SOCIAL SERVICES IMPROVEMENT PROJECT(SSIP): IMPROVING THE QUALITY OF SERVICES FOR EDUCATION AND CARE OF PRESCHOOL CHILDREN

Foundations for Social Cohesion and Cultural Dialogue Programme Educator Effectiveness Training Series: Module 2

Constructivism, Problem-Based Service-Learning, Learning through Play

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Scientific evidence emphasizes that ECEC is critical for the development of overall brain architecture and executive functioning and has enormous consequences over the course of a lifetime. The development of cognitive skills, social and emotional intelligence, and physical and mental well-being in early childhood form the basis for future learning, personal development, and life achievement for the individual, and on social cohesion and cultural dialogue for the society.[1]

Although learning takes place throughout life, in early childhood, learning is taking place at a speed that will never be equalled.[2] The past four decades of scientific research have established the most important period of human development is from birth to eight years old.[3] Preschool education lays the groundwork for success in school and beyond.[4] Failure to develop these foundational skills can lead to long-term, often irreversible effects on educational attainment, overall health, and productive earnings which later result in significant costs for both individuals and society[5]. Recognizing the importance of ECE, Ministry of Labor and Social Policy (MLSP) has started an expansive reform to increase access to and improve quality of pre-school education in the country.

The children of today are the youth, parents, and leaders of tomorrow. If a holistic neuroscience approach is instilled as a foundation in their early years, children will possess

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[1] Ellis, R. G. & Speaker, R. B., Jr. "Merging neuroscience and education: immersing affective-behavioral-cognitive instruction within the constructs of the academic curriculum." *EDULEARN17. Barcelona, Spain: IATED. (*DOI: 10.21125/edulearn.2017.1137).

[2] National Scientific Council on the Developing Child. (2007). *The Science of Early Childhood Development: Closing the gap between what we know and what we do*. Retrieved from http://developingchild. harvard.edu; UNICEF, *Early Moments Matter, for Every Child*.

[3] Shonkoff, Jack P. and Deborah A. Phillips, eds. (2000). *From neurons to neighborhoods: The science of early child development*, National Research Council, National Academy Press, Washington, D.C; García, Jorge Luis, et al. (2016). *The life-cycle benefits of an influential early childhood program*. No. w22993. National Bureau of Economic Research; Britto, Pia R., et al. (2017). "Nurturing care: promoting early childhood development." *The Lancet* 389.10064, 91-102.

[4] Kaul, V., Bhattacharjea, S., Chaudhary, A. B., Ramanujan, P., Banerji, M., & Nanda, M. (2017). *The India Early Childhood Education Impact Study*, UNICEF, New Delhi; Rao, Nirmala, et al. (2017). "Effectiveness of early childhood interventions in promoting cognitive development in developing countries: A systematic review and meta-analysis." *HK J Paediatric* 22(1), 14-25; Jung, Haeil, & Amer Hasan. (2014). *The Impact of Early Childhood Education on Early Achievement Gaps: Evidence from the Indonesia early childhood education and development (ECED) project*. The World Bank.

[5] Naudeau, S., Kataoka, N.,Valerio, A., et all. (2011). "Investing in young children: an early childhood development guide for policy dialogue and project preparation." *The International Bank for Reconstruction and Development /World Bank*, 15.

the self-respect and self-confidence, self-awareness and self-regulation, social awareness and relationship skills, mental wellbeing and resiliency, responsible decision-making and readiness required to be positive and productive in their community and the world in which they live.

Highly trained, continually supported, and empowered staff are more likely to provide high-quality pedagogy and learning environments, which in turn, fosters children's overall development and increases learning outcomes. The project aims at supporting activities that contribute to strengthening in-service preschool teacher training. In particular, the Ministry of Labor and Social Policy is supported by World Bank, UNICEF, British Government, and Dr. Granger-Ellis in designing and implementing a framework for development of young children and collaborative professional practices based on research from pedagogical, educational and cognitive neuroscience to strengthen the competences of preschool practitioners in implementing knowledge and skills in their teaching practice and providing the utmost learning environment for increased educational attainment. Foundations for Social Cohesion and Cultural Dialogue Programme[6] for pre-school staff creates new opportunities for high-performing pre-school teachers to take on additional leadership responsibilities by becoming national teacher leaders. These teacher leaders are responsible for trainings, analysing data, setting learning goals and achievement plans, evaluating traditional pre-school teachers, and providing individual and team coaching. The programme also includes weekly collaborative mentoring and planning time intended to help teachers learn research-based neuroeducation strategies to meet the specific developmental needs of young children. Lead teachers provide pre-school teachers with individual, early childhood playroom-based support through activities such as demonstrating/modeling lessons, team-teaching, conducting observations, and providing authentic and constructive feedback. They also lead Professional Learning Communities and provide oversight and additional support to other pre-school teachers. This includes a series

of trainings for national teacher leaders (Peer Support Teachers). **This module is the second of the six modules.**

Learning *Through* Play

Often in the field of early child development, we focus on learning goals and playroom activities, cognitive and behavioural development skills, and parent and community relationships. However, have we paused to think about *how* to help children's brains to learn? Have we asked ourselves what are the things that every child truly needs and requires to fully develop in these key neuroplastic years?

A newborn is born with approximately 100 million brain cells or neurons. Each neuron has one axon that sends messages to the thousands of dendrites that receive the messages. These connections represent learning. *Neurons that fire together connect together*. Neural networks will form when we pay attention. Attention is a filter through which we see the world and requires focus and concentration. Forming new connections is energy intensive and our brain is not designed to focus for long periods of time, and it needs frequent periods to rest and refocus to strengthen newly formed connections. When we pay attention, memories are formed, stored and recalled through a long process that involves certain regions of the brain. Without memory, there is no learning. The incoming data is stored in short-term memory, but it will be quickly lost if not consolidated into meaningful connections.

With the right stimulation, a child's brain forms neural connections at a pace of at least 1,000 per second. However, recent indications are that the speed could be up to 1 million per second. These connections are triggered by loving and safe environments with attentive and playful caregivers who fosters secure attachment, contributing to positive social-emotional development.

Play is a fundamental part of life; it is a biological, social, cognitive necessity for children, but also has benefits for society and humankind. At 3 to 5 years, children's language, social-emotional, and cognitive skills are rapidly expanding. During this period, the stimulation and learning that come from play: visual, musical, and theatrical arts and interacting with peers

and caring adults are essential. Play in these years enables children to explore and make sense of the world around them and to use and develop their imagination, abstract and creative thinking skills; reasoning, judgement and decision making; deductive, critical thinking and problem-solving skills. It is very important to understand how the cognitive, socio-emotional and psychological components of the brain and body are best activated and stimulated in young children.

If we do not plan each moment in the playroom according to the architecture of the brain, then we are like glove designers without knowledge of the hand or car designers without a knowledge of engines[7]. It is critical that we understand how best to activate and stimulate the cognitive, emotional, social, and physiological components of a young child's brain and body. Positive, stimulating environments, where brains are free to choose their way of learning, reduce stress in the playroom and allow children great flexibility and creativity. Key principles of play are related to the exercise of the neural networks involved in brain processes during learning, including reward, memory, cognitive flexibility, and stress management.

Principle 1 Neuroplasticity & Constructivism: The Brain Is Continually Growing

The brain is constantly growing, changing and adapting to the environment. Intelligence is not fixed at birth, but varies throughout life, depending on environmental stimulation, hormonal levels, and other chemical reactions that occur in the body.

Principle 2 Purposeful Play: Learning is Broad, Interconnected, and Dynamic.

A "brain-compatible" early childhood playroom enables connection of learning to positive emotions and joy. It requires a range of approaches that help children learn information, acquire skills and cope with new information. The most natural way for this to happen is when children are allowed to make decisions and choices that apply to their learning. Children are the ones who lead the learning, while educators are the guides or facilitators of learning.

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[7] Hart, L. (1999). *Human brain & human learning*, Books for Educators, Brain Age Pub.

Principle 3 Scaffolding for Zones of Proximal Development: The Brain Is Uniquely Organized

Each brain is uniquely organized. *It is easy to focus on the children who are the most persistent; however, each child's brain thinks, feels, and learns differently. By providing appropriate materials, according to the levels for developing their skills, all children can not only celebrate their success, but will also be encouraged to undertake more complex tasks for their development.*

Principle 4 Global Learning: Children's Brains Need to Be Immersed in Real-Life, Hands-On, and Meaningful Learning Experiences.

It involves in-depth, conceptual understanding in which children are active and engaged through social and community (local & global) interaction, with practical and meaningful learning experiences that are intertwined with something in common and require some form of problem solving.

Principle 5 Growth Mindset

The aim is to stimulate their motivation to learn, and their ability to think of alternatives and engage in their environment in a positive way. If we embed the content within play, children will need to 'struggle' with the information to find the underlying idea, which leads to a more deeply developed memory of that concept.

Your Roadmap

1. Neuroscience of Learning through Play
2. Service and Experiential Learning
3. Learning Theories

The concept of play and its relation to learning is complex, both in theory and in practice. In this handbook we will explore these connections from multiple points of view.

First, we explore how neuroscience explains the process of learning through play and brain-targeted teaching, including play and executive functioning and play deprivation.

Second, data from an empirical study of teacher play theories, from Maria Montessori and Reggio Emilia, provides insights into how play is conceptualized and delivered in the early childhood playroom, and how teachers and contexts mediate the relationship between theory and practice. We discuss service learning, with practical ways to include it in the early childhood playroom.

Third, we will explore the dominant theories of learning. We consider the three main schemes of learning theories: behaviourism, cognitivism, and constructivism. We discuss the differences between behaviourism and constructivism, then delve into contrasts between the work of Piaget and Vygotsky, two leading constructivists, and the extent to which they influenced pedagogy.

Neuroscience of Learning Through Play

Teachers should be viewed as "brain developers," and all early childhood playroom doors should read: *Construction Zone: Brains in Progress*. In Brain-Target Four: Teaching for Mastery of Content, Skills, and Concepts, [8] we explore the key concepts related to understanding the neuroscience of play in the early childhood playroom (please see textbook for detailed information).

Emotion and Memory

Most of us remember vivid details when we recall catastrophic or traumatic events. We may have intense recollection of visual images from news and remember where we were, who we were with, the exact time of day, and even the weather. For deeply emotional events or even pleasant ones such as a birth or a wedding, our brains create "flashbulb memories" that last a lifetime. Events producing these memories carry emotional meaning and have lasting effects on learning. Emotional reactions influence what our minds focus on and pay attention to, which directly impacts short-term and long-term memory. Information that causes either positive or negative feelings is remembered better over the long-term (seeing things we cannot unsee or seeing the future emerging into today) than information that is emotionally neutral. Positive emotions to information stimulates a comprehensive neurological understanding and encourages superior performance on reasoning, logic, critical and creative thinking, judgment, decision-making and metacognition.

Growth Mindset, Constructivism, and Cognitive Disequilibrium: Exertion of Effort

The exertion of effort to find meaning is something that occurs naturally when people interpret visual arts and theatrical arts (play). To make sense of a song, poem, play,

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[8] Mariale, H. (2012). *The Brain-Targeted Teaching Model for 21st-Centry Schools.* Thousand Oaks, California: Corwin A SAGE Company.

sculpture or painting, our brains must struggle with ideas before being able to comprehend the meaning. If we embed the content within visual and performing arts, children will need to 'struggle' with the information (exertion of effort) to find the underlying concept, which leads to a more deeply developed memory of that concept. Learning through play and constructivism engages children in the effort of making meaning; educators deliberately make the learning a bit more difficult for the brain to make meaning of the concept to lead to enhanced learning.

Making it just a bit harder for our perceptual systems to deal with what we read—can lead to deeper processing and therefore better retention of material.

Repetition for Memory

The more often groups of neurons fire simultaneously, the more strongly and efficiently signals are transmitted. Repeated activation of neural circuits fixes them together in connectivity patters in order to create memories. The more frequently these neural connections are used, the stronger they become, making memories longer-lasting and easier to recall. The brain needs time to solidify or consolidate memories in long-term storage.

Learning: Arts Integration

The use of the arts as an educational method for enhancing and reinforcing learning is a powerful strategy for ensuring information solidifies in children's memories. Research in the neuro and cognitive sciences have shown naturally integrated artistic activities in instruction supports retention of knowledge and enhances long-term memory. Various modalities of art encourage children to practise information in novel and creative ways with each new iteration, thus repetition and rehearsal are critical pieces of storing learning in long-term memory. Elaboration is a critical tool to make information solidify in long-term memory, particularly when children relate information to themselves in some way. The arts provide students with abundant methods to elaborate on learning content and relate it to their own lives. For example: visual arts (drawing a scene from history, geography, or literature in which children place themselves); creative writing (poetry or song that

demonstrates understanding and includes important facts and details); performing arts (acting out a skit that represents the concept as it relates to them).

Generating Information Through Art

When children create information in response to some form of prompt, their recall and retention of that information is significantly improved. The arts encourage challenging questions, careful observations, multiple viewpoints, and new manners of interpretation. For example, when children are asked to depict ideas visually, they will naturally generate details that would typically be told to them, and these visual details will be retained better. Generating information through art also engages students in various forms of divergent thinking, which leads to a variety of possible end products or solutions.

Play: Performing Arts

Multisensory learning, universal design learning, based on multiple intelligences, gifted, dyslexia, autism, or learning disorders use multiple modalities for expressive language tasks. The performing arts provide a natural way for children to orally produce key content in creative, elaborative ways. Forms such as music, poetry, and plays provide similarly powerful mediums for verbal production of content for long-term memory recall and retention.

Studies have shown that information retention is significantly enhanced when children actively perform an action. Enactment, physically acting out information or ideas, is naturally a part of activities such as role-playing. The physical and mental processes involved in acting out learning content instead of simply reading or listening to it have the power to strengthen material into long-term memory. Dramatic play (performing arts) is enjoyable, and activities that trigger dopamine activate long-term memory in the prefrontal cortex.

Meaning Making

The intense effort to find meaning happens naturally when children are interpreting art. In order to make sense of a painting or poem, we grapple with ideas before being able to understand the meaning. If teachers embed the content within art, children will need to struggle cognitively, to make an effort, in order to understand an underlying idea, which leads to enhanced memory of the concept.

Neuroscience, Learning and Play

Positive, stimulating environments where young children are free to choose their own way of learning helps to reduce stress in the playroom and give them great flexibility and creativity. Educators who work with young children create activities in order to ensure the brain learns in a natural way when children interact with their environment, as the child emotionally, intellectually and physically integrates, providing space for self-discovery.

How well we encode memory is important when we want to recall it in the future. Dopamine serves to strengthen nerve connections with each repetition. Learning is not just about positive experiences: more of our learning takes place through trial and error. Learning from mistakes or trial-and-error (it is *not* referred to as failure) is a fundamental component of constructive learning. Holistic learning recognizes that the brain is not just the information that enters, but the whole content that it represents. The learning environment should address the physical, cognitive, and emotional elements of that environment. Exercising our cognitive system by building more and more advanced neural networks is the core of our mental fitness and also acts as a barrier to cell atrophy in later life.

Activation of emotion during coding of new memory improves it in the future when we want to retrieve it for information. This means that the emotional signals associated with learning content create a deeper and richer neural pathway than fact-based content alone. The need for social interaction is based on the biological need for survival but also for learning. During our childhood and adolescence, we learn through direct experience or observation of others, as well as preparation for social integration, which would increase the motivation and challenge to generate different solutions than when a child would work alone.

Learning through play can happen anywhere, providing opportunities for holistic brain development. Characteristics of the play experience are related to the exercise of the neural

networks involved in brain processes, including reward, memory, cognitive flexibility, and the regulation of stress during learning. Learning should be:

Joyful - Joy is one of the most powerful emotions when it comes to learning. It is associated with increased dopamine levels in the brain's reward system linked to enhanced memory, attention, mental shifting, creativity, motivation and stress management. Emotions are integral to the neural networks (prefrontal cortex) responsible for all learning, particularly to make decisions, evaluate and determine what is most important for the brain to learn.

Meaningful - Meaningful experience provides opportunities for learning progress. When switching from hard to automatic processing, learning progresses and the way of thinking is supported by experiences that are meaningful such as contextual learning, analog thinking and encouragement. Making connections between familiar and unfamiliar stimuli guides the brain in making difficult learning easier. Meaningful experiences introduce novel stimuli linking to existing mental frameworks; processing these stimuli recruits networks in the brain associated with analogical thinking, memory, transfer, metacognition, creating insight, motivation and reward.

Active - Active involvement in play requires attention and response to higher cognitive processes useful for learning, such as directed behavior, reward, awareness, long-term memory recovery and stress management. Being an active participant in children's learning provides them with more experience and acts as a catalyst to seek more information and take more action. Active engagement increases brain activation related to agency, decision making, and flow and enhances memory encoding and retrieval processes. Full engagement in a learning task allows the brain to exercise networks responsible for executive functioning skills, such as the ability to stay selectively focused on the situation at present, tune out distractions, and hold the information in our heads, which benefit short term and lifelong learning. A study comparing children assigned to Montessori and non-Montessori schools, discovered that the Montessori children, who had fewer interruptions during their learning activities, performed better at executive functioning tasks.

Repeated - Repetition of a learning task and thought enables new discoveries with each new experience. Effort is key to lifelong learning and is associated with imagination, problem solving, and developing rational reasoning. Perseverance associated with repetition thinking is linked to reward and memory networks that underpin learning. With each practice, repetition increasingly engages networks related to taking alternative perspectives, flexible thinking, and creativity. Evidence suggests that the more improvisation thinking we engage in, the better prepared we become to iterate further.

Socially interactive -Peer interactions help children develop language and skills such as collaboration, adaptability, and cognitive disequilibrium—all of which are brain processes that help us interpret and understand others from a different perspective. Positive caregiver and child interactions help build the neural foundations for developing healthy social-emotional regulation and protecting from learning barriers, such as stress. In addition, early social interaction promotes plasticity in the brain to help cope with challenges later in life. Social interaction activates brain networks related to understanding the mental states of others, which can be critical for teaching and learning interpersonal intelligence and empathy.

Play Deprivation

Play deprivation is highly detrimental to children, communities, and society. If children do not play, their brains will not grow as they should. Not being able to play deprives children of experiences that are developmentally essential and results in being emotionally, physically, cognitively, and socially disabled. If normal play experiences are absent, the child is more likely to become violent and antisocial. If children are kept inside and not allowed out to play several times throughout the day, they will suffer symptoms ranging from aggression, withdrawal, repressed emotions and reduced social skills, to obesity and unhealthy lifestyles. Continuous sensory deprivation causes a gradual loss of electrical activity in the brain.

Play and Executive Functioning

The experience of play changes the connections of the neurons in the prefrontal cortex. Without play experience, those neurons are not changed. Changes in the prefrontal cortex during childhood help wire up the brain's executive control center, which has a critical role in regulating emotions, making plans, and solving problems.

Play is what prepares a young brain for life. To produce this brain development, children need to engage in free play: children have to negotiate. The brain builds new circuits in the prefrontal cortex to help it navigate these complex social interactions.

Play is self-chosen. Without active choice and engagement the learning task is empty and reduced in meaning and significance. Performing an learning task fully immersed in a feeling of energised focus, full involvement, and enjoyment in the process.

The drive to play is innate. Playing is a developmental process, not an activity. Play takes many forms, replicating the evolution of play through bodily actions, social interactions and the development of symbolic thinking.

Play activates the whole neocortex and initiates lasting changes in areas of the brain used for thinking and processing social interactions. About one-third of genes were significantly changed simply by having a half-hour of play.

Neuroscience, Play, and Child Development

Cognitive Development

More than a billion neurons in the brain are dedicated to analyzing and solving problems. Sensory information is interpreted, compared with previous memories and information, and then answered. A relatively small number of neurons are involved in direct sensory

interaction or in regulating the body's basic processes. Brain development and cognitive achievement in young children are well disguised in a seemingly harmless game cloak. Only neuroscientists see physical evidence that reveals the consequences of positive stimulation or neglect in the environment in which they live.

Language Development

The brain of normal children is designed to learn any language from birth. Language learning begins long before babies can say the first words. Language should be taught in preschool and before school. Vocabulary development is strongly related to parents talking to their children. Through conversation, parents strengthen the neural pathways necessary for language development. Living language is warm, it contains emotions that the adult conveys, and thus further strengthens the development of the language.

Social Development

The importance of socialization in young children with adults and older children was emphasized in Vygotsky's theory, which showed that play is the result of high mental functions and develops through the interaction between child and educator and socialization with older children. Play helps to develop cooperation, sharing, negotiation and problem solving and helps children fit into an increasingly complex world.

Emotional Development

The basic nerve endings that control emotions in children are created before they are born. Parents play an important role in a child's emotions. Shared experience amplifies chemical or electrical signals in the brain and thus calms the nerve endings in the brain. Stress also has its effect. Repeated stress changes the structure of the brain. Play is the language in which children communicate. While adults talk about their traumatic experiences, children express their traumas through play. They may lack words or cognitive abilities to understand what has happened to them but play has a therapeutic role that allows them to overcome their conflicts.

Physical Development

Intense sensory and physical stimulation is key to the growth of synapses in the cerebellum, a region that regulates muscle coordination and control. The neural pathways connecting the cortex and muscles were strengthened by repetitive motor movements. Adults must provide experiences that will initiate neural structures for skills that they will need to achieve in a caring and supportive manner.

Theoretical Foundations:

Behaviourism, Cognitivism, and Constructivism

There are many theories for educational learning, how can we use them in the playroom? How do we know which ones are relevant and are based in the neuroscience of learning? Learning theories in education are concepts that describe how information is received, processed, and retained during learning. In ancient Greece, Plato first considered the question, "How does the individual learn something new if the subject itself is new to them?" Since Plato, many prolific theorists have emerged, from Vygotsky to Piaget and Bloom to Maslow and Bruner, we will explore the ones that are evidence-based and supported by neuroeducation research and best-practices in the playroom.
Learning is a process by which the brain incorporates experience with new knowledge or skills in its repertoire. It is the way we acquire, generalize, contextualize and change our cognitive and behaviour patterns and our way of interpreting the world around us.

Behaviourism: Learning as Association

Behaviourism is one of the most well-known paradigms, having a significant impact on various dimensions of psychology, including clinical and educational.

Behaviourism is a theory that sees learning as a set of behavioural changes. Behaviour is based on the idea that knowledge is independent of the student. Through this interaction, new associations are made and thus learning takes place. Learning is achieved when the stimulus provided changes behaviour. This theory is based on the relationship between stimulus and stimulus response (conditioning), and this relationship is strengthened by reward or non-reward in order to achieve the desired behaviour.

Behavioural learning patterns that arise from the association between different possible stimuli, in which elements that in themselves generate aversion or desire are connected to others through contact in space and time, reaching the latter to acquire the characteristics

of the former and causing the same reactions in the body. Later, the individual may generalize these associations to similar stimuli and situations. Thus, behaviourism methodology is based on gathering information from experiments in which both stimuli and response are directly evident as physiological information. Learning is acquired through the repetition of associations between stimuli in the environment.

Cognitivism: Learning as Transformation

Cognitivism focuses on the idea that children process the information they receive, rather than just responding to a stimulus. Cognitive theories describe memory as an active organized processor that processes information, with prior knowledge playing an important role in learning. Cognitive theories purport that memory is an important learning factor and understanding how the brain forms short-term and long-term memory is crucial.

In cognitivism, learning occurs when a person reorganizes information, either by finding new explanations or adapting old ones. This is seen as a change in knowledge and is stored in memory, rather than just seen as a change in behaviour. Teachers can incorporate cognitivism into their early childhood playroom by encouraging children to link concepts together and linking concepts to real-world examples, discussions and problem solving.

Constructivism: Learning How to Create Meaning

Constructivism posits that knowledge arises through a process of active construction, in essence, it is constructed rather than innate, or passively absorbed. Learning is developed through the children's experiences with their environment, actively building or constructing their knowledge and based on previous learning. This prior knowledge influences what new or modified knowledge a child will construct from new learning experiences. Put another way, learning is a process of acquiring and consolidating information based on the child's mental processes. The child plays an active role in this process, attaching information or modifying their mental patterns based on the experiences they live, endeavouring to give meaning to the world around them. Learning is achieved through the construction and

reconstruction of mental models, merging prior knowledge and new knowledge in order to give meaning within the broader systems.

Humans create meaning, we do not develop it. Our brains make or 'construct' meaning from interaction with the environment. The brain processes of learning and understanding knowledge are defined by how the child creates meaning from his or her own lived experiences. Memory is always building as a cumulative history of all interactions. Children do not transfer knowledge from the outside world into their memories, i.e. representations of interactions and experiences are not structured into a single, formal piece of knowledge and then stored in the brain. We make, create, and build personal interpretations of the world based on individual experiences and interactions. The brain filters input from the world through interaction with the environment in order to create meaning and produce its own unique reality. Therefore, the 'knowledge' in the brain is constantly open to change; there is not an objective reality that we are trying to know. Knowledge of our world comes from our own interpretations of our experiences. Since there are many possible meanings from any experience, there is no predetermined, "correct" meaning.

The Role of Context in Constructivism: Creating Meaning from Experience

The role of the educator is not directive, but it is a guide for the child to be able to draw their own conclusions from their interactions with their reality (environment). This generates learning that is shared and adaptable to the environment. Appropriate supplemental tools/materials must be provided and adapted to each situation so that any child can scaffold the information and knowledge.

Constructivism (building on cognitive neuroscience) emphasizes the importance of actively engaging the brain, which only learns and "constructs" knowledge by upgrading new knowledge and experience of the existing knowledge schema. Constructivism is based on the premise that we construct learning, new ideas based on our own prior knowledge and new experiences and interactions with our world. Knowledge emerges in situations that the

learner feels is relevant. It is essential that curriculum content be embedded in the situation in which it is used (i.e. learning a new words is enhanced by exposure and repeated interaction with those words in context). Concepts continually evolve with each new use (i.e. new interactions with known words are constantly changing a learner's "current" understanding of a word).

The goal of teaching is not for children to know particular facts. The goal is for children to interpret information and elaborate, expand, and build on it. Understanding and knowledge is developed through continued, situational use and not in a definition that can be recalled from memory.[9] Situations co-produce knowledge (along with cognition) through learning tasks. Every action is interpreted as understanding the current situation based on the entire history of previous interactions in the brain. (every action stimulates the brain to search for any prior experience with this information). It is critical that learning occur in *realistic* settings and that the selected learning tasks be relevant to the students' lived experience (the brain is continuing to refine, strengthen, and expand it's previous schematic connection to concepts).

Children adjust their mental models of understanding either by thinking about previous theories or by solving new problems, dilemmas, or misconceptions. The curriculum should be designed in a way that supports the upgrading of new knowledge into existing ones. A concept will continue to develop with each new use, new situation, new negotiation. New activities are designed to modify it in a different, more advanced form, perspective, and use. This requires an understanding of students' current cognitive development. Students need to have a prior knowledge base for constructivist approaches to be effective. Bruner's spiral curriculum is a great example of constructivism in action.

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[9] Brown, J. S., Collins, A., & Duguid, S. (1989). Situated cognition and the culture of learning. *Educational Researcher, 18*(1), 32–42.

Because students build their own knowledge base, the educator's anticipated or desired results may not be obtained, so the educator's task is to probe and question any misconceptions that have arisen. The emphasis is not on retrieving knowledge structures, but on providing children with the means to create novel and situation-specific understandings, relationships, and experiences by "assembling" prior knowledge from diverse sources appropriate to the problem at hand. Examples of constructivism include problem-based learning, global service-learning, research and creative projects (better results are typically attained with small groups in collaboration).[10]

Behaviourism	Learning and behaviour changes are aquired by linking stimuli and response
Cognitivism	Learning is internal and is a result of a student processing and organising new information
Constructivism	Knowledge is constructed by adapting new information based on previous experience

As educators shift from behaviorist to cognitivist to constructivist, our focus shifts from teaching to learning, we shift from understanding education as the passive transfer of facts and routines to the active application of ideas, concepts to problems in context.

[10] Bednar, A. K., Cunningham, D., Duffy, T. M., & Perry, J. D. (1991). Theory into practice: How do we link? In G. J. Anglin (Ed.), *Instructional technology: Past, present, and future*. Englewood, CO: Libraries Unlimited.

Constructivist educators emphasize divergent thinking and flexible utilisation of pre-existing schema and mental models (prior knowledge) instead of recall of pre-existing schemas. Knowledge is dynamic and constantly changing with each experience. The process of memory is not independent of the context in which it is formed, retained or recalled. Mental understandings developed through deep engagement with the concept or task increase the proficiency and mastery of advanced or broadened tasks performed in similar or self-same environments.

Traditional Early childhood playroom	Constructivist Early childhood playroom
Curriculum is designed to teach parts of the whole concept (pieces of knowledge build to larger goal of knowledge). Focuses on mastery of basic skills.	Curriculum begins with the whole concept and expands to include the parts. Focuses on mastery of big concepts.
Strict following of the national curriculum.	Follows children's questions and interests.
Materials: books and worksheets.	Materials: original sources and manipulatives.
Learning is based on repetition.	Learning is interactive and based on what students' already know (Zone of Proximal Development)
Educators teach the information to children; and children receive the knowledge.	Educators have conversations with children, helping children construct their own knowledge.
Educator is the authority and directs the class.	Teaching is interactive and lessons are based on negotiation.
Students are assessed based on end products.	Process is more important than product. (children's observations, points and view, and discussions are assessed not the outputs or end products).
Knowledge is seen as passive or given to the children.	Knowledge is dynamic and constantly changing with each experience.

