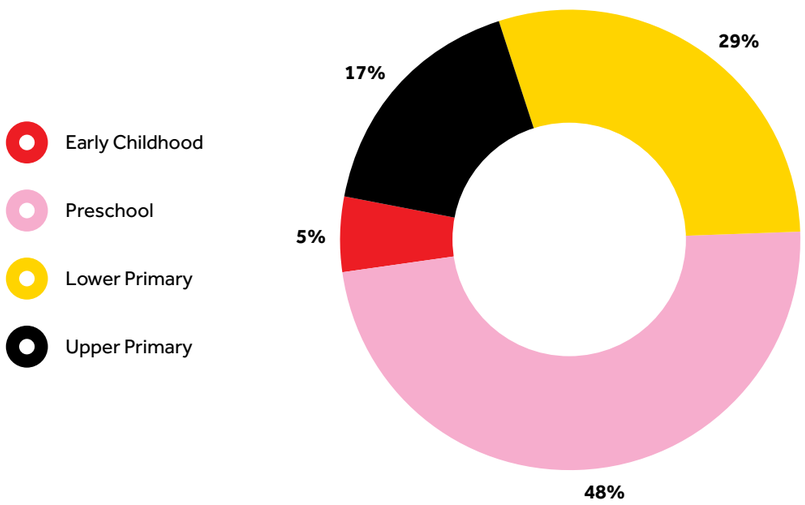


Figure 20: The age distribution of evidence linking learning through play to children's creative skills

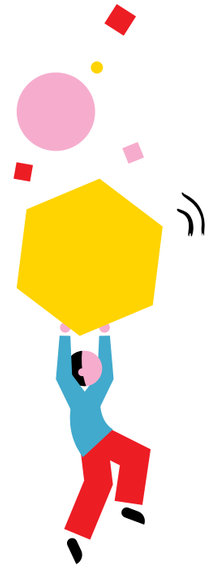
Divergent thinking, exploration and generalised creativity

Children's creativity appears to be malleable and is capable of being built like other skills. Engaging in creativity early on in life has lasting effects on children's creative skills (Mullineaux and Dilalla, 2009). Wyver and Spence (1999) suggest that a reciprocal relationship exists between play skills and divergent thinking skills (one's ability to generate a large number and variety of ideas), a creative sub-skill, such that development in one area has a positive impact on the other.

In particular, make-believe play is a potential pathway to the development of creative skills (e.g., Dansky, 1973), especially the sub-skill of divergent thinking (e.g. Hoffman and Russ, 2016). For example, socio-dramatic play training, led by adults, was shown to be more beneficial than free play in supporting the development of preschoolers' creativity in a US context (Dansky, 1980a).

From interventions in Spain involving preschoolers (Alfonso-Benlliure et al., 2013) to work with children aged 5 and 6 (Garaigordobil and Berrueco, 2011) and 10 and 11 (Garaigordobil, 2006), evidence is mounting that play provides children with the opportunity to develop creativity skills. Research also suggests that higher-quality social play with peers (as opposed to solitary or parallel play) is associated with increased creativity in US preschoolers (Holmes et al., 2015). Similarly, infusing ECE with playful learning has been shown to support creativity in Hong Kong classrooms (Hui et al., 2015), and providing a playful learning environment (Kangas, 2010) supported Finnish children's creative thinking. Divergent thinking seems to be a sub-skill of creative thinking that may benefit especially from pretend play (e.g., Wallace and Russ, 2015).

The link between creative skills and learning through play has been shown across a range of contexts, countries and ages. For instance, a US elementary school-based play intervention helped boost creativity skills (across a range of measures) in girls (Hoffman and Russ, 2016). Digital games have been linked to creative skill development among elementary-aged children in the US, Italy and Taiwan (Atwood-Blaine et al., 2019; Hsiao et al., 2014; Ott and Pozzi, 2012).



Children's creativity also appears to benefit when adults use pedagogical techniques involving guided play, by giving preschool children agency in their activities and supporting skills such as originality (Cheung, 2018; Garaigordobil and Berrueco, 2011). Similarly, school curricula appear to provide a promising avenue for supporting creativity in US schools (e.g., Kirkham and Kidd, 2017), while project-based learning with cooperative elements seems to support scientific creative thinking among Malaysian fifth-graders (Siew et al., 2020). Some research suggests that when teachers support but do not take over, creativity is supported among six-year-olds attending school in Hong Kong (Cheung, 2018). When Welsh children aged six and seven played immediately before a creativity task (in this case, playing with salt dough before making a creature using tissue paper), they came up with more imaginative and colourful creatures than those children who were not allowed to play (Howard-Jones et al., 2002). For Spanish children aged between 8 and 12, even something as simple as doing exercise games before completing a test had an effect on their creative thinking (Román et al., 2018), while the design of a space for US preschoolers (e.g., Kiewra and Veselack, 2016) had a similar impact.

Russ and Wallace (2013) and Zosh et al. (2017a) suggest that playful learning might be foundational to creativity. Zosh et al. specifically argue that through guided play, we can maximise children's agency and inspire innovative and creative thinking.

Limitations and considerations

It is important to acknowledge the limitations of this scoping review:

1.
It is impossible to catalogue every study involving play and its relationship to each holistic skill and sub-skill, across the globe. Not only is the literature large, but also it varies dramatically across holistic skills and even across sub-skills. It is likely that some studies were missed. The numbers presented here are less important than the patterns of evidence: rather than comparing the exact number of pieces of evidence, the reader should consider the evidence as a whole and think about which skills and sub-skills are most studied in the literature. The distribution of the evidence serves as a guide for what has been studied, and highlights what remains to be investigated.

2.
The studies reviewed here are exclusively those that demonstrated a positive relationship between learning through play and a holistic skill or sub-skill. The review did not set out to capture published or unpublished instances in which play was not found to be linked to these skills, or in which there was a negative association between them.

