Application of Learning Through Play in designing school playgrounds (Preschools to Kindergartens) to aid in children's development

by

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Abstract

Children are able to promote their academic learning performance through playing, which is more effective than traditional learning methods. Hence, suitable designing for school playgrounds aimed at providing an effective way to improve children's skills and development is important. However, with reducing playtime and raising academic learning time, children's needs are often not prioritized. Meanwhile, children's unhealthy issues also emerge such as obesity, depression, and anxiety. Moreover, most preschool play spaces are sterile with few or limited equipment.

This thesis is aiming at aiding designers in an approach for designing educational playgrounds at schools, including preschools and kindergartens (2 – 6 years old), to appeal to children's needs in their growth. Their needs and development change faster. Therefore, studying the connection between children development and play is a vital for develop a successful approach at the end of the research. The literature review includes play, children development, school playgrounds, and experience design aspects.

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Chapter 1 Introduction

1.1 Problem Statement

When speaking of outdoor play for young children, most parents, teachers and

pediatricians agree that it could provide numerous benefits to stimulate child development.

Unfortunately, over the last several decades, in the United States and other developed nations,

children's free play with other children has continually declined (Gray, 2011). From 1981 to

1997, children's playtime decreased by 25%. Children 3 to 11 years of age have lost 12 hours per

week of free time under academic pressure (Yogman et al., 2018).

According to the US Department of Education, four million children are expected to

enroll in kindergartens each year in the United States (Education, 2015). Play periods for some

kindergartens are only ten to fifteen minutes long or permit free play only during before-school

transition periods, and preschools have similar lack of playtime (Johnson, Christie, & Wardle,

2005). Since implementing the No Child Left Behind policy, kindergartens encounter a dilemma

that they need to achieve inappropriate expectations, including state and national academic

standards. They have to eliminate recess and outdoor activities in classrooms. Another barrier is

that many early childhood educators lack understanding of developmentally appropriate practice

(DAP) in general and play's role in DAP in particular. Only 33 percent of the early childhood

programs they observed were truly play-based in research by Dunn and Kontos (1997) (cited in

Johnson et al., 2005). According to the *American Journal of Play*, researchers state the lack of

children's playtime, leading to the rise of their anxiety, depression, and problems of attention and self-control (Johnson et al., 2005). Playful learning playgrounds, therefore, makes sure all children have ample opportunities for outdoor activities and develop their attribute to academic learning though play.

Additionally, along with eliminating recess, cutting physical education and allowing pizza, hamburgers, and French fries to be sold in many schools, the amount of children's obesity has dramatically increased. Based on the Centers for Disease Control and Prevention (CDC) report, approximately 17% of children and adolescents aged 2 to 19 years in the United States have obesity. In modern society, children and teenagers grow up immersed in media and digital devices, including TV, iPad, smart cellphone, and Video Games, reducing their outdoor time.

Also, American parents and teachers are concerned with risks of skin cancer and playground injuries so that they usually keep children inside. Then, adding a certain shadow part in school playgrounds is necessary. In the United States all school playgrounds also should cater to those standards by United States Consumer Product Safety Commission, ASTM International, and Americans with Disabilities Act (ADA). However, German playgrounds look riskier and more ambitious than American ones, which some American adults might deem too dangerous for kids to play.

Lastly, school life is a miniature adult world for our children who will become adults in the future. Despite all the grand efforts of many good teachers, the environment of the school does not provide for children with the best conditions for starting life as adults (Hendricks, 2001).

However, most schools' play areas are insufficient and limited, which will have effects if they reduce the chance of children to outdoor play in daily school life. Moreover, existing American playgrounds are normally defined by a sizable, colorful piece of commercial equipment that links steps, deck, and slides (Solomon, 2005). When searching playgrounds on Google, there are a large number of pretty fascinating modern playgrounds with colorful plastic and rubber. In contrast, most of the school play areas are boring, sterile, and limited to child development. When searching keywords like schoolyard, school playgrounds are barren and often unused because of the inadequate school budget. Only a few of them have isolated and conventional physical equipment. Although governments, landscape architects, and educators pay more attention to school playground design and the study of playful learning over decades, it still is hazardous to offer a better play environment to child development at schools.

Hence, increasing the physical activities and making outdoor play areas more attractive and fun are the primary and vital task. This study will analyze problems that exist in school play spaces, and provide an approach for designers, teachers and playground companies who want to design playful learning playgrounds for young children.

1.2 Need for Study

In the last thirty years, a series of coordinated interdisciplinary interests in play studies have risen and pursued the value of certain kinds of play, playgrounds, and toys for child development and community life (Henricks, 2006). This study contains an attempt to discern the educational and playful significance of children development though playgrounds. The

advantage of designing educational playgrounds to accommodate young children is stated above, but how to apply learning with play in design is paradoxical and controversial. This study supports the importance of play for children in daily school life.

First of all, the American Academy of Pediatrics states that learning through play could arouse potential faculties of children, including language, math and social skills, and even coping with stress. Then, that this study is necessary because of the severe condition of children's health and development must be addressed. To solve these schoolyard predicaments, city councils, educators, architecture designers, product designers and playground companies need to seek a rational solution for school play areas. If a schoolyard is for playful learning, teachers could directly observe and evaluate children's school performances. According the Maria Montessori Method, natural materials of equipment and tools will have more benefits for children to be close to nature and explore the world.

Additionally, this approach incorporates the rudimental elements gathering from Child Development and Maria Montessori Methods into school playgrounds to augment children's daily outdoor playtime, and stimulate their potential learning abilities. Different play areas could provide learning environment, materials, and outdoor activities that match the teachers' observations of children's emerging cognitive, social, emotional, and physical development (Johnson et al., 2005). In other words, educational play is connected with enjoyable play so that children will tend to develop positive attitudes for academic learning and mental health.

Furthermore, in order to extend children's play time, educational playgrounds also are designed with evaluation functions for teachers to observe the result of achieving these aims. Carrying through the playful learning playgrounds design possesses the momentous academic value and realistic value. This approach can help designers, teachers and parents make all children have enough daily outdoor activities with educational playgrounds.

1.3 Objective of Study

This approach will help designers understand how to design schoolyards in kindergartens to assist the teachers to foster children with the playful learning schoolyards. Detailed objectives are listed as below:

- To study the theories of play and Child Development, which include physical, social, emotional and cognitive development age 2 to 6 years old

- To define and study types of play

- To study the theories of children's learning through play and play development

- To study the concept of kindergartens' play and play spaces and their benefits

- To define and study the value of playful learning playgrounds

- To determine the relationship between different types of play, playful learning playgrounds, children development and evaluation.

- To develop an approach of using sensory design to develop educational playgrounds at kindergartens.

1.4 Definition of Terms

Play - Engage in activity for enjoyment and recreation rather than a serious or practical purpose ("Play," n.d.).

Sensory - Senses with enjoyable, captivating, intrinsically motivated and process focused elements coming from the playground's feels, smells, tastes, sounds or looks.

1.5 Assumptions of Study

This study includes several assumptions, which are listed as below:

- There is an assumption that all materials such as books, thesis, dissertations, approaches, methods, websites and databases are valid as references to support the research, and it is assumed that all of the materials are authentic and credible.
- It is assumed that the study of children's learning though play is invaluable.
- It is assumed that people do care about schoolyards issue for children's development.
- It is assumed that the issue of unused schoolyards can be relieved by playground design process.
- It is assumed that the designers have already acquired a basic product design skills includes ideation sketching, CAD modeling and prototyping.

1.6 Scope and Limitations

This research attempts to study the educational playgrounds at kindergartens, focusing on developing children's abilities and skills of learning though play.

Scope

- The scope of children in this study refers to the population age 2 to 6 years old in the United States.

- There are various challenges that children are facing in schoolyards, but this study will mainly focus on solving problems existing in designing playful learning playgrounds.

- This study will mainly discuss an approach of how to design educational playgrounds.

- Even though this study is about playground design, some other important aspects in playgrounds will not be developed in this approach, such as manufacturing methods, material recycling and etc.

- Only preschool to kindergarten playgrounds will be discussed in this study.

Limits

- Though the purpose of this study is assisting teachers to cultivate children's learning though play, there may exist some situations in which playgrounds are not the best solution.

- Although play interactions between parents and offspring are important as well, educational playgrounds in kindergartens will be not considered this point.

- According to different schoolyards condition and size, the effectiveness of this study may be limited in certain situations.

- Children's furniture, toys and infant products design will not be included in this design approach. The concluded playful learning playgrounds will be discussed and defined in

the Literature Review. The study focuses on the study of children's playgrounds at kindergartens in the United States. Playgrounds designed for adults will not be considered.

1.7 Procedures and Methodology

Procedure 1: Study the concepts of play and its benefits.

- Studying online research, dictionaries, articles and library resources.

- Analyzing existing playgrounds at schoolyards.

Procedure 2: Study the theories of play and children's development and sensory integration development.

- Analyze and conclude children's outdoor play activities types.

- Determine the children playful leaning

Procedure 3: Study different types of play for child development and learning

- Studying online research, dictionaries, articles and library resources

- Sort and analyze researches.

Procedure 4: Study current playgrounds at preschools to kindergartens.

- Studying online research, dictionaries, articles and library resources

- Sort and analyze researches.

Procedure 5: Summarize the relationship between different types of play, children's development needs and sensory design and build up the frame of the design approach.

- Studying online research, dictionaries, articles and library resources

- Analyze and illustrate relationships.

Procedure 6: Develop the design approach of educational playgrounds at kindergartens by using playful learning and sensory design.

Procedure 7: Apply the approach into a real product design process.

1.8 Anticipated Outcomes

The primary outcome of this thesis is a design approach about how to design educational playgrounds for the children to assist their academic learning and promote health. The target of children's play activities and school playgrounds will be studied. The study will also cover the theories of experience design be applied in the new approach.

Generally, it is anticipated that the children's playful learning environment will be improved, and they will get enough and joyful outdoor playtime at schools.

Chapter 2 Literature Review

Etymologically speaking, the word "playground" is composed of the words of play and ground, which means a space specifically designed for people to play. In order to support this approach of designing children's playgrounds, it is so important to understand play, ultimate players: children, children's development, types of play, play in child development, which will be addressed one by one in this chapter.

2.1 What's the Play?

It is hard to imagine human beings could live without play. Play is so important for our development and survival that is one of human beings' biological drives, including food, sleep, or sex, but all drives are not equal in strength (Brown, 2009). According to the philosopher Jeremy Bentham's (year) study, human behavior is determined largely by pleasure or pain. Besides, in Dr. Stuart Brown's research, he states that all mammals will play spontaneously when they are satisfied with their fundamental survival demands, like being fed, safe and rested. Play is something that can be associated with our growing up, seeing things though a new perspective, living with playful life and enjoying life. For a long time, play is a significant role in early childhood education programs. Later in this chapter, this study will elaborate in more detail information about how play influences in children's learning.

In ancient Greece, education (paideia) is the consequence of play (paidia) and children (paides), which was intrinsically associated with each other (D'Angour, 2013). Just as often people say "play" music and sports. From the histories of play, researchers notes that play often

influences and stimulates brains to work better, and also children could be more optimistic and creative. Hence, it is no doubts that play has the inseparable relationship with education. Also play should be defined as a free and voluntary activity, which could obtain joy and amusement (Caillois, 2001).

Additionally, in a series of studies, Barnett (Barnett, 1990, 1991a, 1991b) demonstrates playfulness consists of five components and distinguishable dimensions of cognitive spontaneity, social spontaneity, physical spontaneity, manifest joy, and sense of humor. Moreover he states children's play reflects child's personality, dreams, fantasies, wishes, traumas, conflicts, emotions, and construction and representation of his world (Barnett, 1998). What is more, Sigmund Freud (1953, 1955) regarded play as developing children abilities to cope with their life circumstances, excite latent energy, and cultivate the spirit of all-life learning; through play he express himself. Therefor, we could see how much play could influence children's development. More information will be discussed in later sections. Let us study theories behind play at first.

2.1.1 Theories Behind Play

Why do children need to play? Diverse theoretical interpretations enhance understandings of the meanings and manifestations of children's play. It may potentially change our firm viewpoint of the play in children's development. Furthermore, scholars' and educators' and psychologists' perspective of play can aid designers better to understand how apply different types of play into creating playgrounds.

Although philosophers and psychologists have been involved with animal and human play for a long term, this field gradually turned into the special psychological research only by the K. Groos's study at the end of the nineteenth century (Elkonin, 2005). The purpose of this chapter as a simple and brief description of some significant theories of play is divided into classical and modern theories in next two sections.

2.1.1.1 Classical Theories of Play

The classical theories of play arose in the 19th and early 20th centuries and aimed to interpret the existence and purpose of play. The first classical theory was mentioned by Friedrich von Schiller, an eighteenth century German poet and philosopher, and he defined play as 'the aimless expenditure of exuberant energy', called The Surplus Energy Theory. Schiller considered children's play as the superfluous energy left over, which was depleted through play (Pepler & Rubin, 1982). However, there are many defects and weaknesses in his writing. Then, Herbert Spencer (1878), a nineteenth century British philosopher and psychologist, refined it as a superfluous activity. According to his introduction, 1) the superfluous activity of the sensory motor apparatus. 2) artistic-aesthetic play. 3) the higher coordinating powers of games. and 4) mimicry (Rubin, Fein, & Vandenberg, 1983). An example cited was the play fight or the rough-and-tumble play for most young boys.

The second classical theory by Moritz Lazarus (1883) contradicted with the surplus energy. For him, play should be the phenomenon derived from an energy deficit rather than from a surplus (Rubin et al., 1983). He pointed out the Recreation Theory of Play that 'play is the

result of the individual's need to overcome a deficit of energy'. But he failed to delimitate that play or recreational activities could provide a restorative function. Nevertheless, an early twentieth-century philosopher G. T. W. Patrick, who argued that play stemmed from a need for relaxation, extended Lazarus' theory. To Patrick, the play of children was motivated by "race habits" and "race memories" (Rubin et al., 1983).

The philosopher Karl Groos (1895) articulated the third one, The Practice (Preexercise) Theory of Play, against The Surplus Energy Theory construed above. Groos evaluated precisely this idea about play as anticipation of future serious activities, expressed first by G. Spencer (Elkonin, 2005). Although Groos did not to solve the conundrum of play, which has not been fully settled even today, his theory is most profound and essential to overall development in childhood. To Groos, play was viewed as adaptive and necessary for the survival of the species rather than an aimless discharge of surplus energy (Barbour, 1999). For him, the development of intelligent behavior is the consequence of children's play. But Groos's theory of the significance of play ignored the nature of play itself.

The fourth one, the Recapitulation Theory of Play, was described by G. Stanley Hall (1920), the 'father' of the North American child psychology movement. To Hall, the function of play was cathartic in nature. Hall believed that child development provided a means for detecting both between and within-species evolution (Barbour, 1999). For example, Hall suggested that, in play, the racial instincts found outlets for expression. (Rubin et al., 1983)

In conclusion, albeit these four theories have considerable shortcomings and logical errors, they still have major impacts in the children's play field today. Later, the modern theories of play assimilated their elite and made improvements.

2.1.1.2 Modern Theories of Play

Modern theories of play occurred after 1920 and tried to explicate the role of play in child development, including Arousal Modulation theory, Psychodynamic theory, Bateson's Meta communicative theory, and Cognitive theories. Table 2.1 presents these four mainly modern theories of play and also includes sociocultural theories of play and infantile dynamic. And this stable is based on Mellou's (year) categorization of play theories and Karen Stagnitti's (year) reorganization of that material.

Modern Theories	
Arousal Modulation theory Daniel Berlyne 1960 Ellis 1973 Hutt 1985	Children play to regulate the level of arousal in their central nervous system. Play is associated with exploration. Exploration of objects reduces the level of arousal when novel situations are encountered. When the organism is bored, arousal is increased by exploration. Play was seen as stimulus seeking behaviour. Eventually, these theories led to the distinction between exploration and play. Exploration occurred in novel situations where the child asked 'What can this object do?' Play occurred in familiar situations where the child asked 'What can I do with this object?'
Psychodynamic theories (Freud, 1961; Erikson, 1985)	Play is a catharsis that allows children to express their feelings and dispel negative emotions to replace them with positive ones. These theories explain the role of play in the emotional development of children. Through play, children can play out wish fulfilment and master traumatic events in their lives.
Cognitive theories (Piaget, 1962; Vygotsky, 1966,	Piaget believed children use their current mental abilities to solve problems because they can pretend the world is different from the way it real is; Vygotsky believed play develops cognitive powers and encourages abstract thought. Both of them thought play is a cognitive process. Play is a voluntary activity. Play contributes to cognitive development, problem solving, and creative thought. Play develops innovation, flexibility, enhanced problem solving and adaptation.
Sociocultural theories of play	
Play as socialization (Mead, 1934) (Freud, 1961; Erikson, 1985)	Through play with other children, children learn social rules and norms. Social roles are practised through play.
Metacommunicative theory (Bateson, 1955)	Play itself is the skill required to function within the real work of daily life. Children frame and reframe roles themselves. Play is learning about learning. Play is affected by the context in which it is played. Children signal that they are playing and play is not an agent of socialization, which develops skills for adulthood.
Infantile Dynamic	
Lewin	Play occurs because the cognitive life space of the child is still unstructured resulting in failure to discriminate between real and unreal.
Buytendijk	The child plays because he is a child and because his cognitive dynamics do not allow for any other way of behaving. Play is an expression of the child's uncoordinated approach to the environment.

Table 2.1 Modern Theories of Play (Stagnitti, 2004)

It is not hard to see modern theories of play pay more attention to the relationship between play and child development than before. The detail of some theories will be discussed later in this chapter.

2.1.2 Definitions of Play

Above all, researchers realize that play is a complex behavior which appears deceptively simple (Green & Myrick, 2014). Heretofore the definition of play remains clouded with controversy, even though many play scholars and advocates devoted accounts of play's manifestations and meanings. Most scholars began with their academic writings about the play, which is extremely abstruse and ambiguous. It is difficult to directly describe with a sentence or express in the titles of those works (Henricks, 2015). Psychology and physiology cope with the observation, description, and explanation of the play of animals, children and grown-ups, to attempt to define it (Huizinga, 2014). Johan Huizinga (1995) a Dutch historian, described play in his book *Homo Ludens: A Study of the Play Element in Culture*, as follows:

> Summing up the formal characteristics of play we might call it a free activity standing quite consciously outside "ordinary" life as being "not serious," but at the same time absorbing the player intensely and utterly. It is an activity connected with no material interest, and no profit can be gained by it. It proceeds within its own proper boundaries of time and space according to fixed rules and in an orderly manner. It promotes the formation of social groupings which tend to surround themselves with secrecy and to stress their difference from the common world by disguise or other means. (p. 21)

He is the first scholar aware of the profound relationship between play and culture. Besides, he asserts that play is older than culture, and interpreted play as both rule bound and

free spirited, serious and nonserious (Huizinga & Iudens, 1955). However, Caillois (2001) argued that all of the words for Huizinga's definition of play seems significant and meaningful. He considered that is too broad and too narrow. Caillois (2001) distinguished his point from Huizinga's and assimilated philosophy into his definition of play. Although his theory is fundamentally sociological, discussion about the play in the *Man, Play, and Games* (1961) is attractive for many reasons (Fine, 1987). Furthermore he expounded that play is to be defined as an activity, which is essentially: "free, separate, uncertain, unproductive, governed by rules, make-believe"

Brain Sutton-Smith (2009), a leading folklorist and play theorist, attempts to unite definitions of play. He considered each discipline from biology, psychology, and education to metaphysics, mathematics, and sociology with play. In his early theories about play, he cited play for children to prepare for adult life by developing flexibility. Most recently, he put forth the theory of adaptive variability and published his famous book *The Ambiguity of Play*. He has contributed in seven elucidative points: "building knowledge and skills, confrontation with fate, power, community identity, the imaginary, self, and frivolity" (Henricks, 2015). p.12 Also, these approaches are connected with culture. Sutton-Smith(2009), though obscure, could define play, as follows:

> Play, as a unique form of adaptive variability, instigates an imagined but equilibrial reality within which disequilibrial exigencies can be paradoxically simulated and give rise to the pleasurable effects excitement and optimism. The genres of such play are humor, skill, pretense, fantasy, risk, contest, and celebrations, all of which are selective simulations of paradoxical variability. p.132

For Sutton-Smith, he assert that one of play's consequence is also one of its causes: optimism (Henricks, 2015). Thomas S. Henricks (2015) summarized views of Joseph Levy and Huizinga, "paradox of what is essential and inconsequential", "serious and the nonserious" which explain why play is not easy to interpret (Henricks, 2015, p. 13) In his book *Play and The Human Condition*, he claimed that play is a form of and for human conduct (Henricks, 2015). In this book, he made clearly two main points to serve his approach as following:

> First, there is substantial variety in the activities that people call play. Play objects can include all manner of psychological, bodily, environmental, social, and cultural elements. The settings of play activities – and the roles of other people in those settings - may also vary dramatically. Second, this diversity of expression and interpretation should be seen as the empirical basis for discovering what is common to all forms of play. (p.15)

His viewpoint includes children cavorting at a swimming pool, an artist painting in her studio, an insult comedian playing his trade in a crowded lounge, two friends in an amusement park, an energetic teacher incorporating active learning into her class and the determined gambler (Henricks, 2015). Therefore, he analyzed and stated play as follow:

> **Action**: play as action is characterized by two key qualities: *transformation* and *consummation*. Transformation refers to the way in which personal understandings are linked to behavior. Consummation emphasizes processes of ingestion
>
> **Interaction**: play can also be seen as something that occurs when individuals encounter one another or engage with external elements of the world. In that context, play is a quality of exchange, relationship, or interaction.
>
> **Activity**: play was also described as a scenario, event, or activity that features sometimes complex understandings of how the process should begin, go through middle stages, and reach a conclusion.

Disposition: people are drawn to play because they want to put their capabilities into action. Watching is not enough.

Experience: one plays with the knowledge that different things, which one could be involved in, are going on elsewhere.

Context: my own phrasing for this general relationship between play and its settings, both within the event and beyond the event, is that play exhibits *ascending meaning*.