Most of the time, children complete work individually.	Most of the time, children complete work as a group.

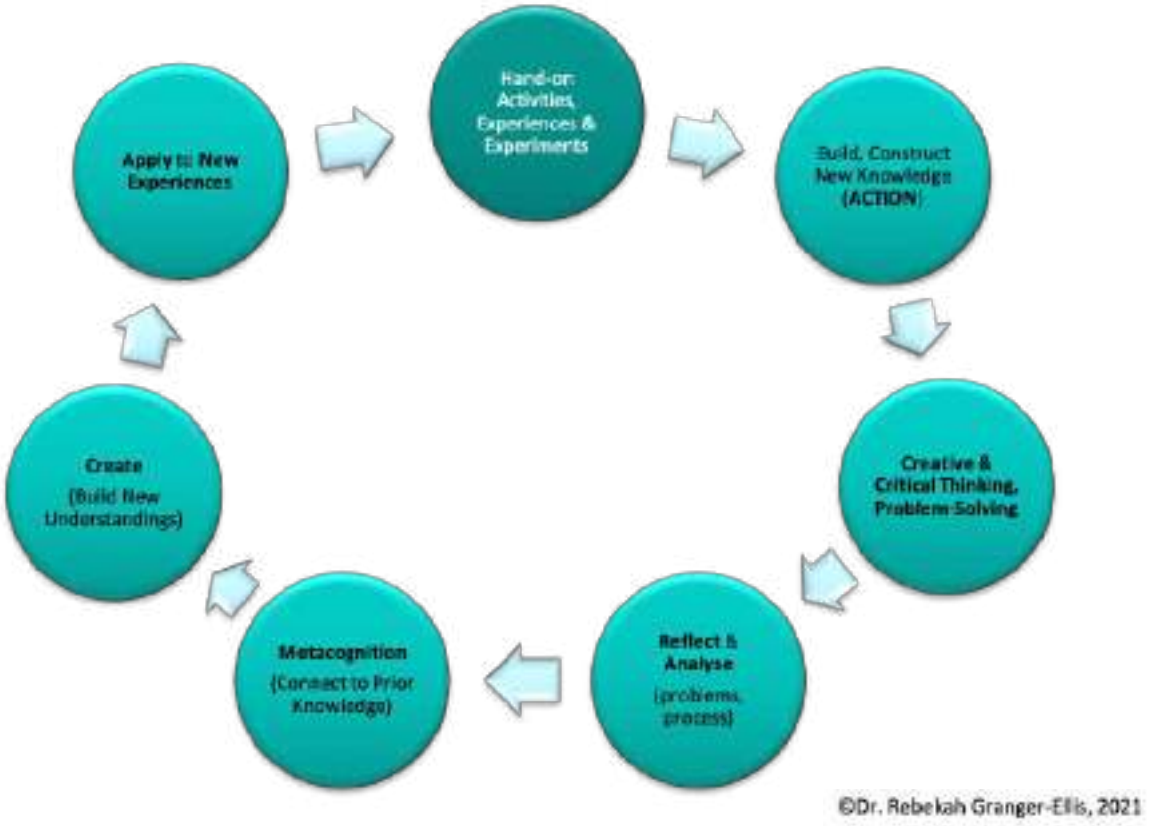
It is not possible to isolate elements of information or divide knowledge domains in the brain, everything is inextricably interconnected and interdependent. In other words, learning always takes place in context.

Knowledge and understanding is processed and stored by the brain according to experience (i.e. word meanings are tied to specific occasions of use), therefore it is critical for the experience to be authentic in order for the child to be able to use the knowledge in the future. Authentic tasks secured (anchored) in meaningful contexts form an inflexible link with the context-embedded knowledge. This is accomplished by creating meaning, understanding, and intellectual tools which reflect the insights and experiences of children and are based in the context/culture in which they are experienced.

If we desire for learning to be effective and permanent, then it must include all crucial factors: meaningful (authentic), practice (learning task), knowledge (concept), and context (culture). This required a shift in our own mental models as educators. The goal of education is not as we previously understood: to define the learning and shape the activities and tasks required to achieve knowledge. Our role as educators is to accurately portray the content and task in context, to engage the children in the actual use of thinking tools (mental models) in real-world situations. If learning is decontextualized, transfer cannot occur. The brain does not learn to use cognitive tools simply by following a list of rules, procedures, directions. Successful and effective use of the knowledge structure comes from engaging the child in the actual use of the cognitive tool (thinking and performing) in real-world situations. Children gain additional knowledge in the conceptual

skills needed to deal with complex and intricate, and obscure problems. They construct new perspectives, explore and experiment from multiple sources, validate through social cooperation, and solidify their new understandings.

Constructivist educators incorporate all learning in real-world, global-learning contexts; model and coach children to 'expert' application; present multiple perspectives; encourage social negotiation, debate, discussion with collaborative learning and alternative views; require knowledge to be presented in a variety of different ways by revisiting content at different times, contexts, purposes, and conceptual perspectives throughout the year; stimulate metacognition with reflective awareness; and assess children on transfer of mental models, knowledge and skills (ability to utilise cognitive tools for new contexts, problems, situations).



Even though the emphasis is on learner's construction, the teacher's role is still critical as the designer: (1) to instruct the child on how to construct meaning, as well as how to effectively monitor, evaluate, and update those constructions; and (2) to align and design experiences for the child so that authentic, relevant contexts can be experienced.

Service Learning, Experiential Learning

The way students learn is more important than how the educator teaches. Every child develops and progresses differently. Hence, it is increasingly difficult for children to make a connection between what they learn in traditional early childhood playrooms and life problems, (i.e. they have difficulty applying traditionally 'taught' knowledge when solving real-life situations).

Building on constructivism, global service learning (problem-based community learning, real-world learning, experiential learning) is based on knowledge building, problem solving, coping and correlation with the problems and challenges of real life and the world.
From everything that has emerged from the *Framework for Social Cohesion and Cultural Dialogue*[11], we can emphasize that without changing the national curriculum, we can implement a reform of the education system by simply shifting to a nueroeducation mindset and child (young brain) centered perspective.

When we develop the Framework for Social Cohesion and Cultural Dialogue in more detail, we will see that it takes in the toolkit for social development, behavioral development and the mental processes that activate and direct behaviour through:

- Social Intelligence,
- Constructivism,
- Service and Experiential Learning,
- Purposeful Play
- Community Mentoring

In this regard, service learning, experiential learning, learning about the world, problem learning are closely related to "Brain Target 5", of Brain-Targeted Teaching12, which explores enduring learning—applying knowledge in real tasks, in the real world, which require creative and critical thinking, and problem solving.

This teaching encourages divergent learning. The term divergence means "development in different directions", and divergent thinking opens your mind in all directions. It opens up new possibilities in life situations because it leads you to consider options that may not be so obvious at first. As such it is at the very core of creative thinking and quite the opposite of convergent.

Characteristics include:

- Comparisons
- Classifications
- Tasks of divergent thinking
- Creative application of content
- Analysis and synthesis
- Metaphors and analogies
- Cause and effect
- Investigations
- Experiments
- Solve problems using the real world

Service learning, a form of experiential education, takes place through a cycle of action and reflection, as children seek to achieve realistic goals for their community (or world) and a deeper understanding of their own skills, capacities, purpose, and connections. In essence, children learn all educational standards by solving authentic problems in their community, society, or planet.

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[12] Mariale, H. (2012). *The Brain-Targeted Teaching Model for 21st-Centry Schools.* Thousand Oaks, California: Corwin A SAGE Company.

Learning and acting through service learning give young people the goal and motivation to think well and do well because what they do is vital and important for something they care about deeply. Global-learning or service-learning nurtures a caring community and prepares children for responsible social action, as well as for continuing education and careers. In the future, these skills, practices, thinking, and abilities help us build a more generous, connected, and civil society. Hence the name: Foundations for Social Cohesion and Cultural Dialogue. In community learning, service learning adds value and transforms both knowledge and the world and emphasizes that academic knowledge is minor in terms of the need and significance of pro-social behavior and connection to real needs in the world, as well as the socio-emotional capacities of the child.

Service learning is far from a new concept. The theoretical roots can be traced to the writings of Dewey and Piaget, who argued that knowledge is built on experience and active engagement is a necessary ingredient for optimal learning. They emphasized the importance of purposeful learning.

Service learning activities usually consist of five basic components:

- investigation
- preparation & planning
- action
- reflection
- celebration (publication, etc.)

Components of Service-Learning (community & global learning)

- Duration and intensity. Service learning allows for the necessary duration and intensity to address community needs and meet specified outcomes.
- Relation to the curriculum. Service learning is deliberately used as the main teaching strategy to meet learning objectives and / or content standards.

- Partnerships. Service-learning partnerships are collaborative, mutually beneficial and meet the needs of the community or global needs.
- Meaningful service. Learning actively involves children in meaningful and personally relevant activities (self or group-selected)
- Voice of youth. Service-learning enables children to take the leadership role in the planning, implementation, and evaluation of experiences and to send a strong message to adults as to the needs of their community, society, and world.
- Diversity. Service learning promotes an understanding of diversity and mutual respect among all participants, particularly focusing on community or global diversity.
- Reflection. Service learning involves challenging reflection activities that are ongoing throughout the projects and encourage deep reflection, analysis, and awareness about oneself and one's relationship with society.
- Monitoring progress. Service learning engages participants in an ongoing process to assess the quality of implementation and progress towards meeting the stated goals and uses results for improvement and sustainability.

I Think, We Think, You Think: Productive Struggle Gradual Release of Responsibility

Gradual release is a way to apply neuroeducation and universal design instruction principles to all content as the responsibility for learning gradually shifts to the learners as they build cognitive confidence and competence, supporting their interests, learning profiles, and knowledge readiness.[13] The basic principles of this are teacher modelling (thinking aloud), prompt to thinking together (teacher and class together co-construct or models with small group of children), independent practice (collaborative pairs or teams of children work

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[13] Fisher, D., & Frey, N. (2008). *Better learning through structured teaching: A framework for the gradual release of responsibility*. Alexandria, VA: ASCD.

together to construct) and novel application (applying thinking skill to new or modified applications). In the "We Think" phase of learning, the teacher continues to model, question, prompt, and stimulate children to ask each other's thinking; but as children move into the "You Think" phases, they rely more and more on their own mental models and learning connections and less on the teacher to engage in the learning task.[14] Through gradual release, the children gain the new information and skills, and the responsibility of learning in the playroom shifts from teacher-directed instruction and activities to children-directed thinking and processing learning tasks.

I Think

In the first phase, the teacher thinks aloud and models the processes necessary to understand a learning concept, performing the thinking and learning task skills in the new concept being introduced, along with scaffolding the tasks. This phase is critical for those children who need extra time to process and understand the concept. It gives all children time to process the information through their zone of proximal development. As teachers, we are purposely thinking through new dendritic connections. (i.e. *Hmmm.. where have I seen or heard something like this before?*) All students are simply listening and watching the process as the teacher models.[15] When scaffolding, the larger chunks of information are broken down into smaller and more achievable thinking processes and steps. It is critical for the teacher to explain the reasoning behind these processes and steps, along with helping children grasp what they should *notice* and *remember*. Children cannot simply be "told" what they need to know, as that does not enable new mental models or help them store it in memory – instead they have to "see" it in their mind's eye.

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[14] Levy, E. (2007). Gradual Release of Responsibility: I do, We do, You do. Retrieved October 12, 2015, from http://www.sjboces.org/doc/Gifted/GradualReleaseResponsibilityJan08.pdf

[15] McCoy, A. (2011, March 4). Teaching New Concepts: "I Do It, We Do It, You Do It" Method. Retrieved October 13, 2015, from http://antoinemccoy.com/teaching-new-concepts

This is particularly important in reading as young children can listen to a book being read aloud and see and hear the way their teacher models a 'think aloud' while reading because this is when they are learning critical thinking and comprehension reading skills that are necessary to develop into a skilled reader.

We Think

After the teacher models the correct way to think through, understand, and construct/perform the new concept, she partners with the children and work through some examples together (partner with one child or a few children). The teacher and the children work together through the steps modelled during "I Think" phase. This allows for a deeper level of learning to develop. This phase allows a teacher to guide and encourage children through the process being taught without leaving them to struggle individually with the new material they are learning. In 'We Think' the teacher is a guide or a coach to help children try to do it independently, she is coaching them through the thinking skills (not how to do the learning task, but how to THINK through the learning task). This phase is critical in building confidence for children who are shy or who have learning disabilities, autism, etc. [16] Children will most likely need more than one attempt at practicing with the teacher during this phase. Teachers should not expect children to be ready for the "You Think" phase after only one We Think modelling.

You Think

Once children have demonstrated understanding and the small group can independently complete the task (with the other children helping them think through it), the children move into the You Think phase. In this phase, children demonstrate their early levels of understanding of the new concept through independently practicing the learning task. While the teacher is still available as needed (*ask 3 before me*), Children practice the

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[16] McCoy, A. (2011, March 4). Teaching New Concepts: "I Do It, We Do It, You Do It" Method. Retrieved October 13, 2015, from http://antoinemccoy.com/teaching-new-concepts

concept or thinking skill repeatedly in small groups until it is mastered. Often concepts involve a lot of steps and skills that need to be integrated all at the same time. If children miss a crucial step or are missing specific skill sets, it can make learning the new concept extremely difficult.

Flipping It Around: An Inquiry-Based Approach

Inquiry-based or constructivists lessons begin with *You Think* and allow children the opportunity to make sense of things for themselves. They make sense of problems and persevere in thinking through them. The neuroeducation theory is that if children work through the thinking processes and learning tasks steps on their own, there is a strong likelihood of retaining the information than if simply modelled and demonstrated the thinking and process steps in the learning task.

Flipping the Productive Struggle Gradual Release (PSGR) model, starting with a *You Think* instead of the teacher-centred *I Think*, allows children to grapple and struggle with new concepts and deepen their understanding through problem solving, reasoning, experimentation, determination, and perseverance. By flipping the model at the beginning of an instructional unit, children take personal ownership of the new content, making meaningful connections with prior knowledge through constructive cognitive disequilibrium, embracing the struggle and forming new dendritic connections. The teacher functions *only* as a facilitator, so that children can learn through their own explorations.

Although it can take on many forms, inquiry-based PSGR often begins with children moving between learning centres or stations to solve different problems or learning tasks, *You Think*. Children use prior knowledge and work together to solve each learning station's problem using manipulatives. The teacher as facilitator simply moves between the learning stations, listening to the children’s discussions, sharing learning insights between the groups, and providing guiding questions to help students through the constructive cognitive disequilibrium. After a period of time, the teacher gathers the children together to discuss their thinking, reasoning, and experimentation. This allows children to engage in inquiry,

abstraction, experimentation, problem-solving, reasoning, judgment, and decision-making thinking processes and metacognition—thinking about their thinking.

During the *We Think* phase, the teacher presents an additional problem or learning task to the children. The entire group then works together by incorporating their discoveries from the *You Think* explorations and modelling their improved solutions. The teacher guides the children through whole-group discussions of previous misconceptions or misunderstandings they experienced during the *You Think* phase and inviting them to defend and explain their strategies and engage in problem-solving discussions as a group.

A zone of proximal development quick assessment should be carried out before the teacher moves to the last phase, *I Think*. This enables the teacher to provide instruction that is based on real-time data. Children who can solve problems independently, transition to scaffolded independent learning tasks and practice; whereas, children who need individualised support, can participate in a small group *I Think* where the teacher thinks aloud in small chunks, breaking down the learning step-by-step.

Following the gradual release and productive struggle, enables the children to take ownership of their new mental models and embrace challenges with determination and perseverance. If we want children to develop the skills they need to succeed in life outside of the playroom, then we need to design learning experiences that develop the thinking skills to keep them curious for exploration, embracing the struggle, actively engaged, and intrinsically motivated to tackle any problem or new situation.

Additional Sources (Peer Support Teachers)

Zone Of Proximal Development in Play

by Maja Beltaseva

Vygotsky shared similar view with Piaget in a way that they both look at the child as curious and problem solving being who plays active role in its own developmental procedures. Furthermore, Vygotsky acknowledges the role of more knowledgeable others in the child's development. He believed that the child acquires the framework of thought and thinking from the adults that it interacts with. These knowledgeable others provide the child with scaffolding that it works towards greater understanding. (Birch 1997, 80-82)

According to Vygotsky, language development and cognitive development are highly interrelated. Language is the tool that individuals use to organize their thoughts. However, it is also dependent to the culture around and the level of support available. Based on Vygotky, there are three major elements that lead to a fully child's ability to respond to the world through action. This basically does not demand language. On the second level, the child is expected to reflect on her own ideas through language. It can be self-talk to solve a certain problem. Thirdly, learning of the world happens through cooperation in different social settings. It is when children interact with parents, peers, teachers and other significant people in their lives. The children learn their culture through art and language, comparisons and explanations, songs and plays. It is emphasized that children learn through knowing their culture and using it as framework to understand their world. (Birch 1997, 80-82)

Vygotsky saw play among children as major contributor to the overall development of children. He paid special attention to rules of play. When children are faced with problems or when they are challenged, they create a make-believe condition which is easier to cope with. It is usually in such conditions that rulers can hospital. The rules they come with can make them behave in a manner which is out of the reality around them. This is usually noticed when children have role plays. He believed that play creates a 'zone of proximal development' in children's level where they act or operate above their normal age level. One way of assessing a child's potential development at a particular time, Vygostsky believed, is to note the distance between the levels of activity reached during play and those of her customary behavior. (Birch1997, 57)

These problems were content problem and instruction problem. The first on happens when the children are not able to understand the subject matter introduced to them while the second one is the planning and implementation of instruction does not meet the level of children and they encounter problem of learning because of it. To solve these problems, the theory of the zone of proximal development was adapted in class rooms so that the children were working in group most of the times doing experiments and discussions. All then children were also constantly forced to act so that they could learn better than following the normal teacher lecture by sitting down as a group. (Daniels 1996, 177-182)

Based on the findings, children come up with different rules to overcome different challenges. In this regard, Vygotsky considers rulemaking as one way of children's coping with a challenging situation. It has been found that even when children want to start a new play and are not sure if it is going to be fun or not, the first solution they come up with is designing rule for it so that it could be more meaningful and fun. In addition, children at play are usually at their zone of proximal development than their actual zone of achievement. (Birch, 1997:57)

The children at play are usually challenged from two directions. One is the challenge of demand to be creative consistently in order to keep their play interesting throughout the play time and the other one is to play with their play mates peacefully. Children tend to overcome all types of challenges through rule making and sticking to their rules. It has covered big part of the findings section that how they differently and widely come up with their own rules and enforce the general societal rules in order to play together as a group. The most interesting point regarding this is that most of them do not show those abilities in formal settings like circle time or story time or when they do activities that are given to them by teachers. That is why teachers have to be careful when they describe the level of their children as the zone of proximal development is not necessarily visible in formal settings. On the other hand, even if it is not visible on formal settings it determines how the following the teaching should be done, on what areas the kids need higher support and what plans should be made for the next lessons or activities.

Constructivism, From Theory to Practice

Children – the next generations, because they belong to the 21st century – will live with globalization and computerization / digitalization on the one hand, but also with the negative phenomenon of climate change on the other hand. Between these two modern conflicts the educational work made a big step and the traditional understanding replace learning with modern methods, practices and tools. In the past (traditionally) it was enough to have a play chair and a play table in the kindergarten.

"... In today's early childhood playrooms, the traditional methods commonly associated with objectivism, behaviorism, and teaching models are being replaced by approaches that emphasize active learning and the different needs of students (Roessingh & Chambers, 2011). These non-traditional, active learning methods have become a necessity at all levels of education in order to support the acquisition of 21st century students by students with new and modern knowledge (Nimi, 2002) ... "

Today's traditional understanding is surpassed especially by the theories and practices of learning by Jean Piaget and Lev Vygotsky who not only pushed the boundaries of a modern approach to educational work, but with their methods and theories contributed to a fundamental change in the understanding of the relationship: child-educator, learning-knowledge and creation of new practices in accordance with modern needs. Thus, the child is no longer an object in the playroom and in front of the educator, but becomes a subject in creating the path for acquiring new knowledge. That clearly and unequivocally inevitably and responsibly, the educator must also make a new step by appearing in the role of a researcher, which means that his work should be constantly upgraded and confirmed through creative activities in which the child will express his desires and interests for learning, but equally and for offering their own and creative solutions. So, the change and the position of the educator, because now he is required to develop the inner creative potentials that should always be in the center of attention, and then the educator should constantly encourage learning in children by thinking not only about new ideas but and the specifically offered solutions, realized in learning, and equally acquired new knowledge, in order to achieve high quality in the development of children in terms of their acquisition of new knowledge and learning.

This sufficiently and clearly shows the inspiring path of the theory of learning which is also called the theory of constructivism. "... Constructivism is a philosophical and scientific position that knowledge appears through a process of active construction (Mascolol & Fischer, 2005)

The deconstruction of the word constructivism from an etymological point of view shows and proves that it is actually a matter of acquiring a new position equally important to the

educator, but also to the children. The children in the group pass into their phase in which they appear as constructors of the topic / game / learning and discoverers of new knowledge and knowledge, but also as researchers on an equal footing with the educator.

To achieve this goal, today the educator has at his disposal numerous objects and tools for the realization of the constructivist occupation, acquisition and enrichment of children with new knowledge and teachings in which they equally participate together in everything they want to achieve. In this sense, the theoretical settings not only of Piaget but also of Vygotsky are especially important. With this we touch on the question that behaviorism, which has hitherto been a validated theory, consisted in the fact that children should always be conditioned and rewarded for what they have achieved. In contrast, constructivism, which is especially established and affirmed as a special theoretical view and practical approach to learning in the last three decades, has placed the educator in a role to follow the research results on the topic and to compile his curriculum according to the actual needs of children. in the group. To achieve this, efforts must be made by the educator to ensure a balanced holistic development of the children with equal emphasis: first on the cognitive, second on the socio-emotional and third on the physical development of the children. The educator is called to follow, respect and encourage children's interests, to think / produce creative activities that will constantly provoke and encourage creative passion and interest in children, than for example the educator to realize an activity in which he is a subject. , and child / children objects. The fact that all children can learn and learn, explore and solve problems, but also give new ideas unequivocally shows that only then children through solving problems and upgrading their learning with new knowledge will not only show success, but and will advance in learning and memory.

Constructivism basically provides children with an inspirational impulse to express new creative possibilities, which will be realized at the specific moment, which means that the child goes through several rapid stages based on a modern approach to learning and creating their own facts and knowledge that forms the basis of the acquired teaching and learning. At the same time, a modern approach is being built.

To make it easier to understand constructivism as a modern theory and practice, one must first cross paths with the traditional method of learning and teaching, and accept the understanding that modern children acquire their knowledge primarily as a result of their internal process and constant development. encouraged and supported in the environment in which it grows and develops, ie by the efforts of the educator. The teachings of Piaget, Vygotsky, Bruner and Bandura should be especially emphasized here, which complement and open perspectives and opportunities for children for new creative approaches to learning.

Let us recall if Jean Piaget's theory is based on cognitive-developmental constructivism, and its maxim is: How children imagine / contemplate and participate in the world with their

needs and opportunities acquired through learning and teaching. Vygotsky's theory and his socio-cultural constructivism ask the question: Does the world shape children in their future development and to what extent? Bandura's theory of constructivism then expands the horizon by adding and incorporating elements that only elevate it to an even higher level of cons Tractivist teaching and learning, in which the child / children are the amalgam that by going through the process of new learning methods, not only upgrades children's research knowledge, but also expands, deepens through new developmental opportunities and learning processes.

The child formulates his current learning or knowledge by relying on what he has learned so far and building new cognitive solutions which he then tries to memorize in order to further practice them in life. At home, the child only chooses what he wants to learn and who he will include in it, while in the playroom in the kindergarten, all this is limited to him: therefore, the educator, knowing this, should be creative and together with the children should stimulate the same interest. to determine and direct in what will be learned and researched in order to achieve knowledge.

Remember: The educator gets a new role in the realization of the constructivist learning task with the children, and it consists in the equal treatment between himself and the children, active and equally includes both subjects in the process of learning with the children. For this purpose, it is inevitably necessary for the educator to create an adequate atmosphere and to offer such a learning activity that will arouse new and increased interest in every child. This means that the current stereotype of choosing topics and activities should inevitably be left behind, and to create awareness that the relationship or integration and interaction child-educator acquires new meaning and mutual creative opportunity for evaluation and evaluation when the educator should be a guide in learning task with children. By supporting the research activities, the children will come to the knowledge on their own to solve a certain problem, and for all that to be useful for the children, the timely and necessary information will be used in the learning task.

In constructivist entertainment, knowledge is acquired by activating internal thought processes, creating interaction with children in the group and the educator, and exploring with materials.

The constructivist playroom also uses active learning strategies that will cover the child's development in all areas. Activities that encourage research, experimentation, self-examination and creativity are offered. Strategies are used to develop higher order thinking and problem solving skills. So, the constructivist approach to work puts the child in the center of attention, which means that from an early age it becomes not an object in the learning process, but an independent entity in its development, in which according to its creativity the educator participates in his work.

Constructivism In-Depth: Piaget, Vygotsky, and Bloom

Piaget's theory of cognitive development

Developmental psychologist Jean Piaget is known for his theory of cognitive-intellectual development and numerous studies of children's mental abilities. One of the most complex theories of cognitive development is the one developed by Piaget. Cognitive development, according to this biologically oriented theorist, is a spontaneous, self-regulatory process that determines the organism by introspective factors and mechanisms. The theoretical understandings are important for performing pedagogical implications and improving the teaching process.

Children develop patterns of knowledge about the world. These are clusters of related real-world ideas that allow the child to respond appropriately.

When a child develops a work pattern that can explain what they perceive in the world, that pattern is in a state of balance.

When a child uses the scheme to deal with a new job or situation, that scheme is in assimilation and accommodation occurs when the existing scheme is not up to par to explain what is happening and needs to be changed.

Once it changes, it returns to balance and life goes on. Therefore, learning is a constant cycle of assimilation; Accommodation; Balance; Assimilation and so on.

Piaget's contribution to education

One of Piaget's great contributions to current education is to achieve cognitive development in the early years of a child's education. Therefore, it is necessary and complementary what the family has taught the child and how it has stimulated him, allowing him to learn the rules and norms that allow him to adapt to the school environment.

Another contribution of Piaget that we can see today in some schools is that the theory taught in one class is not enough to say that the subject has been taught. In this sense, learning involves several methods of pedagogy, such as the application of knowledge, experimentation and demonstration. The main goal of education is to create people who are capable of innovation, not just repeating what other generations have done - developing

creativity. Another goal of education is to form critical minds that can affirm and not accept everything that is conveyed to them as true or true. The main idea of the theory is that knowledge is not a copy of reality, but a product of a person's connection to his environment. The greater the stimulation of the environment, the richer and more positive the development will be.

Although less modern and influential, it has inspired several important educational principles such as:

- Learning to discover;
- Sensitivity to children's readiness;
- Acceptance of individual differences;
- Students do not have a forced knowledge of them - they create it for themselves.

Functional / sensorimotor game

Age: Birth up to 2 years old

Children use simple and repetitive movements with objects, people and sounds during play. For example, shaking shakers during music. They use their senses and physical abilities to move around and explore their surroundings.

Symbolic / dramatic play

Age: from 2 to 7 years

Children begin to express themselves using their imagination and curiosity and during play take on roles of various things. For example, pretending to be a firefighter extinguishing a fire using a stick found outside the playground. Children begin to imitate the actions and language of others around them.

Games with rules

Age: school-age children

Children negotiate the rules before engaging in a play experience or learning task. For example, playing hide and seek. Children collaborate and collaborate with others.

Vygotsky's theory of learning

Vygotsky takes a different approach to Piaget's idea that development precedes learning. Social constructivism which developed Vygotsky rejected the assumption made by Piaget that it was possible to separate learning from its social context.

Instead, he believes that social learning is an integral part of cognitive development and culture, not the developmental stage is the basis of cognitive development. Therefore, he argues that learning varies between cultures rather than being a universal process governed by the type of structures and processes proposed by Piaget.

Vygotsky's theory is one of the foundations of constructivism, ie social constructivism. He advocated three main topics related to social interaction:

Language, culture and knowledge

Vygotsky (1934) emphasized the role of language and culture in cognitive development and how we perceive the world, and argues that they provide the framework through which we experience, communicate, and understand reality.

He showed the importance of language in learning, showing that in newborns, communication is a prerequisite for the acquisition of concepts and language of the child. But he points out that people learn with meaning and personal meaning in the mind, not just by paying attention to the facts:

I do not see the world simply in color and form, but as a world with meaning and significance. I do not see only something round and black with two hands; I'm looking at a watch…. (p. 39)

Language and conceptual patterns transmitted through language are essentially social phenomena. Knowledge is not simply constructed, it is co-constructed.