3.
This review did not evaluate the quality of the evidence, and instead focused only on the quantity of studies linking learning through play to children's skills. As a result, this work cannot summarise the strength of the evidence supporting this link, nor can it support claims regarding directionality or causality between children's skills and learning through play. While some studies included had rigorous designs that could support a causal mechanism, many others showed only simple correlations or did not include control groups.

4.
All the evidence is not equally available. While we worked to find evidence located within the grey literature (e.g., independent and government reports, book chapters), it was often hard to find as it was not catalogued in databases, easily searchable and/or presented in a way that allowed us to determine what research was carried out and what was found. It is likely other related work exists, but without a central place to find this information it becomes more difficult to access and use.

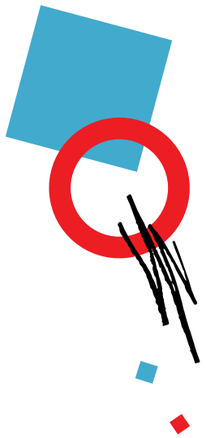
5.
In many of the studies, the way in which the play is supported by adults is not measured directly. Thus it can be hard to determine the exact kinds of playful learning experiences children had across studies, and how effective they are.

Conclusions

Key insights

1. Learning through play is most often linked to cognitive skills

By far, most of the studies reviewed here demonstrated a relation between learning through play and cognitive skills (e.g., literacy and numeracy, executive functioning and spatial skills), followed by social skills (e.g., pro-social skills, social engagement and interaction). There is less evidence available on the link between learning through play and the three other holistic skills – emotional, physical and creative skills. **A meaningful relationship may exist between learning through play and these other skills**; however, there are more published studies available in the cognitive and social domains. This could be due to a number of reasons, including the attention that has been paid to these skills in education systems and by academics across the globe (Care et al., 2016), and the availability of measures to capture these skills.



2. Guided play is a promising facilitation method

The review found that much of the evidence linking learning through play to children's cognitive outcomes is based on examples of guided play, and that this approach is often more effective than direct instruction (Alfieri et al., 2011). It is important to note that other play approaches can also support children's learning. For example, there may be contexts where free play and child-led exploration supports children's learning, without an adult directly setting a learning goal. For instance, research with preschool children in England has shown that children frequently include mathematical concepts in their free play, but the actual effect on their learning is still unknown (Worthington and van Oers, 2016). There may also be cultural and contextual influences that affect how adults interact (or do not interact) in a playful context.

3. We know most about preschool children, primarily in western cultures

Much of the current evidence showing a link between learning through play and children's development of holistic skills is from studies of pre-primary aged children in western cultures. We have more limited evidence about (1) the influence of learning through play among older children, and (2) its relation to more complex sub-skills, such as self-efficacy. This may be due to a lack of measures to capture relevant skills in older children, or a decrease in support for play among children of primary-age and older. This lack of evidence means that we cannot track children's progress in developing holistic skills and respective sub-skills, and this hampers long-term evaluation of the influence of playful learning on child outcomes.

Most of the studies linking learning through play and children's holistic skills take place in western and high-income contexts. We know, however, that culture strongly shapes values and experiences around play (Rogoff, 2003) and, likely, its relationship to the holistic skills. Throughout this report we have highlighted examples of promising work being conducted in low-income settings, showcasing that learning through play has been linked to holistic skills across contexts.

Future opportunities

This review identified where our understanding of the relationship between learning through play and children's holistic development needs to be strengthened. While there are more than 300 studies linking learning through play to children's holistic skills, we still cannot make causal or directional conclusions about this relationship. We still have much to discover: we must systematically weigh the strength of the evidence for and against a causal, directional relationship between them (i.e., whether learning through play supports skill development, or whether the link is simply correlational); we must theorise about and rigorously test potential mechanisms for such a causal relationship, if it exists; and we should consider the role that adult facilitation, as well as the five characteristics of learning through play, has in supporting children's outcomes.

1. Taking a more holistic focus: Interconnected skills mean an integrated mindset is needed

The complex and intertwined nature of skills development means that pedagogies aiming to improve academic skills must also aim to improve other sub-skills which are critical to their success (Golinkoff and Hirsh-Pasek, 2016). This requires a shift in the perspectives of parents, teachers and researchers too, who often prioritise cognitive and academic learning – driven by funding availability, cultural values and curricula, among other reasons. Both the sub-skills and the holistic skills themselves are interdependent, and we need a better understanding of these relationships in order to assess the influence of learning through play and to capture children's outcomes in a holistic and developmentally appropriate way for each age group. Parents and teachers can also be misaligned in their perceptions of each other's roles (Wolf, 2020). Recent work by the Brookings Institution across 10 countries and involving 25,000 parents found that the relationships between parents, teachers and education decision-makers are key to systemic change (Winthrop and Ershadi, 2021). Therefore, across geographies and settings, it is important to focus on the knowledge and attitudes of these groups in relation to holistic skills, and how learning through play can lead to their development.

2. Understanding pedagogies of play: Further exploration of the links between guided play and skills is needed

Guided play approaches were repeatedly linked to children's cognitive skills in this review. It is important that we explore the degree to which guided play is also linked to children's other holistic skills: creative, emotional, social and physical skills. We also need more systematic research to explore more deeply how guided play and skills are linked. For a start, this will require that researchers and teachers closely document and then report the exact approaches they take to supporting play in the play-based programmes that are being studied. If guided play is found to have unique benefits for skills development, we need to make sure that this understanding of the potential of guided play reaches those who implement learning through play and who support children's holistic development. In homes, this means encouraging caregivers to get involved in children's play and embed opportunities for learning. For teachers, it means shifting from the belief that free play is the only form of play, and appreciating that learning goals and play can coexist. There is a need to recognise and support learning through play in other informal learning settings too, such as community settings, and in the digital world (Murray, 2021). This is especially important as the COVID-19 pandemic continues, and children's access to formal learning spaces continues to be affected.