As action, play is *transformative* and *consummatory*. As interaction, it is *contestive* and *unpredictable*. As activity, it is self-regulated and episodic. As a pattern of disposition and experience, play features an emotion-sequence that leads from curiosity to alternations of *fun* and *exhilaration* to remembrances of gratification. In relation to its context, play reveals a pattern of *ascending meaning* both within the event and beyond the event. When we play, we address the implications of these themes and reflect on those experiences. (p.43-50)

However, for Dr. Stuart Brown, the founder of the National Institute for Play and a leading play expert in the Unites Stated, he refused to give an absolute definition of play for many years. He is the proponent of play by personal experience and feeling. First reason is that each person hold different attribute to various play. Secondly, he insists that "play is a very primal activity". Finally, he describes the play as "preconscious and preverbal". Defining play seems to explain a joke or analyze the joy. For him, "there is no way to really understand play without remembering the feeling of play" (Brown, 2009).p.checking

In conclusion, even though many play scholars were devoted to defining play, it is still challenging because play embraces complex and various behaviors. However, though these theories seem considerably cumbersome and questionable, they are still useful for researchers to deeply study in the future. In the next section, elements of play will be studied to fully comprehend play and types of children's play at present.

2.1.2.1 The elements of Play

In the light of Henricks's six perspectives for play, mentioned in the prior section, play scholars and practitioners discovered and developed the elements of play to educators focus on defining elements of play as a means of education.

Scott Eberle (2014), the vice president for Play Studies and editor of *The American Journal of Play* at The Strong National Museum of Play in Rochester, New York, asserted that play is a process with six steps: "anticipation, surprise, pleasure, understanding, strength and poise" diagraming this process as a wheel (see Figure 1.) Besides, his concepts is described in Dr. Stuart Brown's book *Play* (2009) as follows:

> *Anticipation*, waiting with expectation, wondering what will happen, curiosity, a little anxiety, perhaps because there is a slight uncertainty or risk involved (can we hit the baseball and get safely on base?), although the risk cannot be so great that it overwhelms the fun.
>
> *Surprise*, the unexpected, a discovery, a new sensation or idea, or shifting perspective.
>
> *Pleasure*, a good feeling, like the pleasure we feel at the unexpected twist in the punch line of a good joke.
>
> *Understanding,* the acquisition of new knowledge, a synthesizing of distinct and separate concepts, an incorporation of ideas that were previously foreign, leading to…
>
> *Strength*, the mastery that comes from constructive experience and understanding, the empowerment of coming through a scary experience unscathed, of knowing more about how the world works.
>
> *Poise*, grace, contentment, composure, and a sense of balance in life. (p.19)

wonderment	exuberance	desire	curiosity	expectation	readiness	openness	interest	**Anticipation**
astonishment	thrill	arousal	discovery	excitement	stimulation	awakening	appreciation	**Surprise**
fun	glee	delight	happiness	joy	gratification	buoyancy	satisfaction	**Pleasure**
mastery	sensitivity	mutuality	insight	skill	knowledge	empathy	tolerance	**Understanding**
creativity	passion	drive	wit	ingenuity	devotion	vitality	stamina	**Strength**
balance	spontaneity	fulfillment	contentment	ease	composure	grace	dignity	**Poise**

Play Elements

Figure 2.1 Play Elements presented as a linear sequence. Find a full-color downloadable version of this chart at www.museumofplay.org/play-elements. (Eberle, 2014)

Play occurs in many places such as on fields, in woods, on playroom, neighborhood pavements backyard playground, and play organizes in stadiums, rinks, and museums, emerges and develops a process that comprises play (Eberle, 2014). He also created a Tilt-a-Whirl thrill ride as in Figure1.2, helping to imagine play as "an emergent self-feeding process". From this figure, we could perceive the relationship of the elements within play.
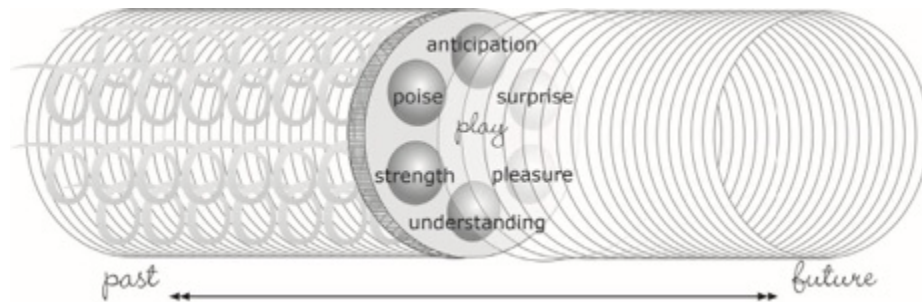
Figure 2.2. Tilt-a-Whirl thrill ride. www.museumofplay.org/play-elements. (Eberle, 2014)

As we've seen theories behind play, what are types of play? Classifying play will be interpreted in the next section.

2.1.2.2 Classifying Play

The most common taxonomy of animal play splits into three types: locomotor (or locomotor-rotational) play, object play, and social play (Burghardt, 2005). In Gordon Burghardt searching The Genesis of Animal Play (2005), identified nine characteristics for children's play, including "sensorimotor or functional play, construction play, pretend or make-believe play, simple games, parallel play, rough-and-tumble play, sociodramatic play, language play, rule play and ritual play." In the Thomas G. Power's Play and Exploration in Children and Animals, play divided into five major categories: "solitary object exploration/play, play-fighting, locomotor play, social object/social pretend play, and parent-child play" (Power, 1999).

In conclusion, scholars hold their own opinions about different characteristics of play until today. Based on the later study, I will choose several major types of children's play to discuss in section 2.2.5. The next sections are attempting to understand why play has more benefits and effective for children capabilities than traditional education methods.

2.2 Play and Child Development

2.2.1 Child Development theories

The children's playful learning, tracking back to the origin of human beings' history, is not a new concept for us. Since the 1800s, most educators, psychologists, pediatricians, and scholars attribute to play that it serves in the child's development. In this section, I explore the collaborative the relationship between play and child development for the approach of designing kindergartens' playgrounds. There are a number of theorists associated with child development from different areas such as brain science, psychology, philosophy, and pedagogy. Below Table 1 lists those distinguished theories in this field, showing broad viewpoints.

Theorist	Theoretical approach	Principles of the theory
Arnold Gesell (1880 – 1961)	Maturation	Growth and development occur in orderly stages and sequence. The individual genetic timetable affects rate of maturation.
Sigmund Freud (1856 – 1939)	Psychodynamic	Behavior is controlled by unconscious urges. Three components of the mind are id, ego and super ego.
Jean Piaget (1896 – 1980) Lev Vygotsky (1896 – 1934)	Psychosocial	Personality develops in eight stages throughout a lifetime. Development is influenced through interactions with family, friends and culture.
Erik Erikson (1902 – 1994)	Cognitive	Qualitative changes in the way children think. The child is considered an active learner going through stages.
John Watson (1878 – 1958) BF Skinner (1904 – 1990)	Behaviorist	Learning is gradual and continuous. Development is a sequence of specific

Albert Bandura (1925)		conditional behaviors. Main emphasis is on the environment, not heredity. Observable behaviors are considered most important.
Uri Bronfenbrenner (1917 – 2005)	Ecological	Balance between nature and nurture. Child is placed in the middle of concentric factors which all influence the child. Emphasis is placed both on environment and heredity.
Noam Chomsky (1928 -	Information processing theory	We all have an innate learning ability. Children are born with specialized information processing abilities that enable them to figure out structure of development.

Table 2.2 Main child development theorists

I will clarify three of them theories main concepts as follows:

Sigmund Freud (1856 – 1939)

Sigmund Freud was an Austrian neurologist and the founder of psychoanalysis. In the Child Development area, Freud mainly focused on the emotional-social development of the child. He considered that play provides an opportunity for children to relieves their emotion and experience catharsis (Freud, 1955). In the process of repeating experiences, children would gain more comprehensive self-understanding and abilities in their environment (Freud, 1955). He (1995) described as follow:

> In the play of children we seem to arrive at the conclusion that the child repeats even the unpleasant experiences because through his own activity he gains a far more thorough mastery of the strong impression than was possible by mere passive experience. Every fresh repetition seems to strengthen this mastery for which the child strives; even with pleasurable experiences the child cannot do enough in the way of repetition and will inexorably insist on the identity of the impression. (p.43)

When talking about child development, there are two dominant developmental theorists who have to be mentioned, Jean Piaget and Lev Vygotsky. Undoubtedly, both of their studies stand as a landmark that has been particularly influential for the study of child development. Scholars often compare Jean Piaget's thesis with Lev Vygotsky's. Piaget focused on inherent factors of child development, but Vygotsky was inclined to external factors of children's cultural, historical and social background.

Jean Piaget (1896 – 1980)

Jean Piaget was the influential Swiss developmental psychologist and genetic epistemologist during the 20th century. Piaget's theory (1962) of cognitive development had a tremendous influence on interpreting how a child builds his/her recognition and understanding of this world. There are two major views of his theory, Process of Cognitive Development and Stages of Cognitive Development that will be depicted in more details in the later cognitive development aspect. Piaget contradicted with the concept of individual interacting with the environment. During the process of cognitive development, it encompasses schemas and adaptation processes.

Schemas

Piaget is the first to add schemas into cognitive development theory. To him, biological development progresses in stages through interaction with the world of nature and objects, and interaction with others affect children's cognitive development (Pankin, 2013). He defined a schema as "a cohesive, repeatable action sequence possessing component actions that are tightly

interconnected and governed by a core meaning" (Boring, Werner, Langfeld, & Yerkes, 1952, p.

240). In his theory, schemas offer children a chance to organize their knowledge to

understanding by mental and physical actions.

Adaptation Processes: Assimilation, Accommodation, and Equilibrium

Children should obtain an equilibrium between themselves and the environment by

continually adapting (Neumann, 1974). Piaget (2013) also describes it as follow:

> This being so, children's play is merely the expression of one of the phases of this progressive
> differentiation: it occurs when assimilation is dissociated from accommodation but is not yet
> reintegrated in the forms of permanent equilibrium in which, at the level of operation and rational
> thought, the two will be complementary. In this sense, play constitutes the extreme pole of
> assimilation of reality to the ego, while at the same time it has something of the creative
> imagination, which will be the motor of all future thought and even reason. (p.162) (Piaget, 2013)

Fostering children's equilibrium, to Piaget, consists of two essential factors: assimilation

and accommodation. He insisted that child mental development is a gradual process. In other

words, children have two options, assimilation and accommodation, if they encounter new

situation or information. In the process of assimilation, children are absorbing new information

into the existing cognitive structure by learning behaviors, attitudes, and capacities, the same as

updating system in software. However, sometimes the new information is too difficult to

swallow in existing structures for children. Meanwhile, accommodation will replace assimilation

to serve children an opportunity to contour new cognitive structure similar with download a new

item in your computer.

As we know, when children enter their preschools or kindergartens, the first goal of teachers is to cultivate homogenization and socialization skills for communication, social interaction, and work discipline. Here is an example of my personal teaching assistance experience at the Nanjing No.2 kindergarten in China. According to my observation, teachers need to lead first grad children (3 years old) to use the restroom during break time. Before entering the bathroom, teachers required students to separate the children into two lines as boys and girls. After teachers' instruction, most students began stirring and whispering, and especially few boys laughed in the one side. Teachers require them to keep quiet and stand in order. When students observed these rules, the teacher started to enlighten them on the physiological differences for male and female of toilet needs and how to correctly deal with this situation in reality life. Furthermore, teachers also mentioned students must wash their hands after using toilets. On the surface, it sounds like just an ordinary recognition, as if children did not already know that. However, in the process of using toilets, kids learned to understand the different between male and female, and obedience.

Lev Vygotsky (1896 – 1934)

Lev Vygotsky was a seminal Russian thinker who had a powerful influence on psychology and education. Vygotsky coincidentally developed his theories at the same time as Jean Piaget's, but in his sociocultural theory, he believed that improving and developing children's learning skills cannot occur without social interaction, which should precede other

aspects. He emphasized culture, social, language, and more knowledgeable peers and adults in cognitive development.

There are two more preeminent playful learning theorists for child development: Mildred Parten and Sara Smilansky.

Mildred Parten (1902 – 1970)

Milder Parten, an American sociologist and a researcher at University of Minnesota's Institute of Child Development, developed six categories of social participation among preschool children (2 – 5 years of age) at free play – unoccupied behavior, solitary independent play, onlooker behavior, parallel play, associative play, and co-operative or organized supplementary play. She discovered that children's development of their social skills is reflected through play to raise their abilities. Table 2.3 adapted from Markhan Stouffville Hospital Child Development Program.

Stages of Development	What it looks like:	What age it typically appears:
Solitary play	Children play alone, with their own toys. They do not get close to or interact with other children. Solitary play should be encouraged because it builds skills for working independently.	Birth-2 years
Parallel play	Children continue to play on their own, but they are beside children and may be using the same toys.	2 ½ to 3 ½ years
Associative play	Children begin to truly play with others. They share play materials but may be following their own story line.	3-4 ½ years
Cooperative play	The highest level of social play where children play in groups and everyone is cooperating to achieve a common goal. This type of play involves negotiation among children. This happens when children change "roles" in the play and/or take turns making suggestions about the plot.	4-5 ½ years
Games with rules	A part of cooperative play that involves winners and losers. These games involve child-controlled rules and are not the same as competitive games, like sports. These games show an understanding of the social rules in our culture.	6 + years
Onlooker Play	When a child watches other children playing but makes no attempt to join in.	Birth +

Table 2.3 Mildred Parten's Stage of development of social play, adapted from Markgam

Stouffville Hospital Child Development Programs Website

Sara Smilansky (1922 – 2006)

Dr. Sara Smilansky, a renowned researcher and a professor from Israel, has researched

the sociodramatic aspect of child's play. She concentrated on children's playful learning and the

relationship between powerful play and children's academic achievement. Smilansky developed

four types of play: functional, constructive, dramatic or symbolic, and games with rules which

own power to affect children's academic success.

The National Institute for Play (2006)	Gene Del Vecchio (The Blockbuster Toy, 2003)	Goodson and Bronson (The Consumer Product Safety Commission, 1997)	Roger Caillois (Man et al., 1962)
Body play	Mastery play	Active play	Agon (competition)
Object play	Creation play	Manipulative play	Alea (chance)
Social play	Nurturing play	Make-believe play	Mimicry (pretend)
Imaginative/pretend play	Emulation play	Creative play	Ilinx (perception disruption)
Storytelling play	Friend play	Learning play	
Creative play	Collection play		
Attunement play	Storytelling play		
	Experience Play		

Table 2.4 Classification of play adapted from (Kudrowitz & Wallace, 2010)

2.2.2   Child Development

From birth to adulthood, natural growth and learning appear in all children, including

four main basic developments of physical, emotional, social and cognitive domains. Scholars

usually define this process as Child Development in different stages. Below, I will elucidate

concepts of each development, and I will make clear more detailed information how each will

combine with types of play in the later Chapter 2.2.2. Indeed, each development does not stand

alone in the developmental processes of childhood, linked with others (see Figure 2. 3).
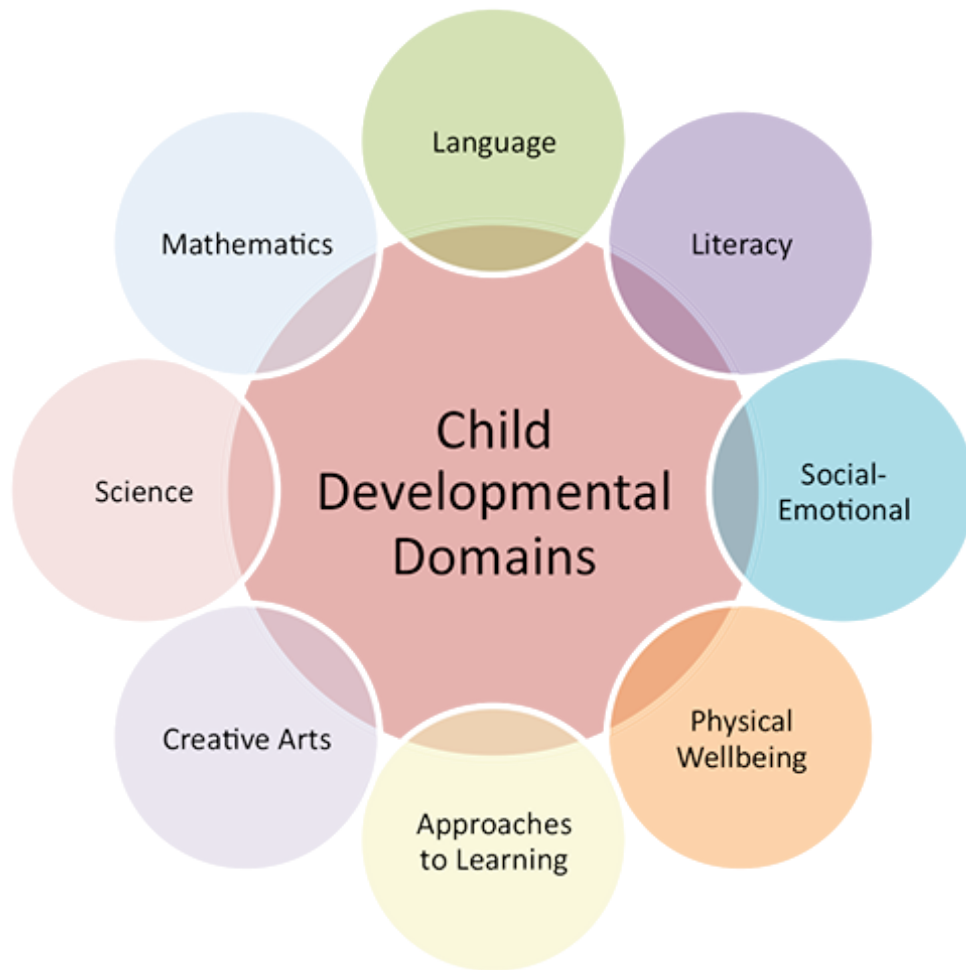
Figure 2.3 Child Development adapted from the grand beginnings website

http://www.grandbeginnings.org/parents-and-families/child-development/

2.2.2.1 Physical (Motor) Development

The process of children's physical and biological changing is defined as physical

development. During this process, children need to learn how to control their body movements

and how to interact with the world around them, particularly muscles and physical coordination.

There is a variety of physical activities with complicated forms and contexts at different ages,

which also are heavily influenced by culture (Päll, 2009). Physical development for the "Golden Age" (3 - 6 years old) is the essential period for children to promote their running, jumping, throwing, and catching abilities through play and physical activities.

Most child development experts accede that vigorous play in childhood is imperative for the satisfactory growth of the various organs and systems of the body (Humphrey, 1980). From the ecological viewpoint, David L. Gallahue (1998), the author of *Understanding Motor Development*, classified physical development into two aspects: movement abilities and physical abilities (Gallahue, 1975). Meanwhile he emphasized that movement abilities may be subdivided into three categories: stability, locomotion, and manipulative (Salehi, Sheikh, & Talebrokni, 2017).

Stability Movement Skills

Stability movement skills form the fundament for all other locomotor and manipulative skills and are referred to as non-locomotor skills. It is a vital element for every child to maintain and acquire balance like static (stationary) balance or dynamic (moving) balance including reaching, twisting, turning, bending, and stretching (Gallahue & Donnelly, 2007).

Locomotor Movement Skills

Locomotor movement skills "involve projection of the body into external space by altering its location in either a vertical or horizontal plane" (Gallahue, 1975). Common locomotor activities in nature are running, jumping, skipping, and galloping.

Manipulative Movement Skills

Manipulative movement skills mean that children are able to physically manipulate an object in their world, such as catching, trapping, and pulling toys. It consists of gross motor skills and fine motor skills, even though there is no clear boundary between both of them.

- **Gross motor skills**

Gross motor skills are aimed to promote children's large muscle groups and are more broad and positive than fine motor movements. Giving force to objects or receiving force objects is usually referred to as gross motor. For example, children's common gross motor activities include walking, kicking, jumping, climbing stairs, other vigorous activities, and eye-hand coordination such as throwing or catching a ball (Burghardt, 2005).

- **Fine motor skills**

Obviously, fine motor skills involve small muscles groups of limited parts of the body, especially in the hand, such as sewing, writing, and typing (Gallahue & Donnelly, 2007) Violin playing, cutting with scissors, and tying one's shoes are considered to be fine motor skills.
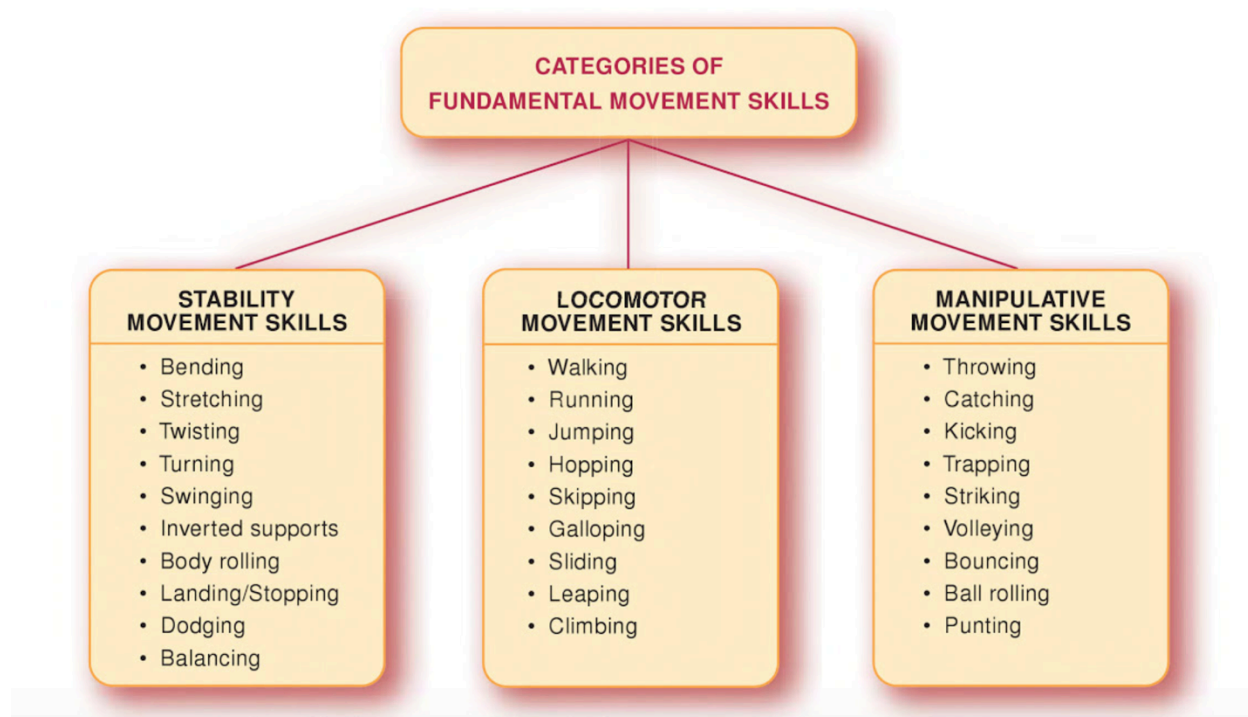
Figure 2.4 Fundamental movement skills details from Gallahue's book *Developmental Physical*

Education for All Children (Gallahue & Donnelly, 2007)

Gallahue's movement phases is dedicated as an hourglass with four phases as follows

(see Figure 2.):

Reflexive Movement Skill Phase (0-4 months)

Gallahue states that the reflexive movement of the fetus and newborn as is their the first

phase of physical development. These behaviors are subcortically controlled (Gallahue, 1975).