Zone of proximal development

The zone of proximal development which children and those who learn and co-construct knowledge. Therefore, the social environment in which children learn has a huge impact on how they think and what they think. They also differ in how they view language. For Piaget,

thought moves language, but for Vygotsky, language and thought intertwine for about 3 years and become a kind of internal dialogue to understand the world.

And where do they get that? Their social environment of course, which contains all the cognitive / language skills and tools for understanding the world.

Vygotsky also outlines elementary mental functions, under which he thinks of the basic cognitive processes of attention, sensation, perception and memory.

By using these basic tools in interaction with their socio-cultural environment, children somehow improve by using what their culture allows them to do. In the case of memory, for example, Western cultures tend to keep notes, mind maps, or memory, while other cultures may use different memory tools such as storytelling.

In this way, the cultural variation of learning can be described quite nicely. What is crucial in this learning theory are the ideas for scaffolding, the proximal development zone (ZPR) and the other with more knowledge (teacher). Here's how it all works:

Teachers

The teacher can be (but does not have to be) a person who knows more than the child. Working together, the child and the teacher work in ZPR, which is part of the learning that the child can not do independently.

As the child develops, the CAF becomes larger because they can do more on their own, and the process of increasing the CAF is called scaffolding. Vygotsky scaffolding.

Knowing where the scaffolding should be placed is very important and the teacher's task is to do so so that the child can work independently and learn together.

For Vygotsky, language is at the heart of it all

- it is a basic means by which the teacher and the child communicate ideas and
- Internalization is immensely powerful for strengthening understanding of the world.

This internalization of speech becomes Private speech (the "inner voice" of the child) and differs from social speech, which occurs between people. Over time, social speech becomes private speech and hey Presto! It teaches, because the child now cooperates with himself!

The bottom line here is that the richer the socio-cultural environment, the more tools will be available to the child in ZPR and the more social speech they will internalize as private speech. Therefore, it does not take a genius to develop that learning environment and interactions are everything.

The scaffolding is also an integral part of Rosenshine's Principles of Instruction.

Bloom's Learning Domains

In 1956, American educational psychologist Benjamin Bloom first proposed three areas of learning; cognitive, affective and psycho-motor. Bloom worked with David Cratwall and Anna Harrow during the 1950s and '70s on the three domains. The cognitive domain (Bloom's taxonomy).

This was the first domain proposed in 1956 and focuses on the idea that cognition-related goals can be divided into categories and ranked according to cognitive difficulties.

These ranked divisions are what we commonly call Bloom's taxonomy. The original divisions are as follows (knowledge is the lowest and evaluation is the most cognitive):

- Knowledge
- Understanding
- Application
- Analysis
- Synthesis
- Evaluation

Affective domain

The affective domain (sometimes referred to as the domain of emotion) refers to feelings and emotions and also divides goals into hierarchical subcategories.

The affective domain is not usually used in mathematics and science planning because feelings and emotions are not relevant to those subjects. However, for art and language teachers, the inclusion of the affective domain is imperative whenever possible. The subordinate domain categories range from "receive" at the bottom end to "characterize" at the top. The full ranking list is as follows:

- Receiving. To be aware of external stimuli (feeling, feeling, experience).
- Answering. Responding to external stimuli (pleasure, enjoyment, contribution)
- Valuation. Referring to the belief or appropriation of the student's value (showing superiority or respect).
- Organization. Conceptualizing and organizing values (examine, clarify, integrate.)
- Characterization. Ability to exercise and act according to their values. (Review, conclude, judge).
- The psychomotor domain.
- The psychomotor domain refers to those goals that are specific to the reflex actions, interpretive movements, and discrete physical functions.

A common misconception is that physical goals that support cognitive learning fit into the psychomotor designation, for example; heart dissection and then drawing.

Although they are physical (kinesthetic) actions, they are a vector for cognitive learning, not psycho-motor learning.

Psychomotor learning refers to how we use our bodies and senses to communicate with the world around us, such as learning how to move our bodies in dance or gymnastics.

Anita Harrow has classified different types of learning in the psycho-motor domain, from those that are reflective to those that are more complex and require precise control.

- Reflex movements. These movements are those we possess from birth or appear as we move through puberty. They are automatic, ie they do not require us to actively think about them, e.g. breathing, opening and closing the pupils or trembling when it is cold.
- Basic movements. These are the actions that are basic movements, running, jumping, walking, etc. And they are usually part of more complex activities, such as playing sports.
- Perceptual abilities. This set of abilities characterizes those that allow us to sense the world around us and to coordinate our movements in order to communicate with our surroundings. These include visual, audio and tactile actions.
- Physical abilities. These abilities apply to those involved with strength, endurance, dexterity and flexibility, and so on.
- Skillful movements. Objectives set in this area include those that involve movements learned for sports (twisting the body during high diving or trampoline), dancing, or playing a musical instrument (placing fingers on guitar strings to get the correct note). It is these movements that we sometimes use the popular term "muscle memory".

- Non-discursive communication. What it means to communicate without writing, non-discursive communication refers to physical activities such as facial expressions, posture and gestures.

Alternative Approaches to Learning: The New School Movement

The new school movement

The first schools as institutions appeared a long time ago, but in the development of the history of pedagogy we can conclude that these institutions primarily took into account the needs of society, the needs of certain groups. Our question is how much these institutions took care and followed the needs of the children.

The old schools were rigid and rigid institutions, where children had a passive and receptive role, where they mechanically adopted the contents. “Teaching is verbal, strict with rigid curricula. "All students, regardless of their individual characteristics, worked according to the same program."

As the avant-garde Ellen Kay will write in her book "The Age of the Book" - killing the souls of children.

But throughout the history of pedagogical theory and practice, several important ideas have emerged that are fundamentally causing substantial change. Heinrich Pestalozzi (four stages of class work) and Johann Friedrich Herbart, whose formal teaching degrees played an important role in the teaching of schools in many countries, also played an important role in making pedagogical decisions.

That is why the representatives of the new school movement insisted on creating new schools tailored to the children. Many of the ideas for creating new schools were operationalized in pedagogical concepts for representatives of the active school, work school, school of life, Montessori pedagogy, Reggio Emilia, and other alternative concepts.

Concepts that offer freedom in learning, children yes learn how else they can gain knowledge and learn directly in life.

Maria Montessori

Although Maria Montessori is best known as an educator, she was also a pioneer in medicine. She started her professional life as the first female doctor in Italy. She developed her method based on the observation of children's learning processes. In 1907 she opened the first Children's House (Casa dei Bambini) in Saint Lorenzo in Rome. Guided by her discovery Dr. Montessori has designed a "ready environment" in which children can choose from a wide range of developmental activities. The success that Maria Montessori achieved with her children aroused the interest of many teachers and pedagogues who came from all over the world to listen to her lectures. Thus, she left her doctoral practice and devoted herself to spreading her pedagogy. Until her death, she held hundreds of courses on her method and helped open many orphanages around the world.

Maria Montessori pedagogy, even after more than 100 years since its creation, is still relevant because it is based on universal values for humanity:

- human dignity
- peace and
- freedom

The child as the builder of man

According to Maria Montessori, child development does not take place by chance but according to certain laws. The child goes through certain stages in its development. She called the first phase of life (from birth to 6 years) the phase of absorbing spirit. At this stage, children literally absorb the impressions of the environment through the "pores" of their senses as the sponge absorbs water. During this period, for example, children learn their mother tongue much easier than adults learn a foreign language. Therefore, the opportunities offered by the environment in this period are a decisive factor in the development of children's intellect.

Dr. Montessori believed that a child's development goes through sensitive stages when it acquires certain skills and knowledge. During these periods the child is focused on certain activities, engages intensively with them and masters them with great ease.

Montessori has developed specific didactic material that corresponds to the sensitive periods and interests of children.

Respect for the child was and is a key feature of Montessori pedagogy. Respect for the individuality of the child in Montessori pedagogy means giving freedom to choose activities in a prepared environment that gives the child the freedom to learn and develop at his own pace, according to his potentials, opportunities and interests. The child just chooses his job. It never forces itself to do something it is not prepared for or something that is too elementary and boring for it.

In Montessori, the early childhood playroom has a pleasant atmosphere where the child feels at home and can work at his own pace and unique nature. Educators prepare the environment in order to meet the specific needs of children who are changing and developing. The teachers follow the interest and we nurture the children's natural curiosity and desire to learn.

Independence is an important principle in the Montessori early childhood playroom. The child is encouraged to be independent in every situation: in choosing his own work, in dressing his jacket, in cleaning the table after the work is done, etc. Every small step towards independence builds self-confidence, self-esteem and a positive concept of self.

Surroundings in the Montessori early childhood playroom

Maria Montessori believed that learning could be fully accomplished by the individual himself. The child acquires knowledge through active manipulation with different materials. It also learns from others around it. The children in the Montessori early childhood playroom are of mixed age, which on the one hand allows older children to teach younger children and develop social skills of tolerance and helping others. On the other hand, younger children get a positive pattern of behavior and learning. The teacher prepares the environment and presents how to work with a certain material.

Physically and mentally prepared environment also contributes to the development of behavior. As the child immerses himself in the purposeful work that he has chosen and that suits his needs, it works with increasing concentration and inner satisfaction. Thus the child gradually develops his inner discipline. It's really impressive to see children in the Montessori early childhood playroom working together calmly, helping and caring for each other.

Maria Montessori thought that "the hand is the basic teacher of the child". That is why the Montessori early childhood playroom abounds with an offer for manipulative activities. Montessori didactic materials are designed to stimulate sensory, motor, and intellectual development. The child is guided from the concrete to the abstract through a carefully graded learning system. You can see this principle in the Montessori early childhood playroom through many examples: in an environment divided into different areas children

start working with concrete materials in the field of practical life and the senses, and then progress to more abstract areas, mathematics and language; within each area children first start with the simplest materials, activities and gradually progress to the more complex ones; for each material there is usually a simpler and more complex way of working. In most materials, only one quality is isolated, such as color or size.

The role of the teacher

The role of the Montessori early childhood playroom teacher is manifold. But its most important role is to stimulate learning that satisfies a personal, childlike need for learning, learning for oneself, not for the satisfaction of others or learning for assessment.

Trained to carefully observe, note the different needs of children and provide a properly prepared environment that will ensure maximum growth and development of children. He presents the proper use and work with the materials and guides the child without interfering in his work. The teacher is the one who will enable each child to progress through the activities from different areas. He sets the boundaries, encourages the hesitant and insecure child, carefully guides the child who has chosen hard work, and maintains the enthusiasm of the children. He is there when he is needed, but he is "invisible" when he is not needed. In other words, he is following the child.

Reggio Emilia

The **Reggio Emilia approach** is an educational philosophy and pedagogy aimed at preschool and primary education. This approach is learning that puts children at the center is based on the principles of respect, community responsibility through exploration, discovery and play. The essence of this philosophy is that children form their own personality in the early years of development and that they are endowed with "hundreds of languages" through which they can express their ideas. The purpose of the Reggio approach is to teach children how to use these symbolic languages (eg painting, sculpture, drama) in everyday life. This approach was developed after World War II by educator Loris Malaguzi and his parents in the villages around Reggio Emilia, Italy. The access name gets its name from the city.

“Our task, regarding creativity, is to help children climb their own mountains, as high as possible. No one can do more. "

~ Loris Malaguzzi (A Founder of the Reggio Emilia Approach)

The aim is to provide an environment as close as possible to the "home". By providing an environment where natural learning can take place through all the "learning resources" in the child's life; such as the natural environment (both inside and out), peers, materials, educators. This is a journey where children are supported in their independent discovery and exploration of the world around them. Children at an early age will learn to love and respect each other, to respect the people who care for them, the animals and living things and the earth (through reuse, recycling, composting, breeding, preservation…).

The Reggio program is very practical in nature learning and visual learning through touch with all the objects offered by nature.

Philosophy: Collaboration, research and collaboration are the main pillars of the Reggio Emilia School, where teaching is project-based and child-led. For example, if children are fascinated by flowers outside, then a lesson can be structured to include gardening and planting.

Teachers: Classmates who work with children instead of just instructing them. There is no curriculum, because it is developed based on the interests of children.

Environment: Outdoors with lots of plants and light. Documentation is an important part of Reggio Emilia's schools (to make learning visible), so the walls are covered with children's photographs, artwork and writing.

Good for: Parents who want their children to become good citizens, with a special emphasis on children learning how to solve problems and resolve conflicts.

Through art, children experience the freedom to experiment with different materials and to learn their characteristics and possibilities. A sensory room combines a range of stimuli to help children of all ages develop and engage their senses.

There are a number of benefits to a sensory room for children, some of which include:

1. Sensory stimulation

Encouraging children to get involved and explore the environment, then it can have positive effects on their ability to react and communicate with the larger world around them

2. Enhance learning and play

Following this, sensory stimulation can involve different areas of the brain, helping children absorb and retain more information and better meet an individual's needs

3. Improving balance, movement and spatial orientation

Sensory rooms can help develop users' visual abilities, as well as their fine and rough motor skills, making everyday life easier.

Key principles of Reggio Emilia

1. Children are able to construct their own learning, they must have control over the direction of their learning - the importance of projects ...
2. Children are collaborators and learn through interaction within their communities. , to learn through their experiences, touch, listening, playing and observing.
3. Children are natural communicators and should be encouraged to express themselves in a way that they feel they can - children should be encouraged to explore.
4. The environment and the playroom are like a third teacher.
5. Educators are partners, carers and guides who help facilitate the exploration of children's interests while working on short-term and long-term projects. The role of the educator as coordinator.
6. Documentation is an important component in communication
7. Parents are partners in education
8. Children must have endless approaches, ways to express themselves.
9. Children have a hundred languages.

The hundred languages of children

The child has a hundred languages

a hundred hands

a hundred thoughts

a hundred ways of thinking

of playing, of speaking.

A hundred always a hundred…

~ from the poem "No way. The hundred is there. " by Loris Malaguzzi

One hundred languages is a key principle of the Reggio-inspired approach. It is about communication and emphasizes the importance of providing children with a hundred ways to share their thoughts about the world around them. As widely accepted by educators and supported in research, children learn in a variety of ways. This knowledge is why providing different means of learning and research is crucial in the educational path. These research tools may include speaking, writing, acting, drawing, using natural materials, and dancing. Providing children with free play, encouraging exploration of the child's own interests and creating a safe and positive environment and community also supports the Reggio-inspired approach in one hundred languages.

Learning is a process that has been around for a long time as a project. Relationships and connections between people, which includes culture, family and history.

Child interaction must be best practice

- eye contact, body language and smile.
- sit down with the children at their level.
- we listen to their speech and body language
- Infinite questions ..
- we laugh with them..we enjoy the moment.
- use of positive language.
- we recognize their communication effort with "It's a wonderful word", "a good idea"
- respect and support the style of communication and the degree of participation.
- we pay attention to the tone and intonation of our voice
- we speak calmly when resolving a conflict or have some behavior.

“The potential is stunned when the end point of their learning is formulated in advanced”

~ Carlina Rinaldi

Ex. The child asks "How do bees make honey?"

How will we answer:

- We provide information immediately.
- We take a book and we will look.
- We will include them in a discussion about this.

What to do?

To include children in thinking, let's ask them what they know, and encourage them to say what they think.

First we say that it is a great question. (Positive affirmations)

What next? Do we focus on books about bees and activities around bees? Should we continue with the questions, and see how much they understand?

Two possible directions

1. Learn about bees as long as they show interest, or
2. Encourage children to explore and through questions to come to knowledge (we leave material-pictures,) we encourage them to explore in small groups, our information is always in the form of a question. With our questions we provoke them and offer potential to materials with which they will get information.

Albert Bandura

The significant scientific contribution of the famous and recognized professor of psychology Albert Bandura is noteworthy. Why? Because until the advent of his Theory of Social-Cognitive Learning, which brought about real changes in education, health sciences, social policy, psychotherapy, etc., behaviorism, learning theory, and social learning theory were known. On the contrary, Bandura is adamant that children can learn by observing other people's activities, because the inner mental state of the child is an essential part of this process. But just because something has been learned does not always mean that every child will change his or her behavior. Bandura suggested that learning can happen by observing the activities of others, that is, that children learn and imitate the behavior they have observed in other people. Bandura points to three basic models of observation for this identification (as the first significant development work):

1. A living model, when an individual demonstrates some behavior, observing it, the child internalizes and repeats the moral judgment and behavior manifested by the adult model;
2. Verbal teaching model that includes descriptions and explanations of behavior, and
3. Symbolic model that represents real or fictional characters read in books, seen in movies, on TV shows or online media whose behaviors are expressed by this model.

Symbolic modeling affects the development of moral judgment by portraying behavior as acceptable or reprehensible, as well as through the sanctioning and justification applied to

appropriate behavior (according to Bandura, 1991). He then points out as a second important thing, the mental states that are important for learning, because he believes that the mental states as well as motivations in each child play an important role in whether the behavior is learned or not. He concludes that in linking learning theories to cognitive developmental theories, inner thoughts and cognitions help, and describes his approach as a "social cognitive theory."

And the third important thing he puts forward is that learning does not have to lead to behavior change. Whether something is learned can be immediately determined by the behavior shown, but sometimes we can learn something, even though that learning is not immediately apparent.

It is necessary to emphasize the necessary steps in the process of observation and modeling of Bandura, which are:

1. Attention - to learn something requires attention;
2. Retention-storage of information, which will be needed later and which will be acted upon;
3. Playback - once you see the model and get the necessary information, it is time to perform the observed behavior;
4. Motivation - for what is observed to be successful, motivation is needed to imitate the behavior that is motivated. Rewards and penalties are also important here. Bandura's theory of social learning has important implications for education. Today, educators and teachers, including parents, recognize the importance of modeling appropriate behaviors.

Other entertainment strategies, such as encouraging children and building self-efficacy, are also rooted in social learning theory.

Bandura in his theory of social-cognitive learning says: "Fortunately, most human behaviors are studied obsessively through modeling from the observation of others. circumstances this information serves as a guide to action. "

Service Learning, Experiential Learning: How to do this with pre-schoolers?

Plan a service and get ready for action

Prepare a plan to address the identified need in the hypothesis / problem. The educator leads students to independence and self-determination, giving them a voice, opportunity and responsibility as much as they are prepared. Help children come up with ideas for possible activities. Encourage critical thinking and communication skills to narrow down options, see if a plan is needed, and determine the next steps.

Take action!

The action children take to solve a need or problem encourages them to recognize that they are capable of making a difference. Real-world experience expands their thinking and expands their world and worldview, giving them the opportunity to see the variety of places, people and opportunities available to them. Children recognize that their actions are important! This is the first step on the road to lifelong empowerment and community engagement.

Document the planning and action steps

Reflect on the process and the impact

As in a scientific experiment, the analysis of the process and action of service learning helps you and your children understand and internalize problems. Open-ended questions will enable children to consider broader community issues and to reflect on their role as an individual in the neighborhood and the global community.

As you facilitate the critical thinking process, use the data collected to help children formulate a conclusion. Direct them to interpret cause-and-effect relationships.

Engage them in a variety of in-service reflection activities (writing, physical activity, music, discussion, social media, and the arts) to broaden your thinking.

Reflection is crucial for service-learning pedagogy; it is a way for children to process information gained throughout the service experience (Taylor and Balengi-Morris, 2004).

During the thinking process, children are helped and encouraged to think about what they have learned, how they feel about it, and what they can do to improve the experience. Reflection helps young children to generalize the knowledge or information gained during the learning experience and apply it to other situations. Taylor and Balengi Morris (2004) consider reflection to be key to the growth process within service learning.

Demonstrate to an audience

Have students share their process of discovering, planning, academic and philanthropic knowledge, and the impact of their service. This can take many forms:

- formal presentation to the parents
- a film or creative work for performance or visual art that shares their story
- essays, songs and performances
- fun with the recipients of their service

Experiential learning

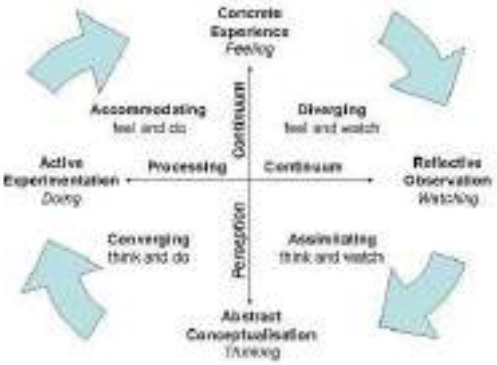
In the empirical model, Kolb describes two different ways of understanding experience:

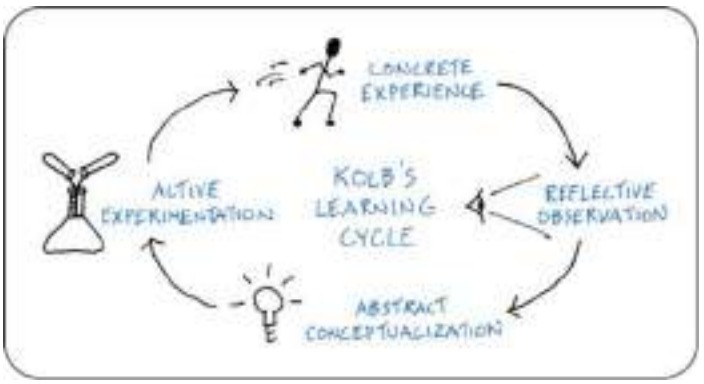
- Abstract conceptualization
- Concrete experience

He also identified two ways of transforming experience:

- Active experimentation
- Reflexive arousal

These four ways of learning are often presented as a cycle. According to Kolb, concrete experience provides information that serves as a basis for thinking. From these reflections, we assimilate information and form abstract concepts.


Concrete Experience
Feeling
Accommodating
feel and do
Diverging
feel and watch
Continuum
Active Experimentation
Doing
Processing
Continuum
Reflective Observation
Watching
Converging
think and do
Assimilating
think and watch
Perception
Abstract Conceptualisation
Thinking


CONCRETE EXPERIENCE
REFLECTIVE OBSERVATION
ABSTRACT CONCEPTUALIZATION
ACTIVE EXPERIMENTATION
KOLB'S LEARNING CYCLE

Strategies for Preschool Children

This list of strategies in educational work with children is compiled by child care professionals. Accept their tried and tested tactics so you can enter the early childhood playroom confident and ready.

1. Marking of logo / symbol

Translating from picture to word helps in language development. Make this activity more interactive by having children and their parents photograph photos of logos or symbols around their neighborhood, such as street signs, car logos or clothing brands. Then, the children can bring the photos to the kindergarten where they can mark them as a group. This labeling practice can add new layers of complexity as children learn - colors and numbers can be easily added to the mix, and it will be an ideal way for them to learn easily and quickly.

2. Sound recognition and matching

This strategy is especially necessary and useful in the English-speaking world, so they successfully use it to combine a voice with a letter image, but that does not mean that it is not useful for learning all other sounds from nature, voice recognition, animals, etc. .

3. Replacement of activities

Children tend to have a short attention span, so long activities are out of the question. To help children stay focused, try changing activities.

Frequent transitions and substitutions of activities are of particular importance to the child's brain. In that way, the child stays focused, active, focused on the activity for a long time and invests the maximum.

4. Make a garden

Whether you have an open space or just a beautiful window sill, a garden can be a great way to teach children about the natural world. Growing a plant from seed to maturity can teach children about their own growth, relieve stress and help promote fine motor skills, but it will certainly become part of every child's daily routine.

5. Involve the senses in science

Encourage and encourage children to use all five senses in science and observation activities.

For example, when planting in the garden, they can talk about how they feel about the soil, how it smells, and what colors we see in the soil. They talk about how different plants will taste and what they will look like as they grow from seed to plant.

6. Establish rules

Establishing rules at the beginning of the school year is a great strategy for maintaining a quiet leisure time. Set the rules in the children's field of vision so that they will see them every day and will be reminded of good or bad behavior. When the child breaks the rule in the playroom, do not use harsh language. Positive speech is a prerequisite for mutual understanding and respect. Remind the child of the rule, instead of using negative words such as "no" or "do not".

7. Create activities for your children

It is easier when you use the previous activities that you used with the previous generation. However, for some children, this can be a problem. Educators need to be sensitive to children from non-traditional home situations. Think twice before asking students to draw a picture of their families - think about how an adopted or separated parent might feel and how other children might react.

Finding inclusive activities can take a little longer, especially at the beginning of the year, when you may not know all of your students, but it will be worth it when you realize that you have protected your child from unnecessary shame, confusion, and discomfort.

Play and Learning In Practice

From the children's own perspective, play and learning are not always separate in practice during the early years. Play, as well as learning, are natural components of children's daily lives. When children are asked what they want to do best, the answers are unanimous: play. On the other hand, education for children is, in general, organized to promote learning instead of play. However, while school has traditionally been seen as a place to learn rather than play, preschool is more often associated with play than with learning, from a child's perspective (Pramling, Clairfelt, and Williams Granald, 1995).

Play is also considered a practice initiated by children, while learning is seen as the result of an exercise or activity initiated by an adult. In the context of early childhood education, play and learning are often separated in time as well as in space. Round time, literacy classes, creative artwork, etc. They are considered teaching and learning practices, and thus the origin of learning, while play is set aside for leisure or outdoors and is part of the children's resort. At the same time, curricula for early education around the world state that play should be of paramount importance.

Playing and the child learning

From a children's perspective, play and learning are not always separate in practice during the early years. Let's start with a description of Hyalmar's video (16 months old):

Hyalmar opens a large drawer in the kitchen, researching all the items there and turning all the buttons on the oven. Then take out a lot of kitchen utensils. All plastic plates are sorted by size. Experiment, change your mind several times. Then he starts putting all the kitchen utensils and plates in the drawer. Suddenly he leans over and lifts a plastic container with both hands, pretending to be heavy and moaning "Oh, oh!" He does this twice. And finally, he stops a little from the drawer, points to the last object and throws it in the drawer.

The project as a whole was initiated by Hayalmar himself and he makes his own decisions and seems to enjoy it. He is approaching this drawer for the first time ever. He researches and we can see the basic math in his comparison of size. At the same time we can see that he is pretending that the vessel is heavy. He also coordinates his movement (throwing) by inserting the object in the drawer. What we can see here, in our opinion, is a child playing and learning at the same time. When Hyalmar acts, he focuses on different things in his mind, something he wants to make sense of, no matter what we adults call play or learning.

In the example above, we describe a child acting on their own, now let's look at another example of an Oscar (2.4, ie 2 years, 4 months):

Oscar comes to the table and sits down with a jigsaw puzzle. He starts pointing at the pieces, "talking" and gesturing (not understandable), but radiates like the sun and "talks" about one piece after another. Karin, one of the teachers, comes and takes a seat next to him. The chair slides backwards. Karin puts him back on the table and says, "No, you're going to slip down!" She asks, "What's on that piece?" "Yes, it looks like pearls." He shows Karin the pearl necklace. "You have pearls around your neck." She looks at his necklace. He "talks" all the time, but the observer cannot recognize what he is talking about. "Shall we put the pieces together?" Karin asks. He wants help from the awakener when Karin leaves for a moment. He fails to put any pieces together. Karin reaches for an easier puzzle. She collects the pieces from the first one and puts them in her box and gives him the new one. He radiates all over his face and says, "Another?" "Yes, another puzzle," says Karin. He takes a cat from the puzzle and tries to put it back in its place. He calls him a "cat." Karin asks him how the cat sounds and helps him put the cat in place. He raises it again, opens his eyes wide and says, "Wow." "Again," says Karin. Once again he puts it in its place. He climbs down from the chair and approaches the table, over and over again. "Is she okay now?" Karin asks as she sits down again. He nods and climbs down again, moving the chair back and forth, over and over again. He carries a doll, which he places on a chair. "Well, he should sit there instead," Karin asks. The doll slides down, and Karin wears a rubber foam block so that the doll appears on the chair. Oscar continues to adjust the doll and picks up a piece of the puzzle. Suddenly he took the doll, ran to the sofa and put it down. "Look, he's really asleep," Karin said. Oscar comes back, throws the foamOscar returns, throws the rubber foam block and sits on the chair. He takes the cat and runs to the sofa and puts it there. He adjusts the chair again. "Sleep there," he said. He goes back, takes the doll, the rubber block and the cat. Once again he puts the doll on the chair. "Will he [the doll] do the puzzle again?" Karin asks. Oscar places the puzzle in front of the doll. He lifts the cat, runs to the sofa and returns to fetch it, over and over again. "I run," he said. On one occasion, he puts it on the chair instead, but then forgets where he placed it and continues to look at the sofa. But finally, with some traces of Karin, he finds him again.

Here we can see how the teacher wants him to make a puzzle, but the puzzle is too difficult for him and she understands that and gives him another one. He radiates joy and immediately begins to use it. But soon, he starts monkeying with his chair. Suddenly he sees the doll and wants her to sit on the chair and make the puzzle. The teacher helps him when he has problems making the doll on the chair. Some time later he decided that the doll should fall asleep and laid it on the sofa. He does the same with the cat. This sequence continues with him fantasizing and acting and alternately placing pieces in a jigsaw puzzle as he continues to communicate with his teacher. It helps him focus on the puzzle, but he also follows it in his tricks and ideas. He also imitates things she did. In this sequence, the mutual activity is not only between play and learning, but also between the teacher and the Oscar as initiators.