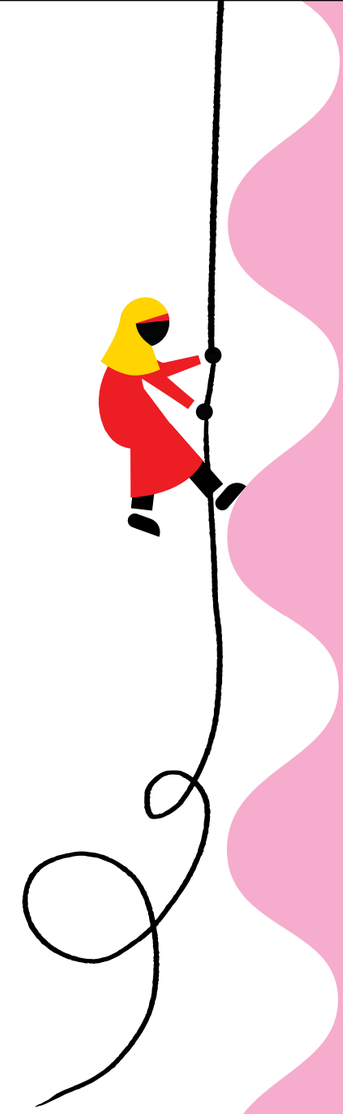
3. Developing measurement tools: Play and skills measures that are sensitive to culture, context and age are needed

High-quality future research on the relationship between learning through play and skills development will only be possible with the development of tools to measure skill development, which are appropriate for different cultures, contexts and ages. This review suggests that there is a dearth of measurement tools available across the five key holistic skills, with particular gaps in relation to social, emotional, physical and creative skills. These measurement tools must be culturally responsive if we are to better understand the link between play and learning across different cultures.

Furthermore, most of the research looking at both play and skills focuses on preschoolers. Measures, methods and approaches to play for older children and young people are needed if we are to understand children's development of play and skills.

4. Conducting longitudinal research: Studies following children, play and skill development over time are needed

The lack of evidence on skills development in older children hampers the evaluation of the long-term effects of learning through play on children's skills. Longitudinal work with a sufficiently large sample of children would allow us to examine the long-term effects of play on holistic skill development, beginning at birth and reaching as far as late childhood and adolescence. This longitudinal work is crucial to understanding how children weave together their skills through development and how they could develop them through play at various stages throughout childhood. The findings of this review show us that future longitudinal work needs to be carefully designed to include children from varying cultures and socio-economic backgrounds. Finally, as child agency is of central importance to learning through play, longitudinal research is needed to better understand the role of child agency and adult facilitation in how play and holistic skills develop.



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Appendix 1: Glossary of sub-skills

Cognitive

Literacy – literacy skills, including language skills, reading and writing, are critical to success in all areas of life. Language is our primary form of communication and with tens of thousands of words to learn, children have an immense task to undertake when learning their native language (and any additional languages). From understanding vocabulary to understanding grammar, semantics and storytelling, children must not only learn about how sounds form words and how words form sentences, but also how to use those sentences to express ideas, tell stories and communicate ideas. Through play, children can practise communicating, listening and expressing themselves.

Mathematics – mathematics is all about symbolic thinking. During childhood, children have to learn not just how to map numbers onto objects, but how addition, subtraction, multiplication and division are powerful tools, not just for performance on standardised tests but also for understanding the world, and manipulating objects and ideas. Rather than the kind of rote learning that children practise using worksheets or flashcards, play allows children to practise mathematics in a more engaging way, from counting out spare change, to dividing toys equally among groups, counting scoops in a pretend ice cream shop or while playing a favourite board game. Play allows children to find the meaning in mathematics and transfer learning from the worksheet to the real world.

Executive functioning – being able to hold information in the mind over short periods for active processing (what did you read in the previous sentence?), paying attention, controlling your thoughts, maintaining concentration, inhibiting distractions from entering your mind, and simply staying on task are all crucial for cognitive functioning. As children stay 'on task' during play – whether that is staying in character during socio-dramatic play, engaging in a board game, playing any kind of sport, or resisting distraction when working on a group science project in their classroom – play affords children the opportunity to practise exercising their executive functioning abilities. Executive function skills are also closely related to socio-emotional development, with cognitive and emotional self-regulation tapping into similar constructs.

Spatial skills – children's understanding of space and spatial relations is emerging as a hot topic in the study of cognitive development. Perhaps because most of us take it for granted when we operate (mostly) easily through space, we sometimes forget that children not only have to learn words and numbers, but also have to plan how to interact with the area around them, picture where things are, plan how to navigate new and old spaces, manipulate mental images (e.g., plan out how to build a castle using blocks), and eventually learn how to navigate their houses, cities, states, countries and even the world. In play, children are able to navigate a garden that doubles as a house, give directions, communicate about time and space, and exercise their spatial thinking abilities.

Problem solving – the world is full of problems. Children must be able to solve problems as they encounter them, from how to get a snack that is high up on a counter to solving riddles. During play, children can try out different approaches, seeing what works and what does not work. They can work together with others and listen to new ideas. They can brainstorm and make educated guesses about what might happen.

Approaches to learning – learning is not simply a matter of pouring knowledge into a child's brain. Instead, children must actively engage with the material and demonstrate intrinsic motivation. During play, children get to do so as they engage meaningfully and with joy.

Reasoning – as children learn more and more, they have to be able to use what they know to reason through new problems. They also have to be able to use causal reasoning in which they make inferences, based on existing knowledge, in light of what they are seeing in front of them. Take, for example, the skill of conservation – or the ability to know that even when the appearance of a set volume of liquid changes due to separating items or pouring liquid into a differently sized container, the amount stays the same. During play with materials such as water and sand, children get to experiment and gain additional experience working with, and comparing, different volumes. While you can tell children your own approach to reasoning, play allows children to reason through problems or situations at their own pace, in a more meaningful way. From thinking about how you can get another child to do what you want, how to build a tower that does not fall down, or experimenting with the volume of liquid that can fit in differently sized containers, when we provide children with plenty of opportunities to learn by doing during play, we can help support these abilities.