Rudimentary Movement Skill Phase (0-2 years)

Rudimentary movement begins involving locomotor activities such as creeping, crawling,

and walking. They also include stability and manipulative experiences such as reaching, grasping,

releasing objects, controlling their head and neck, learning how to sit and standing unaided

(Gallahue, 1975). Here is a figure to show the process of this process from reflexive to rudimentary movement skill phases.
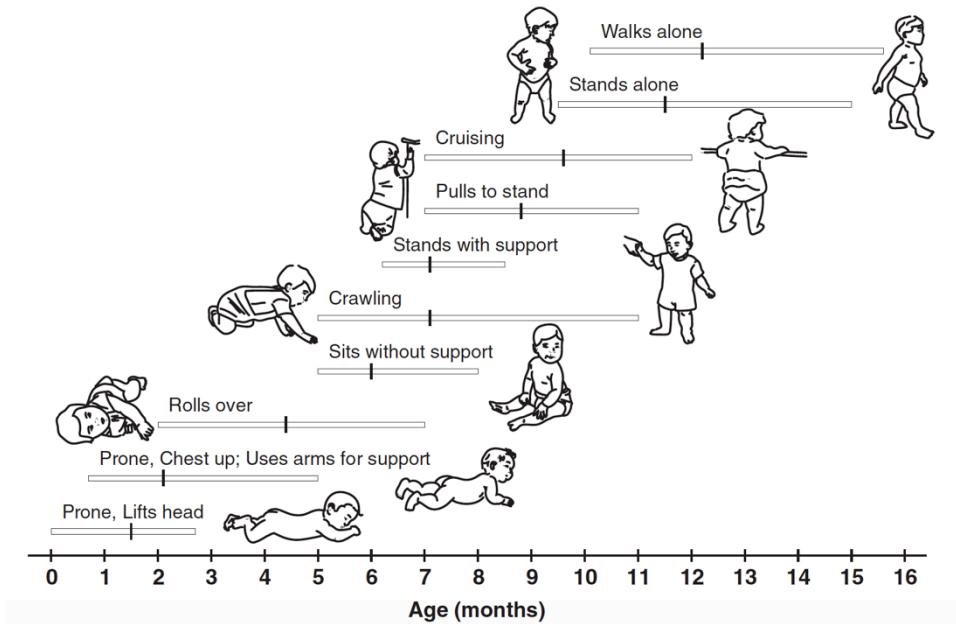
Figure 2.5 Typical example of milestone chart illustrating age-related changes in postural development. (Adolph & Franchak, 2017)

Gallahue and Ozmun (2002) present some detail about fundamental and specialized phases of early childhood as below.

Fundamental Movement Skill Phase (2-7 years)

In fundamental movement phase, children need to learn the basic stability, locomotor, and manipulative skills, a continuum progress from initial to elementary to and mature stage. During elementary stage, coordination and rhythmical performance appear in children's transitional period (three to five years old) between initial and mature stages, gaining greater control over their movement (Gallahue & Donnelly, 2007).

Many adults have only basic activities as throwing, striking, and catching, with insufficient practice in this phase so that it is difficult for them to achieve the mature stage. Therefore, the core of the developmental physical education program is for children to focus on a wide variety of fundamental movements.

Specialized Movement Skill Phase (7-adulthood)

Specialized movement skill phase typically begins around age seven. At this phase, boys and girls will choose their favorite sports and are eager to learn new skills. It contains with three stages: transition, application, and lifelong utilization stages. In the end of this phase, children could gain high interest in specific activities on competitive or a recreational level (Gallahue & Donnelly, 2007). Gallahue's notable hourglass picture elaborates his concept of these four main phases in children's physical development as follows:
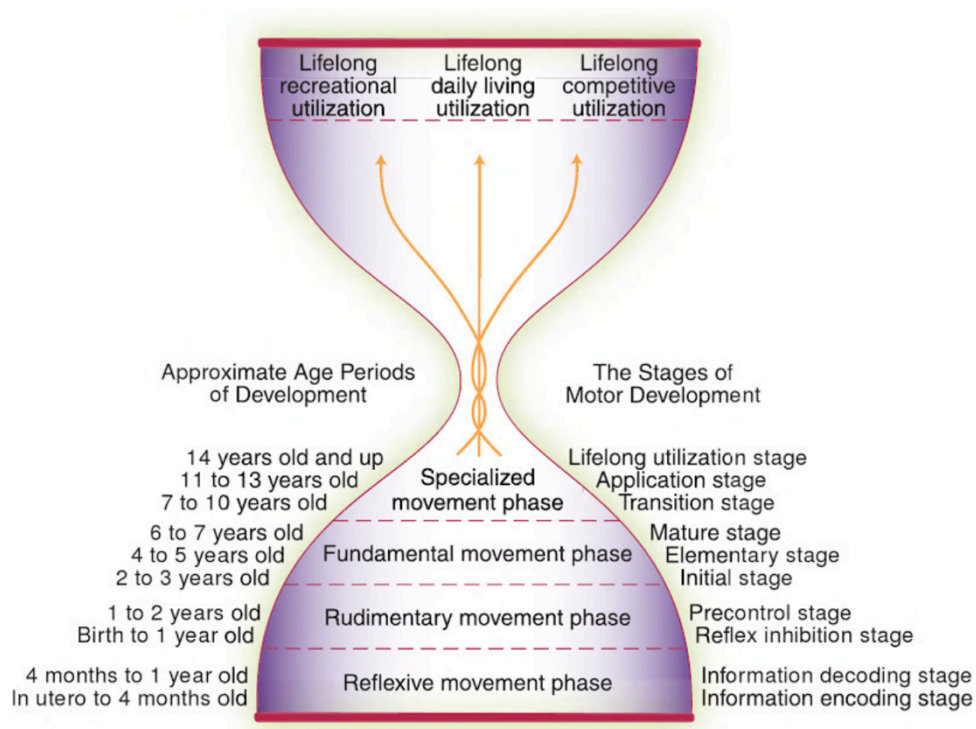
Figure2.6 A descriptive view of the phases and stages of motor development (Gallahue, Ozmun, & Goodway, 2006)

The National Association for Sport and Physical Education has defined the physically educated person in five major focus areas as follows:

- The physically educated person has learned skills necessary to perform a variety of physical activities.

- The person is physically fit.

- The person participates regularly in physical activity.

- The person knows the implications and the benefits of involvement in physical activities.

- The person values physical activity and its contributions to a healthful life-style.

In their guidelines, physical education experts also suggest parents and teachers allow children (5 to 12 years old) to have a minimum of 60 minutes of activity each day and avoid staying still for long periods of inertia.

2.2.2.2 Social – Emotional Development

In Western and other technologically developed societies, young children could enhance their peculiar cognitive and social skills through play (Pellegrini & Nathan, 2011). Freud realized that play is the major function in emotional-social development. In this development, children are able to understand the feelings of others, control their own feeling and behaviors,

communicate with other children, and build relationships with adults. They also need to learn teamwork, obedience, self-control and concentration.

Carollee Howes (2010), a specialist in the area of social development, emphasized the influence of children's relationship with their peers and adults in their social groups. She defined this phenomenon as "cultural community" (Howes, 2010). For the meaning of cultural community, Rogoff (2003) stated that it is a grouping of people who share goals, beliefs, and everyday practices and often a racial or ethnic identity (Rogoff, 2003). In other words, through social interacting with adults, children's siblings, and peers, children develop similar through participating with these people surrounding them. There are three possibilities of play training, which is essentially responsible for gaining in social development as follows (Klugman & Smilansky, 1990):

1. The play itself – object and role transformations that occur in dramatic play may hasten the decentration process.

2. Adult instruction – the adult – child interaction that occurs during the training may directly or indirectly teach the children new skills.

3. Peer interaction – the conflicts among children that occur in sociodramatic play may cause cognitive imbalance or disequilibrium, resulting in new learning.

In developmental psychology research, social play with adults or peers requires cognitive and communicate skills for both sides to immediately understand and give feedback. Furthermore, scholars clarified the component of social play including structure, affective

content, and interactive content. Experts like Howes developed the Peer Play Scale for peer

partners. The common thing appears in children's groups, in which we will see most younger

children imitate the elder's behaviors, tones, and languages. Meanwhile, Musatti (1993) states

that "peer interactions among young children during play constitute the emergence of relations

among processes of social interaction, the acquisition of knowledge about the social world, and

cognitive processes related to the ability to use socially mediated knowledge" (p. #). Combining

the Peer Play Scale of Howes and Matheson (1992), therefore, peer interaction consists of six

play categories: 1) solitary, 2) parallel play, 3) parallel aware play, 4) simple social play, 5)

complementary and reciprocal play, 6) social pretend play, and 7) interaction with adult (Shim,

1997). In Saarni's book *The development of emotional competence* (1999)*,* he pointed three

subsequent chapters of effect that how the emotional competency skill might manifest itself in

other societies.

- **Emotion Management**

How do children cope with their own emotional experience and interpersonal interaction?

Depending on whom they are and what they are feeling, children are able to recognize their

internal emotions to communicate with others. They also need to learn coping with aversive

emotions, taxing relationships, and stressful situations. For example, each child will encounter

the issue that his or her best friend is already partnered with another friend. How should they

deal with it with a positive emotional control?

- **Self-Esteem**

Self-efficacy often relates with self-esteem, but until today scholars still experience trouble to distinguish both of them (Harter, 1982). As we know, there are so many life experiences and lessons in our life. Challenges, setbacks, and predicaments are the compulsory course for everyone. Children with low self-esteem tend to have difficulty coping with the basic challenges of life. Having a negative self-esteem is harmful for children's mental health and raises the likelihood of some disorders, including depression, anxiety, and unhealthy diets. A safe and loving environment is essential to build their self-esteem. Encountering failure is a great opportunity for children to learn and develop their tolerance, patience, peer leadership, listening skills, and collaborative teamwork skills.

- **Resilience**

Resilient or invulnerable children own the capacity to recover after experiencing adversity. During the process of learning how self-esteem and emotional competence may mutually develop, they develop abilities of coping, and growth with handling stressors and coming to terms with losses.

In Murphy and Moriarty' study (1976), they followed a number of children from birth to early adulthood. Those children with higher resilience were the "good copers", self-efficacious in their social transactions with others, showing a range of emotional expressiveness and responsive to others. Even if they faced serious dilemmas and episodes of distressing emotional experience, they were able to handle anxiety and tolerate frustration, seek help when needed and adapt flexibly to alternatives (Saarni, 1999).

In conclusion, social-emotional development is complex with many various areas of growth: the way young children perform and react to different situations, social skills and competence, and their emotions and reactions to the environment and strangers. Accordingly, social - emotional development should focus on mainly four areas: children themselves, adults, peers, and environment. More detail of social-emotional development from birth to 13 years old are as follows:

2.2.2.3 Cognitive Development

This section begins with key concepts from the Piaget's stages: Sensorimotor stage, Preoperational stage, Concrete operational stage, and Formal operational stage, which contribute to advance in understanding of the developing mind. There are two domain-learning goals in this development: language and mathematics with interactions with adults and peers.

Sensorimotor Stage: birth to 2 years

In Piaget's theory the first stage is the sensorimotor period for cognitive development. Infants begin to generally accept language and ape information from their environment. In other words, infants start to discover their body movement and environment. Hence, physical knowledge, logical-mathematical knowledge, and social knowledge are particular stages in sensorimotor play (Parker & McKinney, 2012).

Infants obtain knowledge from their environment through their sensory systems that consists of vision, hearing, touching, tasting, smelling and balance, which also mature with their ages. Another point, newborn babies cannot locomote because they are physically immature,

even though they yearn for whole body play. In common, during this stage, children will try to grab, suck or kick to physically interact with objects, which is called "Object Performance". Besides, they are able to understand the existence of objects even though they do not see or hear these at the end of this stage.

Preoperational stage: Ages 2 to 7

During this stage, children start to learn to manipulate symbols with flawed logic. Therefore, Piaget indicated that role – play becomes the vital position in this stage, such as "mommy, daddy, doctor, teacher and other familiar characters in real life." However, they still have certain obstacles in distinguishing and analyzing from others' perspective, and easily tend to be egocentric. Although, some children express thinking through language, they sill cannot express and understand abstract terms.

Furthermore, in preoperational stage, there are two sub-stages: symbolic function sub-stage (age 2 – 4) and intuitive thought sub-stage (age 4 – 7). For the symbolic function sub-stage, children are able to figure out objects in their brains without sight. Besides, in the intuitive thought sub-stage, children start to develop reasoning by asking a lot of questions such as "mommy, where I come from?" This is when they are inquisitive and discover everything about the world around them.

Concrete operational stage: ages 7 to 11

In this stage, understanding logic and reversibility become two fundamental aspects that occur to allow children to cope with problems. It will influence them to understand more

abstractly and hypothetically in next stage. But, it is too early for them so that their thinking still tends to be super concrete.

Moreover, children's egocentrism also decreases in this stage because of taking the perspective of others. As the result, they not only are able to think from other people views and experience the world, they also apply this information to make decisions or solving problems. In addition, during this stage, children have the capability to perceive inductive logic, but still have difficulty using deductive logic. For example, they could recognize A=B and B=C, but A=C is hard for them to understand.

Formal operational stage: ages 12 and up

This is the last stage from adolescence into adulthood. At this point in development, their abilities develop and they exhibit advanced hypothetical deductive reasoning and abstract thought. They are able to do sensory motor, pre-operational, concrete operational and formal operational. Adolescences develop a complex imagination and a hypothetical approach to deal with problems. They are able to not only understand the question, if A=B and B=C, then A=C, but also they could explain the logic behind it.

Children's language and literacy development are central to each other, including letters, vocabulary, syntax, grammar, phonological awareness, writing, reading, comprehension, and discourse skills. Learning in language and mathematics to develop children's cognitive abilities, which has benefit through play: IQ, conservation, problem solving and creativity(Johnson, Christie, Yawkey, & Wardle, 1987).

" An intelligence is the ability to solve problems, or to create products, that are valued within one or more cultural settings." – Howard Gardner FRAMES OF MIND (1983) (Howard, 1983)

Howard Gardner's, Ph.D., Professor of Education at Harvard University, multiple intelligences theory, which is derived from the Piaget's theory, relates to human being's capabilities as follow:

1. Verbal-linguistic intelligence (well-developed verbal skills and sensitivity to the sounds, meanings and rhythms of words)

2. Logical-mathematical intelligence (ability to think conceptually and abstractly, and capacity to discern logical and numerical patterns)

3. Spatial-visual intelligence (capacity to think in images and pictures, to visualize accurately and abstractly)

4. Bodily-kinesthetic intelligence (ability to control one's body movements and to handle objects skillfully)

5. Musical intelligences (ability to produce and appreciate rhythm, pitch and timber)

6. Interpersonal intelligence (capacity to detect and respond appropriately to the moods, motivations and desires of others)

7. Intrapersonal (capacity to be self-aware and in tune with inner feelings, values, beliefs and thinking processes)

8. Naturalist intelligence (ability to recognize and categorize plants, animals and other

objects in nature)

9. Existential intelligence (sensitivity and capacity to tackle deep questions about human existence such as, what is the meaning of life? Why do we die? How did we get here? (Source: Thirteen ed online, 2004) Thirteen ed online (2004). Tapping into multiple intelligences. http://www.thirteen.org/edonline/concept2class/mi/index.html

Combing some knowledge in playgrounds not only presents an easy-to-understand living class, but also aids children to increases their abilities such as understanding causal inference. In conclusion, it is not difficult to understand that intervening with young children of social and emotional development may benefit for children and society (see Figure2.).
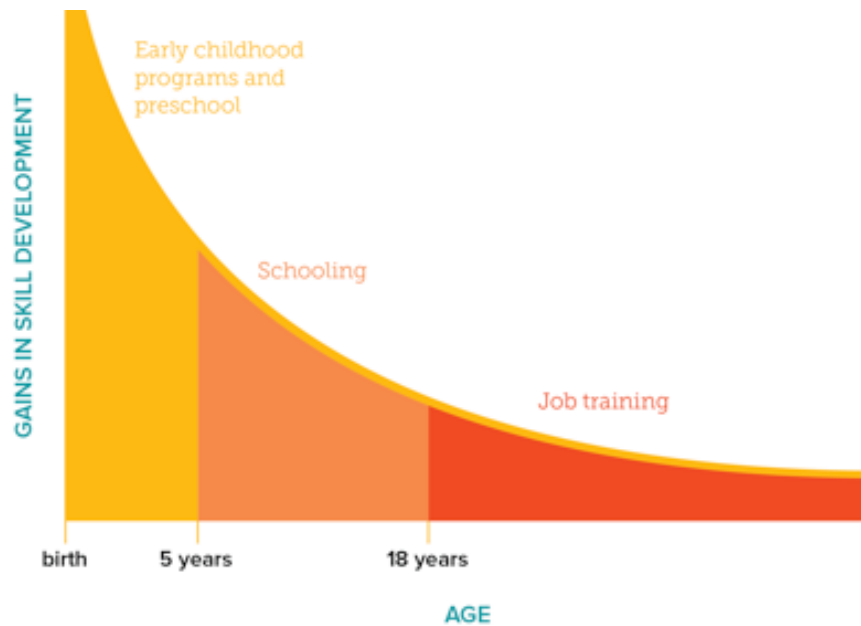
Figure 2.7 Gains in Skill Development, adapted from The Urban Child Institute Website

http://www.urbanchildinstitute.org/resources/publications/good-start/social-and-emotional-development

In conclusion, the theory of Child Development phases interprets general and rough concepts of each development aspect: more information of these developments though play will be discussed in the Types of children's play section.

2.2.3   Sensory Integration in Child Development

In this section, I will discuss about the sensory integration and its importance to young children. All our behaviors, responding to an alarm ringing, stopping by red traffic light, withdrawing hand by hot items, and dodging flying balls, are reactions to the environment from our senses. We could not survive without these feelings: pain, balance, touching hot or cold and others. "Sensory integration assessment is the process of evaluating persons for problems in processing sensation. And sensory integration treatment is a method of intervention" (Miller, Anzalone, Lane, Cermak, & Osten, 2007) . In other words, it is the process of getting these messages from our senses while our brains integrate the input receives (Southpaw, 1990). Ayres (1972), a pioneer with educational degrees in occupational therapy and academic psychology and postdoctoral training as a neuroscientist, defines sensory integration as "the neurological process that organizes sensation form one's own body and from the environment and makes it possible to use the body effectively within the environment" (Ayres, 1972, p. #) . She is the first person to describe the sensory integration of some children that is not an automatic process as a sensory integration dysfunction. According to most scholars' research, there are three levels of our senses: exteroceptors, proprioceptors, and interoceptors.

Exteroceptors:

"What is at a distance, through vision and hearing; what is on the body, through touch; and what is entering the body, through smell and taste" (Ayres & Robbins, 2005).p

- Visual - Sight

The retina of eyes is a receptor that light waves in the environment stimulate the retina to send visual sensory input to the visual processing centers in the brain stem (Ayres & Robbins, 2005). Features of visual sensory development are visual tracking, eye contact, reaching, and eye-hand/foot coordination (Benner, 1992).

When we speak of vision, the children's aesthetic development cannot be ignored. Abigial Housen (2002) began in the mid-1970s to focus on how viewing art works could affect people's viewing experiences based on guidelines of Piaget, Vygotsky, and Loevinger. In her study, some children are able to read an art work for meaning and evidence before reading books (Housen, 2002).

Modify equipment size, weight, color, and texture

Modify rules perceptual clarity & consistency

Modify expectations for level of development

- Auditory - Sound

"Sounds waves in the air stimulate the auditory receptors in the inner ear to send impulses to the brain stem auditory center" (Ayres & Robbins, 2005). Auditory senses enable children to gain a unique sound, which also provides them specific events and objects certain

meaning (Benner, 1992). For example, when parents are calling a child's name to come to them, the child should turn to the adults and react (Ramirez, 1998).

- Olfactory - Smell

"The nose provides information about the chemical makeup of the tiny particles that have suspended in the air to produces odors" (Ayres & Robbins, 2005). P It is different from other senses, going directly through the limbic system without passing the brain stem channels. Therefore, we will immediately react to what we like or dislike. Besides, smell creates memories and incorporations that influence some of our choices and preferences. For example, infants could recognize their mother only through smell.

- Gustatory - Taste

Our experiences of tasting are divided into six different types: sweet, sour, bitter, spicy, fresh, and salty. The tongue provides messages of the chemical makeup of the particles that touch it, called the taste(Ayres & Robbins, 2005). The information could be a signal to notice us to enjoy food or keep away from items that are harmful for our bodies.

- Tactile - Touch

The tactile sense is the key role for children to explore their environment. It allows children to react many skills in different situations. "The skin has many different kinds of receptors for receiving sensations of touch, pressure, texture, heat or cold, pain, and movement of the hairs on the skin" (Ayres & Robbins, 2005).

Proprioceptors:

"How and where the body is moving, through the sense that respond to movement, gravity, and body position (the vestibular and proprioceptive senses) (Ayres & Robbins, 2005)."