Our conclusions are that when young children act, they do not distinguish between play and learning, although they do in their speech (Pramling, Clairfelt, and Williams Granald, 1995).

Some children who have been involved in pedagogy where play and learning are integrated do not even distinguish between play and learning when asked about it in primary school.

School children's thoughts on play and learning are interesting in the way many children express similarities in the way they talk about the two (Johansson, 2004). This means that they describe play, as well as learning as fun, as an activity or as something transgressive, that the two touch each other or collide with each other and transform into each other. The element of delinquency is characteristic of school children 's conversations about play and learning. Eba (8:11) says: "Well, I do not know how to explain, but if you think of something and it is really fun to do, you think of how it игра writing a script is something I want to do then it turns into some kind of game ”(Johansson, 2004, p. 20). Anton (9: 3) says: "I really do not know те understand more… how to learn a new game that you did not understand when you were young, but when you grow old you understand it" (Johansson, 2004, p. 22). Anton refers to learning a certain game that he has previously learned to play, but suddenly it means something different to him. Here is an example when he thinks that play and learning can be related:

The children in this class have elementary and leisure teachers who work together during the day, which means that they can switch between doing "school work" and playing. The play they are involved in is part of the adult planning, ie. game topics are related to the topics covered in the curriculum. Children here have more freedom to make choices and to have control. What can be said about this early childhood playroom is that it does not have the most common access to primary schools, neither in Sweden nor in any other country. (Johansson, 2004, p. 27)

Children play individual students when they are young, and when they begin to divide among themselves, this message is mediated by many of the prevailing school culture.

Recent perspectives on play

Is play still as important as it is often claimed in early childhood education? If we look at the excellent publication "Eager to Learn" (National Research Council, 2001), for what research has told us today about young children's learning, we can still see that the term play is totally invisible. Obviously today there are two parallel discourses about play as something that gains ground or as something that disappears in favor of learning (Pramling Samuelson and Asplund Carlson, 2003).

Many studies today claim that children create knowledge when they play (Dow, 1999; Levin, 1996). Play, according to Levin, gives children opportunities to have control over what is happening and what they know. Play, along with friends, allows children to practice self-control and develop what they already know, take turns, collaborate and socialize with

others (Glover, 1999). In children's play there are undoubted opportunities to symbolize and use objects in a way that is meaningful and exciting to them. Docet (1999) also points to the fact that game research is moving in the direction of inter-subjectivity and shows how these studies help us understand how children at play become aware of other perspectives on children (Astington, 1998, 2000). In this regard, we will shed light on how the reality in play places great demands on the capacity of simultaneity in children, because in play there are different demands at the same time. Children should keep in mind what they negotiated to be characters in the play settings, what role it means, how other children act, which should be different subjects, and so on.

From Piaget's perspective, we think of play as a work of children with the experiences they have gained, but Sawyer (1997) argues that children perceive play as an improvisation where there is no handwriting, but the script is created on the spot in collaboration. The Swedish preschool curriculum (Swedish Ministry of Education and Science, 1998) draws attention to the fact that the preschool environment must be fun, must give children a sense of belonging and must look at communication, play and learning as an intertwined whole. In such an environment, children can be seen to learn by discussing, arguing and exploring each other's ideas and ways of thinking (Johansson and Pramling Samuelson, 2006). Children's cooperation and co-learning is extended to preschool (Williams, 2001) and also as a transfer of culture (Johnson, Christie & Javi, 2005).

In play, children communicate and interpret continuously in peer negotiations and role play. At the same time as they play the play, they produce the content of the play by talking about what to do and how it should be done, ie the children's metacommunication approach to their play (Bateson, 1976; Knutsdotter "Olofson", 1993, 1996) .

Game research has expanded recently and is largely concerned with creating meaning and communication.

Play and learning in preschools: Changed perspectives

During the more than 150 years of education in the early years, there have been a number of more or less successful approaches to preschool, of which we will briefly discuss a few, fully aware of the fact that it is difficult to do properly in the short part. The programs we will use are: Frobel, Montessori, Dialogue Pedagogy, Reggio Emilia and High / Range. But before we do that, we will introduce the notions of act and subject of learning. By act we mean how children play and learn and by subject we mean what children play and learn.

That children learn through active activity seems to agree with all of the above programs. In the pedagogy of Frobel (1995) and Montessori, activity is a question of the child's inner drive. In the High / Volume program, children seem to become active as teachers adjust

activities to the child's level of development and use a structure where children need to be active. In dialogic pedagogy, argued by Blanc (1983) and very popular in Sweden in the 1970s, as well as in Reggio Emilia pedagogy, activities are shaped by interaction with the surrounding world. Activity as such in these programs follows a scale from biological instinct to social interaction or from individual to environment and social relationships, which, on the one hand, can be seen in Montessori where the child should be emotionally free and, on the other hand, in Reggio Emilia, where the child is an individual with opportunities and rights. Homework, which was important in Frobel's pedagogy, had one major point that children should learn in an authentic environment, the perspective given to Montessori (Asplund Carlsson & Johansson, 2000).

Regarding children's activities, there is another aspect, and that is how the child is perceived in relation to adults. Morality and religion are important components in Frobel's pedagogy and global understanding in Montessori's. According to the high / range, it is difficult to see any form of values, but in Reggio Emilia the values are political. So the trend is from religion to democracy. At the same time, it can be seen that only Reggio Emilia's pedagogy refrains from thinking that the child is limited to developmental stages.

Theoretically, there seem to be some similarities between Frobel, Montessori and the High / Range, on the one hand, and Reggio Emilia and Dialogue Pedagogy, on the other. What distinguishes the latter two is the direction and content of the work. In dialogic pedagogy, the child's questions as such are central, while in Reggio Emilia the child's questions about the content, theme, or project decided by the adults are paramount (Rinaldi, 2001). However, the subjects are not expressed at all, but the focus is on the child as a psychological human being and on creating content on the topic in the negotiations between the children and the teachers. The term subject is the strongest in Frobel's pedagogy in relation to religion and mathematics.

Although maturity was not considered a prerequisite for learning, the Frobel, Montessori, and High / Range pedagogies are strongly related to developmental stages. Montessori, through its "sensitive periods" and the High / Range, as stages of Piaget, form the basis. In Frobel's pedagogy one can see more lines than stages, but, of course, the field of child development was not advanced at all in his time.

Another aspect of great importance in the past as well as today is play. Although children play in all of these programs, it is specifically discussed only in Frobel's pedagogy. Play has a need, separate from learning and work, while for Reggio Emilia play appears as integrated in learning or as a dimension of learning. Montessori, in her pedagogy, in principle distanced play from preschool work. Frobel introduced play as an important learning task in preschool education, sometimes called "free play" as opposed to learning (Lindqvist & Löfdal, 2001). Although play with Frobel materials was not particularly free, there was room for the child's

propensity to act. In Reggio Emilia, play has the same dimensions that spread as in learning, although it is never pro blematized.

Another dimension throughout history and the various programs is from specific activities (Frobel, Montessori and High / Range) to communication and interaction (dialogue-pedagogy and Reggio Emilia). At the same time, it is interesting to note that creativity and cultural (re) production (represented in pictures and other expressions) are present throughout the early history of education, although this was particularly emphasized in Reggio Emilia.

It is also interesting to note that all Frobel, Montessori and Higher / Extensive pedagogies have their own group. It is also interesting to note that all Frobel, Montessori, and Higher / Extensive pedagogies have a basis for compensatory thinking, as the target groups were children at risk or from low-income homes. Dialogue pedagogy and Reggio Emilia is for all children.

There have been very clear paradigm shifts in developmental psychology (Somer, 2005a, 2005b). These can also be seen in preschool pedagogy, even if it is not so clear. However, the most obvious is the perspective on children as rights as human beings (Nutbrown, 1996) and the tendency to accept the child perspective. This means that children become partners in their daily lives at a preschool age. This seems to be a universal trend, not just for Western countries (Ernst, 2000, pp. 38–42). Perhaps it can be argued that a new universal paradigm is developing, where the child's experiences become central and that, of course, is influenced by the UN Convention on the Rights of the Child.

Subjects have never been strong in preschool, with the exception of Frobel's pedagogy where mathematics was evident, in Montessori where reading and writing in later preschool years became important and, finally, in the high / scope where defined key terms constitute the learning object (Homan, Bannett and Weikart, 1989). On the other hand, values were important in most programs, although the nature of the values changed. The act of learning, on the other hand, has been very strong and thoroughly developed throughout the history of preschool. To the end, the child and his / her integrity are filled with respect. There is some consensus on the fact that children are different from adults, which is a kind of developmental perspective. Children do not pursue long-term goals like adults, but are interested in questions here and now, and the concrete, not the abstract, is always in the child's mind. Therefore, this has become a central issue in all programs; how to attract their interest and engage children. Perhaps this basis in thinking about the child being active "by nature" has made all people in early childhood education devote all their energy to the act of learning - or the question of how children learn (Bruce, 1990, 2004; Pramling Samuelson & Asplund Carlson, 2003). This means that concepts such as play, integrity, intrinsic motivation, self-control, the active child, starting from where the child is, were central. In this way, the act of learning - how learning takes place - has been, and still is, focused on the

early years. Also, more general learning theories, such as Piaget (1976) or Vygotsky (1972 [1934]), focus on the act of learning. But the preschool is not a place for the general life of children, but a specific arena where children learn and develop within certain limits. The preschool is not home, although many activities that take place there often have the home as a raw model (Dahlberg and Lenz Taguchi, 1994; Nordin-Hultman, 2004) What happens in preschool is different from what happens at home and teachers and parents are aware of this.

Play and Curriculum

At the University of Gothenburg, systematic studies of students, including young children, have shown that learning presupposes both action and object (Pramling, 1990, 1994; Marton & Booth, 1997). In preschool, the act of learning has so far been far more focused than the subject matter. How children learn - by imitation, by doing, by talking, by experimentation, by trial and error or trial and success, or by thinking and communicating, as well as in play - is much more explored than the real subject of learning.

Children's play and learning is always focused on something, a goal (what the child wants to play or learn or the teacher). This is different from what we mean when we talk about a subject, which means:

- the intended subject for learning;
- the adopted learning process; and
- Living subject for learning.

One example is when the teacher and the curriculum have a dual intention to develop children's understanding of signs as a cultural conception of communication (intended goals). To this end, children are active in many activities and engage in certain experiences in which they meet and relate to signs and texts. The teacher has a great influence on the process, which, in this case, is the adopted learning process. The result as a "touch of time" is what a specific child can express at a certain point in time when the child's competence is documented (lived) (Marton & Tsui, 2004). The result may be different three days later when conditions change. This means that the learning object includes the whole, because each aspect depends on the others. In all three aspects of the learning object, play can be used in different ways!

Johnson, Christie, and Javi (2005) focus on the relationship between curriculum and play by describing different types of relationships. As we understand it, the preschools of the highest quality are the ones where you can see in the children's play what they work on in their daily curriculum and also how the topics that come into play are taken over by the teachers in the curriculum work. This means that preschool time becomes complete, which means that the role of the teacher and the role of the children become equally important: they both contribute to what happens in everyday life in preschool. Studies also support the need for both as collaborators if play and learning are to be integrated into education (Johansson and Pramling Samuelson, 2006). Whether teachers call something play or learning, there must be content, a subject to focus on and think about!

In our view (based on practical work with children and extensive research in the field), organizing the learning process of children in early childhood education means that:

- the teacher must be aware of both the child and his / her perspectives - this is of great importance;
- both the child and the teacher must be involved in the process;
- the teacher's direction and sensitivity to the child's perspective should work simultaneously; and
- Both communication and interaction between teachers and children and between children are essential (this also includes power, positions, freedom of choice and creativity).

Organizing activities - working focused - focused - with young children means having an approach that uses all the views mentioned above. This means that attitudes, knowledge, interaction and environment are intertwined in totality. Early childhood education must be organized to enable the greatest possible amount of interaction and communication between children and between children and teachers on a daily basis. They must also have something to communicate about!

Towards a pedagogy for early childhood education based on play and learning

There are in particular three aspects that we will discuss to clarify what we mean by similarities between play and learning. That’s all:

- children's experience as a starting point,
- understanding, concurrency and variation as key factors and
- meta-cognition, meta-cognitive dialogues and meta-communication as key issues.

Children's experience as a starting point

Whatever a child does or says, he always acts from his own perspective. This means that the starting point as well as the outcome of the learning task should be followed in relation to the child's perspective in the preschool environment. Because it is a pedagogical situation in preschool age, the perspective of the child is very closely related to the actions and other experiences of the teacher (Hundeide, 2003). Therefore, consider a situation in a preschool with a five-year-old girl and her teacher to illustrate the child's experience and the role of the teacher in extending the child's experience.

A teacher and some children are working on a mushroom theme. One girl begins by saying that frog stools are poisonous. The teacher has in his mind the goals of the curriculum - learning and knowledge of the symbols. She asks the girl: "How can you let other children know about this poisonous mushroom?" (Symbol). The girl's answer is: "Write a note!" "Can young children read?" The teacher asks. The girl then draws a picture of the mushroom and places a cross on it to symbolize that it is dangerous. Then the teacher continues to challenge her by asking, "Are there more ways to learn about poisonous or edible mushrooms?" The girl draws and talks about a book her mother has about mushrooms. The teacher continues the dialogue and challenges her further: "Are there more ways to find out?" The girl responds: on them and do not see the poisonous frog stools. "

By directing the child's attention to the problem that arises in this dialogue, the child expands his understanding and, thus, changes his perspective, which learns from our point of view. What you focus on is what you attach importance to (or find out), whether it is play or learning from an adult perspective. This is one of the main features of what we call "developmental pedagogy" (Pramling Samuelson, 2006), that one of the role of the teacher is to direct children's attention to learning subjects for which he wants children to develop understanding, regardless on whether this takes place in a game or in learning situations.

Knowledge then becomes an internal connection between the child and his or her world. This means context, experience, situation, intimacy, relationships with others, and so on. They mean a lot, they affect how children understand the world around them (Hundeide, 2006). This is not an argument for an extremely relative perspective. Instead, children are thought to be part of an internal psychological process - yet the environment and cultural experiences influence every situation.

Here, making meaning as a child who plays a game is related to looking at the child's perspective, whether something is initiated by the child or the teacher. This means that the child has to contribute by expressing himself verbally or physically to give meaning. In other words, this is achieved through participation in meaning-making processes (Pramling Samuelsson & Sheridan, 2003). This places demands on the teacher. First of all, the teacher must have knowledge about the children in general (child development) and the specific child in focus (family, daily experiences, interests, etc.). The teacher must also make an effort to listen and awaken the children and be prepared to see what the child sees and interpret it. The teacher must also show respect for each child's experience, knowledge and competence from the child's point of view. The child must contribute to the subject of learning or play, although, in the end, the adult interprets this (see further Johansson and Pramling Samuelson, 2003).

Variation, diversity and simultaneity are a source of play and learning

In his book The Uncertainty of Play, Sutton-Smith (1997) primarily addresses biological evolution as a model for human development, where flexibility is more important than precision. Evolution is characterized by thriving changes and latent possibilities. Both play and learning can be described in this way.

His second principle of variation refers to abundance, that is, the body's ability to overproduce synopses. Again, playing and learning in a similar way involves endless reproduction of many different possibilities. Flexibility is a key word for the biological world - and without great flexibility neither play nor learning is possible!

Suddenly, in this information I saw another useful metaphor with which I would understand the role of play. We can say that just as the brain begins in a state of high potential, so does play. The brain has these connections, but unless they are actualized in behavior, most of them will die out. Similarly, in play, even when new relationships are actualized, they are still not, first, the same as everyday reality. Actions do not become an everyday reality as long as there is no rhetoric or practice that takes into account their use and value. The function of "Play" in the early stages of development can be to help realize the brain potential without even greater commitment to reality. In this case, its function would be to save, both in the brain and in behavior, the greater variability that is potentially there than would otherwise be preserved if there were no game. Piaget's game theory is, of course, quite the opposite. He says that only after establishing connections with real accommodation, they consolidate in play. The current thesis would argue that another function of play, perhaps the most important, may be to actualize new relationships, and thus to expand the potential variability of childhood. (Sutton-Smith, 1997, pp. 225–226)

One form of variation in play is the oscillation between fantasy and reality - when learning about a particular situation and how your thoughts are progressing towards understanding (something that is rarely concrete). Both play and learning are characterized by temporal and spatial variation.

Sutton-Smith also talks about play as a neonatal biological process, as a cultural variation (music, dance, song, etc.). He also claims that there is a transfer of "playing skills" to everyday skills and that children are creating a repertoire of ways to act in play. However, from our point of view, there is another perspective which means that variation creates a basis for differentiation, which is as important in play as in learning.

Consider variation (Runesson, 1999). Both similarity and variation are fundamental to several critical aspects of childhood cognitive development, including the ability to distinguish one subject or learning phenomenon from others, which in turn is essential to

the categorization process. For example, for a small child to be able to understand the concept of a flower, instead of simply naming a flower as a flower, the child needs to experience a variety of flowers to distinguish the basic features that make up what we call a flower. However, it is not enough to simply allow the child to experience a variety of flowers. He must also experience that the flower is different from other plants, such as trees, shrubs, and grass. Gradually the child will become able to understand the concept of one type of flower, distinguishing the critical characteristics of the rose from other flowers. Even if young children can recognize a rose as a flower before they understand the concept of a flower, they probably do not understand what a rose is.

Of course, this case applies to other dimensions of content. In order to learn an important rule in an early childhood program or in elementary school, it must have a personal meaning, which can be challenged by using the rule in different situations (the rule is constant). It should also be clear that this rule can have different meanings (variations). Finally, this rule must have critical features that make it recognizable by other rules. There may be a rule for "every child's right to equality". This must make sense for each child, but it should also be discussed in very different contexts and negotiated in different situations before this rule of value has a deeper meaning for children.

The type of variation we advocate defines learning as a variety of ways in which a child produces variation, as well as a variety of ways in which a group of children think about the same phenomenon, the same problem or concept. These are examples of intra-individual as well as inter-individual variation. The variety of ways in which a child thinks about a single phenomenon, problem, or content is the very content of the learning process (Doverborg and Pramling, 1995; Doverborg and Pramling Samuelson, 1999, 2000; Pramling, 1990, 1994). In other words, the teacher uses variation as a strategy to make specific knowledge, skills, ideas and phenomena visible to the child. Because the child thinks in different ways about a topic or phenomenon, he / she becomes able to recognize variations in the topic or phenomenon and different meanings that can be derived from it.

Play as well as learning are constituted in a society by people who agree on actions, persons, objects, situations, time and motives for play or learning. So, what we have tried to argue about is to look at play and learning as equal dimensions with many similarities in early childhood education.

Meta cognition, meta-cognitive dialogues and meta-communication

For many years, meta-cognitive research has been conducted at the University of Gothenburg on preschool learning (see, for example, Pramling, 1983, 1987, 1996) with great success in influencing the learning of young children (NSIN Research Matters, 2001).

The approach to working with young children is metacognitively focused on focusing on children, as we saw in the example above (this, however, can be done in many different ways, see, for example, Doverborg and Pamling Samuelson, 2000). Regardless of the task or topic, the teacher makes the children think, reflect and express their ideas in different ways (verbally, in drawings, in a game, in experiments, etc.). Then, the teacher uses the different ideas that the children come up with. as content in a second discussion of a topic or task, that is when children's attention is focused on the meta-cognitive aspect. This procedure helps children become aware of the fact that they have different ideas and different ways of thinking about the same phenomena. Thus, the subject in the second round is not the task or topic, but thinking about the task or topic.

Communication and interaction in this way become based on two levels, thinking and thinking for one's own thinking (Pramling Samuelsson & Asplund Carlsson, 2003). A parallel of this approach between the teacher and the children can be seen in the children's play. When children play, they spontaneously use both communication and meta-communication, as described earlier in this article. The equivalence in the learning approach is that, with the help of the teacher, the children's interest is focused on thinking and thinking about something. When children express their ideas, either verbally, in drawings or otherwise, the teacher focuses on how they think about something, that is, on the metacognitive aspect of learning (for example, see Pramling, 1996). This means that the teacher's task is to try to make the invisible visible to children.

Playing is not the same as learning

We do not argue about what we perceive play as learning or vice versa, but there are dimensions of play in the dimensions of learning and learning in play that are important to work on in the learning and development of young children. Nor do we try to redefine the notions of play or learning, but instead use these notions differently to create a new preschool pedagogy, something that Elkind (1988) talked about as a third way of preschool pedagogy many years ago.

A vital dimension of both play and learning is creativity, which is seen here as the source of all subjects for preschool learning. This means that the whole learning is a matter of creating something new for the individual - that is, to experience something in a new or slightly different way (Next Generation Forum, 2000). "As if" is another term that is often associated with play - but this term is as important in learning as it is in play (Weichinger, 2001). This means that learning tasks must also have a "how to" aspect for children, so that they can go further and challenge their own thinking.

Ellen Langer's notion of vigilance (1997) is another dimension of play as well as learning. By caution it means "to be aware, to perceive or to be attentive to something." Being responsible and interested is just as important in play as it is in learning.

The last term we will bring up is the term of Anna Kraft (2002), thinking about possibility. In play, children are constantly confronted with opportunities, but this way of connecting with the world around them is just as important for learning. To take these terms seriously is to recognize and use the close connection between play and learning. It is a common question for the teacher to look at the possibilities in all early childhood education activities.

The experience of action research with teachers involved in the preschool approach presented here is that they can say, "I have always thought of play as something children learn - but I have never seen the play aspect of learning." Another teacher argues that there are less planned activities for the whole group today because communication and interaction are difficult to use in large groups (Johansson and Pramling Samuelson, 2006). What the teachers are saying here is that they must make room for the children to improvise, interact and listen.

Let us listen with all our senses to the two girls in the following example:

Hiardis (6 years old) and Frida (5 years old) play in the living room. The context is that the rest of the family has dinner in the garden. Someone just asked, "Where are the girls?" Ingrid volunteered to find out, and what she found was the following: They were there in the living room, arranging all the umbrellas they could find in the house (by color and pattern) and took out all the Danish cinemas, playing at a party.

We can only imagine their dialogue and negotiations in arranging and producing this situation. Did Frieda learn anything from Hiardis or vice versa? As far as we know, this was the first time they had produced this specific arrangement; so what did they invent together? How did you come up with this idea and how did it come about? Although we do not know this, we can see how creative they are, and there is probably a "how to" dimension and two caring children who allow their "possible thinking" to guide them.

What we do know, though, is that this situation is typical of learning children playing! The child's perspective naturally leads to integration between play and learning.

Towards an alternative approach to preschool pedagogy: "Developmental pedagogy"

Different early childhood curricula have different ways of presenting goals to very young children. Paula Oberhumer (2005) argues that the most common way to perceive goals is to state what knowledge or skills children should attain before leaving the early childhood setting. The Swedish Early Childhood Curriculum (Swedish Ministry of Education and Science, 1998) differs from the others in that it only lists the goals we should strive for but do not have to achieve.

The goals for early childhood education are defined in the curriculum and in the mind of the teacher. This means that the way he constructs the environment and what kind of experiences are provided are crucial to children's learning and opportunities to understand the world around them. The curriculum must be internalized and lived by the teacher. This means that he / she must see opportunities everywhere in the child environment (Doverborg and Pramling Samuelson, 1999; Pramling Samuelson and Asplund Carlson, 2003). The teacher must also contribute to a challenging and rich environment (Siraj ira Blatchford, 1999). This includes using one's own knowledge to create situations, tasks, playing a mile, and so on. (Doverborg and Pramling, 1995).

One of the main features of the approach we are discussing is how the teacher can direct the children's awareness towards the learning objects. At one level, learning subjects in early childhood education are related to values and norms, skills and opportunities and to understanding different aspects of the world around us. This means that the subjects are the same throughout the education system, but at different levels of complexity from the teacher's perspective.

From the child's point of view, it can be difficult to understand the concepts of number four at the age of four, how to understand multiplication later in school. They are all dimensions of the same learning object at different levels of learning. This does not mean that preschools should be subject-oriented, but the basic dimensions of, for example, reading and writing, mathematics, science, culture, etc. They must be there. More general dimensions such as democracy, gender equality and social, emotional and cognitive competencies should also be included to align with the curriculum. The object of learning is then similar in the whole school system. The act of learning, however, is different!

Perhaps there is a reason why the focus on how children learn has been so strong throughout history (Bruce, 1990). Young children are different from school children, not only because they have not yet learned to be school children, which for many children means taking instructions and waiting for their teacher to respond. Young children are active "by nature". They are constantly "continuing"! This places certain demands on the

teacher. These requirements can be described as making children interested in specific learning subjects, but also as capturing the child's interest. All of this requires the teacher to be able to adapt to the children's world (Pramling Samuelson, 2004; Stern, 1985, 1991). Siraj - Blatchford, Silva, Mutok, Gilden and Bell (2002) talk about "shared sustainable thinking" as an important factor in the quality of children's learning. This means that the teacher and the child / children have the same object of communication and thinking - something that many studies have shown to be rare (Doverborg and Pramling Samuelson, 2000; Kerby, 1985; Pramling, 1983).

The role of the teacher is equally important for learning and playing. It is important to give support and inspiration, to challenge and encourage the child's readiness and desire to continue the process of creating meaning in the world. This means that the focus should be on the process of communication and interaction.

The approach to early childhood education, built on a goal-oriented perspective related to the child learning game, challenges teachers to be child-centered and focused on learning objects at the same time. It also challenges children to retain their right to self-determination while paying attention to the subject matter.

To be able to integrate play and learning in a goal-oriented preschool means to see how the child learns through play and, thus, to make room for creativity, choices, initiatives, thinking and the like. It also means being aware of the objects of learning and utilization throughout the day and all activities to develop a child's understanding of the various aspects of the world around them (Pramling Samuelson, 2005).

Play is so important for the optimal development of the child that it has been recognized by the United Nations High Commissioner for Human Rights as the right of every child. However, even those children who are lucky enough to have plenty of resources available and who live in relative peace may not get the full benefits of play. Many of these children are brought up in an increasingly hasty and pressured style that can limit the protective benefits they will receive from child-led play. Because every child deserves the opportunity to develop to their unique potential, child advocates must take into account all the factors that hinder optimal development and press on circumstances that allow each child to take full advantage of the benefits associated with play.

Free play versus guided play

Most researchers agree that play is fun, flexible, voluntary and internally motivated; involves active engagement and often involves belief in persuasion. With guided play, the child still experiences the joyful, self-directed aspects of free play, but with the addition of

adult guidance to ensure that the child progresses towards a particular learning goal. Regardless of the type, play can work to help a child learn the important skills they will need as adults to succeed in today's global society.

1. Play can encourage effective communication

When a child plays, either alone or with others, he or she develops important speaking and language skills as well as listening skills. If the child is playing alone, he will usually recount his actions or talk to himself while handling various toys. For example, "the superhero jumps from a tall building to save the girl from the river." When playing with other children, the child will communicate goals and organizational ideas to others. For example, when playing "school", children will decide who is a teacher, who is a student and what they will learn. If there is disagreement, the children are led to discuss the issue and work on a compromise. The lead game is a model for setting up language learning. Exposure to additional vocabulary enriches their own variety of words, which they can then insert into their language. Guided play encourages word learning for preschoolers, especially those in disadvantaged environments.

2. Play helps to develop social skills

During play time, children learn to work with others towards a common goal. A child can play a game, but he must learn to look at other people's needs. Through play, children learn to be confident, to negotiate, to collaborate and to share. This co-operation skill is important in developing social skills and building friendships. Through play, children learn to work through their emotions. Even before they can speak, they express their feelings through physical play, storytelling, art, and other activities. If they experience a negative feeling, they can repeat that experience even though they are playing. These social skills are also a vital part of language development. Language is much more than just spoken words.

3. Game develops cognitive, critical thinking and motor skills

Critical thinking is an opportunity to analyze and sift information in order to make sense of it and apply it in the context of the environment. This skill involves the front part of the brain that manages attention, memory, control and flexibility. Having a child point out that they always have time to tell before the flood is an example of how she uses critical thinking. Children learn math and literacy skills by playing with various toys and books and demonstrating their thinking while talking about what they do. Playing with shapes, counting mattresses at night for each child or pages in a book, using illustrations in books to support understanding - all are examples of the important learning that takes place during free time and guided play.

Physical play also helps develop important motor skills, as well as helping your child work through stress and anger. The first children develop great motor skills such as running, throwing and pedaling. Then, fine motor skills such as writing, coloring and buttoning are developed. Jumping takes balance, climbing monkey bars creates strength, and sports activities involve coordination. Carefully arranging blocks in towers means not only learning about gravity and balance, but also developing hand-eye coordination. When your child is able to feed and dress, he or she will gain a sense of independence that is directly related to the next benefit of play.

4. Play creates trust in children

One of the most important outcomes of play is the development of trust even in the youngest child. Without trust, the ability to take risks and try new things is jeopardized. As babies, we gain self-confidence by learning that our needs are important to our parents or other caregivers. Young toddlers use adults as their home security base to explore and learn, and they gain confidence when they discover many things they can do on their own. By the time children reach preschool age, they know they can still trust the adults in their lives, but they also have the confidence they need to take responsibility.