Science – today's children will inherit a host of challenges that will require scientific discovery and insight to solve – from climate change to curing today's diseases and tomorrow's novel viruses, children not only need to learn scientific content but also the scientific method. Play affords children the opportunity to guess what will happen (hypothesise), test possible outcomes (experiment), and update their knowledge based on those outcomes – all steps towards the scientific method.

Computer programming – as the world becomes increasingly technologically focused, children will need to learn to navigate an ever-expanding digital world. In response to this shift, there has been recent interest in helping children to develop foundational programming skills so that they begin to exhibit the kind of logic and skills necessary to excel in programming. Many of these efforts have centred on children learning programming through play (e.g., board games or digital games that are based on programming logic).

Metacognition – while children learn more every day, there is still a lot that they do not know. Part of what children must do is begin to understand what it is they do understand and what it is they do not. During play, children can explore what they do and do not know, especially when interacting with others who might tell them.

Critical/logical thinking – children not only need to be able to identify what they see in front of them, but also they have to be able to think about the information they already know about what they see in front of them, mentally evaluate how this new information fits in with what they know to update their existing understanding, and think through logical problems. Play affords children the opportunity to practise these skills. For example, children must think logically through a play situation in which they set up a pretend store on the corner. They need to choose what items will be for sale as they look around at the available materials, determine how the 'customers' will check out their purchases, and identify what they will use as pretend money. In another example, children may use critical thinking to evaluate evidence to solve a science mystery as part of a teacher- or parent-arranged guided play scenario.

Social

Pro-social skills – while all of the sub-skills discussed in this section are considered social skills, many studies have investigated pro-social development more holistically. **Broadly speaking, pro-social skills are the everyday skills that help children interact effectively with others**. To participate in society, children must learn how to wait their turn, share, not bully others or respond aggressively. All of these pro-social skills are central to play with other children or adults.

Social engagement/interaction – importantly, social interactions require the participation of at least two social partners. We must learn how to respond contingently and flexibly while also learning how to re-engage a social partner if and when they lose interest. This kind of interaction is apparent in social play from early on in development – from the joy of playing peek-a-boo in infancy to turn-taking during games throughout childhood, social play allows children to practise socio-emotional skills and engage in social interaction early and often.

Managing problem behaviours – children use childhood to learn how to manage their own problem behaviours (with the assistance of caring adults), often through losing their own temper. Play allows children to learn how to manage their emotions and behaviours. Even something as simple as playing pretend games engages children's socio-emotional skills in ways that can help them learn how to manage their own behaviours.

Theory of mind – theory of mind is a term used to describe a person's ability to conceptualise what is going on in someone else's mind. It forms the centre of a person's ability to interact in society, hold meaningful relationships and be considerate of others whose experience may differ from one's own. Play, especially that which involves pretending and social interaction, allows children to explore how others may feel.

Cooperation/collaboration – children are part of larger social units and can accomplish more when they are able to work collaboratively with others. Cooperating to solve a problem and combining resources, knowledge and ideas are all skills that are engaged during play with others.

Negotiation – anyone in a social environment needs to learn the art of negotiation. Whether it is negotiating between roles in pretend play or negotiating in the boardroom, being part of society means being able to share one's opinions and compromise when others have different opinions. Negotiation between children (or between children and parents) is inherent in play, from deciding who goes first, to who gets to be what colour in a board game, to assigning roles or choosing an activity to play, and it builds children's socio-emotional skills.

Communication – a core part of being in a social world is communicating with others. Communicating requires the ability to identify and express one's own ideas and emotions, consider what someone else might know and/or how they might be able to help, the ability to understand what someone else is communicating, and the ability to combine new information with what is known, and respond dynamically to other people. This type of communication is central to play with peers or parents.

Social and community values – part of the work of becoming a member of a social group is understanding that the values, spoken and unspoken rules, and standards are central to being a part of a community. Children have to learn about respect, cultural values, honesty.

From acting out different roles in pretend play (e.g., someone is the teacher and someone is the student) to learning the rules of games, play affords children the opportunity to learn about cultural norms and practise being a member of a community.

Empathy/perspective-taking – while children sometimes get the reputation of being unable to see beyond their own needs and wants, during childhood they begin to learn about what others are feeling and how they perceive situations, and respond accordingly. During play, children can experience what it might feel like if something happened to them, practise seeing something from someone else's perspective, and explore the role of empathy in relationships.

Emotional

Emotions/affect – finding joy and leveraging enjoyment are core concepts related to life fulfilment. It is perhaps unsurprising to anyone who has spent time with children that play affords children opportunities to experience joy and explore what can create that joy in their own lives. Similarly, being able to label, understand and deal with our emotions is crucial. From playing with a cardboard box to handling disappointment and frustration when playing with friends, to stacking sticks and leaves to create a world for imaginary gnomes, emotions are inherent in play, and play provides important opportunities for children to practise and explore their emotions.

Self-regulation/self-control – we cannot always get what we want when we want it. Similarly, we sometimes have to control our frustration, sadness, anger, disappointment or even excitement. Play provides important opportunities for practising the control of children's emotions. From the child playing pretend and regulating their own thoughts, behaviours and actions to play the part, to the kind of self-regulation that happens during a game of freeze tag, play is a perfect opportunity to build up these critical skills.

Self-efficacy – as any parent will attest, children like to feel that they are in control and are competent. From the countless requests to 'watch me' to the seemingly steadfast dedication to doing things on one's own, self-efficacy is not something that is limited to independent adults. Children's self-efficacy is central to learning through play, with free play, guided play and games allowing children to try, try and try again and in the process, deepen their learning – including in subjects such as mathematics and science.

Coping and resilience – the fact is that bad things happen, even to children. Children need to develop the skills to cope with adverse experiences and challenges, and the ability to be resilient and overcome that adversity. Play provides safe spaces for children to simply have fun, but it also provides them with opportunities to work through feelings, allowing them to simultaneously cope in the moment and practise skills that will build resilience. Further, warm and responsive caregiving can help buffer adverse experiences and build resilience: play is one potential mechanism for creating these kinds of warm and responsive interactions.