- Vestibular – Gravity, Head Movement and Balance

This system is sensitive that change in position and movement have a very powerful effect on the brain (Ayres & Robbins, 2005).

- Proprioception (Position and Movement)

"The word proprioception refers to the sensory information caused by contraction and stretching of muscles and by bending, straightening, pulling, and compression of the joints between bones" (Ayres & Robbins, 2005). In other words, it helps our bodies to move.

Interoceptors:

"What is going on inside the body, through the senses within our internal organs (the visceral receptors)" (Ayres & Robbins, 2005).

- Visceral Input

Actually, visceral input associates us to adjust blood pressure, digestion, breathing, and the other functions of the autonomic nervous system (Ayres & Robbins, 2005). When we feel hungry and thirsty, it is the message from visceral input. It also influences other sensory systems as well. That is the reason that when we are spinning that we could feel painful and dizzy.

Children with sensory processing disorder may:

• Lack coordination

• Have poor kinesthetic awareness

• Lack spatial and whole body awareness

• Have a hard time engaging in conversation and play

Sensory system	Examples
Visual system Sight	Dimming lights, Completing puzzles, mazes, dot to dots, Decreasing visual distractions/use of environmental modifications Looking at picture books, Playing I Spy, Putting out less toys to avoid visual overloads
Auditory system sound	Listening to classical or slow music, Use of headphones, Singing, Nature sounds, Play musical instruments, Humming Labeling sounds
Olfactory system smell	Scented candles, Calming scents – vanilla, lavender, sweet orange, Alerting scents – peppermint, lemon/lime
Oral system Taste	Blowing bubbles, Use of straw when drinking, Blowing whistles, Exploring different taste and texture of food Calming, Sweet – lollipop, hard candy, fruits, Chewy – bagels, gum, gummy candy, Warm food- soup Alerting: Salty, crunchy, sour, spicy and cold food
Tactile system touch	Playing with Play doh or putty, Sand, water, rice play, Lotion massage, Use of hand fidget toys, Giving hugs Finger painting or messy play, Use of vibrating toys
Proprioceptive system position sense	Deep pressure massage, joint compression, wheelbarrow walk, animal walks (crab walk, bear walk, seal walk, etc.) Chair push up, Wall push up, Pushing and pulling activities, Playing tug of war, Carrying groceries or books, Riding a bicycle, Swimming, Popping bubble wraps
Vestibular system movement sense	Swing, Somersault, Log rolling, Figure eight walk, Spinning using a swivel chair, Bouncing or inverting on a therapy ball Playground slides, Playing hopscotch or a balancing game, Slow rocking, Jump rope, Jumping jacks, Sit ups

Table 2.5 Examples of Each Senses, adapted from Liezel Fernandez (Fernandez, 2013)

Above all, in this section, sensory integration support children language development, and encourage children's motor skills. It allows children to refine information from other people or the environment, and emphasize to build children's physical, social-emotional, and cognitive development. Then, multi-sensory design has rapidly grown in various fields, also including playground design. Visual collections have been developed with stronger support. Yet, others are lacking tools and methods to apply (Schifferstein & Desmet, 2008). In the next section, I will focus on educational play for children.

2.2.4   Educational Play

2.2.4.1 What is Educational Play?

"Play and learning are like the two wings of a butterfly – one cannot exist without the other.

Carla Rinaldi – President of Reggio Children"

The idea of "Earlier is better" is prevalent among many parents and educators, allowing

children to start theirs academic learning of reading, mathematics, karate, and others.

The concept of playful learning, from Jean Jacques Rousseau (France), Johann Pestalozzi

(Switzerland), and Friedrich Froebel (Germany), is not new and still use in children's

curriculums. In the book *Play, Development, and Early Education,* authors mentioned three

factors, attempting to keep play in education:

- Developmentally Appropriate Practice (DAP)

The National Association for the Education of Young Children (NAEY) considers a high

quality early childhood programs should offer a safe and nurturing environment, promoting

physical, social, emotional, and cognitive development. Hence, they propose the concept of

Developmentally Appropriate Practice, divided into two dimensions: age appropriateness and

individual appropriateness (Bredekamp & Copple, 1997).

For the age appropriateness: experts think there is a universal growth and change of

human development, apparent in children's the first nine years life. During this period, teachers

should prepare the learning environment and plan appropriate experiences for children within the

age rang. The other individual appropriateness: each child is a unique person, so the experiences

and curriculums should match their developing abilities, also along with challenging their interest and understanding (Bredekamp & Copple, 1997). Among the guiding principles of the NAEYC position statement is that play is at the center of developmentally appropriate practice and should be a vital instructional goal during the early years (Johnson et al., 2005).

- Constructivism

A method to teaching and learning relying on the premise that cognition (learning) is the result of "metal construction", defined as constructivism (Bada & Olusegun, 2015). In other words, children learn and build new knowledge embrace with their own understandings based on experience. This social process is called constructivism. "Children need to form their own hypotheses and keep trying them out through social interaction, physical manipulation, and their own thought processes – observing what happens, reflecting on their findings, asking questions, and formulating answers" (Bredekamp & Copple, 1997). Play activities provide an ideal context for children's social learning.

- Self-regulation

The development of self-regulation enables children to adjust and control their behavior, interacting with others in positive, and being more independent persons (Johnson et al., 2005). Play promotes and stimulates children's learning abilities because of its "intrinsic motivation" and "collaborative nature".

Many educational play proponents insist that play could help and develop children to be self-motivated leaners. However, the boundary of play and academic learning is a long time

argument. Some play proponents who believe in the value of free play are afraid that play will be careful planned by adults. Sutton-Smith (2009) states that it is better allow and encourage children to play by themselves without our didactic intervention.

2.2.4.2 The value of Educational Play

"Learning through play is about continuity; bring 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

In previous sections, we have discussed play and child development at length in this chapter. What is the relationship between both of them in educational areas? In book *Play, Development, Early Education*, authors summarized Sutton-Smith's play categories of play: each set of value, play forms, and play theories as follows:

> ***Play as progress***. Emphasizes that children learn something useful from play. Major disciplines: biology, psychology, education.
> ***Play as fate***. Refers to gambling and other games of chance. Major disciplines: economics, statistics, mathematics.
> ***Play as power***. Is usually applied to sports and festivals, in which power is wielded or inverted and mocked. Major disciplines: history, sociology, anthropology, cultural psychology, multicultural education.
> ***Play as identity***. Is often applied to festivals and celebrations which are viewed as creating group identity. Major disciplines: history, anthropology, folklore.
> ***Play as imaginary***. Refers to the improvisation, creativity, and imagination found in the artistic endeavors. Major disciplines: arts (music, dance, visual arts, drama) and literature.
> ***Play as self***. Emphasizes the role of play in shaping the personality and in providing peak subjective experience. Major disciplines: leisure studies, psychiatry, therapy.

Play as frivolity. Refers to the activities of tricksters, clowns, and comedians. Major disciplines: history, folklore, popular culture.

Therefore, play supplies an opportunity for children to achieve educational goals. In other words, play makes academic learning more meaningful and attractive to increasing children's skills, attitudes, and interests. Here are three vanguard schemes in education: Friedrich Froebel, John Dewey, and Maria Montessori.

Friedrich Froebel Scheme:

Friedrich Froebel, an educational reformer during the first half of the nineteenth century, built the first modern kindergarten in the world and advocated the development of kindergartens. In order to establish his viewpoints, he developed a philosophy of man, play-education, a consequent curriculum, and methodology. For him, a place to cultivating children's imaginations and discovering enriching experience, is a good society. In his *The Education of Man*, he wrote as following:

> The activity of the senses and limbs of the infant is the first germ, the first bodily activity, the bud, the first formative impulse: play, building, modeling are the first tender blossoms of youth…
> Play is the highest phase of child-development – of human development at this period: for it is self-active representation of the inner – from the inner necessity and impulse. Play is the purest, most spiritual activity of man at this stage, and at the same time, typical of human life as a whole - - of the inner hidden natural life in man and all things. It gives, therefore, joy, freedom, contentment, inner and outer rest, peace with the world. It holds the courses of all that is good…. As already indicated, play at this time is not trivial, it is a highly serious and of deep significance…. The spontaneous play of the child discloses the future inner life of the man. The plays of childhood are the germinal leaves

of all later life; for the whole man is developed and shown in these, in his tenderest dispositions, in his innermost tendencies. p. #

His great contribution was that he cited play as the hub of child development and education: specific activities and materials were developed to foster development through play. He also added concrete materials and sensori-motor activities in his program for children from the easy level to the difficult level.

John Dewey Scheme:

John Dewey, a prominent American educator and philosopher, shared Froebel's concept of individually directed activity. In Dewey's theory of play, he analyzed the "work-play dichotomy". For work, it is an activity that focuses on products or results. And play is contributes to processing (Henricks, 2015). Play is children's natural living and learning experience. He defines play as: " A man given to those activities which are not consciously performed for the sake of any result beyond themselves; activities which are enjoyable in their own execution without reference to ulterior purpose."

There is another importance prominent approach to combine work and play, Maria Montessori.

Maria Montessori Scheme:

Maria's famous method is still used in schools around world, "play is the work of children". She believed child's mental, physical and spiritual nature, and skills are developed in the early years, to achieve future success. "Activity is important since through it the child

acquires, explores, practices sense-experiences, and, eventually, ideas." In her book *The secret of childhood* (Montessori & Carter, 1936):

> Though the school contained some really wonderful toys, the children never chose them. This surprised me so much that I intervened to show them how to use such toys, teaching them how to handle the doll's crockery, lighting the fire in the tiny doll's kitchen, setting a pretty doll beside it. The children showed interest for a time, but then went away and they never made such toys the objects o f their spontaneous choice. And so I understood that in a child's life play is perhaps something inferior, to which he has recourse for want of something better. p. 3

In Montessori schools, children have multiple chances to freely choose what they prefer to play. She realized that children grow are in different contexts. Hence, according to children's potential abilities, she created more freedom for children to enable individual spontaneous activity. Moreover, she organized the environment to enable the child to order and comprehend his or her activities. Furthermore, she considered that the natural environment is the vital element for children to explore the real world, and applied natural materials to teaching tools As a result, she developed her unique teaching materials and methods: abstracting and formalizing elements of play for children activities and environment. There are four kinds of materials in Montessori schools:

- Practical life activities and materials are divided into four areas: care of the environment, self-care, life skills, and grace and courtesy. Various materials used for practical life include pouring items such as water and beans, tweezers and eye-droppers for transferring, dressing frames, jars with lids, and nuts and bolts.

- Sensorial materials are also called 'materialized abstractions,' 'keys to the universe,' and

'paths to culture.' These attractive materials are arranged from simple to complex, have a single built-in concept, and are self-correcting, such as precut shapes and inserts to teach shapes. Children learn abstract concepts such as seriation, classification, and resistance from concrete materials such as cylinder blocks, the pink tower, color tablets, and the fabric box.

- Academic materials are for language, writing, reading, and math and cover a variety of cognitive skill and concepts. Examples of these materials include bead frames, cubes for learning powers, sandpaper letters, and movable alphabet letters.

- "Cultural materials include those related to the arts, science, and social science. p. #

Cognitive	Social	Physical	Emotional
▪ Increase flexibility in thinking (imagination; symbolic representation) ▪ Make new connections of meaning ▪ Gain concrete experience with visual/spatial, & mathematical relationships ▪ Solve problems	▪ Express ideas and negotiate with peers (language development) ▪ Learn what is acceptable language and behavior in the culture ▪ Learn to share, compromise, respond to others ▪ Make friends	▪ Practice and consolidate small and gross motor skills ▪ Oxygenate & stimulate blood flow to the brain ▪ Gain concrete experience with relationships of weight, size, distance, etc. ▪ Increase control over tools and materials	▪ Interact with others and learn to express feelings appropriately ▪ Work through emotionally charged experiences ▪ Experiment with new roles for self ▪ Learn to show empathy ▪ Build self esteem

Table 2.6 Benefit of Play (Davis, Larkin, & Graves, 2002).

According to three schemes, play has a unique function to trigger children's senses and appeal their demands. Besides, the advantage of educational playgrounds has five points:

positive affect, free choice, nonliterality, means-over-ends orientation, making learning

meaningful, and balancing the school day (Johnson et al., 1987).

2.2.4.3 Play Environment - Nature

Today, the opportunities for stimulating children's free play at outdoor play environments

seems decrease and amount of wastelands in child education institutions so that more and more

children tend to disconnect with natural world and immerse in digital devices. Albeit, though

there is limited research to demonstrate the natural environment functions as a playground for

children, many scholars recently tend to argue that an unstructured environment affects

children's learning and play habits. Besides, they pay more attention on how natural environment

could offer possibilities ad challenges for children to explore their abilities (Fjørtoft, 2004). As I

mentioned before, Maria Montessori used natural materials for cultivating children. Moreover,

Joe L. Frost (1992), the contemporary father of play advocacy, described that natural features are

important qualities of playgrounds. Some Scandinavian studies have analyzed the affordance of

nature and the impact on children's physical development such as open spaces of rocks and

meadows, rough surface, and slope (Fjørtoft, 2001). Additionally, Robin Moore, the director of

Natural Learning Initiative and a nationally and internationally known play advocate and play

space designer, devotes the concept of natural learning to appeal and encourage children to

experience in real world. He cites that "Environmental experience is a function of diversity and

access – itself limited or controlled by a variety of social, culture and physical factors. These

factors coact with each other and the child's personality in a complex ecological process of

growth and development" (Moore, 2017, p. #). What is more, Titman (1994) confirms that children need green grounds, trees to climb and shrubs for shelter and building of constructions. In play ecologists Jane Perry's and Lisa Branum's (year) views, they advocated as following:

> When children playfully interact with their environment, they receive immediate information and feedback about how the world works, including how their bodies work in the physical world. During play, their own thinking, feelings, and experiences are tested again and again by the consequences of their actions. Playful interaction with objects and people in the child's world builds confidence, self-esteem, and an inner drive to seek out new information. p. #

As research has demonstrated, outdoor environment includes broad factors such as geography, climate and the neighborhoods and communities. And Jim Greenman (year) claims several general considerations in children's play environment:

- Places rich in experience
- Places rich in play
- Places rich in teaching
- Places rich with people
- Places to be significant

2.2.5 Types of children's play at schools play system

How different types of play could help children at school play spaces. The study of The LEGO Foundation states that there four main phases in children-adults playful learning experience: free play, guided play, game, and direct instructions. The continuum of playful learning in Figure2 shows different levels of children and adults in playful experience (Zosh et

al., 2017). It is important to ensure that adults could associate with playful learning for children (Weisberg, Hirsh-Pasek, & Golinkoff, 2013).

Figure 1. Continuum of Playful Learning
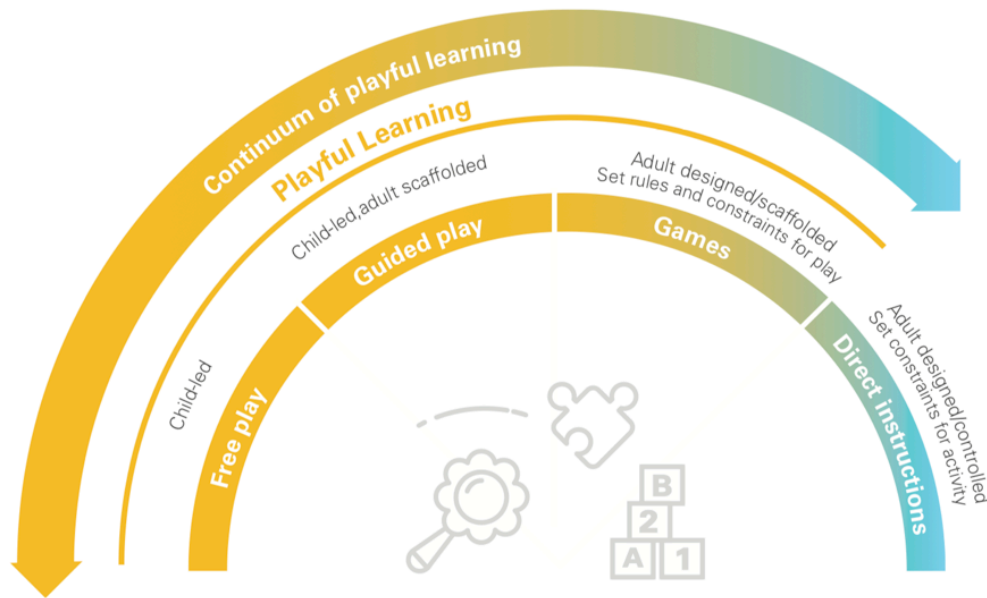
Source: Adapted from Zosh, Jennifer N., et al. Learning through play: a review of the evidence. LEGO Foundation, 2017.

Figure 2.8 Playful Learning Processing

In free play, children have enough freedom to participate in a variety of play activities without any guidance from teachers (Weisberg et al., 2013). In the Deborah Stevens-Smith and Jami Murdock's study (year), there are seven types of play activities, which are important and valuable to children's physical, social-emotional, cognitive development.

1. **Sensory Play**

Section 2.2.3 has described the sensory as a vital role in child development. During play time, children utilize one or more of the sense, stimulating sight, sound, smell, touch, taste, balance and movement (see Figure 2). Besides, John Comenius (year) suggested sensory experiences rather than conventional teaching methods. Later, Froebel (2005) developed sensory

play and first-hand experience as a tool for children's learning. Moreover, Maria Montessori

considered that children best learning through their sense as a core of Montessori practice today

(cited in Gascoyne, 2016). In this system, maximizing each sense helps children determine and

organize information.
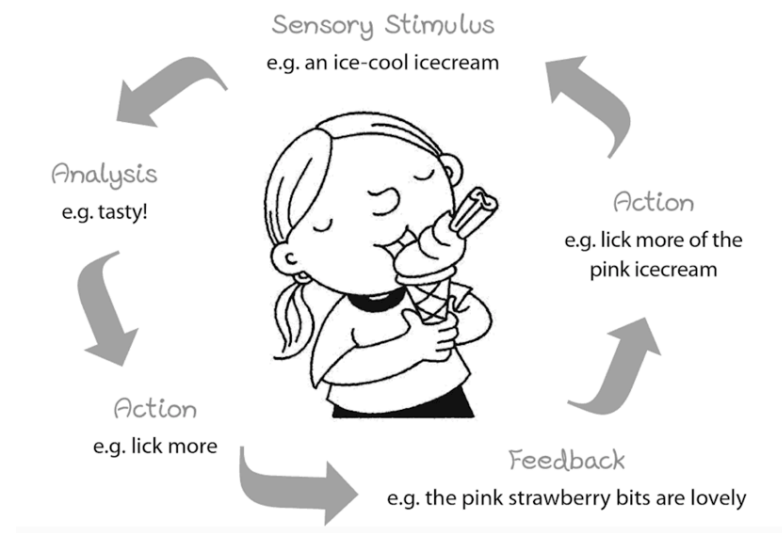
Figure 2.9 Sensory Processing, adapted from Gascoyne (2016)

In this system, maximizing each sense helps children determine and organize information.

There are various examples at playgrounds as follow (see Table 2).

Sand	Leaves, twigs, moss etc
Water, bubbles, ice	Shaving foam, gloop, paint
Pebbles and shells	Mud
A treasure basket - a basket of natural and household objects	String, fabric, buttons etc
Pastry, playdough, plasticine etc	Dried rice, pasta, couscous, lentils and seeds etc

Table2. Examples of sensory play adapted from Gascoyne (2016)

Benefits for sensory play (Murdock, 2018)

- Builds nerve connections in the brains' pathways, which lead to the child's ability to complete more complex learning tasks.

- Supports language development, cognitive growth, fine and gross motor skills, problem-solving skills and social interaction.

- Aids in developing and enhancing memory

- Helps calm an anxious or frustrated child.

- Helps children learn sensory attributes such as hot, cold, sticky, and dry (Murdock, 2018).

So, in the process of designing educational playgrounds should enhance sensory experiences for children to seek in their free play such as wind chimes, sand to dig in, nubby surfaces, mazes to explore, mirrors, kaleidoscopes or bouncy swings.

2. **Swinging Play**

Swinging is the most popular pieces of equipment at playground, park or backyard, the back and forth movement making their relaxing and exciting. It develops children vestibular system, including muscle tone, ability to balance, body coordination, and coordination of eye movements with our head. Also, it develops fine motor skill such as hand, arm and finger coordination (Frost, Brown, Sutterby, & Thornton, 2004). It also contains small risk behaviors such as jumping from the swing while in motion or standing on the swing (Frost et al., 2004).

Cognitive Development

- Physical development: Large and small motor

- Promotes sensory processing

- Relaxes and soothes

- Helps develop problem-solving skills (Murdock, 2018)

ning and pushing the tire swing

Jumping onto the tire swing

Squatting on flat swing

Standing on flat swing

Leaning back

Figure 2.10 The progressing of swing play adapted from *the developmental benefits of playgrounds*.

3. Climbing Play

Climbing is an activity that children enjoy from an early age, seeking and climbing the peak to view the world around them such as climbing a tree or a rock wall (Frost et al., 2004). From birth to two years old, babies begin to crawl and explore the world. With their motor skills developing, they attempt to challenge themselves to climb different levels. After climbing, the have feeling of achievement when they overcome challenges to improve their abilities. With practicing in climbing play, it will improve children's power, strengths, speed, balance, coordination, and visual perception.

Benefits for climbing play

- Excitement

- Feeling of accomplishment

- Experience basic physics – gravity, inertia, pendulums

- Overcome physical challenges

- Test abilities, show off and compete

- Engage in pretend games

- Retrieve objects

- Stimulate kinesthetic perceptions

- Increase vestibular sensations (Murdock, 2018)

Figure 2.11 The progressing of climbing play adapted from *the developmental benefits of playgrounds*.

There are various climbing equipment at playgrounds (see Figure 2.). Megarock is the highest frequency of use by children at kindergarten in Frost's study (Frost et al., 2004).

4. **Sliding Play**

Sliding play is to move over a surface while maintaining smooth continuous contact. When children join in sliding play, they have to wait in line for their turn, improving their cooperative, patience and tolerance of other's abilities. Besides, they will look for different way to go down for helping their problem-solving skills (Murdock, 2018). There are multiple types of slides: spiral slide, wavy slide, tube slide, straight slide, amusement-park slides, drop sliders, and water slides.