5. Play inspires creativity

Creativity occurs when a child's critical thinking and skill development come together to produce something new or different. Pretending or imaginative play is one of the foundations of the children's world and they begin to demonstrate this skill around the age of two. The child can use anything in her world to stimulate her imagination, including ordinary household items because she has learned the symbolism something can stand for in other things. He may have his new ability to disguise himself using cookie cutter bottoms or transforming a fishing rod. And he will not only use objects for a fake game, but will also have various roles. He can be a superhero one day, a doctor the next day, and a father the next. This allows children to explore different scenarios, reactions and conclusions. Research shows that children who play games have a more sophisticated level of interaction with others and a greater cognitive ability.

What does a performance-based approach to learning look like?

Educators of early childhood education and care services use a wide range of play-based experiences for children's learning and development, rather than using structured "lessons" or formal teaching experiences. They set up indoor and outdoor games that are age-appropriate and safe for any child to play.

Educators encourage children to learn through play through:

- Providing resources that reflect the age, interests, knowledge, strengths, abilities and culture of children to stimulate and support play. Resources that enable the open use of objects such as blocks or cardboard boxes encourage creativity and the ability to mentally manipulate concepts as children. For example, turn the box into a car.
- planning play experiences based on an assessment of children's individual differences, interests, developmental needs and abilities. For example, as the child learns to hold a pencil for drawing and writing, educators will give children different sizes of objects and build strength in the child's fingers.
- Awakening children while playing so that they can understand how they play with other children, what skills and understanding they demonstrate in play and what activities can enhance their play skills.
- Involvement in children's play to expand the child's learning and modeling skills such as reasoning, appropriate language and positive behavior.
- Providing large blocks of unhurried and uninterrupted play time for the development of children's ideas and games.

White paper

Learning through play: a review of the evidence

Jennifer M. Zosh, Emily J. Hopkins, Hanne Jensen, Claire Liu, Dave Neale, Kathy Hirsh-Pasek, S. Lynneth Solis and David Whitebread

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Executive summary

The aim of the LEGO Foundation is to build a future where learning through play empowers children to become creative, engaged, lifelong learners. This ambition is more critical than ever. The world of today and tomorrow is one of challenges but also of tremendous opportunity. An increasingly interconnected and dynamic reality means children will face continuous re-skilling and a need for lifelong learning as they grow. Many children also face hardship in the shape of stress, poverty and conflict. They need positive experiences and coping skills to counterbalance negative factors in their lives, and support their confidence and opportunity for making a difference. We firmly believe that promoting children's drive to learn, their ability to imagine alternatives, and to connect with their surroundings in positive ways, is absolutely essential.

This white paper summarises current evidence on the role and importance of children's learning through play. We first consider what it takes to thrive in a 21st century context, before defining learning in a broad sense: both as a deep understanding of content and as learning-to-learn skills that build on children's natural affinity to learn and engage with their world from birth. We then draw on the science of effective learning, rigorous play research and neuroscience to explore the potential of playful experiences for promoting deeper learning and a breadth of skills. We outline what evidence is known, what gaps exist, and propose future directions for research. The three boxes below summarise these insights under three headlines: what we know, what we think and what needs to be done.

Through active engagement with ideas and knowledge, and also with the world at large, we see children as better prepared to deal with tomorrow's reality - a reality of their own making. From this perspective, learning through play is crucial for positive, healthy development, regardless of a child's situation.

What we know

Learning through play happens through joyful, actively engaging, meaningful, iterative, and socially interactive experiences.

Our goal is to develop creative, engaged, lifelong learners who thrive in a 21st century world

What we think

Learning through play supports overall healthy development, acquisition of both content (e.g., math) and learning-to-learn skills (e.g., executive funtion)

The benefits and role of learning through play differ across contexts and cultures

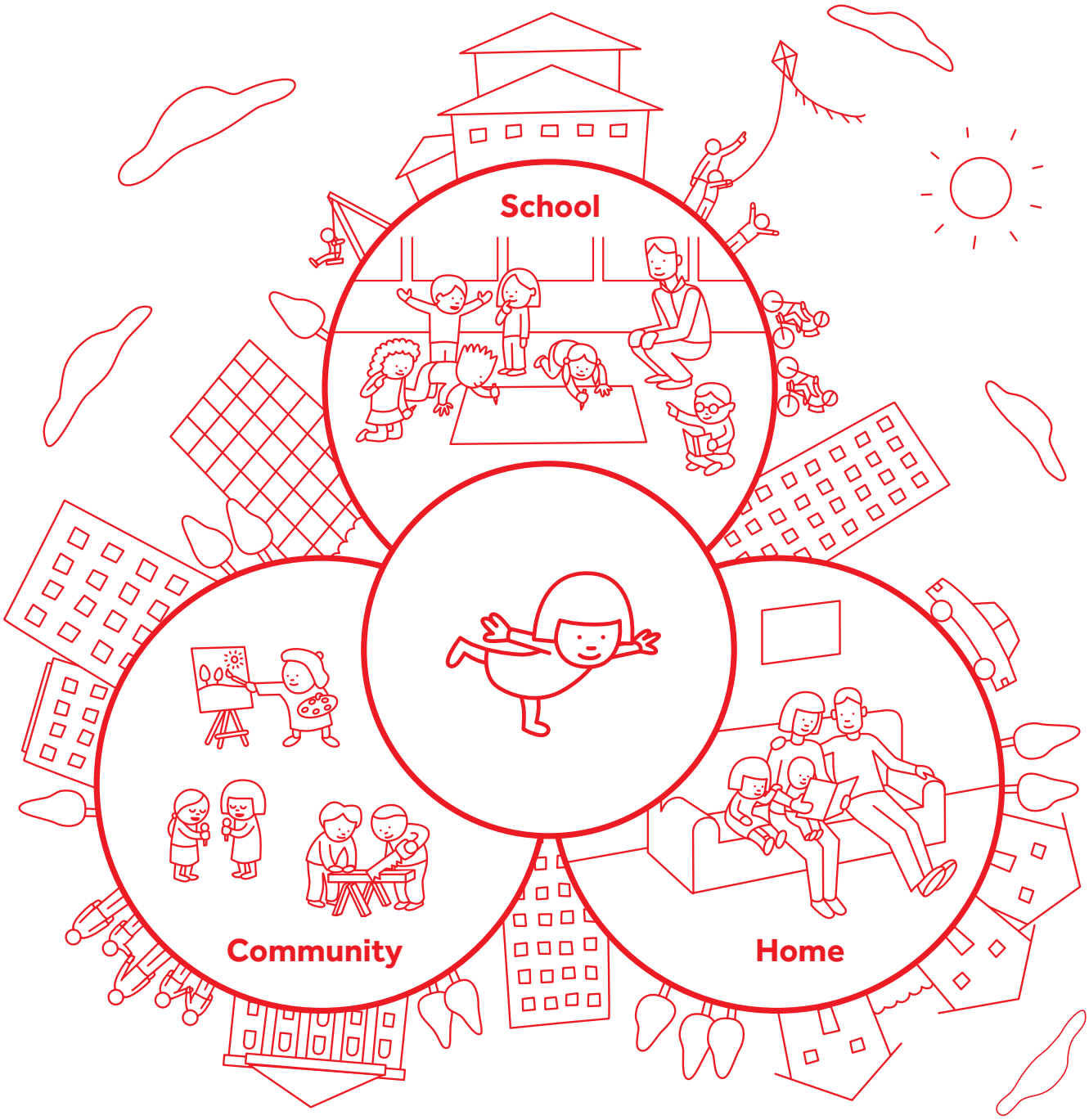
What needs to be done

Learning through play research across cultures

Well-controlled studies examining play's role for higher-level skills

Greater understanding of how play and its benefits change over time and context

Insights from neuroscience on play in real-life contexts



> **Learning through play is about continuity; bringing together children's spheres of life - home, school and the wider world, and doing so over time.**

Susan MacKay,
Director of Teaching and Learning
at Portland Children's Museum

Thriving in the 21st century: challenges and opportunities

Today's children (tomorrow's adults) grow up facing rapid change, global challenges, and connectivity, all of which affect their prospects of life and work.

The LEGO Foundation aims to build a future where learning through play empowers children to become creative, engaged and lifelong learners. UNESCO uses the term global citizenship to highlight this need for empowering children to take active roles in the face of global challenges and to become contributors towards a world characterised by greater peace, tolerance and inclusion (UNESCO, 2015). Their call to action also reminds us of a difficult reality; all over the world, children face hardship. Neglect, loss, poverty and conflict are just some of the situations where they are at risk. They need protective experiences and coping skills to counterbalance negative factors in their lives (NSCDC, 2015). In this white paper, we focus on three specific potentials for learning through play: during children's development in the first years of life, through entering school age and laying the foundation for lifelong learning.

Play in early development

Neuroscience presents us with strong evidence for the profound influence of early experiences. In order to build healthy brain connections from the outset, young children need responsive and rich social interactions with caregivers, combined with sufficient nutrients and an environment free of toxins (CDC at Harvard University, 2016). Playful experiences offer a unique context for these supportive and rich learning experiences in early childhood (see also the forthcoming white paper titled Learning through Play in the First 1000 Days by J. Robinson, in progress).

Connecting play and education

As children grow, preparing them for the demands of school and the wider society is key. However, content only serves children as far as they can apply and build on it: a child who has not grasped the concepts of plus and minus stands little chance of understanding equations. Attaining key content and facts is important for school and life, but children also need a deep, conceptual understanding that allows them to connect concepts and skills, apply their knowledge to different situations, and spark new ideas (Winthrop & McGivney, 2016; Frey, Fisher, & Hattie, 2016). We see playful experiences as optimal for engaging in this type of deeper learning (see the section on 'Characteristics of playful experiences' in this white paper).

Play and lifelong learning

Finally, today's world is uncertain and constantly changing – from shifting career and political landscapes to increasingly digital economies and social life. New technologies mean we live and work in ways that did not exist twenty years earlier. Children need skills and mindsets allowing them to step into this uncertainty, create opportunities for themselves and their communities, and learn throughout life. Using the simple, yet compelling words by researchers Golinkoff & Hirsh-Pasek (2016), realising children's potential in the face of this uncertainty means supporting them to be "happy, healthy, thinking, caring, and social children who will become collaborative, creative, competent, and responsible citizens tomorrow".

What global citizenship, coping and thriving look like for children may differ dramatically across time, culture, and context, but the deep understanding that comes from effective learning experiences will no doubt be an important step. In playful experiences, children tap a breadth of skills at any one time. When playing together, children are not just having fun but are building skills of communication and collaboration. A game of hide-and-seek helps them to manage feelings about the unknown while also helping them to think about what other people know and see. Beyond enjoyment, playful experiences have the potential to give children the skills they will need in the future that go beyond facts. As we discuss more fully below, playful experiences appear to be a powerful mechanism that help children not only to be happy and healthy in their lives today but also develop the skills to be the creative, engaged, lifelong learners of tomorrow.

In the following sections, we present insights from diverse scientific literatures to describe the nature of children's learning and the role of play and agency in their development. This leads to five characteristics that describe the interface between play and learning: joyful, meaningful, actively engaging, iterative and socially interactive. This evidence base offers a broad, yet compelling picture of how playful experiences support children's development and learning, particularly in the early years of life. Yet, we also recognise that more work is needed to discover the mechanisms by which child play engages with learning outcomes, and what happens as children grow older. In the closing remarks of this white paper, we point to future directions and unanswered questions on learning through play.

> **“We don’t teach uncertainty in schools. It should be the absolute bedrock of what we teach children – how we come to know and how we describe reality. In fact, we teach the exact opposite.**
>
> **Adam Rutherford, science writer, & Rufus Hound, comedian**

Learning is broad, interconnected and dynamic

Learning is sometimes thought of in the strictly cognitive or academic sense, yet research in child development has shown us that learning is much broader and interconnected.

A holistic view on learning

Newer approaches to theory and practice have done an excellent job of extending the view of learning to include areas such as physical (e.g., fine and gross motor skills), social (e.g., empathy and theory of mind), emotional (e.g., development self-regulation and even self-conscious emotions), and creative development (e.g., divergent thinking, making and expressing). This broad view of learning is a tremendous step forward in our understanding. However, some still view these different domains as separate from each other. Such a view fails to capture the real nature of learning-to-learn and particularly the skills required in learning to learn that truly allow children to be prepared for 21st century opportunities (Golinkoff & Hirsh-Pasek, 2016). We see the shortcomings of this domain-based model in two ways.

Child development is interconnected

First, research in the last few decades has repeatedly shown that the different domains of development are not silos as much as they are interconnected gears: development in one area can influence development in another. For example, physical development lays the foundation for later cognitive and social skills. A whole new world opens to a toddler who learns to walk instead of crawling. Now, he can hold a toy with ease and go in search of his caregiver, gaining access to new interactions, language and play (Karaski, Tamis-LeMonda, & Adolph, 2014).

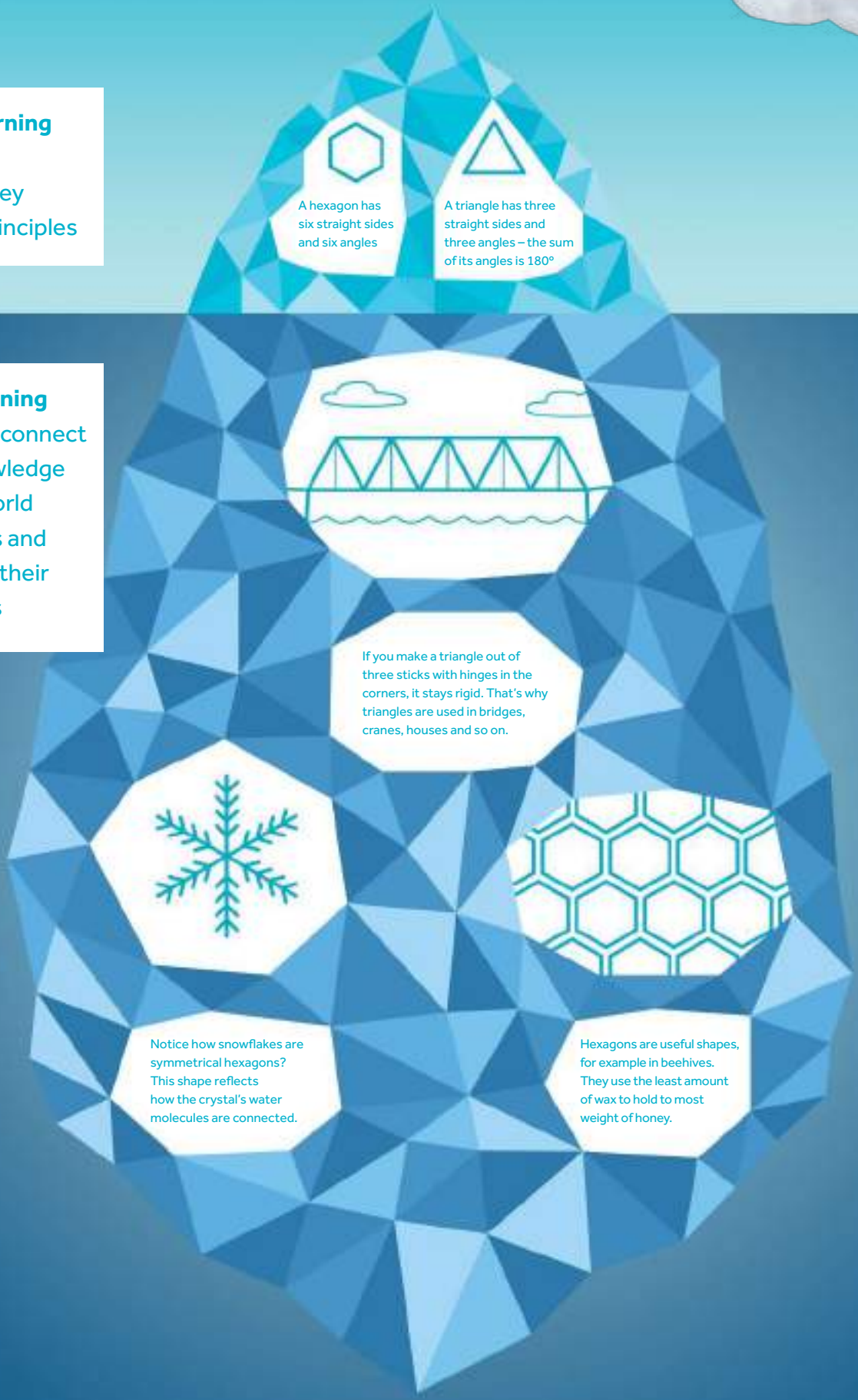
Social competence and emotion regulation in turn underpin children's cognitive skills (McClelland, Acock & Morrison, 2006), and language helps children interact with peers in positive ways (Vallotton & Ayoub, 2011). Studies looking across the span of childhood find that infants who are more physically active and explore more at the age of 5 months show more success in school at age 14 (Bornstein, Hahn, & Suwalsky, 2013). These examples highlight that children's growth and development is beautifully complex and not easily broken down into neat divisions. Importantly, lessons from neuroscience also tell us that learning is dynamic and not easily divisible into separate and independent mental processes (e.g., Bassett et al., 2004; Dahaene, 2009; Sporns et al. 2004; Wandell, Rauschecker, & Yeatman, 2012).

Learning-to-learn skills

Second, if we think about development as fitting into neat domain-based divisions, we lose sight of the crucial learning-to-learn skills that cut across domain boundaries (Golinkoff & Hirsh-Pasek, 2016). Truly learning information and new skills requires a dynamic, deep, conceptual understanding that often relies upon all of those domains. For example, executive function - a suite of abilities that includes working memory, the ability to inhibit impulses, and switch attention between tasks or rule sets - has been shown to relate to a variety of academic skills including math and literacy. Some studies have even found that children's impulse control in preschool predicts a wide range of outcomes in adolescence and adulthood, including higher SAT scores, better health, and lower rates of substance abuse (Mischel et al., 2011).

Surface learning means we memorise key facts and principles

Deeper learning allows us to connect factual knowledge with real-world experiences and really grasp their implications



Learning-to-learn skills encompass a wide variety of abilities that help children learn information, acquire skills, and deal with new situations (e.g. Care, Kim, Anderson, & Gustafsson-Wright, 2017; Deci & Ryan, 2000; 2012; Dignath, Buettner, & Langfeldt, 2008; Harvard CDC, 2011). They include the ability for children to be motivated drivers of own experiences. This involves focus and attention to avoid distractions that pop up, the curiosity and motivation to seek out new opportunities and information, the willingness to take risks, have confidence, and have a love of learning. Additionally, children benefit from having the skills necessary to be a self-starter - namely autonomy, persistence, and goal setting - and the ability to rise to meet new challenges. This requires imagining innovative and creative solutions to problems and adapting those solutions if the first try fails.

When children develop the ability to explore their environment, be resourceful about the materials, people, and skills that they engage with, and think flexibly about different approaches to a situation, they are better equipped for whatever challenge next confronts them. Many problems will also require the ability to isolate important aspects of a situation, test out hypotheses, and reason critically and scientifically about evidence. We must also think about how best to prepare children to think in this critical, scientific way. Finally, we cannot ignore the fact that we live in a social world, and to succeed in life children must have the ability to interact and work with other people. Young children need to not only understand and regulate their own emotions but also express those emotions effectively and to understand and empathise with others. Beyond communication, the ability to effectively work with other people to accomplish goals is critical. Children and adults are more successful when they can communicate their ideas to others, collaborate to accomplish joint goals, negotiate when partners disagree, and take leadership when necessary to help move a team forward (Jones, Greenberg, & Crowley, 2015).

Importantly, these kinds of skills not only build upon themselves, but also upon one another in a dynamic cycle of development. Let's imagine two children building with blocks, and one decides to knock the other's tower down. In this situation, the tower-builder must try to control the negative emotions this action causes. In building this emotional regulation, the child

How do we build these important skills for the future?
Research suggests that playful learning experiences appear to be a particularly effective mechanism for the development of these broad, dynamic, and interconnected skills (termed "the 6 C's" by Golinkoff & Hirsh-Pasek, 2016). Imagine a group of neighbourhood children playing on a playground. These children are pretending to be part of a family, with different children taking on different roles in the family - the parents, the siblings, even the family pet! At first glance, this appears to be a simple game of pretend. But when viewed through the lens of playful learning, we see that children are actually building much more than a pretend family. As they negotiate roles, they are building the skills of communication and collaboration. As they look around for new materials to incorporate into their pretend reality, the are exhibiting creative innovation (e.g., a bicycle turned upside down becomes an ice cream truck). As the younger ones begin to question the 'rules' imposed by the older children, they are practicing their critical thinking skills. As they all begin to act out things outside of their comfort zones, they are building confidence in themselves and their ability to face new challenges. Finally, even content knowledge is being strengthened through increased exposure to language and even math as they pay the ice cream seller with their "currency" (e.g., sticks). These are the same skills that will help children to become successful adults and are reviewed in the rest of this piece.

Content is not learnable if communication skills are not in place, and critical thinking operates on content, not in a vacuum. In this way, the skills build on and reinforce one another.

Rebecca Winthrop & Eileen McGivney,
Center for Universal Education, Brookings Institution

is now better prepared to interact more effectively with others in similar circumstances; equally, she is building the skills that will help her to control her fear during a doctor's visit or her sadness when a parent leaves for the evening. In this way, play experiences can help children to exercise those same skills in safe contexts and extend them to more challenging situations.

By highlighting a breadth of skills, the idea is not to lose sight of content. In fact, the two are sides of the same coin. For example, critical thinking and reasoning is easier when one has knowledge of the context of a problem (see Willingham, 2006) or can think of the problem in terms of information that is personally familiar. Ingenuity often depends on knowing how something is currently done and looking for ways to make it better (DeHaan, 2009). In short, learning content is critical because the more you know, the more you are able to learn. Children can learn content directly, for example when taught about scientific discoveries in school or reading a picture book about animals with a caregiver. In these cases, the content is presented directly to them. The point is, however:

New information is learned better when it connects to and expands what we already know.

See Willingham (2009) for a discussion and the section on meaningfulness in this paper. Learning experiences can also build up the learning-to-learn skills that allow children to find relevant content through their own efforts. It is important to cultivate both paths, and playful experiences provide a context that can support both. In the next section, we present insights from research on how children learn best - both skills and content.

Children are born to learn through play

The tools for enhancing and strengthening children's learning are already available in our homes, communities, and classrooms. The answer is, in essence, as simple as child's play.

From the first moments of life

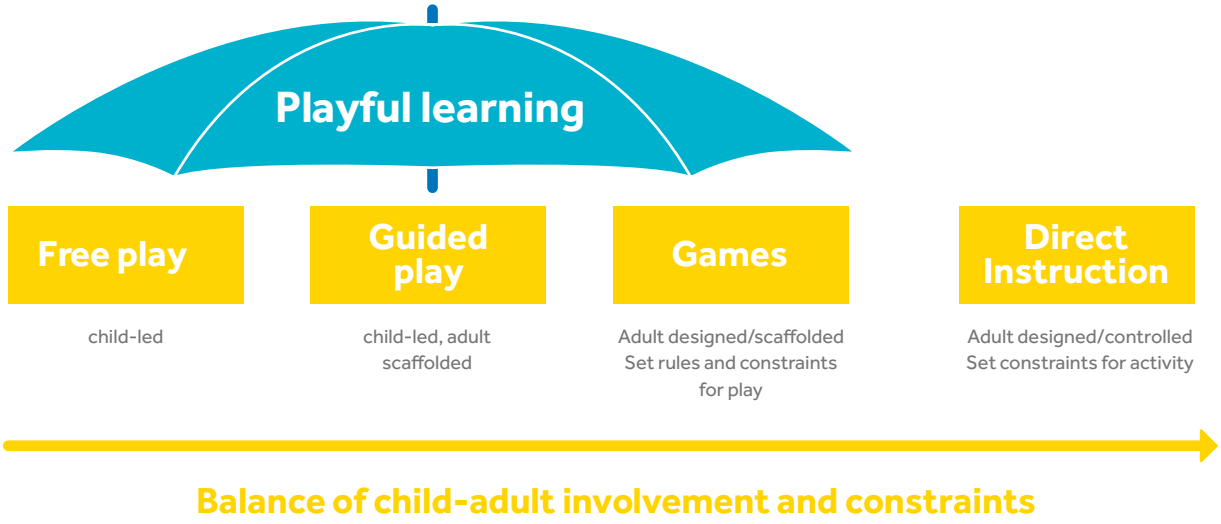
Children possess an amazing, natural potential to learn. Infants as young as a few hours old prefer to listen to the sounds of human voices over any other sound (Vouloumanos & Werker, 2007) and young infants have even been referred to as "scientists in the crib" (Gopnik, Meltzoff, & Kuhl, 1999) due to their natural curiosity and drive. Beyond more obvious areas, such as language development and motor skills, young children also have an imagination and inventiveness that helps them create new ideas and opportunities, and a strong motivation to connect and engage with others. Play harnesses and builds on this potential. From pretending to discover a new country in one's own backyard to hours spent building the world's largest train-station, there is no doubt that play and childhood go hand-in-hand. In the past few decades, research has repeatedly shown that play experiences are not merely fun, nor just a way to pass the time along the way to adulthood. Instead, play has a central role in learning and in preparing you for challenges later on in childhood and through adulthood. In the next section, we will explore the characteristics of play that lead to deeper learning - ultimately preparing children for handling unforeseen events and taking advantage of opportunities in their lives in the 21st century.

Play is natural and necessary

From vocal play in human infants to play observed in other animal species such as rats, non-human primates, and dolphins, play seems to be a natural inclination across the animal kingdom and help individuals within a species to learn, grow, and thrive (Pellegrini, Dupuis, & Smith, 2007). Extreme cases, where infants were raised in deplorable conditions (Bos, Fox, Zeanah, & Nelson, 2009) or experimental manipulations where rats and mammals were raised without play (Spinka, Newberry, & Bekoff, 2001) have shown that play is not simply a 'bonus'. Rather, play has a key role in healthy, positive development. Although natural, play must also be supported by the environment. A report from the American Academy of Pediatrics highlights the need and importance of play for promoting healthy child development, especially for those children living in poverty whose access to safe, playful experiences may be lacking (Milteer, Ginsburg, The Council on Communication and Media, & Committee on Psychosocial Aspects of Child and Family Health, 2012).

A continuum of playful learning

Generally, the literature conceptualises play as existing along a continuum. At one end, free play gives children the freedom to explore, play, and discover with minimal constraints. But play is not just something that happens in a vacuum: our environments structure play (e.g., the materials available when playing in a home, in a yard, in urban environments, in rural environments, etc.) as do the peers, adults, and other people around us. And so, at the other end of the continuum is play that is more guided or structured. The term "playful learning" is an umbrella term that is used to include free play as well as these more structured, guided play contexts (see figure below). Additionally, researchers have recently added games under this umbrella (Hassinger-Das, Toub, Zosh, Michnick, Hirsh-Pasek, & Golinkoff, 2017). Playful learning can take many forms, including physical games such as hide and seek, construction play with blocks, board games, pretending with objects, or engaging in fantastical role play (see the literature review on play types and children's development by Neale, Whitebread et al., 2017). Although there is ongoing debate in research and practice about where free play ends and more guided play begins (e.g. Pyle & Danniels, 2017), our goal in this piece is not to resolve this theoretical debate. Instead, we maintain that learning through play can happen through free play *and* when adults or aspects of the environment structure the play situation towards a particular learning goal.



The importance of child agency

Whether adults are supporting or not, a critical requirement for learning through play is that children must experience agency and be supported rather than directed. Anyone who has spent time with an 18-month-old knows just how much children like to take control. Whether it is putting on her own shoes or feeding herself despite lacking fine motor skills, a hallmark of toddlerhood is the idea of the self as an agent. This quest for control, initiative, and, in a way, leadership, does not end with toddlerhood however. Indeed, the challenge of balancing a child's own desires with the reality of rules, social norms, and situation has been at the heart of many psychological theories. From Freud's id, ego, and superego to Erikson's psychosocial stages of development, the idea that children have a drive for at least some degree of agency is prevalent both anecdotally and theoretically. Having agency does not equal 'anything goes' for children either at home or in education contexts. Agency in learning through play means seeing the child as capable rather than a blank slate to be filled (Daniels & Shumow, 2003).

Agency is about the balance of initiative in the child-adult relationship: are children's interests listened to? Are they consulted on decisions that concern them? Do they initiate an activity and invite adults to join them in play and decision-making? In other words, what opportunities do children have for exerting their thinking and actions in a social context where others hold the same rights? Two dimensions may be helpful to consider: how planned the learning environment is, and how much the child and adult control the evolving 'flow' of activities (Sinclair, 2004; Toub, Rajan, Golinkoff, & Hirsh-Pasek, 2016; Cheng, Reunamo, Cooper, Liu, & Vong, 2015).