Self-esteem – beyond feeling that we are capable, we also need to consider what we are realistically capable of doing and feel good about our ability to achieve it. As children grow, they can become more accepting of the idea that they may not be able to run around the whole World, but they can feel good about how quickly they can run during a soccer game with friends.

Self-awareness – not only do we need to control our emotions, but also we need to be aware of what we are feeling, how we are doing and what is going right or wrong. This development of self-awareness starts as early as the second year of life and is what helps us to act appropriately, whether others are watching or not. Play affords us the opportunity to experiment with our actions, reflect upon the decisions we make, and explore how those actions and decisions make us feel.

Persistence/grit – learning how to stick with tasks when things get difficult is an ability that challenges adults, not just children. In childhood, children build up key skills related to persevering with something when it does not come naturally or is challenging (and, we would argue, this is a key opportunity for learning). Children can also develop grit, or the unique powerful coupling of perseverance with passion (Duckworth et al., 2007) in childhood. Whether children stick with trying to learn how to tie their shoes, building a castle out of sand, working through a challenging level of a video game, or finding their passions and persisting through challenges, they have many opportunities to learn how to persist and thrive through play.

Physical

Gross motor skills – moving our largest muscle groups to locomote, support ourselves, swim, run, skip, hop or dance is no small feat. Our gross motor skills are among our earliest to develop and it is perhaps unsurprising that games, especially, help support the development of our gross motor skills throughout childhood.

Fine motor skills – moving our smaller muscle groups allows us to write, speak, knit, paint, draw, feed ourselves, type and colour. These fine motor skills can also be supported by games – from moving game pieces on a board to practising writing and counting change in a pretend store, play allows children to meaningfully engage their bodies as they play.

Physical activity – physical skills are not just acquired; they are built gradually, through practice. Fine and gross motor skills, for example, are practised and built through the actual use of activity and movement. From measuring how many steps one can take, to one's ability to run a long distance, physical activity has its roots in childhood. Guided play seems to be especially helpful in supporting children's physical activity levels. Both sensory-motor skills and physical fitness skills are important components related to physical activity.

Physiological health – physical development is not just a matter of movement. We must also develop physiological fitness (e.g., cardiovascular health), and this starts in childhood. Physical play allows children (and adults) to build strength, lung capacity, heart health and more.

Spatial awareness – objects in space relate to each other in different ways, and as humans, we have to determine how we relate to the objects around us, how to move through space, and how the objects around us relate to one another. From remembering how to get to the store to the ability to put together furniture or repair a car, we must develop the ability not just to know what things are but an awareness of where things are within physical space. Play provides children with the opportunity to experiment with this, and practise moving their bodies throughout space, at different heights, on different surfaces and at different speeds.

Play can support children's spatial awareness, – from taking things apart and putting them back together again to discovering how to play a created game using balls and sticks in their neighbourhoods.

Creative

Divergent thinking – very few problems have a single answer. Divergent thinking, in which adults or children are able to come up with a large number of potential ideas, is typically used as a construct of creativity. Play gives children the opportunity to explore ideas, experiment with solutions and flexibly create new solutions, all of which seem particularly well suited to supporting the development of divergent thinking.

Exploration – imagine you see a toy in front of you, but you do not know how it works. You pick it up and discover that if you tap on a button, it makes a noise. Do you keep exploring the toy? Exploration is the key to learning about new things, discovering new breakthroughs and solving problems. In play, children are able to explore new and confusing situations, practise methodical ways to discover new scientific knowledge, and discover what makes us all unique.

Motor creativity – we typically think about creativity in terms of ideas, but we can also be creative in terms of our movement, in terms of both fluency and flexibility. From creating a new dance routine to creatively working out how to get to a cookie jar on top of a refrigerator, play can serve as a context for children to experiment with their bodies and movements.

Curiosity – children are "scientists in the crib" (Gopnik et al., 1999) and, like adults, they are curious about the world around them. From asking why the sky is blue to why oranges are round, children are naturally curious and research is just beginning to explore if and how play may support children's curiosity.

Appendix 2: Methodology of scoping review

Databases searched

The electronic databases searched in this review included: Academic Search Complete, APA PsycArticles, Health and Psychosocial Instruments, PsycINFO, ERIC, Education Source, Google Scholar.

Search terms

The search terms were the following:

Play type: "play" OR "games" OR "free play" OR "guided play" OR "pretend play" OR "block play" OR "construction play" OR "object play" OR "sociodramatic play" OR "physical play" OR "rough and tumble play" OR "cooperative play" OR "solitary play" AND "child-led" OR "child-centered".

Age: "children" OR "child" OR "kid" or "youth" OR "infant" OR "preschool" OR "primary school" OR "elementary school".

AND

Skill (individual searches were conducted for each sub-skill):

Cognitive	Social	Emotional	Physical	Creative
Critical thinking/ Logical thinking	Social and community values	Persistence/ grit	Sensory motor skills	Creativity
Problem solving	Civic values/ citizenship	Resilience	Spatial awareness	Curiosity
Decision making	Awareness of and respect for diversity	Self-regulation	Fine motor skills	Evaluating ideas
Reasoning	Cooperation/ collaboration	Self-efficacy	Gross motor skills	Divergent thinking
Metacognition	Communication	Self-directed-ness	Physiolog-ical	Exploration
Executive function (working memory, behavioural self-regu-lation, concentration, inhibition, attention, flexible thinking)	Empathy/ perspective-taking	Self-esteem	Physical activity	
Concentration	Theory of mind	Emotions/ affect/ enjoyment	Physical fitness	
Language/literacy	Negotiation	Hope		
STEM (mathematics, spatial skills, pro-gramming, science)	Social skills	Empathy		
Conservation	Socio-emotional development			
Approaches to learn-ing	Social engagement/ interaction			
General cognitive de-velopment/learning				
IQ/mental age				

AND

Learning: "learning" OR "benefit" OR "development" OR "inquiry-based" OR "project-based" OR "active" OR "hands-on" OR "pedagog" OR "discovery learning" OR "experiential learning" OR "montessori".