Benefits for swinging play

- Promotes leg-hip flexibility

- Encourages cooperation and following directions

- Develops spatial awareness

- Develops critical thinking skills (Murdock, 2018)

5. **Spinning Play**

Spinning play is to rotate rapidly or whirl, a swift whirling motion, including go for a walk/run, hula-hoop, jump rope and etc. it enhances children's senses of touch, balance and feel, and helps them with postural control when children have to grip and hold on spinners.

Benefits for swinging play

- Kinesthetic awareness

- Cognitive development

- Vestibular system

- Muscle tone and endurance (Murdock, 2018)

6. Brachiating Play

Brachiating play is a locomotion accomplished by swinging by the arms from one hold to another such as an overhead ladder, including building strength, endurance, and flexibility, eye-hand coordination, visual distance perception, and balanced locomotor (Frost et al., 2004). We could find many different types of overhead ladder and ring at playgrounds.

Benefits for swinging play

- Strengthens the upper body and develops grip strength

- Increases endurance, flexibility and general coordination

- Promotes kinesthetic awareness and rhythmic body movement

- Develops gross, small and fine motor skills

- Helps develop hand-eye coordination

- Helps develop visual perception of distance (Murdock, 2018)

7. Balancing Play

We need the ability to maintain controlled positions during both still and moving activities. Static balance is the ability to hold a stationary position with control, such as when children play Freeze games. Dynamic balance is the ability to remain balanced while moving, such as riding a bike.

Benefits for balancing play

- Cognitive development and introduces mechanical principles

- Encourages pretend play and learning to take turns

- Muscle strength and endurance

- Proprioceptive awareness (Murdock, 2018)

In conclusion, play is joy, spontaneous, active and challenge. Each types of play aims to foster children's four domains: physical, social, emotional, and cognitive. Besides, learning through play serves children to develop their abilities and skills. How do designers to create more enriching, playful learning experience with children? I will elaborate my approach in Chapter Four. Before starting Chapter 3, let us talk about what should playgrounds do.

2.3   Playground Evolution and Design

2.3.1 The play movement - playgrounds

The concept of playgrounds is relatively new for children in European and American in later-nineteenth-century cities (Solomon, 2005). In previous section, I have mentioned Fredrich Froebel created the first kindergarten in Germany 1837. At the beginning of 1900, Anna Bryan, an American kindergarten leader and principal to the training school of the Chicago Free Kindergarten Association, continued and supplied Froebel's occupations (Parker & Temple, 1925). The American children's movement started in Boston in 1885 with opening the first outdoor children's playground based on Marie Zarkrzewska recommendation of simple piles of sand boarded, which adopted Froebelian ides of playgrounds. At that period, the idea of

playgrounds was spreading rapidly. Despite various playgrounds emerged in major American cities, children's play still was limited in the 1907 – 1930 period, and this influence still disappoints at the present time (Benner, 1992).

Lately, sculptor Isamu Noguchi (1904 – 1988) created several art works into playgrounds, the idea accidently matched Abigial Housen's aesthetic development. However, his creative and notable equipment appear in American in a limited because of concerns of risk and dangerous. Fortunately, more and more art workers realized this problem and refine his concept to create more suitable sculptures in playgrounds.

Today, three new demands of playgrounds emerge: civic monuments, unexpected play zone, and specific antidotes for tricky problems (Solomon, 2005). More and more people begin to acknowledge that playgrounds are a crucial element in our communities. Yet, current architects and product designers pay attention to creating multiples playgrounds so that they ignore business, market, history, philosophy and etc behind playgrounds. Furthermore, most play scholars and educators still consider that existing American playgrounds are a disaster (Solomon, 2005). Common types of playgrounds including school playgrounds, park playgrounds, wilderness playgrounds, zoo playgrounds, arboretum playgrounds, camp playgrounds, casino playgrounds, dog playgrounds, cruise playgrounds, street playgrounds, rooftop playgrounds, loose parts playgrounds, check-a child playgrounds, imagination playgrounds, accessible playgrounds, intergenerational playgrounds, natural playgrounds, and etc. (Frost, 2010). In this thesis, we only focus on playgrounds at kindergarten for children from 3 to 6 years old.

2.3.2 The important playground role at schools

When we speak of play and academic learning, people commonly consider they are two sides of the same coin, even though many educators cite play is the most effective way for children to acquire knowledge. Some people point out the main question about play scholars' viewpoint, which is that couldchildren receive Ivy League Universities offer through play? It is important to understand child's play, since I interpreted before that children learn to play and learn from play. Playgrounds aim to enhance development for children so that the demands of a school outdoor play spaces are enormous as a resource to support the facilities of indoor (Hendricks, 2001). However, most people usually refer playgrounds as an antidote for the national epidemic – obesity that was mentioned before. Indeed, today playgrounds tend to become a teaching tool for children to instill unmitigated self-confidence (Solomon, 2005). "School's essential task, then, was to teach us not so much how or even what to think, but rather how to work. The work ethic became central to the moral teachings of school, and even though it was rooted in the moral philosophy of Puritanism, it was gradually transferred to the moral philosophy of capitalism" (Combs, 2000, p. #). Playgrounds not only enhance children's physical development, but also offer a quality space for children to communicate with peers and interact with older children with a variety of equipment (Frost & Klein, 1979). Hence, high quality and well-designed playgrounds can promote social interaction, self-confidence, individuality, and a sense of responsibility (Bhattacharya et al., 2003).

2.3.4 Playgrounds at preschools and kindergartens

Educational institutions playgrounds should focus on optimizing interaction between groups of various sizes. However, fixed play equipment limits children from playing specific games (Veitch, Salmon, Ball, & Bagley, 2005). Adventure playgrounds still are refused in the Unites States by parents who worry about playing injuries. The Little School (1996) case (see figure), an existing warehouse as a private preschool, demonstrated people that the form and shape of playgrounds could be more diverse and unusual than common points that people would imagine (Solomon, 2005). Educational playgrounds should provide children enough selections and meaningful activities. Here are some general ideas for supporting playful learning on playgrounds:

- Sciences
  Teachers develop students' awareness of living and non-living things, energy sources, hear energy, animals and exploring the Universe.
  In playgrounds, students have options of sundial, shadows, weeds, birds, planting vegetables or flowers, velocity

- Math
  In math, students need to recognize number up to ten, learn how to sort objects, and concepts of more and less, develop basic addition and subtraction skills, and recognize and create basic patterns.
  Playgrounds offer collecting stones, hopscotch, traffic signs, charting tomatoes, market, racing against the clock, measuring rainfall

- Literacy
  Kindergarten students need to learn how to identify letters in the alphabet and pronunciations, and how to put letters and sounds together to form words. Besides, teachers arouse their awareness of the relationship of letter to words and words to

sentences. In the end of school year, they should master the basic reading skill.

For playgrounds, they include outdoor writing, signs, obstacle course, dramatic play, story reading, story drama

Figure 2.12 Mark Horton, the Little School (1996), San Francisco, California.

Courtesy of Mark Horton/Architecture

Adapted from https://sextonlawton.com/projects/commercial/the-little-school/

Here is *The Play for All Guidelines* about outdoor playgrounds at kindergartens institution

should include things from book *Play and Playscapes* (author, year)*:*

- Children learn and develop through play.
- The quality and diversity of physical and social settings affect the quality and diversity of children's play.
- The quality and diversity of the social setting including play leadership directly affects play value.
- Children with disabilities have a right to play opportunities.
- Integration of disabled and able-bodied children is based on the concept of accessibility to the play environment and on the concept of positive, facilitative, attitude and awareness of the staff.

- The quality of play environments is threatened by liability costs and law-suits. Strategies and policies should be developed to protect the quality of children's play environments."

Although many contemporary early childhood programs emphasize the importance play role in child development, political events still make it   a risk.

2.3.4.1 Safety

American designers and educators yearn for a long time to provide more fun activities with small risk or danger for children to enjoy at playgrounds. However, they encounter the main challenge in designing playgrounds of giving more safety equipment and space for children to play.

The Consumer Product Safety Commission (CPSC)'s Public Playground Safety Handbook, American Society for Test and Materials (ASTM) F1487 and ASTM International offer outline of techniques for designing and constructing safe play environments. Besides, surfacing safety standards could be found in ASTM F1292. Moreover, the International Play Equipment Manufacturers Association (IPEMA) gives the guideline of manufactured playground equipment as third-party certification of a manufacturer's product meeting one of the ASTM standards listed above or the Canadian equivalent (Ruth, 2008). Another key standard is the Americans with Disabilities Act (ADA), which is suitable for the popular concept of inclusive playgrounds.

2.3.4.2 Gender Differences in Playgrounds

There are a limited number of documents and materials of sex differences in outdoor play environment (Johnson et al., 2005). Tizrd, Philps, and Plewis studied preschool children (3 to 4

years old) during free play on playgrounds. They reported that sex differences affects children's choice of what kind of play materials. They also noticed that girls spent more time than boys on playing fixed physical equipment such as climbing frames and swings, while boys play more than girls on wheeled vehicles, and construction materials such as tires, crates and ladders (Tizzard, Phillips, & Plewis, 1976). However, some boys also are interested in playing dolls or girls are inclined to play boys' games. Then, there is no hard and fast rule to distinguish gender difference at playgrounds.

2.3.4.3 Activity Zones

By choosing different activities of children, the playground space should be divided into multiple zones. Here is the guideline with variety options for designers' brainstorm before designing. And, designers should pay attention on the distinction of quiet and noise zones to avoid children in the quiet zone being disturbed by children from the noise zone.

- **Quiet Zones**

Quiet zones should include transitional, water play, sand play, dramatic play, comfort/social, service zones (Ruth, 2008). In transitional zones, children are able to make their decisions where they prefer to go. Water, sand, and dramatic play zones provide multiple chances to develop children's gross and fine motor skills, and social skills that are mentioned before. In comfort/social zones, children could sit under shaded areas with tables, water fountains, and restrooms to take a break. Service zone is aimed to aid in the maintenance of the playground such as storage balls, jump ropes and big loose parts.

- **Intermediate Zones**

Intermediate zones consist of swing and hard surface zones. Albeit swing equipment is the most popular activity on the playground, based on the CPSC's Public Playground Safety Handbook, they separate it from others under safety reason. Providing a surface suitable for sidewalk chalk games and ball bouncing games such as square and hoops is also good in this zone(Ruth, 2008).

- **Noisy Zones**

Natural, big loose parts, and gross motor play zones should be incorporated together as the noisy zone. In these zones, children with a chance create their own play way or utilize physical equipment such as sliding, climbing and crossing.

- **Playing in the corners**

Large space seems mainstream idea of schoolyards. However, educators and researchers noticed that a mount of young children prefer to play at the edge of these open spaces and in the corners. Indeed, corners at the small schoolyards attracted more kids than the large open empty space (Hendricks, 2001). This is a kind of unexpected play zone form. Then, playing in the corners, as the element of playgrounds at schools, should be considered in designing processing.

2.3.4.4 Materials

Pressure-treated wood, steel, galvanized steel, aluminum, and various recycled materials are usually considered as the major materials for manufacturing play structures. In order to avoid children injury, playground equipment should be set above a shock absorbing or safety surface

with a Critical Height factor. Rubber mats are becoming popular in using as a safety surfacing in playgrounds (Ruth, 2008).

2.3.4.5 Accessibility

The ADA Accessibility Guidelines of Play Areas in the Architectural and Transportation Barrier Compliance Board make these play areas accept individuals with disabilities to meet the inclusive playgrounds.

2.3.4.5 Estimating Budgets

It is difficult to predict the cost of playgrounds because they are a complex system. However, the Access Board in the Play Area Accessibility Guidelines developed a standard formula to provide an estimate of the costs associated with the development of Gross Motor Play Zone in a playground:

Cost of playground equipment (x) + Cost of installation (.30x) + Cost of surfacing (.12x) + Cost of design fees, grading, landscaping, and other expenses (.10x) = Total project cost or budget

2.3.5 Child development & Educational Playgrounds

According to the whole viewpoints above, playgrounds for children make up indoor activities deficiency at kindergartens to provide different play experiences and habits. Educational playgrounds not only give children more opportunities to freely enjoy nature and fresh air, but also develop their domain development of physical, social, emotional, and cognitive thought children sensory system. Besides, educational playgrounds associate children

to acquire basic knowledge spontaneously through play, and stimulate their interest in deeper learning.

Children need enough play spaces and time to release their energy and for different child development at kindergartens or after schools. As described earlier, the child development has three major aspects, physical, social-emotional, and cognitive development through sensory integration. In order to creating a better and suitable playground at kindergartens, designers should apply these child developments into designing through seven types of play for different ages and genders.

In this case, educational playgrounds, as the playful learning functions that this type of playgrounds offers not only solve problems of limited play time and physical exercises, but also make more chance for children to learn knowledge and skills through play.

Chapter 3 Case Study

Facing sterile of playgrounds and play spaces at schools where children activate and play, designers have to come up with strategies to cater to the escalating demand. Therefore, this chapter studies and analyzes existing school playgrounds solution as references of strategies from these cases.

3.1 Designing for playgrounds at schools

Designing children schools outdoor play spaces need to consider many aspects that are described in pervious chapter. Before the case study, another two vital elements need to be described in this section: outdoor climate, and the ground of playgrounds.

Outdoor climate

Outdoor play at schools happen every day, but weather can be unfriendly for children, including raining, snowing and hot summer days. It is hard for adults to decide when is the right time to allow children play outside. When making this decision, schools faculties have to consider many factors such as wind and temperature. Besides, teachers need to follow the Child Care Weather Guideline from the National Weather Service as below:

Understand the Weather

Wind-Chill

- 30° is *chilly* and generally uncomfortable
- 15° to 30° is *cold*
- 0° to 15° is *very cold*
- -20° to 0° is *bitter cold* with significant risk of *frostbite*
- -20° to -60° is *extreme cold* and *frostbite* is likely
- -60° is *frigid* and exposed *skin will freeze* in 1 minute

Heat Index

- 80° or below is considered *comfortable*
- 90° beginning to feel *uncomfortable*
- 100° *uncomfortable* and may be *hazardous*
- 110° considered *dangerous*

All temperatures are in degrees Fahrenheit

Child Care Weather Watch

Wind-Chill Factor Chart (in Fahrenheit)

Wind Speed in mph

Air Temperature	Calm	5	10	15	20	25	30	35	40
40	40	36	34	32	30	29	28	28	27
30	30	25	21	19	17	16	15	14	13
20	20	13	9	6	4	3	1	0	-1
10	10	1	-4	-7	-9	-11	-12	-14	-15
0	0	-11	-16	-19	-22	-24	-26	-27	-29
-10	-10	-22	-28	-32	-35	-37	-39	-41	-43

Green: Comfortable for out door play   Yellow: Caution   Red: Danger

Heat Index Chart (in Fahrenheit %)

Relative Humidity (Percent)

Air Temperature (F)	40	45	50	55	60	65	70	75	80	85	90	95	100
80	80	80	81	81	82	82	83	84	84	85	86	86	87
84	83	84	85	86	88	89	90	92	94	96	98	100	103
90	91	93	95	97	100	103	105	109	113	117	122	127	132
94	97	100	103	106	110	114	119	124	129	135			
100	109	114	118	124	129	130							
104	119	124	131	137									

Figure 3.1 Child Care Weather Watch, used with permission of the Iowa Department Public Health, Healthy Child Care Iowa, Produced through federal grant (MCJ19T029 & MCJ19KCC7) funds from the US Department of Health & Human Services, Health Resources & Services Administration, Maternal & Child Health Bureau. Wind-Chill and Heat Index information is from the National Weather Service.

    Hence, in order to solve climate problem, techniques of playground design trend to create shade or shelters to avoid children play being influenced by sun exposure, wind, raining and other microclimates at schoolyards. These ideas also provide a rich chance for children to observe nature and learn more knowledge in real world. For example, when suddenly rain falla, teachers could lead children run into shelters and tell the story about the rain.

Figure 3.2 Grace Shelter & Forest Story House from Hand Made Places Playgrounds for

Learning & Fun

https://www.handmadeplaces.co.uk/products/forest-story-house/#prettyPhoto

Ground of school playgrounds – Surfacing

When designing for outside play spaces at schools, designers will see that grounds

usually are flat and left without plants because of considering function for physical lesson and

safety. However, to make more spaces for sports areas, many old trees and plants at schools have

to be cut down. Well-designed quality outdoor environment should carefully think about how to

make play spaces better, not build a new one after removing all items there before. With many

extraordinary tree house concepts emerging, designers realize how to keep balance of spaces for

children. We will describe the Fuji Kindergartens and IMJ Tree House cases in the next section.

Additionally, today, surfacing materials are able to stand in all weathers so that numbers

on the surface and asphalt turn out to be a useful and playful surface for many schoolyards. Math

and Language lessons could be some aspects in educational playgrounds. For example, Notts

Sport invented a new material - sand filled carpeting. The surfacing Notts Sport ChildsPlay is not only more vibrant and colorful to attract children, but also stays cooler in summer and reduces transmission of sound, to keep children's environment safer and cleaner.

Figure 3. Surfacing, adapted from Notts Sport Synthetic Surfacing

Lastly, there is no reason that grounds have to be flat. In fact, they could be multiple forms to appeal to children and be more playful if some areas are not flat. Designing floor elements that roll up and down is able to create a new way for children's playful learning at some areas of playgrounds.

In sum, according to theses two factors of educational playgrounds, they increase more opportunities to learn through play. Later, the approach for playful learning playgrounds design will be elaborated in Chapter Four.

3.2 Current Educational Playgrounds

Educational playgrounds are suitable for children to learn through play, stimulating and developing their learning skills and physical activities in different ages. Here are several case studies below:

Name: The Little School

Location: San Francisco, California

Architect: Mark Horton/Architecture

Project Year: 1998

Figure 3.4 The Little School in San Francisco, Mark Horton, 2005 (Stanković & Stojić, 2007)

The Little School has long valued the importance of design in children's space. It is a private nonprofit facility for two to six year olds with play-centered and multi-sensory curriculum that is specific, compared with others. Horton designed a curved and abstract background wall as an entrance to interior classrooms and a backdrop to play. He provides tables, chairs, cavernous entryways, ladders and ledges for children's play. In addition, he emphasized the welcome form as inside and outside spaces such as applying colorful light glass filled entry portal in Figure 3. Moreover, the outdoor playground is filled with lots of natural elements such as water, trees and sand play area.

According to his project, firstly, we can see that the concept of shape of play areas could be unexpected forms that people usually would not imaginge. This suggests that the playground design could challenge traditional form, size and shape of play spaces. Secondly, this building blends play and interesting architecture for children to learn in natural and constructed environment.

Name: Fuji Kindergarten

Location: 2 Chome – 7-1 Kamisunacho, Tachikawa, Tokyo 190-0032

Architect: Tezuka Architects

Project Year: 2007

Figure3. Fuji Kindergarten, Photographer: Katsuhisa Kida

Educational playgrounds can also be instead of the whole kindergarten building in this

case. Tezuka Architects' Fuji Kindergarten won the 2017 Moriyama the Royal Architectural

Institute of Canada (RAIC) International Prize, an extraordinary and innovative concept of blending the playground into the building. They pay attention to designing an open and inclusive educational environment under the Montessori education method: independence and freedom that was mentioned before. Tezuka said, "We want the children here to grow into people who do not exclude anything to anyone." Fuji Kindergarten looks simple; however, it took ten years to develop. The main concept is of a single-story and oval-shaped building that encourages children to play and freely interact with others.

Fuji Kindergarten in the shape of the oval roof with a perimeter of 183m, made for 500 children. Besides, the interior of classroom is an integrated space softly partitioned with furniture. Moreover, there are three zelkova trees 25m in height growing up through the rooftop of the building. Firstly, the unique simple and huge oval-shaped roof becomes the main play space for the school, offering students an endless path to run on in circles, jump, climb trees and slide back down to the ground. Due to the weather, the building's sliding doors open between April and November. Then, there is no distinction between indoors and outdoors. Additionally, there is no wall between spaces indoor. Moreover, they also keep trees instead of removing them to maintain a natural environment for children.

Play areas include skylights and outdoor faucets for children to wash up. On rainy days, children have chances to collect rainwater flows through five gargoyles and into five large basins in the courtyard below. Therefore children can gather rainwater. Based on Montessori's method, there is no hierarchy and segregation between students and staff in this open space. According to

Tezuka's public speaking in a TEDTalk (year), he observed children play behaviors in this area. He found that a large number of children preferred to climb and crowd around zelkova trees, like monkeys. There is an annex building next to the oval-shaped kindergarten, five meters tall and seven floors. The ceiling height is low and safe for children. He noticed his son tried to jump off and other children came and followed his son's behavior. For his point, children need some small risk and dangerous to learn to help each other. Overprotected children lack this opportunity.

Name: IMJ Tree house

Location: Israel Museum, Museum Boulevard, Jerusalem, 91904, Israel

Architects: Ifat Finkelman and Deborah Warschawski

Project Year: 2014

Figure 3.6 Tree House in Israel Museum. Photographs: Amit Geron

Ifat Finkelman and Deborah Warschawski developed a wooden structure around an old

pine tree to update a space at the Israel Museum in Jerusalem. They consider that a tree house is

able to collect childhood memory as a tribute. They gave a roofed shelter where children can

hide and overlook the outside surrounding environment. This tree house is made up of hardwood

boards with a steel skeleton. There is a metal pole with foot pegs inside the platform for children

to enter and exit the structure via it. The ground is covered with a soft EPDM rubber surface. At

night, the area of the tree house will be illuminated.

Company: ADA SciencePlay

The design concept behind of SciencePlay is a great example to match the main goal of

the approach in this study, combining learning with outdoor fun. They focus on outdoor activity

with science and engineering with games to stimulate and teach children. For example, the

Spinning Universe is a unique playground game of solar system (see Figure 3 image on the left).

Children could sit inside the sphere-shaped roundabout to control the sun. During play time,

children engage to learn more about galactic knowledge of the length of days, months and years.