Imagine a teacher arranging creative centres in the classroom. In one corner, children cut cardboard owls from a template; in another, they choose and colour print-outs with a shape - triangles, squares, or circles; in the third corner, children work together to build a city from wooden blocks. On the surface, all children are busy doing a task with creative materials but they have different degrees of choice: from none when they are cutting out templates to at least some when choosing and colouring shapes. The greatest opportunities for flexing their 'thinking muscles' come when they are allowed to create and develop a city from their own idea to a final product. Likewise, we can picture a two-year-old with her dad, trying to solve a puzzle. In one scenario, the dad hands over the puzzle pieces, one by one, and indicates where to place each piece. In this case, he controls almost all aspects of the activity. Alternatively, he might support her to work on the puzzle herself, but occasionally make suggestions, such as rotating a piece if it doesn't fit at first or trying to look for similar colours. Researchers find that this kind of scenario, where caregivers ensure that children play an active role in solving a problem-solving task, promotes children's executive functions - that crucial suite of skills used in goal-setting and flexible thinking (Matte-Gagné, Bernier, & Lalonde, 2015; Hammond, Müller, Carpendale, Bibok, & Liebermann-Finestone, 2012).

Benefits for development

The importance of agency and self-directedness and their impact on learning for humans across the lifespan is, in fact, widely researched. From the work on self-determination theory (Ryan & Deci, 2000) and intrinsic motivation with adults (Cordova & Lepper, 1996), the literature is full of examples in which choice and a sense of agency in determining what is learned appears to be a powerful mechanism. Even before adulthood, seeing oneself as an agent has been linked with learning. Infants who are given experience with grasping objects themselves are better able to

understand the mental states (such as intention and desire) that underlie actions of others (Sommerville, Woodward, & Needham, 2005). As children begin to move through the world on their own instead of being carried or pushed in a stroller (and thus, have a higher degree of agency), we see widespread benefits to cognition. According to Campos and colleagues (2000), "...the onset of locomotor experience brings about widespread consequences, and after infancy, can be responsible for an enduring role in development by maintaining and updating existing skills." (p. 150). For example, elementary school children who are allowed choice about the features of a game are more motivated to play and learn more from it (Cordova & Lepper, 1996).

Play is an agentic learning context

Play captures many of the features that we know from research lead to deeper learning, and thus provides an optimal environment to develop the skills and knowledge that children need to thrive and succeed as adults. Children are intrinsically motivated to play, which makes it fertile ground for learning and developing new skills. During play, children can take charge, making choices about what they do and how. Play can be a highly social activity, allowing for opportunities to learn from and about others. Thus, play can provide many opportunities for learning, but not all play is learning, and not all learning is play. Next, we describe five characteristics that specifically define playful learning experiences and review evidence on how these link to children's deeper learning.

Characteristics of playful learning experiences

What does it look like when children learn through play? On the next pages, we dive into five characteristics of play with insights from research on how they promote deeper learning.

Regardless of whether a play activity falls closer to free play, guided play or games on the continuum, we say that optimal learning through play happens when the activity (1) is experienced as joyful, (2) helps children find meaning in what they are doing or learning, (3) involves active, engaged, minds-on thinking (4) involves iterative thinking (e.g., experimentation, hypothesis testing), and (5) involves social interaction (the most powerful resource available to humans - other people). The selection of these characteristics is based on the theory presented by Hirsh-Pasek, Zosh, Golinkoff, Gray, Robb, & Kaufman (2015) where they provide evidence that a deep, conceptual understanding requires that children are active (minds-on) and engaged (not distracted) with meaningful material especially in socially interactive contexts. Here, we use this conceptualisation as a foundation, combined with a playful state of mind - joy and iteration - to further explain learning through play.

The five characteristics ebb and flow as children are engaged in learning through play activities. All five characteristics are not necessary all the time, but over time children should experience moments of joy and surprise, a meaningful connection, be active and absorbed, iterate and engage with others. Joy is a necessary requirement for an experience to be playful. Indeed, the '...predominant emotions of play are interest and joy.' (Gray, 2013, p. 18). When it comes to deeper learning, active engagement is necessary as one cannot imagine children reaching a depth of understanding and ability to apply without being minds-on and actively processing information or experiences. Additionally, learning through play requires that an experience is meaningful to the child. Exposure to abstract concepts that are not connected to children's real-life experience may lead to shallow memorisation of information, but will not foster the type of deeper, flexible learning we wish to encourage (see illustration on page 9).

Together with a sense of agency, we suggest that joy, meaningfulness, and active engagement, are necessary for children to enter a state of learning through play, and the addition of any combination of the other two characteristics (iteration and social interaction) supports even deeper learning. In the following sections, we draw on existing research to describe the potential of learning through play.


Socially interactive
Iterative
Joyful
Actively engaging
Meaningful


#1

Joyful

Joy is at the heart of play

Here, we define joy in a broad sense: as pleasure, enjoyment, motivation, thrill, and a positive emotion - whether over a short period of time or over the entire play session. In other words, joy is seen as both enjoying a task for its own sake and the momentary thrill of surprise, insight, or success after overcoming challenges. From a child enjoying a pretend play session with a peer to the thrill of building that tower just right, joy is a key facet of play. Saying that learning through play must be joyful does not mean that there can be no negative or neutral emotions at all. Sometimes frustration with a problem is necessary to feel the joy of breakthrough when it is finally solved. Further, the power of surprise or the thrill of the unexpected can bring joy to an otherwise boring or even potentially intimidating situation (e.g., just think of a child's reaction to a jack-in-the-box or when a child who is pouting because she is losing a board game lands on a piece that puts her in first place). Crucially, joy is also linked with learning in a number of ways.

In developmental research, joy is often linked with interest or motivation. Over the last few decades, researchers have made great strides in investigating motivation through concepts such as mindset (Dweck, 2006) and grit (Duckworth, 2016), and how these can improve learning. For example, everyone can intuitively remember just how hard it can be to learn or be productive when we are sad about something happening in our lives, or when that inner critic swallows all our mental energy. This is not just an impression. Research repeatedly shows that negative life experiences have implications on learning and development, just as perseverance and positive outlook improve our ability to handle stress and challenges in life (Donaldson, Dollwet, & Rao, 2015).

We can also easily remember the excitement felt and the ease of learning about something that caught our attention in a surprising way. Recent work suggests that even infants show more learning after a surprising event than after one that is expected (Stahl & Feigenson, 2015; 2017). From neuroscience, we find that emotions are integral to neural networks responsible for learning (Immordino-Yang & Damasio, 2007). Joy, for example, is associated with increased dopamine levels in the brain's reward system linked to enhanced memory, attention, mental shifting, creativity, and motivation (e.g., Cools, 2011; Dang, Donde, Madison, O'Neil, Jagust, 2012). Indeed, thinking of emotions as secondary to thinking in learning goes against recent research in the developmental and neuroscientific disciplines (Immordino-Yang & Damasio, 2007).

> **"The predominant emotions of play are interest and joy.**
>
> **Peter Gray,**
> play researcher

Meaningful

Making sense of experiences

Meaningful is about children finding meaning in an experience by connecting it to something they already know. In play, children often explore what they have seen and done, or noticed others do, as a way of grasping what it means. By doing so, they can express and expand their understanding.

Imagine a two-year-old who will readily say "1 2 3 4 5 6 7 8 9 10!" when asked to count to 10. His parents are happy and the child feels proud to have given the right answer. But when this same child is given five pieces of candy and asked to count how many he has, he can't come up with the answer. Although this child appears to know a "fact" - this is really just an illusion. He has no true conceptual understanding that he can use flexibly or that connects to his world. The same kind of "learning illusion" is also apparent when children can recite the alphabet song but are unable to identify the letters or the relevant sounds that go with each letter. To move past rote learning to more meaningful understanding (Ausubel, 1968), the child must learn to connect the illusory fact to something in real life. Children need to count actual objects rather than reciting the count list without context. By showing that each successive number in the list corresponds to an individual object in a set, children begin to understand the true meaning of counting.

The importance of meaning making cannot be underestimated: from Ausubel's (1968) distinction of rote versus meaningful learning, to Shuell's (1990) writing on rote learning being a precursor to "real" learning, to Chi's (2009) more recent paper outlining the importance of active construction of new understanding based on what is already known, deep learning must extend beyond facts to conceptual understanding.

When thinking about applying the importance of meaning to our conceptualisation of learning through play, a particularly strong example comes from the work of Fisher, Hirsh-Pasek, Newcombe, and Golinkoff (2013). In this work, the researchers compared children's learning when they were told a new fact directly (e.g., a triangle has three sides, some triangles have sides of equal size although others do not) to contexts in which children were given a goal to discover the 'secret of the shapes.' Children in the latter condition, who had to think about the shapes in a more meaningful context, were not only better able to identify non-standard shapes (e.g., skewed triangles) but also retained this information a week later. As such, learning through play can help children to tap into their existing knowledge and spur them to make connections, see relationships, and gain a deeper understanding of the complex world around them. Another method used to help children find meaning that seems powerful for learning is known as dialogic reading. When parents or caregivers engage in dialogic reading, they do not simply read the words on the page. Instead, they prompt children to think about what might come next or how a character might be feeling. They may ask children to relate what is happening in the story to something that is happening in their own lives. This type of meaning-making in reading is linked to greater vocabulary gains (Hargrave & Senechal, 2000). Also, making connections between familiar and unfamiliar input guides the brain in making effortful learning easier (Luu, Tucker, Stripling, 2007). Meaningful experiences help us connect new insights with our existing mental frameworks; this way of processing recruits networks in the brain associated with analogical thinking, memory, transfer, metacognition, insight, motivation and reward (e.g., Bunzeck, Doeller, Dolan, & Duzel, 2012; Gerraty, Davidow, Wimmer, Kahn, & Sohomy, 2014; Hobeika, Diard-Detoeuf, Garcin, Levy, & Volle, 2016).

Actively engaging

Learning is hands-on and minds-on

Learning through play also involves being actively engaged. When children are immersed in the act of self-directed effort, are minds-on, and persist through distraction, we see benefits to learning. Imagine a child who is intently absorbed in playing with a set of building bricks. She is actively imagining how the pieces will go together and is so immersed that she fails to hear her father call her for dinner. This mental immersion and resistance to distraction is a hallmark of both play and learning separately, but seems to be especially powerful within the context of learning through play.

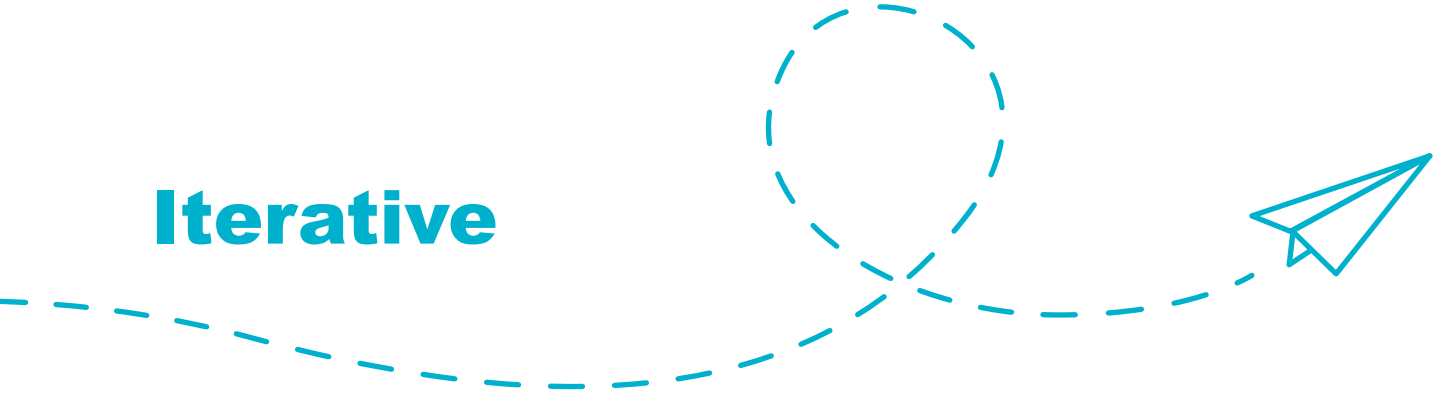
Hirsh-Pasek, Zosh, et al., (2015) make the distinction that active learning requires children to be "minds on," whether or not their bodies are active. From studies finding that children learn best when they play an active role in solving a problem rather than being explicitly instructed (Zosh, Brinster, & Halberda, 2013; Matté-Gagne, Bernier, & Lalonde, 2015) to studies showing that children as young as 3 months of age are more likely to interpret others' actions as goal-directed if they had personal, active experience with something like reaching for an item themselves (Sommerville, Woodward, & Needham, 2005), it is crucial that children adopt an active and engaged mindset. Learning through play creates that mindset without falling victim to the downsides of instruction-based pedagogy.

Adults influence child curiosity

Bonawitz and colleagues discuss this double-edge sword of pedagogy (Bonawitz, Shafto, Gweon, Goodman, Spelke, & Schulz, 2011). In this study, children were allowed to play with a novel toy with a number of hidden functions. When an adult taught them how the toy works by showing a limited number of those functions (e.g., actions A and B yield results X and Y), the children tended to play with only those functions. In contrast, when an adult who claimed not to know about the toy "accidentally" revealed one of the hidden functions, children tended to explore more widely and discover more of the other hidden features of the toy on their own. The didactic context in the first condition led children to believe that the adult had taught them all there was to know about the toy and they explored no further on their own.

This finding does not suggest that we should leave children in a world with zero guidance or instruction; they can and do learn from listening to and observing others. Children in the first condition of Bonawitz and colleagues' study learned the functions that were shown to them, but when they were put in a less structured environment, they engaged in the kinds of minds-on thinking that led to more exploration of the toy. These more self-directed, discovery-based techniques can support a deeper, conceptual understanding. In fact, neuroscience finds that active and engaged involvement increases brain activation related to agency, decision-making, and flow (e.g., Kuhn, Brass, & Haggard, 2012). It enhances memory encoding and retrieval processes that support learning (e.g., Johnson, Singley, Peckham, Johnson, & Bunge, 2014). Full engagement in an activity allows the brain to exercise networks responsible for executive control skills, such as pushing out distractions, which benefit short term and lifelong learning (Diamond, 2013).

Iterative



Neither play nor learning is static

A fourth characteristic of learning through play involves the iterative nature of children's play and learning. From a toddler playing with a puzzle and trying out different strategies to a young child discovering that the angle of a slide impacts how far a marble will shoot across a room, iteration - trying out possibilities, revising hypotheses, and discovering the next question - leads to deeper learning. Because play is a scenario that provides children agency to direct their own activities and a safe space to experiment without risk, it encourages iterative and exploratory behaviour. For example, children engaged in a playful building activity with a peer built larger, more complex structures than pairs of children engaging in an adult-directed, structured activity (Ramani, 2012).

Children also use play to test out hypotheses and explore unknowns. In one study, preschool children observed a demonstration of a toy where the causal structure was unclear (two buttons were pressed simultaneously and two effects occurred) or a demonstration that made clear how the toy worked (each button was pressed separately and led to distinct effects). Children who viewed the ambiguous demonstration spent more time playing with the toy, whereas children who viewed the clear demonstration chose to play with a new toy instead (Schulz & Bonawitz, 2007; see also Cook, Goodman, & Schulz, 2011; Buchsbaum et al., 2012). Even infants show this tendency: 11-month-olds who observed an object appear to pass through a solid wall subsequently banged the object against the table to test its solidity, and others who observed an object appear to hover in mid-air dropped it repeatedly to test if it would fall (Stahl & Feigenson, 2015). Engaging in this type of iterative play not only helps children learn and understand more about the world around them, but also strengthens their critical thinking and scientific reasoning.

Pretend play itself is a form of counterfactual reasoning, where children have to keep in mind a set of premises separate from reality and reason about what those premises imply (Weisberg & Gopnik, 2013). For example, if a child is pretending that an empty cup contains tea, and then the cup tips over, they continue their game as if the table is now covered in tea (Harris & Kavanaugh, 1993). When children naturally engage in this type of reasoning during play, they are using the same set of skills that scholars and scientists use when they test theories by reasoning about what would follow if a given set of conditions were true.

With practice, iteration increasingly engages brain networks related to taking alternative perspectives, flexible thinking, and creativity (Kleibeuker, De Dreu, & Crone, 2016; Kleibeuker et al., 2017; Van Hoeck, Watson, & Barbey, 2015). In addition, perseverance associated with iterative thinking is frequently linked to reward and memory networks that underpin learning (Boorman, Behrens, & Rushworth, 2011; Nemmi, Nymberg, Helander, & Klingberg, 2016).

Socially interactive

Social interaction is key

Finally, although play and learning can happen on one's own, a powerful context for both learning and play is social interaction. Through the processes of sharing one's own mind, understanding others through direct interaction, and communicating ideas, children are not only able to enjoy being with others, but also build a deeper understanding and more powerful relationships.

In fact, infants are driven to look for, and participate in social interaction. Social partners are key resources for learning from as early as the first few hours of life. From imitating a tongue protrusion of a social partner right after birth (Meltzoff & Moore, 1983) to increased learning of new object labels when a social partner looks at and labels an object rather than just a straight, non-social presentation of the identical information (Wu, Gopnik, Richardson, & Kirkham, 2011), evidence continues to mount that social partners and social information are not just a support to learning but may actually be a key to learning. The importance of social interaction is perhaps best highlighted by the classic work of Vygotsky (1978) whose sociocultural theory is centred around the idea that learning happens through social partners.

Although some types of play are solitary in nature, most play involves others, and as such, is an important scaffold for learning of all types. Social interaction may be important for some of the more complex, learning-to-learn skills such as critical thinking. Gokhale's (1995) work demonstrated that there is a particular benefit for critical thinking skills when children work in groups versus when they work alone. Similar positive relationships are seen among children's language abilities, creativity, and social play (Holmes, Romeo, Ciraola, & Grushko, 2015).

Interactions fuel learning throughout life

Importantly, research shows that social interactions early in life set the stage for learning and development throughout the life course. Positive caregiver-child interactions help build the neural foundations for developing healthy socio-emotional regulation and protecting from learning barriers, such as stress (Center for the Developing Child at Harvard University, 2016). Early social interaction can promote plasticity in the brain to help cope with challenges later in life (Maier & Watkins, 2010; Nelson, Fox & Zeanah, 2013; Nelson, 2017). Furthermore, social interaction activates brain networks related to detecting the mental states of others, which can be critical for teaching and learning interactions (German, Niehaus, Roarty, Giesbrecht, & Miller, 2004).

Future directions and unanswered questions

In the 21st century, space for learning through play is contested across children's spheres of life: at home and in their communities, as well as in school contexts.

Many families, in particular those with lower incomes, are pressed to make ends meet: 'It's exhausting to be a parent in any circumstance, but it's much more exhausting to be a parent when you don't have the resources that other families have" (Lew-William, October 3, 2016). This leaves caregivers little energy for positive interactions with their children, despite the significant benefits of such interactions (Bono, Francesconi, Kelly & Sacker, 2014; Hurley, Yousafzai & Lopez-boo, 2016). At a policy and practice level, recent decades have seen a push for children to learn academic skills at ever younger ages. For example, US kindergartens have shifted towards more literacy and math content, direct instruction, and assessment, over creative and child-led activities (Bassok, Latham & Rorem, 2016) as well as recess in both US and Britain (Pellegrini & Bohn, 2005).

International evidence is mounting

On the other hand, the importance of learning through play and child-centred practices is gaining traction internationally, fuelled by inspiring examples such as ReachUp. This home visiting programme is based on the Jamaican Study (Gertler, Heckman, Pinto, Zanolini, Vermeersch, Walker, ... & Grantham-McGregor, 2014), and showed impressive gains for children living in under-resourced contexts. In the intervention, a community health care worker visits new mothers for one hour weekly, teaching parenting skills and encouraging them to interact and play with their children. Amazingly, the participating children caught up with more advantaged peers in their cognitive development, mental health and social behaviour.

Research also begins to show how child-centred preschool lays a more solid foundation for later learning than an academic focus alone (Marcon, 2002; Campbell & colleagues, 2008; Weisberg, Hirsh-Pasek & Golinkoff, 2013). A number of educational programmes offer inspiration for future efforts. For example, the Montessori curriculum, which emphasises the importance of children actively directing their own experiences, has been shown to lead to positive results on academic as well as social and behavioural measures (Lillard, 2016). Another programme worth noting is the Abecedarian Approach (Ramey, Sparling & Ramey, 2012). This early childhood education programme targeted infants and young children from low-income families. The researchers investigated if providing children with enriched learning experiences, embedded in stable, nurturing and responsive relationships with caregivers, could buffer against the adverse effects of poverty.

In the first longitudinal study, two groups of children were compared: 57 children were enrolled in the programme, while 54 children were not. For both groups, families received basic nutrition, supportive social services, and health care during the first five years of the child's life. The main difference was attendance of the full-day preschool programme, where activities were designed to be highly engaging

and fun (Ramey, Sparling & Ramey, 2012). The authors underscore an important view of children as active learners, explorers and responders. Learning was seen as occurring throughout the day including during daily routines, physical play and exploration. Results showed that children experiencing the Abecedarian Approach improved on their academic and social competencies, achieved higher education levels, and were more likely to have full-time, higher paying jobs than the control. Still, some have raised questions about the programme's effectiveness (Spitz, 1992) and the relative cost versus benefits of implementing such a programme on a large scale (Masse & Barnett, 2002).

More research is needed

It is clear, more work has yet to be done: the reality for many children is that gaps persist between good intentions, policies and actual practices (Yoshikawa et al., 2013; Ramstetter, Murray, & Garner, 2010; Cheng, 2015; Nicholson, Bauer & Wolley, 2016). Next, we outline five particular areas of research that, to our minds, are central next steps in helping clarify our understanding of learning through play, and in overcoming gaps in policy and practice.

1. **Cross-cultural evidence**
   Almost all work cited in this review, and available via traditional research streams, is done in Western cultures. Although many would interpret the play characteristics and the impact of learning through play to be universal, the data simply does not yet exist to back up this claim. In the future, it will be important to conduct studies across cultures to determine whether learning through play yields the same benefits across contexts and cultures.

2. **Linking learning through play to diverse outcomes**
   Although many studies have investigated playful learning and its benefits for content knowledge (e.g., math, spatial information, vocabulary), much less work has been done to examine the benefits of learning through play on more dynamic, learning-to-learn skills such as executive function, communication, collaboration, and critical thinking. Many of the current studies that do investigate whether play interventions improve skills such as sociability or creativity suffer from methodological flaws that limit the conclusions that can be drawn. A recent review, for example, examines the impact of pretend play on child development and finds that the evidence is mixed and additional studies are needed before one can draw a firm conclusion on the impact of pretend play (Lillard, Lerner, Hopkins, Dore, Smith, & Palmquist, 2013). This kind of principled, objective, critical view of the data is necessary for play research in general and especially needed when examining more complex learning-to-learn constructs.

3. **Methods for testing higher level skills**
   As the skill one is testing becomes more complex, it becomes harder to investigate the impact of learning through play. For example, although researchers can easily test a child's vocabulary before and after playful learning, it is harder to test whether a child's critical thinking or innovation improves. Secondly, due to the changing and dynamic nature of both child development in general and of play in particular, it is difficult to do the kinds of principled, controlled studies that would allow researchers to determine the causal mechanisms linking play to outcomes. One cannot simply assign children to either a "no play" or "play" group and measure outcomes. Although highly problematic, these are challenges that can be solved. The job of scientists and researchers is to develop innovative ways of testing these constructs.

4. **The changing nature of play and play characteristics**
   In this white paper, we outlined five evidence-based characteristics that help children learn and that define playful learning contexts. Much work remains to be done, however, to determine how varying levels of these characteristics support different types of learning across childhood. For instance, work on the video deficit with children (e.g., Anderson & Pempek, 2005), in which younger children are unable to learn new information through passive television watching but older children can, suggests that social interaction helps younger children to learn but that it becomes less important (at least in some cases) over time. The literature review on the role of play in children's development (Whitebread, Neale et al., 2017) starts to theorise about the way different types of play espouse these characteristics in different ways. However, work remains to be done to establish how different types of play support learning across ages.

5. Neuroscientific insights

As hinted at in this piece, neuroscience is beginning to uncover the neural mechanisms of the characteristics of playful experiences and how these link to learning. Although neuroscience evidence is beginning to mount, further work is needed. This topic is covered in the literature review 'Neuroscience and learning through play: a review of the evidence' (Liu, Solis et al., 2017) and we anticipate much more insight over the next decade as the technology improves enough that testing infants and young children in more naturally occurring situations (e.g., play situations) becomes more affordable and less invasive.

Closing thoughts

The goal of this white paper has been to summarise the most recent, rigorous research on the role and importance of play for children's life and learning. We conclude that the evidence on learning through play is mounting; more than an enjoyable experience, engaging with the world in playful ways is essential for laying a foundation for learning early in life. Beyond infancy and toddlerhood, learning through play is also proving to be an effective and worthwhile pedagogical technique for teaching in the 21st century.

Still, we have much yet to discover about learning through play. For example, what is it about play that fuels learning more specifically - from the level of neurons to children's behaviour and interactions with peers and adults? How can we extend research on guided play to the more complex learning-to-learn skills, as well as other cultural contexts? Research into each of the areas will help close important gaps in our understanding of learning through play, and offer a crucial evidence base to inform the decisions of those influencing children's daily lives, learning and prospects: across homes, communities, schools, governments and wider systems.

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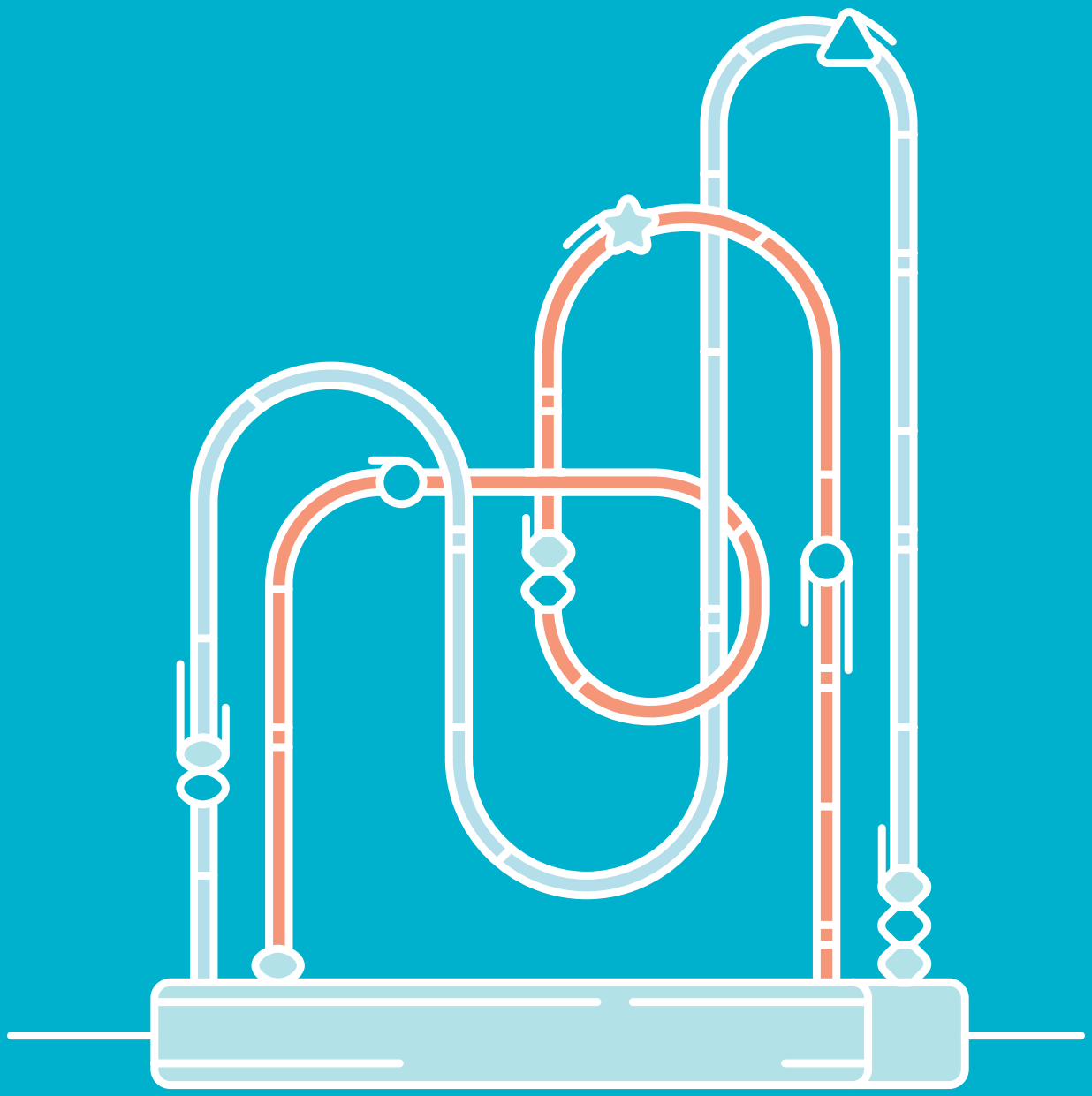

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How Play Makes for a More Adaptable Brain

A Comparative and Neural Perspective

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Studies of rats and some primates show that rough-and-tumble play among juveniles improves social competence, cognition, and emotional regulation later in life. Most critically, such play makes animals better able to respond to unexpected situations. But not all animals engage in play, and not all animals that play appear to gain these benefits. Using a model developed by Burghardt (2005), the authors argue that there are enabling conditions—such as how behavior systems develop and the presence of surplus resources—that make play-like behavior possible. Once such behavior emerges, other enabling conditions help transform it into more exaggerated patterns of play that can be co-opted for various functions. For species living in complex social systems with an extended juvenility, play has become a tool to refine the control that the prefrontal cortex has over other neural circuits. Such control permits these animals to have more nuanced responses to a variety of situations. In short, the juvenile experience of play refines the brain to be more adaptable later in life. **Key words:** comparative studies; developmental benefits of play; play and adaptability; play in the animal kingdom

Introduction

There is growing experimental evidence that play in rats, especially social play, serves an important developmental role. It helps refine social skills (Byrd and Briner 1999; van den Berg et al. 1999), improve the regulation of emotions (da Silva et al. 1996; von Frijtag et al. 2002), and enhance executive functions (Baarendse et al. 2013) by modifying the neural mechanisms that underlie them (Bell, Pellis, and Kolb 2010; Himmler, Pellis, and Kolb 2013). Data on several primate species (e.g., Kalcher-Sommersguter et al. 2011; Kempes et al. 2008), including humans (Lindsey and Colwell 2013; Pellegrini 1995), are consistent with these findings. In essence, the experience of play in the juvenile period pro-

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vides a context within which young animals can experience loss of control and deal with unpredictable events (Pellis, Pellis, and Foroud 2005), but do so in a rewarding setting (Panksepp 1998; Vanderschuren 2010). This appears to enable animals to train to deal with the unexpected vicissitudes of life (Pellis, Pellis, and Reinhart 2010; Špinka, Newberry, and Bekoff 2001). But before we explore how such play-induced brain changes can help make animals better at dealing with the life's uncertainties, we need to answer a more fundamental question.