Inclusion criteria

The 323 studies reviewed here contain a combination of empirical experimental or quasi-experimental methods as well as qualitative approaches. Many studies include a mix of both qualitative and quantitative methods.

We chose to begin with the broad search terms of "play" and "games" to net as many studies as possible, since not all authors define play or games in the same way. As such, many of the terms used in this report are defined in different ways by various bodies of educational research. The glossary in Appendix 1 clarifies how each term is used in this study.

We then reviewed each individual study and classified it along the following lines:

- → Country where the research was conducted
- → Setting (lab, ECE, school, community setting, museum)
- → Age group (early childhood (0–2 years), preschool (3–5 years), lower primary (6–8 years), upper primary (9–12 years))
- → Peer-review status (peer-reviewed, non-peer-reviewed)[2]
- → Type of research (qualitative, correlational, quasi-experimental, experimental, mixed methods)[3]
- → Alignment with five characteristics of play (actively engaging, meaningful, socially interactive, joyful, iterative)[4]

[2] Peer-reviewed studies undergo rigorous review, usually by at least two other experts in the field, before they are published in academic journals.

[3] Qualitative research focuses on interpreting others' words and experiences. Quantitative research focuses on numbers and statistics. The next three types of research are all quantitative. Correlational research does not show if one variable causes another; instead, it shows a relation between two variables. Experimental research can show causation; it features an experimental group (which receives treatment) and a control group (which receives no treatment). Participants are assigned to these groups at random. Quasi-experimental is missing an aspect of experimental research; commonly, it is missing the random assignment of participants. For example, in a school, researchers do not randomly assign students to their classrooms, so research in this setting is quasi-experimental. Mixed methods research includes a mix of qualitative and quantitative (correlational, quasi-experimental, experimental) approaches.

[4] Since many of these characteristics are not described using these exact terms, the authors of this review looked for exemplification of them through the study descriptions of activities. For example, a study examining the effectiveness of a board game for learning new vocabulary (Hassinger-Das et al., 2016) exemplified the "meaningful" characteristic because it tied success in the game to children's knowledge about vocabulary they learned while reading a story. It also demonstrates the socially interactive characteristic because children play the game in pairs. Children are actively engaged, because they must participate and remain focused when playing. By combining the fun nature of games with learning content, the "joyful" characteristic is activated. Finally, children could demonstrate the "iterative" characteristic by observing and determining the most effective way to spin the game spinner to land on their desired spot for winning the game.

- → Test of play (direct, indirect)[5]
- → Holistic skills measured
- → Holistic skills measurement tool(s)
  - — Validated or author-generated measure[6]
  - — Type of measurement
    - › Experimenter observational rubric
    - › Teacher observational rubric
    - › Experimenter rating scale
    - › Child rating scale
    - › Teacher rating scale
    - › Parent rating scale
    - › Child experimental task coding
    - › Child physiological measure
    - › Child survey
    - › Child interview
    - › Parent survey
    - › Parent interview
    - › Ethnography
    - › Child assessment
    - › Parent assessment
    - › Teacher assessment
    - › Experimenter document analysis
    - › Teacher survey
    - › Child focus group
- → Play measurement/manipulation[7]
  - — Validated or author-generated measure[8]
  - — Type of measurement
    - › Experimenter observational rubric
    - › Teacher observational rubric
    - › Experimenter rating scale
    - › Child rating scale
    - › Teacher rating scale
    - › Parent rating scale
    - › Child experimental task coding
    - › Child physiological measure
    - › Child survey
    - › Child interview
    - › Parent survey
    - › Parent interview
    - › Ethnography
    - › Child assessment
    - › Parent assessment
    - › Teacher assessment
    - › Experimenter document analysis

[5] A study with a direct test of play included play as a variable that was examined or manipulated. A study without a direct test of play included play elements that were part of a larger intervention but not tested individually.

[6] Validated measures have been tested in multiple studies and are standardised for use in many populations. Author-generated measures are created for the purposes of that specific study.

[7] This category notes how play was treated in the study. In other words, we evaluated whether play was measured and/or experimentally tested.

[8] Validated measures have been tested in multiple studies and are standardised for use in many populations. Author-generated measures are created for the purposes of that specific study.

- Teacher survey
- Child focus group

– Type of activity (free play, guided play, games, direct instruction)[9]

Exclusions and limitations

The decision to include a study in this review was based on:

→ The availability of evidence regarding the impact of the method on children's (0–12 years of age) holistic skills

→ The fit of the method with the five characteristics of play.

For journal articles, the following additional criterion was used:

→ Published in a peer-reviewed journal.

In an effort to gain a more comprehensive understanding of learning through play across contexts, we also searched for non-peer-reviewed literature and included pieces that met the following requirements:

→ White papers and reports with novel data (such as those supported by a non-profit organisation, non-governmental organisation)

→ Book chapters with novel data

→ Undergraduate, Masters' or Doctoral theses.

Accordingly, studies were excluded if these conditions were not met. Additionally, this review does not address children with developmental disabilities or clinical-focused studies (i.e., play therapy) since these require their own separate inquiries.

Our conclusions are informed by grey literature reports such as:

→ *The Case for Play* (Playground Ideas)

→ *Brain Fitness and Executive Function: Evidence-Based Interventions That Improve Student Outcomes* (BrainFutures)

→ *A World Without Play* (Make Time to Play)

→ *Educating for the Social, the Emotional and the Sustainable* (NISSEM Global Briefs).