Figure 3. ADA SciencePlay Adapted from ADA SciencePlay website

Another product from this company, Möbius Bench (see Figure 3 image on the right)

brings the Möbius loop concept into real life, two-dimensional surface with only one side and

one boundary. Attaching   balls to its edge, players start to slide the balls along the bench, and

they will notice the outer side of bench will complete the circle on its inner side. After

completing this processing, children not only acquire geometric information, but also have a

chance to sit and relax.

Chapter 4 Design Approach

Previous chapters are aiming to support the theories and reasons behind this approach, which is easier and more effective than traditional education methods for children to promote their leaning abilities through play. Hence, this chapter will develop the approach for educational playgrounds, aiming at rationally using schoolyards to create rich chances for children to engage in outdoors play activities and help them to get better achievement in their future academic study.

As we have studied in Chapter 2, the major play functions not only correspond to elicit children's demands in different ages stages, but also makes up for the indoor activities deficiencies. Teachers could observe and estimate children's multiple abilities at playgrounds. In other words, the playground equipment plays a role for aiding teachers to train and develop children's skills in outdoor spaces. The connection between three-domain child's development and seven major play categories is the innovation core for this approach.

For the last dozen years, a number of idealistic American educators are trying to reform and improve current education. K-12 education is so exhausted that they refocus on early childhood (Kristof, 2015). According to Maria Montessori's different periods in human being growth, the first one is from birth to six years old, but there two sub-phases in this period, the unconscious (birth to three years old) and the conscious (three to six year old) (Montessori, 1959). Maria (1959) asserted that if defects are not corrected by treatment at the age of three to six, they would not only remain, but will increase and have an influence over the second period.

Due to this, the approach will only focus on playground equipment at preschool and kindergarten. American preschools age ranges are usually from two to five years old so that most playground companies appealing to preschools divide the age range into two to five and five to twelve. However, there are multiple preschool whose ages extend to six years old. Additionally, we know some children maturity beyond age than others or lower than others. Therefore, offering more option for design as references, the two to six years period is the central age range in this approach.

There are six steps in this approach, including playground planning, criteria study (skills, types of play, and safety), skills selection, types of play selection, ideation process (multi-sensory design and safety standards compliant), and final delivery which are described step by the step.

4.1 Playground planning

The first of all steps is focusing on the playground planning such as age range at the chosen school, assess location, envision play area and discus with school officials. Albeit this is playground consultants' responsibility, product designers should understand which direction or main goal of child's development the school is seeking for aiding with their teaching ideas. Once the site is decided and the main goal pre-defined, the next step is ready to be taken.

4.2 Criteria study

The second step, criteria study, is aiming to for designers to study children's skills for each development in two to six years old. Kids' skill is fanned out three fundamental

developments: physical, social-emotional, and cognitive development in their growing process. Selection of skills is going to not only analyze the existing play space performance at the first step, but also could be referenced as evaluating concepts. Then in this step, designers could use forms in the evaluation section to analyze the existing location performance.

4.2.1 Skills

4.2.1.1 Levels of challenge

Various skills in different developments will be interpreted in next section. To clearly observe children's growth, levels of challenge is referenced as the different age stages from two to six, each age stage is considered as different levels for designers to design the level of playground equipment from easy to challenging. Level One (Easy) – two to three years old, Level Two (Normal) – three to four years old, Level Three (Hard) – four to five years old, Level Four (Challenging) – five to six years old (see Figure 4.1).
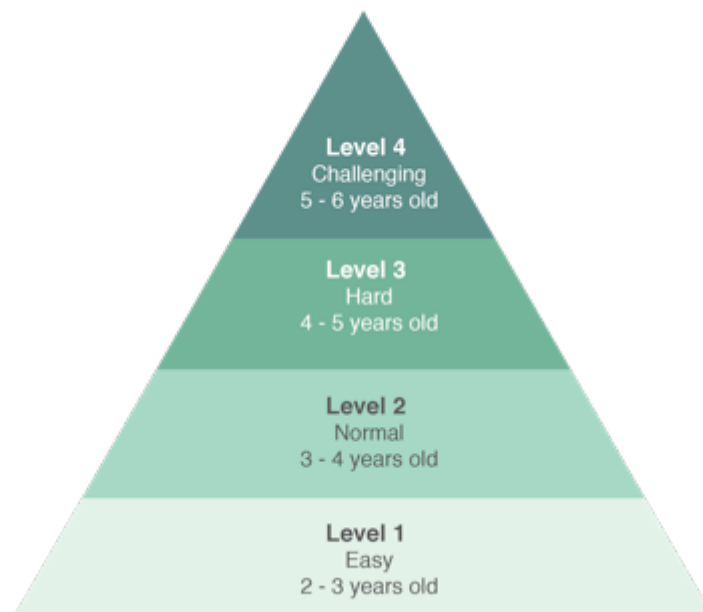

Figure 4.1 Levels of challenge

4.2.1.2 Skills Selection Table

At this phase, the children's skills selection makes an easier and effective method for designers to see deficit of this play space and generate new concepts.

4.2.2.2.1 Skills in the Physical Development

Stability, Locomotor, and Manipulative skills

Based on Gallahue's (2007) theory of physical development in Chapter Two, Section 4.2.2, stability, locomotor, and manipulative (Gross & Fine) skills stand for physical development status in this approach. There are four main development stages in Literature review, but with children (two to six years old) as the major group, skills in fundamental stage are emphasized in this approach. In fundamental movement phase, children need an abundance of opportunities to practice and refine the basic stability, locomotor, and manipulative skills in different play activities. For the final goal of the mature stage, children motor skills should gain the basic all sport abilities including running, kicking, throwing, catching and heading/trapping (Gallahue & Donnelly, 2007). Combining *the developmental benefits of playground* guideline (2004) with Gallahue's theory, children need to learn a set of skills by a certain age, including basic stability - body assistance and body/equipment relationship, and locomotor - speed.

On average, young children can expect to grow two to three inches in height per year (Iivonen, Sääkslahti, & Nissinen, 2011). Between ages two and three years old, young children stop toddling and are able to run, jump, and hop. Children of this age can participate in throwing and catching games with larger balls. From three to four years old, children are able to jump and

hop higher while their large muscles grow stronger. Some of them also are able to hop on one foot in a short time. Their catching and throwing skills also advance in speed and accuracy at this stage. Children four to five years old could go up and down the stairs alone in the adult fashion. Their running continues to smooth out and increase in speed. As ages five to six, young children continue to refine and improve earlier skills. They're running even faster and can start to ride bicycles with training wheels for added stability. At this age, children begin mastering new forms of physical play, and participate in physical extracurricular activities such as karate, gymnastics, or dance (Wang, 2004).

Moreover, gross motor skill is body, and fine motor skill connects with the hand/foot relationship (see Table 4.1).

Physical Development		Level1	Level 2	Level 3	Level 4
Basic Stability	Body Assistance	"Back up" assistance to prevent	Climb up stair with bringing both feet together	Can go up and down the stairs alone	Participate in physical extracurricular
	Body/Equipment				
Locomotor	Speed	Slow	Improve	Increase	Faster
Manipulative	Gross	Body	Jump, and hop	Jump higher, catching and etc.	Jumping rope, hitting balls with bats and etc.	Multiple sport activities
	Fine	Hand/Food Relationship				

Table 4.1 Skills in the Physical Development - Body

Visual perception

With help from the Section 2.2.3 in Chapter 2, Gallahue's statement, although children's visual apparatus is mature at 2 years old, their visual skills are still incomplete (Gallahue & Donnelly, 2007). Besides, his research defines the visual perception by three aspects, visual acuity (the ability to distinguish details), figure-ground perception (the ability to separate one object from its surrounding visually), and visual-motor coordination (the ability to integrate using of eyes and hands) (see Table 4.2). During the age from two to six years old, children's visual perception – eye hand coordination is the skill to control hand movement guided by vision (see Figure 4.2). At this phase, designers should mainly focus on children's eyes coordination and hands relationship with equipment at playgrounds.
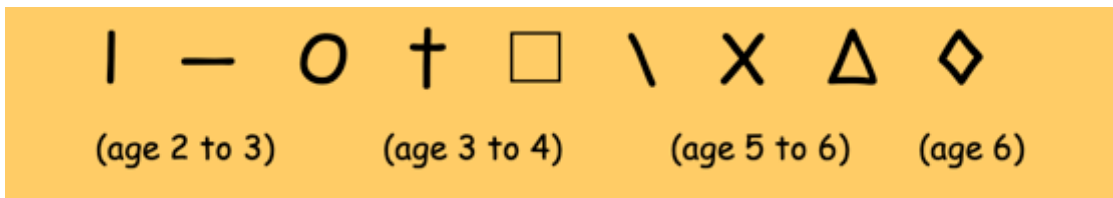
Figure 4.2 Drawing processing, adapted from the Therapy Street for Kids website

Physical Development		Level 1	Level 2	Level 3	Level 4
Visual Perception	Visual Acuity	Low acuity	Improve	Increase	Mature
	Figure-ground perception	Match same objects by single color or shape	Base on visual memory to do simple puzzles	Intermediate level puzzles	Difficult level puzzles
	Visual – motor coordination	Draw simple shape	Draw square	Draw triangle	Draw complicate shape

Table 4.2 Skills in the Physical Development – Eyes and Hands

4.2.2.2 Skills in the Social-Emotional Development

Improving children's skills through play associated with social-emotional learning, to understand the thoughts and feelings of themselves and others, and to interact with others by using their knowledge and skills. According to the literature review in Chapter 2, Howes's play stage and Parten's play stage, skills will be defined from unoccupied play to solitary play, to onlooker behaviors, to parallel play, to parallel play with mutual regard, to associative play, to simple social play, to complementary and reciprocal play with mutual awareness, to complementary and reciprocal cooperative play. Due to the age range, parallel play, associate play and cooperative play will be the measurement in this aspect (see Table 4.5).

Social-Emotional Development	Level 1	Level 2	Level 3	Level 4
Play stage	Solitary & parallel play	Associative play	Cooperative play	Game and rules

Table 4.3 Skills in the Social – Emotional Development

4.2.2.3 Cognitive Development

There are four stages in Piaget's theory of cognitive development, sensorimotor stage, preoperational stage, concrete operational stage, and formal operational stage. However, designers only focus on preoperational stage because the age range is limited. Besides, Dr. Gardner's theory of multiple intelligences is a very useful model to nurturing and teaching children at schools, which has been studied in Chapter 2. But, the interpersonal and existential intelligence is inherent development that could estimate in the social-emotional development, so other intelligences are referred as skills in this aspect.

Spatial/Visual - Dimensions

Spatial ability is a complex cognitive capability that requires an organization of the knowledge of objects in relation to oneself as well as in relation to each other ("A wealth of play and playground information at your fingertips.," 2019). Children at three years old are able to remember an object's location within an arrangement and can retrieve it from a novel viewpoint (Nardini, Burgess, Breckenridge, & Atkinson, 2006). Children could promote their spatial skills to manipulate and rotate two dimensions or three dimensions at this age range (see Table 4.6). Research states that spatial skill are malleable and that early experiences like block building in four to six years old and puzzle play in two to four years old can alter spatial thinking (Verdine et al., 2014). Moreover, experts usually use the spatial reasoning test to estimate children's capacity to think about objects in three dimensions from limited information such as match the pattern on the unfolded cube.

Spatial / Visual	Level 1	Level 2	Level 3	Level 4
Dimensions (2D – 3D)	2D	2D	2D – 3D	3D

Table 4.4 Spatial / Visual Skills in the Cognitive Development

Verbal/linguistic

Thought and language are initially separate systems from birth, merging at around three years old (Vygotsky, 1964). Vygotsky (1964) claimed that language plays two critical roles in cognitive development, "It is the main means by which adults transmit information to children." and "Language itself becomes a very powerful tool of intellectual adaptation". In this stage,

children could absorb information, knowledge or language around them (Heo, Han, Koch, & Aydin, 2011). Catts and Kamhi (1999) defined five features of language skill, including phonology (speech sounds of language), semantics (meanings of words and phrases), morphology (meaningful parts of words and word tenses), syntax (rules for combining and ordering words in phrases), and pragmatics (appropriate use of language in context) (see Table 4.5). Between the ages of two and four, children's language rapidly grows, particularly in understanding the meanings of words, interrelationships, and grammatical forms (Scarborough, Neuman, & Dickinson, 2009). So, the language learning process includes alphabet, vocabulary, meaning, order, reading, and writing. There are multiple options for symbolic play, which can be anything such as the sequence of letters, animals, countries, names, and etc.

Verbal / Linguistic	Level 1	Level 2	Level 3	Level 4
Phonology, Semantics, Morphology, Syntax, Pragmatics	Begin to understand several action words (example, eating, sleeping etc.) By age 2, most children can say at least 50 words.	At 3 years of age, children enjoy listening to people. By 4 years they listen to longer stories and answer questions about a story they have just heard.	At this stage, children need to listen, understand more and share their ideas within the classroom.	By 5 or 6 years, children often have good communication skills. They are better at using language in different ways, ideas or giving opinions.

Table 4.5 Verbal/Linguistic Skills in the Cognitive Development

Mathematical/Logical

Mathematics knowledge in preschool predicts mathematics achievement even into high school (Geary et al., 2008). Logical & Reasoning is the most important ability in mathematics, and refers to thinking through problems and applying strategies for solving them, and is an essential phase in child development (see Table 4.6). Albeit young children learn informal knowledge of mathematics at preschool or kindergarten, their logical and reasoning thinking are stimulated in play activities to solve the simple arithmetic problems through play activities such as counting objects, comparing magnitudes, exploring patterns, shapes (Council, 2015).

Mathematical/Logical	Level 1	Level 2	Level 3	Level 4
Logical & Reasoning	Begin to understand the concept and use of numbers, for example, realize that when they count their crackers, each is given one number	Recognize and look for geometric shapes in the environment enjoy sorting and classifying objects, usually only one characteristic at a time – color, shape, or size	Enjoy playing games involving numbers struggle with classifications that are not obvious count objects or people up to 10 or 20 with less skip-counting or double counting	Start to add small numbers in their heads, but still are more comfortable adding real objects they can actually touch and move classify objects

Table 4.6 Mathematical/Logical Skills in the Cognitive Development

Musical

Schoen (1940) lists the important components of musicality as being primary factors including auditory sensitivity and musical feeling and understanding. In the Montessori approach

to education, children are able to learn rhythm, pitch, and melody, instrumental, listening,

musical memory abilities in their sensitive period (Montessori, 1959).

Musical	Level 1	Level 2	Level 3	Level 4
Auditory sensitivity	Manipulating objects while creating songs; repeated songs; having their own movements/ideas copied by others	Awareness of beat, tempo, volume, pitch, and form; sings a wide variety of songs; sings in D–A range;	Play in ensembles; explore many pre-keyboard instruments.	Singing phrases or an entire song with accurate pitch; occasionally to consistently matching the beat of music.
Musical feeling and understanding				

Table 4.7 Musical Skills in the Cognitive Development

Naturalist

Most educators and scholars emphasized that a nature environment will stimulate

children's growth, which has been described in Chapter 2, Section 2.2.4.3. Children at this age

stage begin to curious and explore the nature world to remember name of plants, floras, and

animals (Meyer, 1998). Observation and pattern recognition are the fundamental skill in this

intelligence so that will be the main point here.

Naturalist	Level 1	Level 2	Level 3	Level 4
Observation	Interest in nature such as plants, minerals, and animals	Recognize and classify simple plants, minerals, and animals	Recognize and classify more plants, minerals, and animals	Attend nature camp
Pattern recognition				

Table 4.8 Naturalist Skills in the Cognitive Development

Skills in the Child's Development Chart

Skills			Level1	Level 2	Level 3	Level 4
Physical Development	Basic Stability	Body Assistance / Body/Equipment	"Back up" assistance to prevent	Climb up stair with bringing both feet together	Can go up and down the stairs alone	participate in physical extracurricular
	Locomotor	Speed	Slow	Improve	Increase	Faster
	Manipulative	Gross — Body	Begin to run, jump, and hop	Jump higher, catching	Jumping rope, hitting balls with bats	Multiple sport activities
		Fine — Hand /Food Relationship				
	Visual Perception	Visual Acuity	Low acuity	Improve	Increase	Mature
		Figure- ground perception	Match same objects by single color or shape	Base on visual memory to do simple puzzles	Intermediate level puzzles	Difficult level puzzles
		Visual – motor coordination	Draw simple shape	Draw square	Draw triangle	Draw complicate shape
Social - Emotional Development	Play stage		Solitary & parallel play	Associative play	Cooperative play	Game and rules
Cognitive Development	Spatial / Visual	Dimensions (2D – 3D)	2D	2D	2D – 3D	3D
	Verbal / Linguistic	Phonology, Semantics, Morphology, Syntax, Pragmatics	Begin to understand several action words (example, eating, sleeping etc.) By age 2, most children can say at least 50 words.	At 3 years of age, children enjoy listening to people. By 4 years they listen to longer stories and answer questions about a story they have just heard.	At this stage, children need to listen, understand more and share their ideas within the classroom.	By 5 or 6 years, children often have good communication skills. They are better at using language in different ways, ideas or giving opinions.
	Mathematical / Logical	Logical & Reasoning	Begin to understand the concept and use of numbers, for example, realize that when they count their crackers, each is given one number	Recognize and look for geometric shapes in the environment enjoy sorting and classifying objects, usually only one characteristic at a time – color, shape, or size	Enjoy playing games involving numbers struggle with classifications that are not obvious count objects or people up to 10 or 20 with less skip-counting or double counting	Start to add small numbers in their heads, but still are more comfortable adding real objects they can actually touch and move classify objects
	Musical	Auditory sensitivity / Musical feeling and understanding	Manipulating objects while creating songs; repeated songs; having their own movements/ideas copied by others	Awareness of beat, tempo, volume, pitch, and form; sings a wide variety of songs; sings in D–A range;	Play in ensembles; explore many pre-keyboard instruments.	Singing phrases or an entire song with accurate pitch; occasionally to consistently matching the beat of music.
	Naturalist	Observation / Pattern recognition	Interest in nature such as plants, minerals, and animals	Recognize and classify simple plants, minerals, and animals	Recognize and classify more plants, minerals, and animals	Attend nature camp

Table 4.9 Skills in the Child Development

4.2.2 Types of Play

To develop great and friendly playground equipment to appeal children's need, designers need to what types of play have powerful in children's development. According to theories study and research in the Chapter2, seven types of play have benefit and effective energy to promote children learning skills as follows. This study gives designers a new insight into developing playground concepts at the play components selection step.

- Sensory play - During play time, children utilize one or more of the sense, stimulating sight, sound, smell, touch, taste, balance and movement

- Swing play - It develops children vestibular system, including muscle tone, ability to balance, body coordination, and coordination of eye movements with our head.

- Climbing play - It develops children vestibular system, including muscle tone, ability to balance, body coordination, and coordination of eye movements with our head.

- Sliding play - It is to move over a surface while maintaining smooth continuous contact. When children join in sliding play, they have to wait in line for their turn, improving their cooperative, patience and tolerance of other's abilities.

- Spinning play - It is to rotate rapidly or whirl, a swift whirling motion, including go for a walk/run, hula-hoop, jump rope and etc.

- Brachiating play - Brachiating play is a locomotion accomplished by swinging by the arms from one hold to another such as an overhead ladder, including

building strength, endurance, and flexibility, eye-hand coordination, visual distance

perception, and balanced locomotor (Frost et al., 2004).

•   Balancing play - It is the ability to maintain a controlled body position

during task performance, whether it is sitting at a table, walking the balance beam or

stepping up onto a curb.

4.2.2 Safety

This is main issue in designing playgrounds is to provide challenging and fun activities

while designers need to pay more attentions on keep safety for children using the playground.

Safety standards documents have been described in the Chapter 2; more detail information will

be depicted in ideation process phase.

Here are three tables of skills, types of play, and safety from researches as designing tool

for designers to analysis the location play space situation and current problem at this step.

Skills			Excellent	Adequate	Absent
Physical Development	Basic Stability	Body Assistance			
		Body/Equipment			
	Locomotor	Speed			
	Manipulative	Gross	Body		
		Fine	Hand /Food Relationship		
	Visual Perception	Visual Acuity			
		Figure- ground perception			
		Visual – motor coordination			
Social - Emotional Development	Play stage				
Cognitive Development	Spatial / Visual	Dimensions (2D – 3D)			
	Verbal / Linguistic	Phonology, Semantics, Morphology, Syntax, Pragmatics			
	Mathematical / Logical	Logical & Reasoning			
	Musical	Auditory sensitivity			
		Musical feeling and understanding			
	Naturalist	Observation			
		Pattern recognition			

Table 4.10 Skills Table

Types of Play	Excellent	Adequate	Absent
Sensory Play			
Swing Play			
Climbing Play			
Sliding Play			
Spinning Play			
Brachiating Play			
Balancing Play			

Table 4.11 Types of play Table

Safety		Excellent	Adequate	Absent
Activities zones	Quiet zones			
	Intermediate zones			
	Noisy zones			
	Corner zones			
Surfacing	Material			
Entrapment	Machine pitch points	**N/A**	**None**	**Yes**
	Head entrapment			
	Hazard zone demarcation			

Table 4.12 Safety Table

4.3 Skills Selection

In this step, designers need to choose which skills they prefer to apply into concepts generation phases. This table is the tool to help with designers to mark which skills is selected.

SKILLS SELECTION				
PHYSICAL DEVELOPMENT	Basic Stability	Body Assistance		
		Body/Equipment Relathionship		
	Locomotor	Speed		
	Manipulative	Gross	Body	
		Fine	Hand/Foot Relationship	
	Visual Perception	Visual acuity		
		Figure-ground perception		
		Visual-motor coordination		
SOCIAL-EMOTIONAL DEVELOPMENT	Play stage			
COGNITIVE DEVELOPMENT	Spatial/Visual	Dimensions (2D - 3D)		
	Verbal/Liguistic	Phonology		
		Semantics		
		Morphology		
		Syntax		
		Pragmatics		
	Mathematical/Logical	Logical & Reasoning		
	Musical	Auditory sensitivity		
		Musical feeling and understanding		
	Naturalist	Obsevation		
		Pattern recognition		

Table 4. 13 Skills Selection table

4.4 Types of Play Selection

4.4.1 Play Components Selection

Both Montessori and Piaget have the common key point: play has a stronger power to trigger children's senses and appeal to their needs. Therefore, this phase is generating concepts based on play components in seven types of play (sensory play, swing play, climbing play, spinning play, brachiating play, and balancing play) discussed Chapter 2, aiming to establish concepts for further designing. Components selection is extremely vital for designing children's play system because of child's development and safety. The categories and criteria have been stated in Chapter 2 and 3. In this section, comparisons of existing playground equipment is for designers to collect existing products information, find the lacking aspect in this site and determine levels of challenge. In addition, designers need to pay more attention on making sure the feasibility of manufactory while they are developing concepts in the Ideation Process step next. Moreover, playground companies have different sets for patented hardware that are highly recommended; designers could use one company for easy assembly and layout, but this is not mandated. After collection information, designers should analyze strengths, weaknesses, and

opportunities of selected products to improve in the future designing development.