We should be bear in mind that the animal kingdom consists of about thirty phyla that represent major groupings based on the unique features of each phylum's body plan. Consider the difference in body organization between an insect like an ant and a vertebrate like a dog. The division of body parts, the number and placement of the legs, the location and organization of the nervous and circulatory systems all differ in fundamental ways (Tudge 2002). An exhaustive review of the literature has shown that play occurs in only five of the thirty phyla (Burghardt 2005). For example, play appears in many species in the phylum Chordata, which includes people, dogs, and ravens and some species of the phylum Arthropoda, which contains insects (like ants), crustaceans (like shrimp), and arachnids (like spiders). We dot not find play, however, in the phylum Echinodermata, which contains starfish and sea urchins, or the phylum Annelida, which includes earthworms and leeches. Indeed, even in the phyla containing species that play, not all the species in those phyla play. For instance, researchers report that in Chordata only some in the subphylum Vertebrata (those creatures with a vertebral column like humans and fish) play, and among these vertebrates, play seems fairly common in many lineages of mammals, less common but present in some lineages of birds, but rare among other groups like amphibians, reptiles, or fish. In this context, we are left to wonder why play, which seems important to training some animals to be more adaptable and resilient, is so rare in the animal kingdom?

This rarity, rather than impeding our understanding of the origins and functions of play, may actually prove useful to it. Consider rough-and-tumble play (or play fighting) alone. When we examine it within a particular group of animals, such as the rodents, we find it absent in some species and present in others, and where present, it can range from simple to complex (Pellis and Iwaniuk 2004). In play's simplest form, one animal attacks another, who does not respond (Wilson 1973). Added complexity arises when the defender flees from the attacking partner (Pellis and Pasztor 1999). Still greater complexity comes with the defender holding its ground as it wards off the attack, but this

too can vary in complexity, as some species are more likely to adopt defensive actions that promote close-quarter wrestling (Pellis, Pellis, and Dewsbury1989). On top of these gradations in complexity, there are also differences in frequency across species: even those having the most complex patterns do not necessarily use them with the same frequency (Pellis and Pellis 1998a). How does all this diversity map onto the functions of play?

As a useful organizing principle, we recognize that not everything we call play has a function and that even those forms of play that are functional have many different functions. Before delving much further into this issue, we should make clear what we mean by function in a biological sense. When we consider a trait—whether a behavioral trait like play or an anatomical trait like the horns of a goat—in terms of the functions it serves, we look primarily at how the trait contributes to an animal's survival and reproduction. In an evolutionary sense, we call traits functional if they increase the "fitness" of the possessor, such as giving the animal a reproductive advantage over its competitors. That trait may do so indirectly, by enabling the possessor to survive longer and thus enjoy more opportunities to breed, or it may do so directly, by making the possessor, for example, better at winning mates or rearing young. However, when we use the word "function" in more colloquial parlance, we tend to mean something different. For example, when we eat that extra slice of Thanksgiving pumpkin pie, we do so because it is delicious, not because we are hungry. So eating functions to increase our pleasure. In the context of play, we may say animal A performs X during play because the animal finds it pleasurable to do so, meaning that the function of the behavior is to induce pleasure. We resolve these divergent usages of the term "function" by recognizing that we do pleasurable things because for our ancestors pleasurable activities generally increased their fitness (eating and having sex come to mind). Pleasure seems to induce us to do things, like play that increase our fitness.

While most functional accounts of play focus on the way play in juveniles produces better functioning adults (Baldwin 1986; Fagen 1981), this emphasis on the young neglects the considerable play in which adults engage (Cohen 2006). Yet in some lineages of animals that play, such as the order of primates (to which we, chimpanzees, and rhesus monkeys belong), adults continue to play in 50 percent or more of species (Pellis and Iwaniuk 1999, 2000a). Some comparative evidence shows that when adults play, the play can have several immediate functions, such as regulating intragroup and intergroup tensions (Palagi 2011) and enabling them to navigate dominance relationships (Pellis 2002). Thus, some functions of play offer immediate, rather than delayed, benefits.

When researchers focus on delayed functions, the difficulties increase, as it becomes more problematic to decide which adult skills to compare with the purported gains made from juvenile play. Indeed, associations that seem promising in one species evaporate when researchers study another species, leading some to a dismal view of play as having minimal or modest benefits at best (Martin and Caro 1985). For example, a recent paper on play and development in free-living marmots has shown a convincing correlation between juvenile play and a later capacity to gain dominance (Blumstein et al. 2013), and work on free-living bears has found that cubs that play more are also more likely to survive to weaning (Fagen and Fagen 2004). But detailed studies of free-living meerkats (an African species of social mongoose) that specifically tested these functions, among others, found no support for them (Sharpe 2005a, b, c; Sharpe and Cherry 2003). The paucity of evidence and the conflicting support provided for the different functions of play add to the problems raised by the absence of play in much of the animal kingdom and to the variation in the complexity of play seen in the species that engage in it (Burghardt 2005; Pellis and Pellis 2009).

The comparative evidence clearly shows that play is not a unitary trait, neither does it have a clear and singular function. Talking about play in this way seems to lead to pointless arguments about the supposed benefits of play (Fagen 1981; Martin and Caro 1985). In our view, the best way to address the conceptual and empirical difficulties created by the absence of play in so many branches of the animal kingdom (and by the diversity in the patterns of play among those species that do play) and to pinpoint the illusive functions of play is to examine the variability in the structure and function of play in a historical context. This perspective recognizes that, within lineages, patterns considered as play may have undergone unique transformations, with different functions becoming possible with different kinds of transformations (Burghardt 2005; Pellis and Pellis 2009). For example, the play of cats has a stronger link to the underlying motivations associated with predation (Hall 1998) than does the play of dogs, in which stronger social influences pervade (Biben 1982).

The Origins and Multiple Transformations of Play

Compare two juvenile chimpanzees engaged in play fighting and two immature cockroaches tussling for no apparent reason. Most readers would have little difficulty labeling the behavior of the chimpanzees as play, but they would most

likely label that of the cockroaches as some form of immature aggression (Fagen 1981). With examples like these in mind, Burghardt (1984, 1988) has deliberately focused on the borderlines of play, those cases with elements of behavior that, observed in a mammal, would be called play, but observed in non-mammals, would probably not be called that. This focus on borderline cases led to two major breakthroughs (Burghardt 2005). First, Burghardt developed a comprehensive definition of play as behavior that meets five criteria. These are: (1) the behavior should not be completely functional in the context in which it occurs, (2) it should be voluntary, (3) it should be modified in some way compared to its normal occurrence in a functional context, (4) it should be performed repeatedly but not necessarily invariantly, and (5) it should appear in healthy, unstressed animals. In applying these criteria, researchers have shown that not only does some behavior in mammals—such as dogs and monkeys—qualify as play, but that some behavior in animals as diverse as turtles, wasps, and octopus also does so (e.g., Dapporto, Turillazzi, and Palagi 2006; Kramer and Burghardt 1998; Kuba et al. 2006). Indeed, as we already noted, the rigorous application of these criteria has led to identifying play in a wide range of animals from several phyla. However, this still leaves play unidentified in most phyla and, again, as we noted, not all lineages of species within phyla in which play occurs exhibit behavior that can be considered play.

Clearly, play seems relatively rare in the animal kingdom, and the fact that it appears among distantly related phyla implies that play must have arisen independently many times (Burghardt 2005). These comparative data confirmed a hypothesis that the conditions enabling play to arise are multiple and likely occur only in peculiar circumstances (Burghardt 1984, 1988). Moreover, in many cases, these enabling conditions create play that is barely recognizable as play; yet, in some lineages, the play is so spectacular and exaggerated that few observers, if any, would refuse to call it play. Indeed, to recognize the play of some turtles as being play, Burghardt had to speed up the film he watched. No such speeding up of the film is necessary to recognize the play of otters. Thus, first, we have to overcome our own prejudices and limitations as observers, but when we do we need, second, to recognize that not all the play we observe is the same. In short, some cases that fit Burghardt's criteria, just barely do so, whereas others do so completely.

These considerations led to Burghardt's second major insight. Play arises as a byproduct of enabling conditions, producing an incipient or play-like form of behavior that may be borderline in qualifying as play (primary-process play). But

once such play is present, further conditions may exaggerate its frequency or its content making it more recognizably play (secondary-process play). Additional enabling factors may lead to even more exaggerated behavior unquestionably related to the play category (tertiary-process play). That is, in this historical perspective, the conditions for the origins of play can be characterized and distinguished from the conditions that may act to transform play further (figure 1). Moreover, even though in its origins, play may have arisen as a byproduct of propitious circumstances and so without any functional benefits, once such behavior existed, the various transformations that then accrued could have created the conditions for novel functions to arise (Burghardt 2005).

The broad comparative view of play, then, reveals a diverse range of phenomena encompassed within the label of play. Different lineages have evolved play-like behavior, and then some of those lineages have further transformed that behavior into patterns of play that serve particular functions. Importantly, this framework allows for those functions to be multiple and disparate, with some overlapping due to convergence and some differing due to divergence. Certainly, this framework can account for both the presence and absence of play in the animal kingdom and for the complex array of functions that it can support. Comparative research on variations in the social play of rodents provides examples of each of these kinds of transformations as envisioned by Burghardt's theoretical schema.

The View from Rodents and Their Play Fighting

Rodentia is the largest order of the class Mammalia, consisting of about 40 percent of all mammal species. For example, there are about two thousand species of rodents, but less than three hundred species of primates. The rodents are divided into three major subgroups; the rat-like or mouse-like rodents (murid rodents) are the most abundant, comprising about 50 percent of all rodent species (e.g., rats, mice, gerbils, and hamsters). The other two groups consist of the squirrel-like and the guinea pig-like rodents (Nowak 1999). Detailed analysis of play fighting in murid rodents shows that play is not distributed in a uniform manner (Pellis and Pellis 1998a). In this group, such play can be absent, and, if present, can be simple, complex, or something in between. Given their differing patterns of relatedness to one another, the possible transformations in the content of play can be traced. To do so, we need a specialized approach from

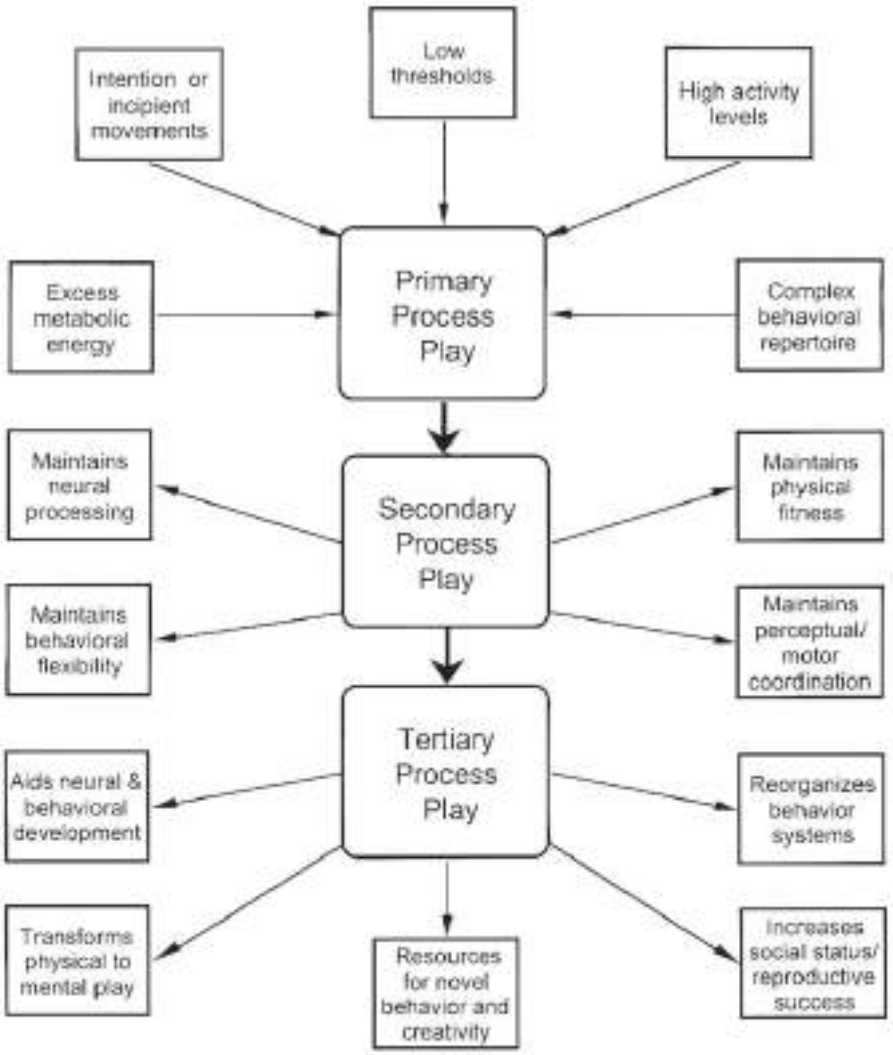

Figure 1. Sequential transformations of play over evolutionary time and their enabling factors (Burghardt 2005, reprinted with permission)

comparative biology, and this needs some explanation.

Species can be placed on a tree diagram (i.e., a cladogram) that shows the pattern of relatedness among the set of species. Importantly, cladograms do not claim ancestor-descendent relationships among the species, rather, all the

species appear on the terminal branches with species linked to one another at nodes, which represent bifurcation points at which presumed ancestors have diverged into the daughter species (Hennig 1966). Placing the murid species on a cladogram, the degree of complexity of the play fighting performed can be mapped. In doing so, using the assumption of parsimony so that the tree shows the fewest transitions possible, the pattern of transformation in the lineage and branches of the lineage can be determined (figure 2).

The cladogram shows two important patterns. First, the most likely ancestral state suggests the animals have moderate levels of complexity in their play (dark stippling). Second, the terminal branches show that extant species have either exaggerated that complexity (black for most complex, grey for next most complex) or reduced it (light stippling for simplified play, white for play being absent or near absent). Consistent with Burghardt's framework, the cladogram of the rodents shows that play changes in form over evolutionary time with different lineages transforming play in different ways. The elimination of play shown in some lineages also proves telling. While the costs—small, moderate, or large—of playing have been debated (Martin and Caro 1985), specific cases have emerged that suggest play can be costly, indeed. For example, in free-living chimpanzees in West Africa, play fighting appears as a means of transmitting lethal infectious diseases, which, in some years, may lead to a major culling of juveniles (Kuehl et al. 2008). Again, whether the costs sustained are small or large may depend on whether a particular lineage has co-opted play for some critical fitness-enhancing function. Sustaining larger costs suggests larger counterbalancing benefits for play to be maintained in the population. The rodent cladogram indicates that if the benefits are insufficient, play will be eliminated.

Broadening the comparative framework to include the other major subdivisions of rodents (Pellis and Iwaniuk 2004) and embedding rodents with the other orders of mammals (Burghardt 2005) suggests that the ancestral group giving rise to the rodents either did not play or had a very rudimentary pattern of play. Using this pattern as a starting point to consider the variation across extant species of rodents, a rough framework can be developed for the kinds of play envisaged in Burghardt's primary, secondary, and tertiary processes. However, we must keep a caveat in mind: such a framing of extant species does not represent the true pattern of evolutionary change, since, as shown in figure 2, there have been losses as well as gains. Nonetheless, the play in the extant species can be ordered in a manner that conceptually illustrates the kind of grades of organization and transformation envisaged by Burghardt's model (figure 1).

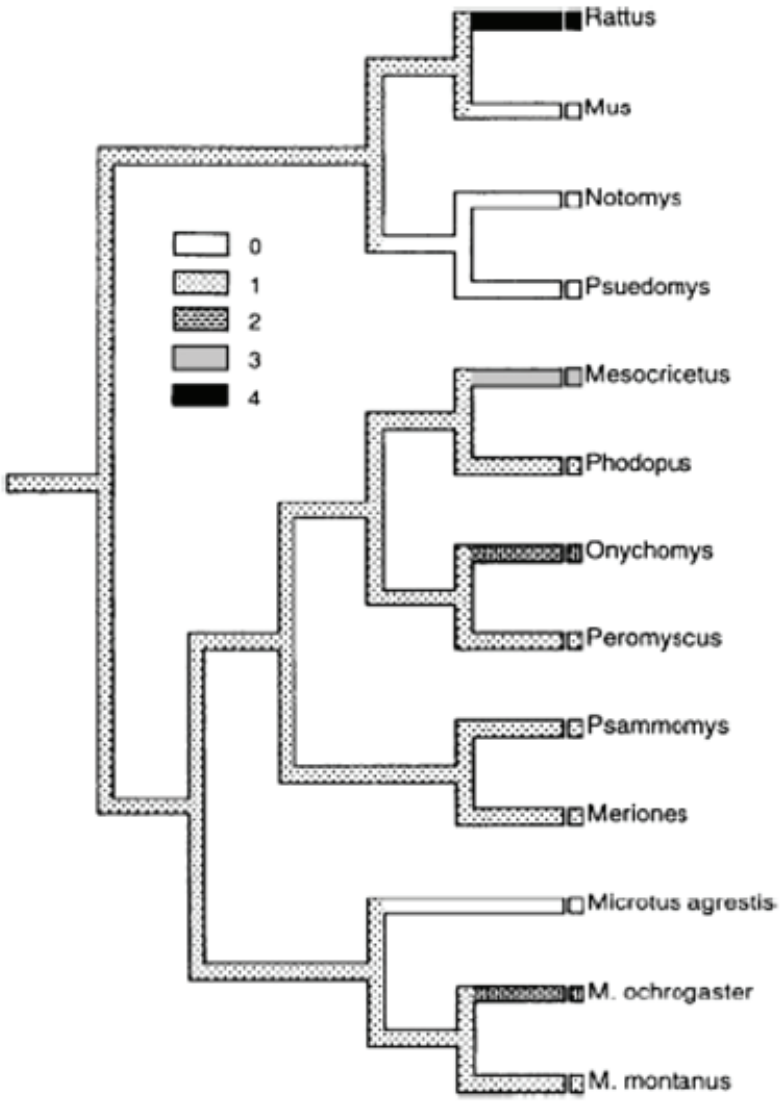

Figure 2. Complexity of play fighting and its evolution for murid rodents (Whishaw et al. 2001, reprinted with permission)

Among murid rodents, play fighting primarily involves the simulation of precopulatory behavior, in which partners compete for access to the body targets that are contacted during adult sexual encounters. For example, rats compete to

contact and nuzzle the nape of the neck, and Djungarian hamsters compete to lick and nuzzle the partner's mouth, whereas during serious aggression, these species attempt to bite each other on the rump and lower flanks (Pellis 1993). Despite these similarities, there are species differences in the degree of similarity of the playful version of this behavior to the adult, functional version (Pellis and Pellis 1998a). Importantly for the evolution of play, the developing behavioral system changes in a piecemeal manner, which, without regulatory control, can be expressed precociously. Add to this an environment offering protection against predators and abundant resources provided by parents, and the likelihood of precociously performed behavior increases—and may do so to the level in which it begins to meet the criteria for it to be labeled as play (Burghardt 2005). Therefore, for some rodents, when the behavior closely resembles the expression of precocial sexual behavior, we may think of it as play-like behavior, or incipient play (figure 3). Such an origin would be consistent with Burghardt's primary process play. Once the presence of this fragmented, immature behavior becomes a reliable part of the experiential world in which the animal develops, it can substitute for maturational processes that are otherwise insensitive to experience. This second stage may not involve any modifications to the content of the immature behavior expressed, but simply by its increased frequency of performance, such behavior in the juvenile stage could nonetheless provide essential, experiential feedback for wiring the brain, and so, at least functionally, may be thought of as rudimentary play fighting rather than simply as immature behavior (figure 3). This, then, reflects a transformation that would make the play more like Burghardt's secondary-process play.

A further transformation can arise by modifying the content of the juvenile version of adult sexual encounters. For example, if the majority of the beneficial experiences derived from play fighting occurs when the animals are wrestling one another, then increasing the frequency of the tactics of attack and defense that increase the frequency of wrestling would be advantageous, and, in the absence of countervailing costs, would be selected for, and the organization of the play would, over generations, change to that we see in the adult sexual encounters. Once modifications have been made to the organization of play fighting itself, not only would this behavior facilitate the development of sex, but it also would become an essential component of the normal developmental experience. Thus, with this third step, the playful interactions become both quantitatively and qualitatively different from sexual interactions and the label of rudimentary play seems insufficient and would be better labeled true play fighting (figure 3).

Behavior and context	Consequences and functions	Classification
Components of sexual behavior, especially precopulatory elements. These are expressed in a precocious manner during the juvenile period.	None	*Incipient play* (i.e., play-like behavior)
Under appropriate conditions, precocious sexual behavior becomes a frequent and expected component of the juvenile period. However, at this stage, the juvenile interactions differ little from adult sexual interactions.	Precopulatory behavior becomes necessary for the maturation of normal, adult sexual performance.	*Rudimentary play fighting*
Some components of precopulatory sexual behavior are elaborated during the juvenile period, making the interactions more clearly different from adult sexual behavior	These elaborations ensure that the necessary sexual skills are acquired during the juvenile period.	*True play fighting*
Under some conditions, this sexually derived pattern of play fighting is modified to a more exaggerated degree and co-opted into use in novel domains of juvenile and adult life	These patterns of interactions now serve nonsexual as well as sexual functions.	*Emancipated play fighting*

Figure 3. Hypothetical stages in the transformation of immature sexual behavior into play fighting in murid rodents (adapted from Pellis 1993, reprinted with permission)

This transformation is more consistent with Burghardt's tertiary-process play.

Note that in the model, what has transpired is that, through successive changes, precocial sexual behavior has been transformed into playful behavior, functioning to promote the development of sexual skills. In rats, the organiza-

tion of play fighting is more greatly modified than in any other murid rodents so far studied (Pellis and Pellis 1998a), which suggests another layer of transformation. Juvenile play in rats has been further modified, so that it not only facilitates the development of sexual behavior but also the promotion of social competence beyond the sexual domain. Even more strikingly, play fighting itself is retained into adulthood as a tool for social assessment and manipulation (Pellis and Pellis 2011). Because of the novel organizational changes as well as its expansion beyond its original function in sexual development, this form of play fighting requires a different label, emancipated play fighting (figure 3). It may be merely semantic whether such a transformation corresponds to an advanced tertiary-process play or represents an addition to Burghardt's original formulation, quaternary-process play. What is important is that new transformations are laid over past transformations with new functional opportunities emerging as further transformations are made.

The evidence supporting these various transformations in the play of rodents have been detailed elsewhere (Pellis and Pellis 2009); the key message to take from this brief review is that, when viewed comparatively, play has multiple levels of organization and potential functional uses. Thus, it is naïve to expect that all animals that play will play similarly or gain the same benefits. That being the case, we can go back to, and modify, our opening question: why is it that all animals do not play to accrue the kinds of benefits shown for rats?

To understand some of these transformations, it is first necessary to have an idea of how the vertebrate brain is organized. The brain divides into two major components: the cerebral cortices and the remainder (Kolb and Whishaw 2009). When we open the skull of a mammal, the largest and most obvious structure we see is the cortex, composed of two hemispheres that cover most of the rest of the brain. The subcortical structures lie beneath the cortical hemispheres. These different layers have complex patterns of interconnection with the different networks that modify each other's function.

To explain why rats gain so much from playing as juveniles and other rodents do not, we need to keep several points in mind. First, the comparative evidence clearly shows that not all rodents play in a manner comparable to rats (Pellis and Pellis 1998a). Second, the organizational transformations present in rats that are not shared with other rodents involve novel regulatory controls originating in the cortex (Kamitakahara et al. 2007). Third, the higher-level cognitive benefits that accrue from playing in rats are not present in other rodents that play (Einon et al. 1981), and at least some of these cognitive benefits have

been shown to involve changes in cortical function (Baarendse et al. 2013). That is, in rats play has been modified to provide a novel function—that of enhancing cortical regulation of emotional and cognitive processes—especially as they pertain to social behavior, and this has had the effect of modifying the cortical neural circuits important to such regulation (Bell et al. 2010; Himmler, Pellis, and Kolb 2013).

As we can see, the transformative approach to comparing play across species yields novel insights into play because it shows that not all species that play gain the same benefits from doing so. Moreover, the evolution of novel benefits require changing both how the play is organized to yield experiences that are important for shaping the development of the relevant brain mechanisms and the capacity of those brain mechanisms to be influenced by such experiences. Among close relatives of rats, play has been transformed in a way that has led to divergence in the form and function of play (see figure 2). However, we have already touched on the possibility that the higher-level transformations of play in rats have converged with organizational and functional properties similar to those we see in some primates. For example, the quaternary changes in the play of rats that influence the development of executive function are similar to those we see in humans and some other primates. Understanding that convergence can help frame the question about how the play-induced brain changes we see in any of these species may lead to improved adult social competency.

Convergence in Play Fighting

Most of what we know about the impact of play fighting in primates on later social, emotional, and cognitive function comes from studies of Old World monkeys (Kempes et al. 2008) and apes (Kalcher-Sommersguter et al. 2011). In these groups of primates, play fighting appears primarily as a simulation of conspecific fighting—the same body targets are bitten and the same combat tactics are used (Aldis 1975; Owens 1975; Pellis and Pellis 1997; Reinhart et al. 2010; Symons 1978). For example, gorillas wrestle one another during both play fighting and serious fighting to gain access to the lateral edge of the shoulder, which is bitten if contacted (Schaller 1963). Even though the same target and tactics are used during both play fighting and serious fighting, applying the criteria for play established by Burghardt shows that play is not just an immature version of serious fighting. Thus, while the play fighting of rats has evolved

from precocial sexual behavior and that of the rhesus monkey and gorillas from precocial agonistic behavior, depriving juvenile play experience in these species not only affects the development of their sexual and aggressive behaviors, but also has more wide-ranging effects on the development of social competency, emotional regulation, and cognitive performance (Pellis and Pellis 2009). Both rats and monkeys have modified their play fighting to exaggerate the experience of loss of control and unpredictability (Pellis, Pellis, and Foroud 2005; Petrù et al. 2008), and, indeed, it is unpredictability that provides the key experience.

In monkeys and apes, maternal interactions are critical to prepare the young animal for engaging in, and benefitting from, play with peers at a later age (Blum 2002; van Leeuwen, Mulenga, and Chidester 2014). These monkey studies show that even an inanimate surrogate mother is better than no mother at all, and, in this context, they found that a mobile, inanimate mother was better than a stationary one. The mobile mother moved up, down, and around the cage on an irregular schedule throughout the day. As crucially, the studies observed that the infants initiated more play with the mobile surrogate than with the stationary one and that they reacted to unexpected retreats and hits from the mobile surrogate. When these monkeys were weaned and introduced into peer groups, the monkeys that had been reared by mobile, surrogate mothers were more outgoing and more likely to approach other animals. They made fewer threats when they did so and paid more attention to novel social stimuli. Moreover, when they were young adults, they were also more likely to engage in successful copulations. Unlike those infants reared by the stationary surrogate mothers, those reared by the mobile surrogate mothers behaved more like the monkeys that had been reared by their natural mothers (Mason 1978).