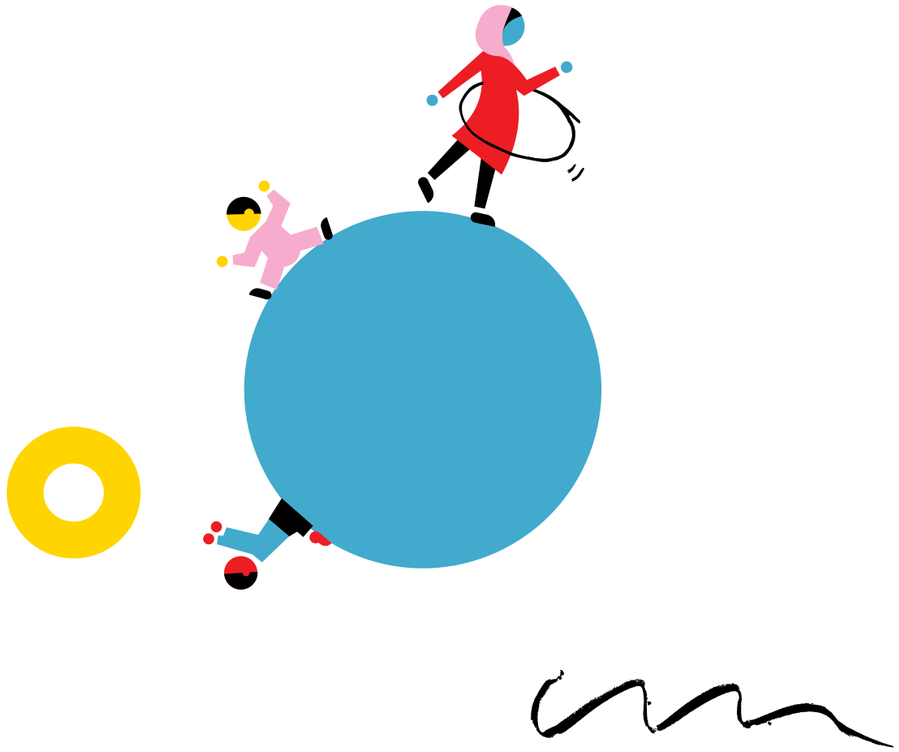
While these are not included in any analyses presented here, we consulted this work and this literature does inform our conclusions and recommendations.

[9]As the types of activity were not always defined in the studies, the authors of this review looked for exemplification of the characteristics of each type. A study such as Schulz and Bonawitz (2007) was classified as 'free play', because children were asked to explore the activity freely. Studies such as Toub et al. (2018) that involved teacher-supported play were classed as 'guided play', and studies such as Ramani and Siegler (2008) that included games were classed as 'games'. Studies that also included more traditional teacher-led instruction, as in Toub et al. (2018), were classed as 'direct instruction'. Studies could be classified as more than one type.

Appendix 3: Countries where evidence was found on the relationship between learning through play and children's holistic skills

Country	Pieces of evidence	Context classification
Australia	19	High income
Bangladesh	4	Lower middle income
Belgium	1	High income
Bhutan	1	Lower middle income
Canada	15	High income
China	4	Upper middle income
Colombia	2	Upper middle income
Croatia	1	High income
Cyprus	1	High income
Czech Republic	2	High income
Ethiopia	2	Low income
Finland	4	High income
Germany	3	High income
Ghana	3	Lower middle income
Greece	3	High income
India	2	Lower middle income
Indonesia	4	Upper middle income
Iran	3	Upper middle income
Israel	2	High income
Italy	6	High income
Jamaica	2	Upper middle income
Japan	2	High income
Kenya	4	Lower middle income
Kyrgyzstan	2	Lower middle income
Malawi	2	Low income
Malaysia	2	Upper middle income
Mexico	2	Upper middle income
Netherlands	5	High income
New Zealand	4	High income
Norway	2	High income
Pakistan	1	Lower middle income
Portugal	2	High income

Country	Pieces of evidence	Context classification
Rwanda	1	Low income
Saudi Arabia	1	High income
Scotland	2	High income
Singapore	1	High income
South Africa	5	Upper middle income
South Korea	1	High income
Spain	8	High income
Sweden	4	High income
Switzerland	1	High income
Syria	1	Low income
Taiwan	7	High income
Tanzania	1	Lower middle income
Thailand	1	Upper middle income
Turkey	7	Upper middle income
UK	23	High income
USA	154	High income
Zambia	1	Lower middle income



Appendix 4: Measurement considerations and existing measurement tools

The literature covers a number of different types of tools used to measure both children's play and skills, and each type brings both benefits and limitations. For example, some research uses author-generated measures (i.e., a researcher develops their own tool to evaluate whether children learn a specific outcome) and other research employs standardised measures of skills (e.g., a standardised mathematics battery). Similarly, some research evaluates and measures play and other research simply includes learning through play as a method of intervention. Each of these kinds of studies can provide important insight, but the variety of tools does present an important challenge for both studying and evaluating the state of the research.

As outlined in this white paper, measurement is a key challenge – from thinking about how play is both measured and facilitated to measuring the holistic skills and sub-skills which are often interdependent and change across development. Below, we outline a number of measurement considerations across holistic skills and highlight some often-used measures. This list is not necessarily exhaustive but instead highlights measures that were used multiple times and are available.

Measures of holistic child development

Examples of some standardised tests that collect data that goes across the holistic skills:

- → Wechsler Intelligence Scale for Children (WISC)
- → Raven's Standard Progressive Matrices Test
- → Monitoring Early Learning and Quality Outcomes (MELQO)
- → Woodcock–Johnson Psycho-Educational Battery
- → Bayley Scales of Infant Development
- → Ages and Stages Questionnaire (ASQ)
- → International Development and Early Learning Assessment (IDELA)
- → The Home Observation for Measurement of the Environment (HOME).

Cognitive skills

The majority of studies investigating the **cognitive** effects of learning through play experiences fall into two distinct classifications:

- → Narrowly focused on a single cognitive outcome – for instance, understanding the features of different shapes (e.g., Fisher et al., 2013), learning new words (e.g., Hassinger-Das et al., 2016), understanding a maths concept (Ramani and Siegler, 2008)
- → Broadly investigating a play-based curriculum on general academic achievement (McGuinness et al., 2014).