PRODUCT COMPARISON Existing Products	Image PRODUCT 1	Image PRODUCT 2	Image PRODUCT 3	Image PRODUCT 4
Strengths				
Weaknesses				
Opportunities				

Table 4.14 Play Components Selection and Analysis Table

4.5 The Ideation Process

4.5.1 Experience Design concern

- **Incorporate multi-sensory**

After all above steps, as I mentioned in Chapter2, sensory play is another important role

in child development, so designers should consider how to develop playground equipment

through senses with enjoyable, captivating, intrinsically motivated and process focused elements

coming from the playground's feels, smells, tastes, sounds or looks (Kudrowitz & Wallace,

2010). Physical experiences take advantage of building stronger connections to children at

playgrounds. Sensory impressions obtained through hearing, seeing, touching, tasting and

smelling which contribute to children's play experiences and free choices. When developing a concept, designers are able to not only control and consider visible aspects of products such as vision, but also need to think of other invisible aspects such as sound, touch, and scent, enhancing multiple experiences in product development, because sensory design makes the design process easier to connect children's potential skills with each product. However, it does not mean more is better. Therefore, below there are examples for designers to consider the direction they could go in each sense to appeal in preschool playgrounds.

- Vision – According to a scientific research, the human body receives about 80% of the message in a day through vision. So the appearance of a product is very important. Several elements of vision are involved, including color, line, two dimensional shapes, proportion, visual combination, and etc. For this aspect designers should consider a system of planned trails with special features at school playgrounds. See reference list below. Light, shadow and shade could be reflected in the structural as well as other important aesthetic details of this site. Color also should be systematically specified from sophisticated palette composed of a wide, coordinated range in hues, values and shades.

Visual - Sight selection

sunrise / sunset view points	light meters
rainbow generators	magnifying leans
scenic view points	periscopes
graphics/murals	telescopes, binoculars
flower gardens	microscopes
mirror - flat, parabolic one-way	cameras, lens, filters
	night-lighting

Table 4.15 Visual examples adapted from (Rohane, 1983)
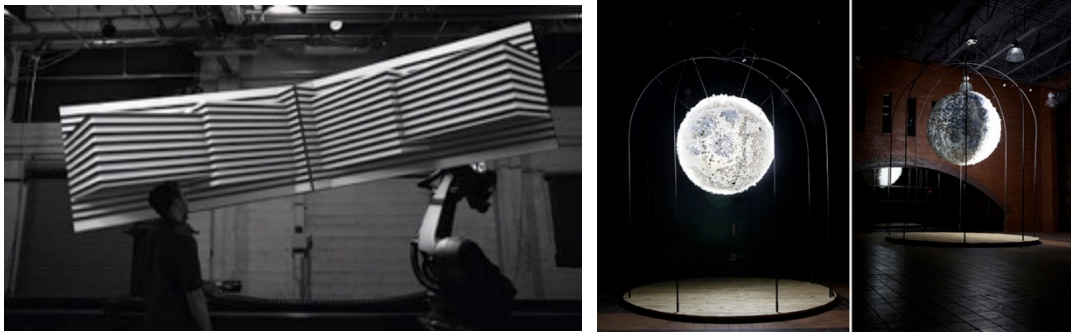
Figure 4.3 Visual illusion examples
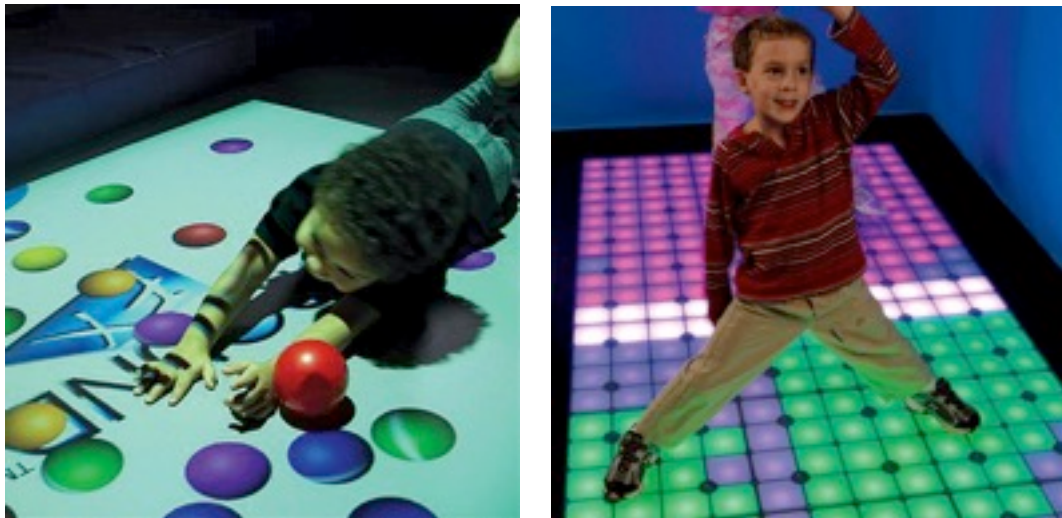
Figure 4.4 Color electric light examples
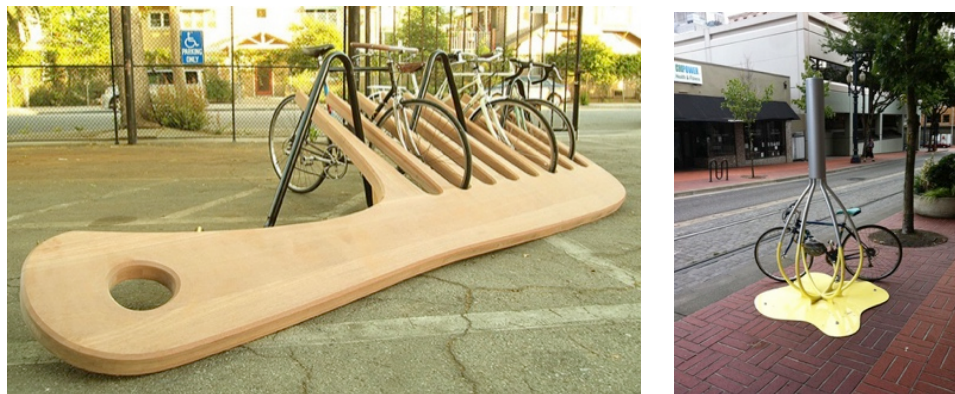
Figure 4.5 Size examples

- Sounds – Hearing can also give signals. For this aspect, designers need to consider to

mimic sound into their concepts such as echoes, quiet and loud noise, animal sounds, musical instruments, toys and games that beep, squeak, honk and squeal. See reference list below.

Auditory -Sound selection

bells, chimes, triangles	public address systerm
drums, rhythm sticks	sheet metal "thunder"
gongs	tamboutines
hollo pipes	type players and recorders
horns	whistles
metal roofs	door bells

Table 4.16 Auditory examples adapted from (Rohane, 1983)

Figure 4.6 Instrument playgrounds examples

- Smelling and Tasting – Both of them also could be a part at school play spaces, including natural and safe smelling of herbs, flowers, and spices. Besides, designers also need to create areas where sensitive people can avoid these smells. See reference list below.

Olfactory - Smelling selection

flower beds	sulphur springs
animal pens	grassy fields
watr activity -setting	compost piles

Table 4.14 Olfactory examples adapted from (Rohane, 1983)

Figure 4. Garden playgrounds examples

- Tactile – Touching

The qualities of products will also be increased by applying the feeling of touch, hearing, taste and smell. Touch allows children to sense the temperature, texture and shape. Warm and soft surface provides a comfortable and safe feeling. Children love to touch their world so designers should promote a rich variety of things to touch. Children are easily over-stimulated through water play, especially soothing. See reference list below.

Tactile Touching selection

smooth and rough concrete	loose sand
grass lawns	crushed gravel
textured or smooth plastic	river worn rocks
slick, metal slides	foam rubber mats

Table 4.18 Touching examples adapted from (Rohane, 1983)

Figure 4.8 Touching playground equipment examples

Albeit many ideas look great, lots of structures are not accessible, so designers should create alternate equipment using existing structures and manufactory. Besides, some playground companies offer customized options. With all of the components selected and how to appeal, in the next step, designers are going to evaluate their concepts from this step to refine better concepts into the final delivery.

4.4.2 Safety standard compliant - Accessibility
Ergonomics Concern

After skills and play components are selected, designers are engaged to consider the measurement for developing concepts, including activities zone, surfacing, safety (ADA and the Public Handbook of Playgrounds) which have been describe in the Chapter 2. However, there are several playground safety and measurement requirements, which still need to be emphasized here.

Before showing these points, there is the physical development measurement of children from 2.5 to 6 years old from the book *The measure of man and woman: Human factors in design* (Tilley, 2001) as references of anthropometry to determine suitable products' size and shape.

Figure 4.9 Young Children Body Measurement (2.5 – 4 years old), adapted from the book *The measure of man and woman: Human factors in design* (Tilley, 2001)
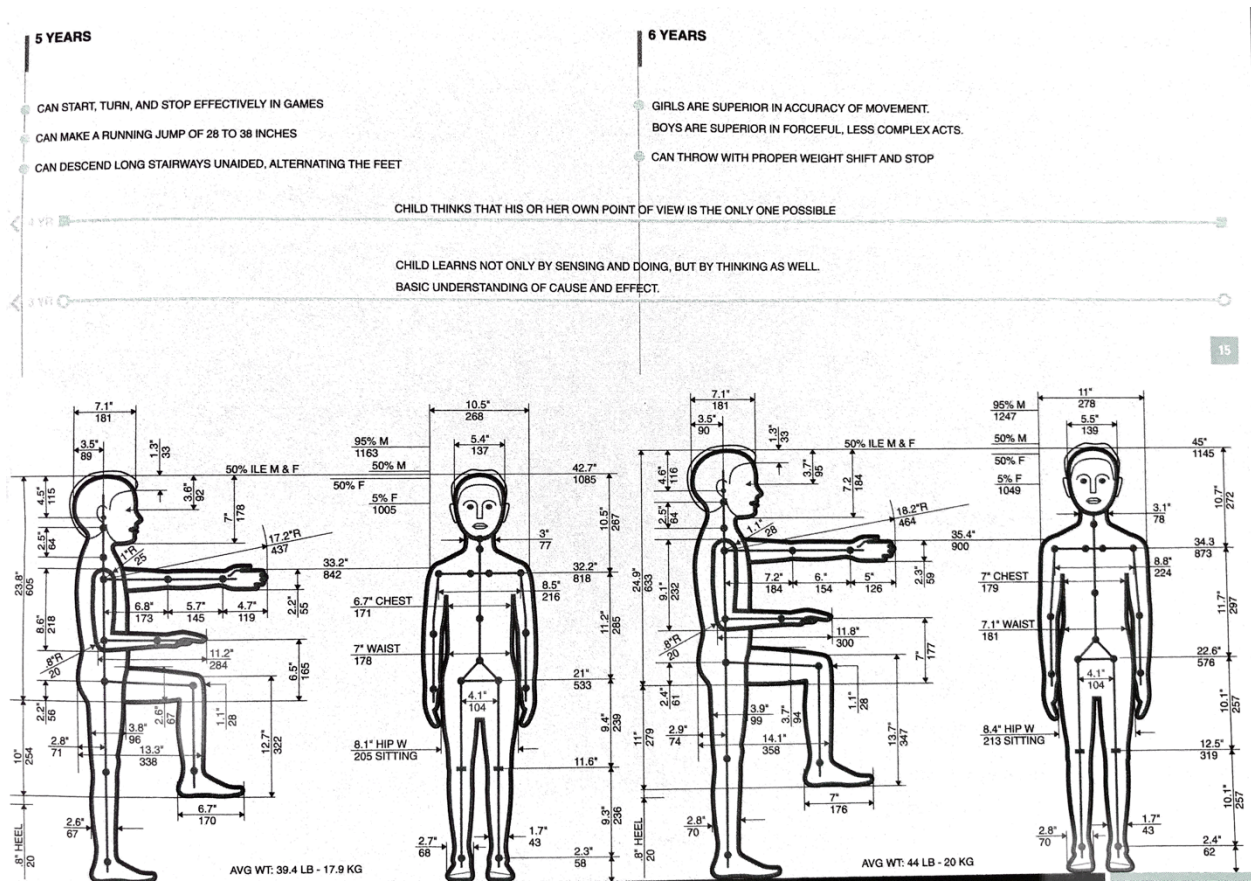
Figure 4.10 Young Children Body Measurement (5 – 6 years old) adapted from the book *The measure of man and woman: Human factors in design* (Tilley, 2001)

The Americans with Disabilities Act (ADA) Compliant

ADA is a comprehensive civil rights law, and must be complied with to ensure chances for people of all abilities. Here are several aspects that should be considered for designing school playgrounds to prevent children getting injured at this site.
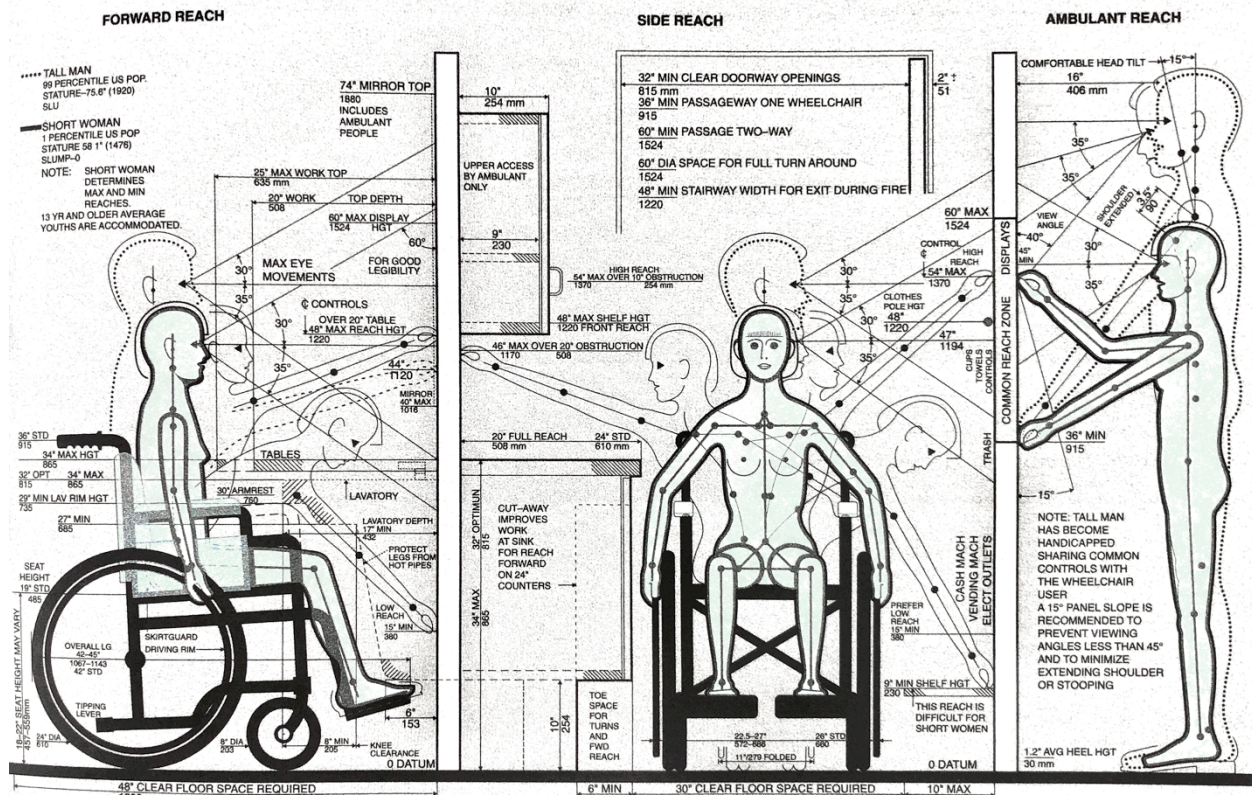
Figure 4.4 People use wheelchair adapted from the book *The measure of man and woman:*

Human factors in design (Tilley, 2001)
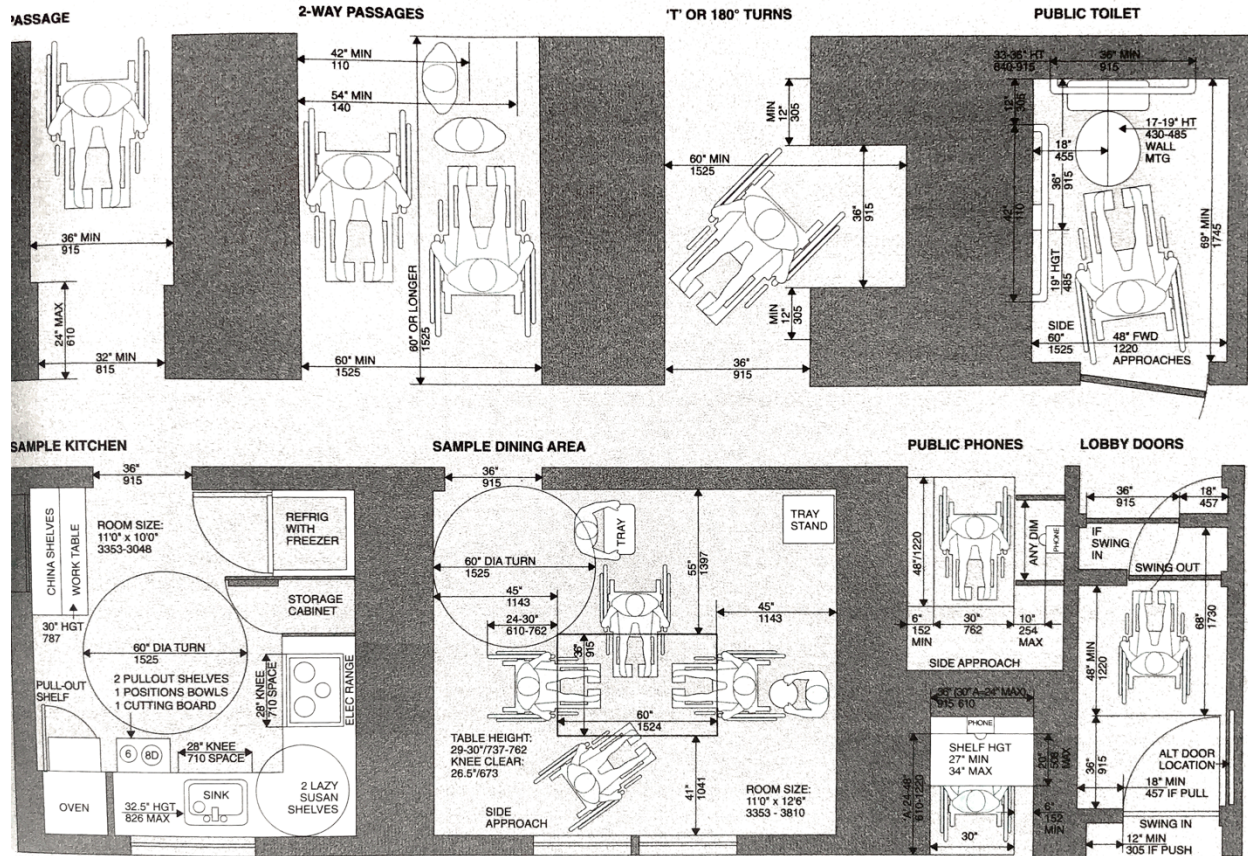
Figure 4.12 Wheelchair, adapted from the book *The measure of man and woman: Human factors in design* (Tilley, 2001)

Ramps

For each elevated ramp run:

- 12-inch (305 mm) maximum rise

- 1:12 maximum slope

- 36-inch (915 mm) minimum clear width

Landings

- Landings are the level surfaces at the top and bottom of each ramp run.

- Must be as wide as the ramp they connect to

- A minimum length of 60-inches (1525 mm)

- If ramps change direction, the minimum landing size must be 60 inches (1525 mm) wide to accommodate a turn

Handrails

Handrails are required on both sides of ramps connecting elevated play components. Handrails must comply with the following:

- Clearance between handrail gripping surfaces and adjacent surfaces and shall not be 1 1/2 inches (38mm) minimum.

- Handrail gripping surfaces shall be continuous along their length and shall not be obstructed along their tops or sides.

- The bottoms of handrail gripping surfaces shall not be obstructed for more than 20 percent of their length.

- Where provided, horizontal projections shall occur 1 1/2 inches (38mm) minimum below the bottom of the handrail gripping surface.

Public Handbook of Playgrounds Compliant

Preschool to kindergartens playgrounds could contain as stated in this handbook as follows:

• Certain climbers – for older preschool children are beginning to use flexible climbers, arch climbers, and upper body devices.

• Horizontal ladders less than or equal to 0" high for ages and 5"

• Merry-go-rounds

• Ramps

• Rung ladders

• Single file step ladders

• Slides

• Spiral slides up to 30°

• Spring rockers

• Stairways

• Swings – belt, full bucket seats (2- years) & rotating tire

The Commission has included recommendations that playgrounds not be installed over concrete, asphalt, or paved surfaces to address serious head injuries due to falls from the equipment. Additionally, the Commission has made suggestions for commonly used loose-fill and unitary surfacing materials (e.g., wood mulch, pea gravel, sand, gym mats, and shredded/recycled rubber mulch) that provide head impact attenuation and can mitigate the hazard presented by falls from playground equipment. Maintaining the focus on falls, the Handbook's surfacing recommendations are based on the surfacing material's energy absorbing effectiveness (Commission, 2008). Table 4.1 below is to show detail requirement of each vital components measurement at school playgrounds.