Play fighting in rats and monkeys provides a context for experiencing the unexpected—all the more so, since for play fighting to remain playful it has to follow a certain rule structure. Unlike in serious fighting, where winning is the sole object, in play fighting, the winning has to be attenuated so that some degree of reciprocity is possible (Pellis, Pellis, and Reinhart 2010). On the rare occasions that play fighting escalates to serious fighting in rats, one rat has used excessive force to restrain its partner (Pellis and Pellis 1998b). However, in the exuberance of play fighting, hits and bites may be delivered too firmly, and the partner may resist following the rules. The problem for the animal is to assess the situation and determine whether the excessive force was accidental or part of a concerted pattern and so decide how to react to the infraction. At the same time, as the animal loses control—often because of its own injection of reciprocity

promoting movements that it performed (Pellis, Pellis, and Foroud 2005)—it has to recoup from the mishap but to do so without using excessive force. Not surprisingly, species such as rats and monkeys—species in which the organization of the play has been modified to exaggerate these experiences—develop in the absence of such play a compromised impulse control, emotional regulation, cognitive performance, and social competency.

Play Fighting and the Development of Executive Function

Play fighting can be cognitively and emotionally challenging because it exaggerates the experience of loss of control, especially given the unpredictability that arises from having to use an implicit rule-structure (one that promotes reciprocity) to recover from instability in rapid sequences of behavior that may last only a few seconds. Yet these are precisely the experiences found frequently in the play fighting of many species. Moreover, growing evidence suggests that such experiences affect the development of the prefrontal cortex (at the anterior end of the cortex, abutting the front of the skull), the area of the cortex known for its role in executive function.

The term *executive function* here describes a collection of control processes necessary for the organization of complex—and often goal-oriented—sequences of movements in humans, monkeys, and rats. These include, but are not limited to, monitoring behavior, attention, resistance to interference, behavioral inhibition, planning, decision making, and task switching (*see* Dalley, Cardinal, and Robbins 2004 for a review) as well as impulse control (Baarendse et al. 2013).

Rats that have been reared in social isolation show many deficits linked to executive function. For example, they react with heightened anxiety to fearful situations (da Silva et al. 1996) and have an exaggerated stress response to such situations (von Frijtag et al. 2002); they overreact to benign social contact (Einon and Potegal 1991); they fail to behave submissively when confronted by a dominant rat, impulsively moving about and leaving a safe place (van den Berg et al., 1999); they have difficulty coordinating movements with a partner in both sexual and nonsexual contexts (Moore 1985; Pellis, Field, and Whishaw 1999); and they are less competent in solving cognitive tasks (Einon et al. 1981). However, before the link between play experience and executive function can be fully developed, we must consider an important caveat.

When we rear a young rat in social isolation, we deprive it of more than just the experience of playing with peers. The reasons to believe that a major contributor to the isolation-induced effects on such rats arise from the absence of play experience have been reviewed in detail elsewhere (Pellis and Pellis 2006). So here, we present only some of the key evidence. In the juvenile period (spanning from weaning at around twenty-three days after birth to when they sexually mature at around sixty days of age), rats devote about one hour of every twenty-four–hour cycle to play. Giving an isolated rat the opportunity to interact with a peer for one hour per day over the juvenile period proves sufficient to offset the many negative effects of isolation on behavior and cognition. However, giving the isolated juvenile an hour per day exposure to an adult does not (Einon and Morgan 1977; Einon, Morgan, and Kibbler 1978). Whether paired with a juvenile peer or an adult, the juvenile rat will socialize by sniffing, grooming, huddling, and, generally, coordinating its movements with its partner, but if paired with a peer, the socializing also includes playing together. Thus, at least to some extent, socializing that includes play appears to be important in relation to the deficits that arise from being reared in isolation during the juvenile period (e.g., Arakawa 2007a, 2007b).

Using the paradigm of housing juveniles either with adults or with other juveniles to avoid the rats being reared in complete isolation, researchers found that the opportunity to engage in social play with one other peer is sufficient to modify the rats' dendritic arbor (think of branches of a tree) of the neurons of the medial prefrontal cortex (mPFC) and that being reared with multiple social partners, whether or not they provide play experiences, is sufficient to modify the dendritic arbor of the neurons of the orbital frontal cortex (OFC) (Bell, Pellis, and Kolb 2010). Moreover, such studies show that for the mPFC, the play-induced neuronal changes result in increased dendritic plasticity when exposed to other experiences later in life (Himmler, Pellis, and Kolb 2013). Selective lesions of the mPFC and the OFC in rats that have been reared socially as juveniles reveal somewhat different roles for these circuits. With damage to the OFC, rats fail to modulate their social interactions with different partners—that is, they interact similarly with dominant and subordinate partners (Pellis et al. 2006). With damage to the mPFC, rats can modulate their play with partner identity, but appear to have difficulty in coordinating complex movements with their partners (Bell et al. 2009; Himmler et al., 2014). Therefore, prefrontal damage mimics some of the typical social deficits from being reared in isolation, providing strong evidence that play and other social experiences (e.g., interacting

with multiple partners) during the juvenile period are critical for refining the neural circuits of the PFC that are involved in producing a socially competent adult (Pellis, Pellis, and Bell 2010).

The PFC and several subcortical structures we believe to be involved in the neural circuitry for executive function are activated during playful interactions (Cheng, Taravosh-Lahn, and Delville 2008; Gordon et al. 2002). This includes the amygdala, which is essential for the expression of emotion (van Kerkof et al. 2014). Given the play-induced structural changes in the neurons of the mPFC, we could expect that the cells in the amygdala would also undergo structural remodeling, but preliminary data suggest that this is not the case (Himmler, unpublished observations). As noted previously, rats that are socially isolated and so denied the opportunity to engage in playful interactions during the juvenile period exhibit deficits in emotional regulation (e.g., da Silva et al. 1996; von Frijtag et al. 2002). Therefore, it seems possible that the play-induced changes in emotional regulation may arise from improved control of subcortical systems by neurons coming from the cortex, like those from the mPFC, that are changed structurally by the experience of play. Because there are strong connections between the mPFc and the subcortical neural systems that make up the executive-control complex, the play-induced activation of both the cortical and subcortical circuits may strengthen their connections. While this possibility remains to be tested, closer consideration of the anatomical links between the mPFC and selected subcortical circuits makes it a plausible hypothesis.

The mPFC has strong excitatory connections with multiple nuclei in the amygdala, including the intercalated (ITC) and the basolateral nuclei (BLA). A majority of the connections from both of these nuclei are then sent to the central amygdala (CeA), which then projects to a variety of structures in the limbic system. Whereas cells in the BLA are excitatory (McDonald et al. 1989), the cells in the ITC are inhibitory (Nitecka and Ben-Ari 1987; McDonald and Augustine 1993; Paré and Smith 1993). Therefore, information sent through the BLA (excitatory) and the ITC (inhibitory) neurons are likely to have different effects on the target systems. Given that mPFC has strong connections to both these nuclei in the amygdala, some of the deficits seen in emotional regulation due to play deprivation may arise from reduced regulatory control of the amygdala by the mPFC. In part, the mPFC may exert regulatory control by modulating the activation of the excitation and inhibition of the specific nuclei in the amygdala (Rosenkranz and Grace 2002). Regardless of the specific mechanisms, the play-induced changes to the mPFC likely have an effect on the regulation of the amygdala.

The dorsal raphe nuclei (DRN) constitute another subcortical area activated by playful interactions (van Kerkof et al. 2014). The majority of the neurons that innervate the DRN come from the mPFC (Peyron et al. 1998; Vertes 2004), and these connections act to inhibit serotonin neurons (Jankowski and Sesack 2004; Hajos et al. 1998). The DRN is strongly activated if animals encounter uncontrollable stress and this is coupled with heightened levels of fear and anxiety (Grahan et al. 1999; Maswood et al. 1998). However, the strength of this activation and behavioral response can be reduced if animals are exposed to mild controllable stressors earlier in life. The attenuation of DRN activation likely arises from improved regulatory control from the mPFC (Amat et al. 2005; Amat et al. 2006).

Linking these neural connections with play suggests the following model. Engaging in playful interactions, young rats are exposed to both controllable and uncontrollable situations (Pellis, Pellis, and Foroud 2005), and it is these experiences that are hypothesized to influence the development of the mPFC (Pellis, Pellis, and Bell 2010). In turn, these play-induced changes to the mPFC may improve the regulatory control of the mPFC over subcortical regions such as the amygdala and the DRN. These play-induced changes in neural organization are the basis for the improved executive control present in rats that have played as juveniles.

Conclusion

Why do rats have complex patterns of play fighting that contribute to the juvenile experiences that, in turn, refine the development of the neural circuits that regulate executive function? And, why do mice not have these patterns of play? Mice and rats have much of their behavioral repertoire in common, but for a wide range of naturally occurring behaviors and in tasks requiring motor and cognitive-skill acquisition, mice appear to be a pared-down version of rats (Whishaw et al. 2001). Quite simply, mice have a behavioral repertoire that is only modestly capable of being refined. Possibly, this results from mice having a shorter life span and achieving sexual maturity at a younger age than do rats, so that the capacity for excessive refinement of skills would be counterproductive—i.e., the cost of such a capacity would exceed the benefit. For their part, rats live in a somewhat more complex social system, have a longer lifespan, and reach sexual maturity at a later age, increasing the benefits that arise from an increased

capacity to be more flexible in dealing with unpredictable events (Whishaw et al. 2001). There is support for such a hypothesis.

It has been shown that in rodents, primates, and birds more complex patterns of play correlate with longer juvenile periods (Diamond and Bond 2003; Pellis and Iwaniuk 2000b), and, in turn, longer juvenile periods are correlated with larger brain sizes and a greater variety and flexibility in species typical behavior (Joffe 1997; Walker et al. 2006). Moreover, innovative ability correlates with increased brain size, especially in those brain areas associated with executive function (Lefebvre, Reader, and Sol 2004; Reader and Laland 2002).

When comparing primate species, those that have more complex social systems require more nuanced social cognition and actions, and these are the species that are also more likely to use play in adulthood as a social tool for assessment and manipulation (Pellis and Iwaniuk 2000a; Ciani et al. 2012; Palagi 2006). Importantly, with regard to the role of play in the juvenile period promoting improved executive function, the juveniles of such species have a modified pattern of play that exaggerates the experiences shown to be important for the development of such capabilities (Reinhart et al. 2010). Indeed, these changes in the pattern of play, such as increasing the movements that lead to loss of control (Pellis, Pellis, and Foroud 2005), are associated with changes in factors related to the timing of development—they extend the juvenile period (Palagi and Cordoni 2012). These age-related changes in development, which lead to longer juvenile periods and to the retention of more juvenile-like features into adulthood, are the same kinds of processes that underlie domestication (Hare, Wobber, and Wrangham 2012). Interestingly, domestication in rats has made them more playful and more likely to engage in wrestling (Himmler et al. 2013), whereas the play fighting of domesticated mice (Pellis and Pasztor 1999) is little different from that of the wild type (Wolff 1981).

Thus, like other transformations in play (Burghardt 2005), there are likely important enabling factors, such as an enlarged brain, a long juvenile period, and complex social systems, that create the conditions that make it beneficial to change the pattern of play to refine the brain's executive functions. It is among such species that we can find the role of play in making the brain more adaptable.

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GUEST EDITORIAL

Neuroscience, Early Childhood Education and Play: We are Doing it Right!

Stephen Rushton

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Abstract This editorial examines neuroscience and its impact on the field of education. Starting with a narrative between two young children, the author intertwines research with basic principles of learning, using the interaction between two 4-year-olds to illustrate the precepts. The four principles are: (1) the brain is uniquely organized; (2) the brain is continually growing; (3) a "brain-compatible" classroom enables connection of learning to positive emotions; and (4) children's brains need to be immersed in real-life, hands-on, and meaningful learning experiences. The editorial concludes with an illustration of how the brain works while two children are playing at the small animal center in their classroom.

Keywords Neuroscience · Play · Early childhood education · Four principles

The Power of Emotions

Returning from our weekly Kindergarten swimming lessons, Alexandra was in a hurry to get to the classroom and have her snack before launching into her hour of free exploration. On her way, she passed a group of boys enjoying their snack. They were engrossed in a deep conversation about dinosaurs. Alexandra's backpack inadvertently knocked over Michael's glass-lined thermos container, a relic from the past. The inside shattered when it hit the ground. Alexandra turned pale, became speechless, and was afraid to move. You could see the excitement drain out of her. Michael, on the other hand, looked fascinated as he held up the thermos and a trickling sound rattled inside, somewhat akin to a modern-day rain-stick.

I watched Alexandra's face turn red, consumed with some internal sense of guilt. Nothing was said between the two. A moment etched in time. Should I intervene? What would I say? I stood motionless, waiting. Decisively, Alexandra ran to the paint center, grabbed a long, thin brush, dipped it in the black paint and started methodically painting. She began at the top right corner and slowly, deliberately, painted the paper one precise stroke at a time. Until the once-white paper was covered in black paint. Then she took a deep breath and let it all out as she gazed toward her emotions displayed on the paper. A smile slowly spread across her face. Placing the paint brush back in its container, she sprang back into life, headed over to the house center and started playing as though nothing had happened.

(Junior Kindergarten, Ontario, Canada).

Introduction

Many years have passed since I taught Kindergarten. And yet the memory of watching Alexander's shock at breaking Michael's thermos and the subsequent release of her emotions through the painting etched a vivid memory within my own neuro-pathways.

I often share this story with my pre-service students and early childhood teachers, for a variety of reasons. Primarily, it models part of the neuroscience of learning and how fear can be aroused once the amygdala has been activated. Alexandra saw the thermos fall and heard the glass interior shatter. The sound waves and visual stimulation made their way to her ears and eyes, and then deep into her brain to Alexandra's thalamus. The waves had been converted into

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an electro-chemical reaction, and at the thalamus, decisions were made as to where to send the impulse next (Sylwester 2010). They headed to the parts of the brain that process particular information; in this case, the occipital and temporal lobes. There, through an exchange of chemicals in the synaptic space between neurons, memories and information were formed. At the same time that the thalamus sent the incoming stimuli to the appropriate parts of the brain, it sent the same signal to Alexandra's amygdala, right next door.

This organ is critical as it sorts for danger in the environment without consulting with the rational processes of the frontal lobes (Rushton and Juola-Rushton in press; Whalen and Phelps 2009). In Alexandra's case, she saw the thermos fall and heard the glass break, froze for a few seconds, and turned a shade of red. A series of reactions had taken place, and a release of neurotransmitters and hormones had aroused her nervous system. Once her frontal lobe caught up, Alexandra knew instinctively what to do in order to release her anxieties. Through color and movement of the brush, Alexandra relieved herself of what could have been an overwhelming rupture of emotion.

A second reason I share this story with my teachers in training is that this brief interchange between Michael and Alexandra illustrates an important philosophy in early childhood education: It is essential that we allow young children to make their own decisions and choices. Alexandra needed to integrate her emotional, physical, and mental processes on her own terms. Giving her the freedom to choose her next step was critical. She had an internal sense of what she would need to do and decided that painting a canvas black would help. Incidentally, all of Alexandra's paintings prior to this were of bright rainbows, colorful homes, and her family.

I believe this narrative also helps to depict an important aspect, and perhaps even a growing concern, for early childhood educators. As teachers, we make hundreds of decisions daily. Knowing when to step in, take over, wait, model, and lead is a balancing act that requires much skill. How much freedom do we give? When do we intervene in the course of a child's learning? And now standardized testing has made its way down to 1st-grade classrooms. As a result, Kindergarten classes become the training grounds for success in 1st grade, and not necessarily a place where children can explore, grow, and learn at their own pace. What is our role as educators in this new world of standardized education? This editorial will review and address some of these important questions from the perspective of brain-based education and a constructivist lens.

We live in uncertain times. Once again, the field of early childhood education balances between two contrasting educational and political perspectives. On the one hand, we have educators such as Otto Weininger, professor emeritus in the Early Childhood Education Department at OISE/UT, whose now-eloquent expression—"You can't make children grow faster by pushing them, just as you can't make flowers grow faster by pulling them"—depicts the essence of a constructivist's philosophical belief that young children need to unfold at their own developmental pace. Constructivism is practiced by those early childhood educators who subscribe to the tenets of developmentally appropriate practices (Bredekamp and Copple 1987; Copple and Bredekamp 2010), brain-based research (Rushton et al. 2009; Sylwester 2010), and multiple intelligences (Gardner 1993).

Juxtaposed to constructivism as a way of teaching our young are educators who believe in a more traditional, teacher-led approach to education. Many of these educators are guided by the political pressure for standardized testing. Accountability and setting measurable standards are fast becoming just as synonymous with early childhood as the concept of developmentally appropriate practices (Schiller and Willis 2008). An emotional dissonance is rising in early childhood educators as they balance the two. Funding is directly linked to testing, and in some states this begins as early as pre-Kindergarten (Golan et al. 2008). This new wave has been emerging in our educational arena for nearly a decade. It is driving the belief that all children need to be on the same page at the same time. Beginning with the 1983 report *A Nation at Risk: The Imperative for Educational Reform* (National Commission on Excellence in Education 1983) to various Commission Reports during the 1990s, to the most influential initiative, the *No Child Left Behind Act of 2001*, early childhood educators have been contending with political pressure and struggling to balance assessment with best practices (Rushton and Juola-Rushton 2008).

Indeed, today's children certainly face a world that is unique, fast-paced, and accelerating at a level that never existed before. Information on the Internet is in competition with, and in many cases outperforming, classroom instruction, not only in terms of the availability of information but the exponential rate at which it changes. Young children's exposure to playing games and picking up misinformation via the Internet is a novel concept in the world of teaching, one that needs addressing. When compared to a teacher, the artificial world created by interactive, high-definition video games such as Xboxes, Wiis, and PS3s can be far more enticing. Wolfe (2007) states that every 2 years, approximately half of what we know could be obsolete, which begs the questions, what are we teaching, and why?

Clearly, times changed when the industrial age shifted to the information era. Our way of thinking and the neuropathways of our young are also changing (Diamond and Hopson 1999). It has become clear that educators need not

only to help children to do well in school but also—and more importantly—to help children survive in a world we ourselves cannot truly comprehend, see, or even imagine (Wolfe 2007). It is our task as early childhood educators to help today's children learn to analyze, synthesize, and clarify information, not simply recite facts and figures from the past. Never before in the history of early childhood education in the U.S. has this truth been so realized as we move into a new political era. We are in a time of embracing and understanding the heart of the whole child.

Research to Support Early Childhood Educators' Approach to Teaching

Research during the past decade provides a clear road map of how best to accomplish the difficult task of balancing assessment (Jones et al. 2007) to standardized outcomes (Drew et al. 2008) with best practices (Copple and Bredekamp 2010). With the exciting convergence of studies from the fields of neuroscience (Diamond and Hopson 1999; Friederici 2006; Nelson et al. 2006; Sylwester 2010) and cognitive psychology (Gardner 1993), educators (Bergen and Coscia 2001; Gallagher 2005; Rushton et al. 2009; and Rushton and Juola-Rushton in press) are now making important links to help early childhood educators stay true to their training and knowledge about hands-on, developmentally appropriate experiences that allow young children to learn best.

In their paper titled *Shaping the learning environment: Connecting developmentally appropriate practices to brain research*, Rushton and Larkin (2001) connected nine of the 12 DAP position statements as outlined in Bredekamp and Copple's (1987) initial paper to nine brain-based principles gathered from the literature in the field. Our intent was to help teachers connect the importance of developing strong curricular components that immerse children's experiences in real-life situations, allowing the child's natural curiosity to develop. At that time, we had hoped to draw parallels between how the cognitive processes of the brain work and the ties to early childhood. Fortunately, many teachers of young children are working toward developing the brain's natural way of learning when they listen and interact with the child. The opening narrative illustrates how the child's emotional, intellectual and physical domains naturally integrate by providing room for their own self-discovery. Many teachers are becoming knowledgeable about the neurosciences, are well versed in DAP, and create engaging, meaningful experiences for their children to explore, assess, and learn. It is through these exciting yet complicated times that early childhood educators can deepen their educational pedagogy without childhood needs being sacrificed.

Similarly, positive, stimulating environments where young children are free to select their own learning help to reduce stress in the classroom and allow for great flexibility and creativity. Millions of neuro-pathways are readily forming and connecting within the child's brain. These connections will support children throughout their entire lives. In addition, the use of play as a form of learning, when left open-ended, is congruent with individual differences. Each brain's structure is designed to process information uniquely, much like Michael and Alexandria taught us in the opening vignette. Playful learning allows for individual differences and mastery to occur.

Finally, the child's 'mirror neurons' reflect their external world. Research (Iacoboni et al. 2005) suggests that a positive, enthusiastic teacher sends signals to the child's mirror neurons, which, in turn, can impact how they receive the learning objectives being delivered. How we present not only ourselves, but also the phenomenal journey of learning, is critical to the child's emotional development. It would be amazing if we could support children in such an open, engaging environment that they don't want to leave when the school day ends.

In 2007, Pat Wolfe, an educational consultant and expert on brain research, suggested that the bridge between the field of neuroscience research and education is not the job of neuroscientists, but instead, that of educators. It is easy to become overwhelmed with the language that is often associated with neuroscience. Such neurological terms as *occipital and parietal lobes*, *amygdala*, *thalamus*, *neurons*, *dendrites*, *neurotransmitters*, etc., may be difficult to put into the context of a Kindergarten classroom. The idea that a connection exists between the firing of an electro-biochemical synaptic reaction taking place between neurons in a 4-year-old's brain, which may release neurotransmitters such as dopamine or serotonin, and the child's ability to stay focused and learn is a stretch for most of us. Comfortable with the terminology or not, it is our responsibility as early childhood educators to understand that every child each school year represents a virtual explosion of dendritic growth. We are so fortunate to be in a profession where we can create learning opportunities to best support young children's development and their biological wiring, so let's start there.

Brain Principles

Leslie Hart (1983, p. 21) states, "Anyone who does not have a thorough, holistic grasp of the brain's architecture, purposes, and main ways of operating is as far behind the times as an automobile designer without a full understanding of engines." With this in mind, here are the four basic principles of brain-based learning and applications, to

help you get to know 'the engines' you mold each day. It is our belief that many ECEs are already skilled and armed with the knowledge of what best practices are. It is also our belief that any developmentally appropriate program focuses on the 'whole child'; that is, it comes from a stance of how can we best touch the mental, emotional, social, and physical life of the young child. As such, it is already involved in practices that are brain-compatible and reflects the four principles that follow.

Principle Number One

Every brain is uniquely organized. It's easy to focus on the children in your class who are the most persistent. We all know the old adage, 'the squeaky wheel gets the grease.' Remember, each child's brain thinks, feels and learns differently. By providing skills-leveled materials, those students who are below, average, and above can not only celebrate successes, but also maximize their development to venture on to more complex tasks. For example, when reviewing the objective of a child's becoming secure in their alphabet awareness, we would require a variety of materials to support this goal. We would stock the writing area with various materials, based on the students' developmental needs, such as sandpaper letters for finger tracing, sand trays for letter scrolling, paints, brushes, and jumbo pencils for scribing.

Principle Number Two

The brain is continually growing, changing and adapting to the environment. Intelligence is not fixed at birth but fluctuates throughout life, depending upon the stimulation of the environment, hormonal levels and other chemical reactions taking place throughout the body. The fact that children today spend more time in school than with their primary caregivers requires educators to be far more diligent about the environments they are creating. During the first 5 years of a child's life, billions of neurons are being connected, depending upon the stimulus of the environment (Miller and Cummings 2007). Each day we greet our students with a warm welcome, encourage them as individuals, provide personal challenges, involve them in the development of the classroom environment, and support individual differences. Educators are aware of the changes that take place in children from day to day, month to month. Many of these changes are biologically driven and unique from child to child. Our job is to notice, accept, and modify the curriculum to each student.

Principle Number Three

A 'brain-compatible' classroom enables connection of learning to positive emotions. The most naturalistic way for this to occur is by allowing students to make relevant decisions and choices about their learning. I am not suggesting we give full rein and see what happens. Instead, our curriculum objectives are set as a target and our preparation to meet these targets requires thought and understanding of each child's strength and weaknesses. Ultimately, it is the students who guide the learning and we, the facilitators, course-correct along the way. Given that each child's brain is unique and varying levels of individuality exist, it takes a special educator to not want to force each child into a lock-step curriculum. Different levels of neurochemicals create different emotions. Too much of one chemical, or too little, (say, either dopamine or serotonin) will impact the child's mood and therefore their ability to want to learn or simply respond.

The Fourth Brain Principle

Children's brains need to be immersed in real life, hands-on, and meaningful learning experiences that are intertwined with a commonality and require some form of problem-solving. Visiting early childhood classrooms and seeing the children interacting with their world is an exciting endeavor. When we approach the classroom environments, the teachers who continue with a small group as if no one is there, lost in the exploration of shapes with straight or curved edges, speak volumes. Equally communicative are, the children who question or invite us into their learning adventures, talking us through it the whole way. These are the developments of critical thinking that reach the core of dendritic growth.

Either you recognize yourself within some of these simple principles provided above, or you now have a definitive direction for your teaching. We realize that there is a lot to the brain lingo (dendrites, synapses, neurons, etc.). We encourage you to stretch yourself a bit and actually see if you can get inside the heads of your students.

Brief Overview of the Brain's Mechanism

In short, each experience a young child has typically involves one or more of their senses. As the child interacts with the environment, various stimuli enter the body via the five senses. These experiences are then converted into *electrical/chemical impulses* that travel, via nerves impulses, to the *thalamus* – an almond-shaped organ in the center of the brain. This important organ assigns the incoming stimuli to one of the four lobes (*occipital, temporal, parietal* and *pre-frontal*) or the *motor cortex* part of the brain for further processing.

For instance, imagine two children who are playing with different toy animals and are classifying them into types

(wild, farm, pets). Both children are using numerous portions of their brains at once, all very similar, yet different neuro-pathways are used in different sequence to get to the same result. To begin with, picture the two students subdividing the animals into 'farm animals,' 'predatory animals' and 'house pets'. Light rays enter the eyes' pupils, convert to an electro-chemical impulse behind the *retina*, and follow neurons to the *thalamus*, which sends the signal to the *occipital lobe*'s millions of cells, each one designed for a specific task. Some cells help determine the different shapes of the animals, others the various colors, and some help sort the varying shades of a particular color. As the children pick up the different animals and classify them according to texture (say, the difference between wood and plastic), their fingers connect with the material. The nerves from their finger-tips send a similar electro-chemical message to the *nerves* within the hand. This travels up the arm to the *spinal column* and again to the thalamus. The signal is then sent directly to the *motor cortex* located midline center of the brain, which allows the child to place the animal in one pile or another. As the child decides in which pile to place the animal, the *pre-frontal lobe* is also activated, as this is the decision-making center of the brain. The pre-fontal lobe is also considered the executive center of the brain, and as children grow into adults, this portion of the brain develops further, allowing sound judgments to be made.

Although this is a highly simplified explanation of how the brain works, it is clear that the process is both natural and complicated. Let's review the function of some of the terms used above.

Table 1 Overview of brain terminology

Electrical/chemical impulse	Used by neurons to signal to each other and to non-neuronal cells
Thalamus	The information messenger between the cortex, brain stem, and other cortical structures. Contributions include perception, timing and movement
Occipital lobe	The primary visual area of the brain. Two important pathways of information that originate in the occipital lobes are the dorsal and ventral streams. The dorsal stream is what projects to the parietal lobes and then processes the location of the object. One of the functions of the ventral stream is to then process what that object was
Temporal lobe	Functions include perception, face recognition, memory acquisition, understanding language, and emotional reactions
Parietal lobe	Integrates information from the ventral visual pathways and dorsal visual pathways, thus allowing us to coordinate our movement in response to the object in the environment
Pre-frontal lobe	Processes "higher" brain functions. A part of the executive system that refers to our ability to plan, reason, and make judgments. Also important contributor to the assessment and control of appropriate social behaviors due to involvement in personality and emotion
Motor cortex	Generates the neural impulses controlling the execution of movement
Retina	Light-sensitive tissue lining the inner surface of the eye
Nerves	Provide the pathway for the electro-chemical impulses that are transmitted along axons
Spinal column	Also known as the vertebral column, backbone or spine. It houses and protects the spinal cord in its spinal canal

To find more information about the parts of the brain, you can go to wikipedia.com, or check out the interactive applications via Apple's iTunes.

Conclusion

Thirty years ago few educators would have predicted that many schools in 4th and 5th grade would send their children home with Apple laptops to complete homework, or that most schools would have computer laptop trolleys that are shared between two classes. Children are exposed to stimulations, sounds, sights that often blur reality. Modern games are often more intense than real life and certainly have a way of stimulating the opiate receptors of the brain "Michael, Michael are you there?" Mom yells upstairs, knowing her child has been classified as ADHD at school yet can't seem to pull himself away from the video game hour after hour at home. Today's early childhood educators need to be genuine, engaging, intentional, and aware of what is affecting their students.

Young children's brains are expanding at an incredible rate. Miller and Cummings (2007) estimate that by the time a child reaches the age of 5, more than 100 billion neurons have made connections within the cerebral cortex (the grey matter of the brain). In truth, many of these neurons, if not used, die out, as neurons are initially overproduced so the child can be supported to navigate through life. Learning one of the 3,000 languages that are present (Nevills and Wolfe 2009) and making decisions about when to crawl, stand, walk, and talk are both developmental and connected to the neurons in the brain, making strong healthy connections. The stronger the connections between neurons, the strong and faster the reaction will be in recalling information (Gallagher 2005). It's exciting to be part of the

intense growth in a young child's brain. Early childhood educators literally have the ability to help shape a child's mind.

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