For studies focused on a narrow outcome or a specific sub-skill only, the majority of papers designed measures to answer specific questions (e.g., do children show better retention of vocabulary words when presented using method X or method Y?). This provides a high level of internal validity (establishing cause and effect) as these studies are very tightly controlled and few variables are manipulated. However, the generalisability of these studies, i.e., how the findings relate to learning outside laboratory and tightly controlled environments, can be limited.

General cognitive development

- → International Development and Early Learning Assessment (IDELA)
- → Wechsler Preschool and Primary Scale of Intelligence (WPPSI)
- → Wechsler Intelligence Scale for Children (WISC)
- → Woodcock Johnson Tests of Intelligence (WJ)
- → Stanford Binet Intelligence Scale
- → Raven Progressive Matrices Test.

Literacy

- → Quick Interactive Language Screeners (QUILS)
- → Peabody Picture Vocabulary Test (PPVT)
- → Dynamic Indicators of Basic Early Literacy Skills (DIBELS)
- → MacArthur-Bates Communicative Development Inventories (MB-CDIs)
- → Test of Early Language Development (TELD)
- → Reynell Developmental Language Scales and Language Interview.

Mathematics

- → Number Sense Screener (NSS)
- → Panamath (Approximate Number System test)
- → Early Mathematics Assessment System
- → Test of Early Mathematics Ability (TEMA)
- → Tools for Early Assessment in Mathematics (TEAM)
- → Preschool Early Numeracy Screener (PENS)
- → Building Blocks Assessment of Early Mathematics.

Executive function

- → Tap Test (TAP; Diamond and Taylor, 1996)
- → Minnesota Executive Function Scale (MEFS)
- → Three-Dimensional Change Card Sort (DCCS; Zelazo, 2006)
- → Head-Toes-Knees-Shoulders (HTKS; McClelland et al., 2007)
- → Go-no-go paradigm task (Groot, de Sonneville, Stins, and Boomsma, 2004; Robertson, Manly, Andrade, Baddeley, and Yiend, 1997)
- → Standard Dimensional Change Card Sort (Zelazo, 2006)
- → Behavioural Rating Inventory of Executive Function (BRIEF)
- → Forward Digit Span Task.

Social skills

Quantifying **social skills** is certainly challenging. Most of the research reviewed for this white paper used author-generated measures of social skills and standardised tests or subtests of larger batteries. There are two main challenges in the measurement of social skills specifically. First, social skills often are combined with emotional skills, making it difficult to pull apart the measurement of these skills into separate areas. Another major challenge facing the measurement of social skills is that social skills are relative to the communities in which they are being tested. This means that social skills are some of the harder holistic skills to investigate.

Some examples of standardised measures include:

- → Behavior Assessment System for Children (BASC)
- → Second Step Assessment
- → Strengths and Difficulties questionnaire (SDQ)
- → Social Skills Rating System
- → How I Feel Toward Others (HIFTO; Agard et al., 1978).

Emotional skills

Similar to the challenges facing those wanting to measure social skills, measuring **emotional skills** is also limited by both the culture-specific aspects of emotions and the inherent relationship between social and emotional skills. Similarly, the same standardised scales used to measure social skills (e.g., Second Step) are often used to measure emotional variables in children.

Some examples of standardised measures include:

- → California Child Q-Sort (CCQ; Block and Block, 1969)

- → Adjustment Scales for Preschool Intervention (ASPI; Lutz, 1999; Lutz, Fantuzzo, and McDermott, 2002).

Physical skills

Tests of **physical** development vary based on the outcomes in focus for assessment. Technology, perhaps more so than any other developmental domain, provides an unbiased and easy way to assess some physical outcomes. For instance, accelerometers can be used to quickly measure physical activity in children and pedometers can measure steps taken. These provide unique technological solutions to measure physical activity across spaces, times and experiences. There are also standardised measures, such as the Bruininks-Oseretsky Test of Motor Proficiency, that must be administered by a trained professional, but offer comprehensive and standardised ways of assessing wide-ranging motor skill development. Other standardised tests, such as the Movement Assessment Battery for Children, are less comprehensive (in this case, specifically measuring manual dexterity, ball skills and balance). A notable consideration of standardised tests is the potentially high cost of purchasing the testing and training kits, as well as the training demands.

Some examples of standardised measures include:

- → Bruininks-Oseretsky Test of Motor Proficiency
- → Test of Gross Motor Development, Second Edition (TGMD-2)
- → Movement Assessment Battery for Children (Movement ABC)
- → Beery Buktenica Developmental Test of Visual-Motor Integration (Beery VMI).

Creative skills

The measurement of **creativity** has a long history, with measures developed in the middle of the 20th century still in use today. Some measures of creativity ask participants to generate as many potential outcomes/possibilities as they can while others profile the range or uniqueness of responses. There are some standard measures, but also some measures that are used widely in the literature and do not require a standardised test. Many measures only examine divergent thinking, which is only one component of creativity.

Some examples of commonly used standardised scales include:

- → Divergent thinking tasks – e.g., stressed originality and variety – Unusual Uses Task (Wilson, Guilford, and Christensen, 1953)
- → Torrance Test (Torrance, 1990)
- → Wallach and Kogan Test (see Kim, 2006 for a review)
- → Alternate Uses Task (Wallach and Kogan, 1965)
- → Goodenough Harris Draw a Person Task (GHDPT) (1926) MLU
- → Test de Creatividad Infantil (TCI) (Child Creativity Test) (Romo, Alfonso-Benlliure, and Sánchez-Ruíz, 2008)
- → Analysing Children's Creative Thinking Framework (Robson and Rowe, 2012)
- → Test for Creative Thinking - Drawing Production (TCT-DP)
- → Prueba de Imaginacion Creativa-Ninos test (PIC-N; Gonzalez and Mairal, 2004)
- → MacArthur Story Stem Battery (MSSB)
- → Scientific Creativity Test (SCT; Ambo and Siew, 2017).

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