Table 6. Recommended dimensions for access ladders, stairs, and ramps*			
	AGE OF INTENDED USER		
Type of Access	**Toddler**	**Preschool-age**	**School-age**
Ramps (not intended to meet ADA/ABA specifications)			
Slope (vertical:horizontal)	< 1:8	≤ 1:8	≤ 1:8
Width (single)	≥ 19"	≥ 12"	≥ 16"
Width (double)	≥ 30"	≥ 30"	≥ 36"
Stairways			
Slope	≤ 35°	< 50°	< 50°
Tread width (single)	12-21"	≥ 12"	≥ 16"
Tread width (double)	≥ 30"	≥ 30"	≥ 36"
Tread depth (open riser)	Not appropriate	≥ 7"	≥ 8"
Tread depth (closed riser)	≥ 8"	≥ 7"	≥ 8"
Vertical rise	≤ 7"	≤ 9"	≤ 12"
Step ladders			
Slope	35≤65°	50-75°	50-75°
Tread width (single)	12-21"	12-21"	≥ 16"
Tread width (double)	Not appropriate	Not appropriate	≥ 36"
Tread depth (open riser)	Not appropriate	≥ 7"	≥ 3"
Tread depth (closed riser)	8"	≥ 7"	≥ 6"
Vertical rise	> 5"and ≤ 7"	≤ 9"	≤ 12"
Rung ladders			
Slope	Not appropriate	75-90°	75-90°
Rung width	Not appropriate	≥ 12"	≥ 16"
Vertical rise	Not appropriate	≤ 12"	≤ 12"
Rung diameter	Not appropriate	0.95-1.55"	0.95-1.55"

* entrapment recommendations apply to all openings in access components

Table 4.19 Recommendation measurements at school areas

Playground Hazards

The CPSC (2008) handbook states the potential playground hazards that designers should avoid. Besides, designers are responsible for understanding these hazards to develop in safer design. Here are some of hazards below:

- Crush and Shearing Points

Anything that could crush or shear limbs should not be accessible to children on a playground. Crush and shear points can be caused by parts moving relative to each other or to a fixed part during a normal use cycle, such as a seesaw…

- Entanglement and Impalement Projections on playground equipment should not be able to entangle children's clothing nor should they be large enough to impale...

- Entrapment

   - Head Entrapment

Head entrapment is a serious concern on playgrounds, since it could lead to strangulation and death. A child's head may become entrapped if the child enters an opening either feet first or head first (See Figure 4.) …
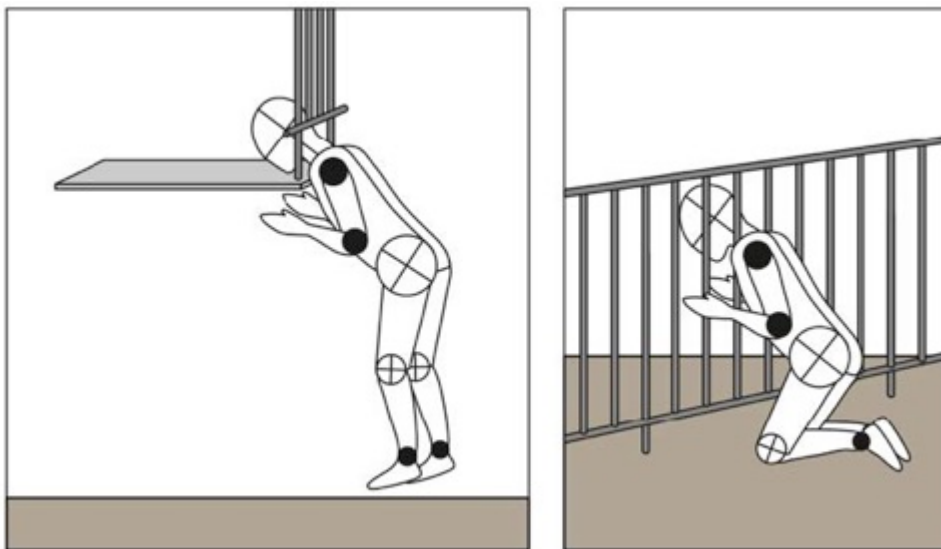
Figure 4.13 Examples of entrapment below a barrier and between the vertical bars of a barrier (CPSC, 2008, p. 15)

   - Partially bound openings and angles

Children can become entrapped by partially bound openings, such as those formed by two or more playground parts (See Figure 4.)…
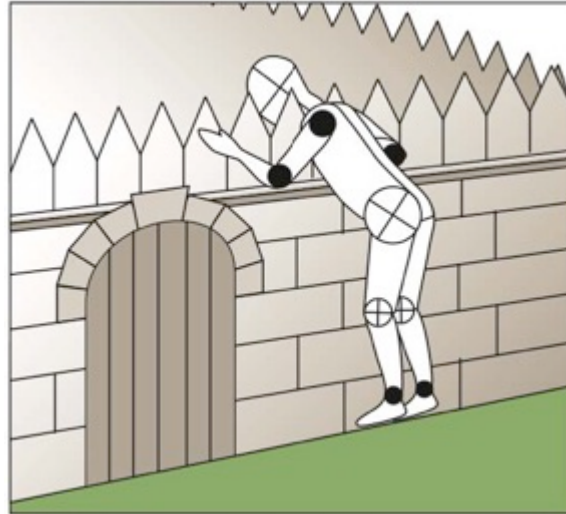
Figure 4.14 An example of entrapment in an angle less than 55 degree on a fort (CPSC, 2008, p. 16)

- Sharp Points, Corners, and Edges

Sharp points, corners, or edges on any part of the playground or playground equipment may cut or puncture a child's skin. Sharp edges can cause serious lacerations if protective measures are not taken…(pp. 14-16)

4.5.3   Materials

Play equipment materials

The majority of manufactured play structures use one or more of the following as the main construction material: pressure-treated wood, steel, galvanized steel, aluminum, and various recycled materials. Environmental conditions, use, and desired aesthetics should be

considered when selecting the materials to be used in the constructions of the playground equipment.

Pressure-treated wood

There is recent concern for the use of wood-preserving chemicals in the manufacture and construction of play structures. There is a wide range of opinions as to the possibility that the most common preservative, CCA, poses a health risk to those using playgrounds constructed of CCA-preserved wood. The Consumer Product Safety Commission has published an informative report regarding this issue.

Safety surfacing materials

To reduce the risk of injury due to falls, playground equipment should be located above a shock-absorbing, or safety, surface. Each surfacing material has a Critical Height factor. The Critical Height of a material is approximately the height below which a life-threatening head injury incurred from a fall would not be expected. The Critical Height factor is directly related to the depth of the material: the thicker the material, the greater its shock-absorbency and its Critical Height factor. The proper material and depth of a safety surface is determined by installing a material at a depth at which the Fall Height of the playground equipment is less than the Critical Height of the safety surfacing. The Fall Height is the maximum height from which a child may potentially fall from a particular piece of play equipment. Page 11 of the CPSC's Public Playground Safety Handbook , offers a table that indicates the Critical Heights for the most common playground surfacing materials at various depths.

Poured-in-place rubber and rubber mats are becoming increasingly popular in their use as a safety surfacing in playgrounds. Because of the wide variation among such products on the market, the CPSC suggests that test data be requested from the manufacturer identifying the Critical Height of their specific products.

The United States Consumer Product Safety Commission Compliant

Soft safety surfacing should be used under and around playground equipment and anywhere there is a risk of falling (Congress, 2008). The United States Consumer Product Safety Commission (CPSC) (2008) lists appropriate and inappropriate surfacing for theses so called fall zones.

Appropriate Surfacing

• Any material tested to ASTM F1292, including unitary surfaces, engineered wood fiber, etc.

• Pea gravel

• Sand

• Shredded/recycled rubber mulch

• Wood mulch (not CCA [Chromated Copper Arsenate]-treated)

• Wood chips

Inappropriate Surfacing

• Asphalt

• Carpet not tested to ASTM F1292

• Concrete

• Dirt

• Grass

• CCA treated wood mulch (p. 9)

Here are some examples of the surfacing materials.

Ground Material	Advantages	Disadvantages
Pea Gravel	- natural look - attractive price	- no protection for fallings - choking hazard - wheels can get stuck in it
Rubber Mulch	- shock absorbent - low-maintenance	- dirty after long-term use - escape area border - may smell in hot temperatures
Poured Rubber Rubber Tiles	- slip resistant - shock absorbent - wide color range - provide surface for playing - accessible for wheelchairs and strollers	- very expensive
Natural Grass	- natural look	- high-maintenance - prone to pests and bacterial buildup - by watering it is easier to cause the rust on metal play sets - not easy-accessible for wheelchairs and strollers
Artificial Grass	- low-maintenance comparing to natural grass - accessible for wheelchairs and strollers - offers a softer cushion for rough play	- installation is more expensive than natural grass - needs to be occasionally rose and fluffed
Play Sand	- absorb falls (if is not shallow)	- needs to be refilled to avoid shallows - can bothers while and after playing - not accessible for wheelchairs and strollers
Wood Chips and Mulch	- good visual appeal - color range	- can mold - make good habitat for insects - choking hazard - needs regular refreshing
Engineered Wood Fiber	- slip-resistant - shock absorbent - good appeal - biodegrade - accessible for wheelchairs and strollers	- needs refilling - quite expensive

Table 4.12 Surfacing materials

4.6 Final Delivery

For final delivery, it is necessary to develop a reasonable and suitable to clearly explain the whole concept. It should contain the product CAD File (measurement), Top view File, the final scale model, and animation for marketing groups to easier understand for making a decision which will be transferred to technical groups to implement this final concept.
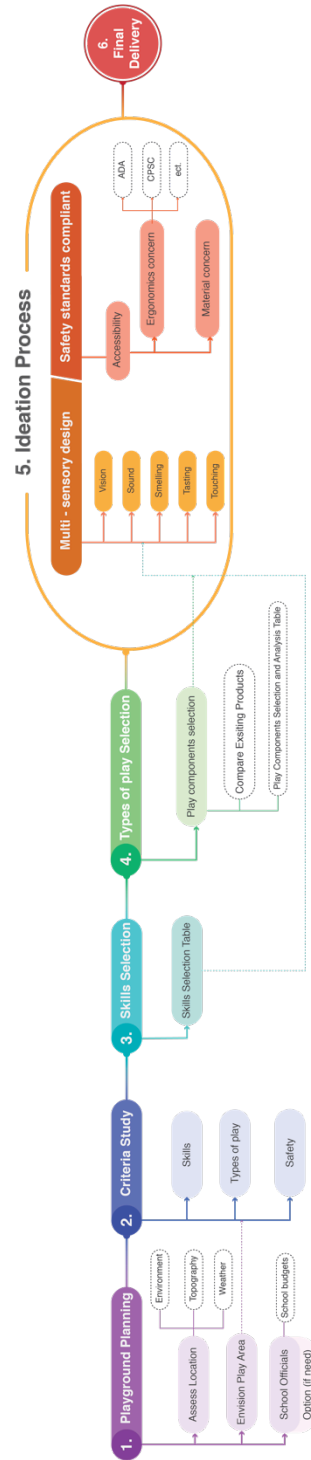
Figure 4. 12 The approach flowchart

Chapter 5 Design Application

In this chapter, the approach described in the last chapter will be demonstrated with a design application to show how successful the approach could be. The sequence will be the same as the flow chart in Figure 4.12

5.1 Playground Planning

For the first step, I chose the Auburn Montessori School, at Alabama that only serves three to six years old children. Besides, I went in a field trip of this school to see the environment. As can be seen in Figure 5.1, the school is the enclosed area that does not allow strangers to come in. Moreover, the yellow outlined box shows their existing play space.
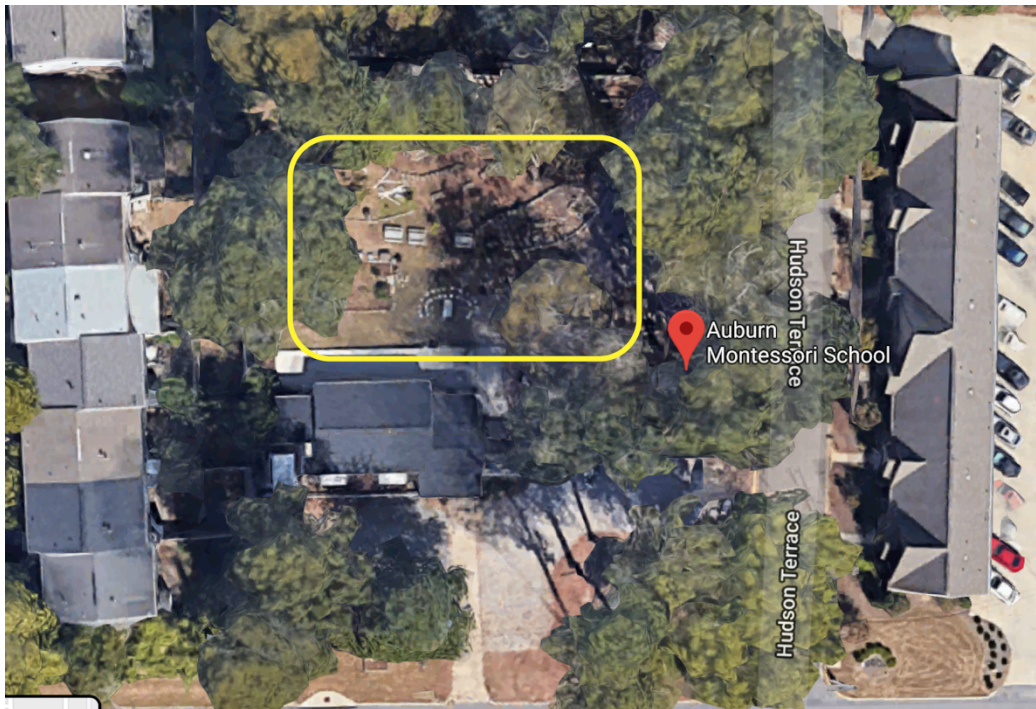
Figure 5.1 Top view of the landscape of the Auburn Montessori School, searching from

the Google Map

After the site decision, following the approach, the next phase is to assess this play space. For the topography, this site surfacing is almost flat and some play equipment is scattered in this play space.

Figure 5.2 Auburn Montessori School play space Adapted from the children's house Auburn Montessori School website

The next phase is to collect the weather information of Auburn, Alabama, where the summers are hot and muggy; the winters are short, cold, and wet. Over the course of the year, the temperature typically varies from 38°F to 91°F and is rarely below 25°F or above 97°F.
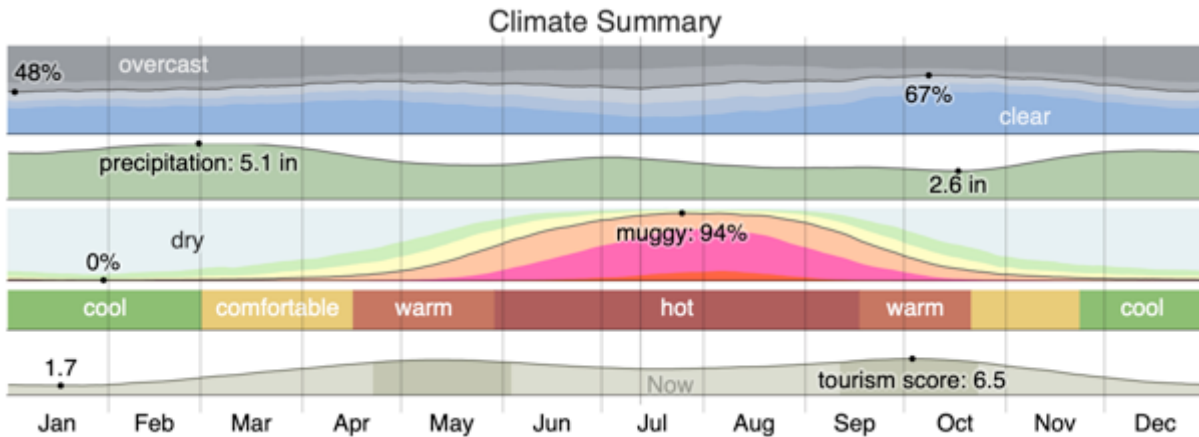
Figure 5.3 Auburn Weather, adapted from the Weather Spark website

Checking the school general calendar is the next step. For this school, this year 2019, first semester started in January.8. 2019 (classes beginning) to June 21, June 24th to August 5th (no school, summer break) and the second semester will begin in August.6 2019. But they still offer summer camp nine-week period in the early June to the mid August as an option for parents and children to choose. According to what I mentioned in Chapter 2, Montessori asserts that good environment is the key point in child development. Therefore, their play space is filled with natural materials, which is considered as the core material in this site design.

5.2 Criteria study

5.2.1 Skill

The analysis of the existing playground performance from three aspects: skills, types of play, and safety are as follows. We could realize that there is limited play equipment of manipulative and visual skills in physical and social – emotional development (see Table 5.1).

Skills				Excellent	Adequate	Absent
Physical Development	Basic Stability	Body Assistance			√	
		Body/Equipment				
	Locomotor	Speed			√	
	Manipulative	Gross	Body			√
		Fine	Hand /Food Relationship			
	Visual Perception	Visual Acuity				√
		Figure- ground perception				√
		Visual – motor coordination				√
Social - Emotional Development		Play stage			√	
Cognitive Development	Spatial / Visual	Dimensions (2D – 3D)				√
	Verbal / Linguistic	Phonology, Semantics, Morphology, Syntax, Pragmatics			√	
	Mathematical / Logical	Logical & Reasoning			√	
	Musical	Auditory sensitivity			√	
		Musical feeling and understanding				
	Naturalist	Observation		√		
		Pattern recognition				

Table 5.1 Skills table

The next aspect is the types of play. I noticed there are three swinging sets. Two sets are located in the front of their main house, on the big tree at the welcome area. The other one is at the play space (see Figure 5.4).

130

Figure 5.4 Swing sets at the Auburn Montessori School, adapted from the Auburn Montessori

School Facebook

At the play space, there are a sand box play area, green garden play area, quiet zones for

outdoor classes, several balancing steppers equipment, and only one slider set equipment.

Figure 5.5 Outdoor classroom space and slider set equipment, adapted from the Auburn

Montessori School Facebook homepage

5.2.2 Types of play

According to the result of types of play checklist, we could see the lack of sensory play

and climbing play at this play space.

Types of Play	Excellent	Adequate	Absent
Sensory Play			√
Swing Play		√	
Climbing Play			√
Sliding Play		√	
Spinning Play		√	
Brachiating Play		√	
Balancing Play		√	

Table 5.2 Types of Play Table

5.2.2 Safety

Before beginning the ideation processing, analysis of the surrounding and ground surfacing situation at the Auburn Montessori School is necessary.

Safety		Excellent	Adequate	Absent
Activities zones	Quiet zones		√	
	Intermediate zones		√	
	Noisy zones		√	
	Corner zones		√	
Surfacing	Material	√		
Entrapment	Machine pitch points	N/A	None	Yes
			√	
	Head entrapment		√	
	Hazard zone demarcation		√	

Table 5.3 Safety Table

After completing these checklists, we could see this site is lacking of several physical skills, sensory, spinning and climbing play for appealing to children's needs.

5.2.1 Skill Selection

After analyzing the existing play space condition, the next step is to choose skills and

develop the pre-defined skills table as the direction in the concept generation phase, using

Table 4.9 as the reference to choose skills. After collecting all information, it is not hard to see

the deficit of speed, gross and fine motor skills at this play space (see skills selection Table 5.4).

SKILLS SELECTION				
PHYSICAL DEVELOPMENT	Basic Stability	Body Assistance		
		Body/Equipment Relathionship		
	Locomotor	Speed		√
	Manipulative	Gross	Body	√
		Fine	Hand/Foot Relationship	
	Visual Perception	Visual acuity		√
		Figure-ground perception		√
		Visual-motor coordination		√
SOCIAL-EMOTIONAL DEVELOPMENT	Play stage			
COGNITIVE DEVELOPMENT	Spatial/Visual	Dimensions (2D - 3D)		√
	Verbal/Liguistic	Phonology		√
		Semantics		
		Morphology		
		Syntax		
		Pragmatics		
	Mathematical/Logical	Logical & Reasoning		√
	Musical	Auditory sensitivity		√
		Musical feeling and understanding		
	Naturalist	Obsevation		
		Pattern recognition		

Table 5.4 Skills Selection Table

5.3 Play Components Selection

As it was stated in Chapter 4 on the approach to create a play space at preschools, the play components selection is vital for concept generating. In this section, based on analysis of this location, the Auburn Montessori School, this play space is lacking climbing play. For matching skills that are selected in the previous step, choosing the climbing play is the main goal for achieving appeal to these skills. I have selected two famous the United State playground company to compare existing products, including the Landscape Structure and the GameTime at Playcore where I worked before as an intern. All the manufacture will use the GameTime's products for the final delivery. After selecting skills to be used in this play space, designers are engaged to modify and embellish it to create or redesign new play equipment. Therefore, here are the comparative product charts below. For all of these charts, product 1 and 2 are from Landscape Structure. Product 3 and 4 are selected from GameTime.

The comparative product chart (see Table 5.5) is for different possibilities of climbing play with natural elements to appeal to the Auburn Montessori School as references. Both Landscape Structure and GameTime have multiple ages for the simple play. Besides, they offer children rich experiences in sensory aspects (proprioception, tactile, vestibular, and visual), motor skill (balance, coordination, core body strength, flexibility, lower body strength, motor planning, upper body strength), cognitive skills (problem solving), and social/emotional skills (cooperation, imaginative play, social skill development). To appeal to this location's special needs, natural elements will be the first aspect in the ideation process.

PRODUCT COMPARISON Existing Products	Mushroom Stepper	Log Stepper	Mushroom Path	3 Stump Climber
Strengths	• Have nature elements • Suitable for multiple ages children • Saving more spaces.	• Have nature elements • Suitable for multiple ages children • Saving more spaces.	• Have nature elements • Suitable for multiple ages children • Saving more spaces.	• Have nature elements • Suitable for multiple ages children • Saving more spaces.
Weaknesses	• Not friendly for children with disabilities • Only one child could enjoy at a time. • Risk in the space of the red marked circle	• Not friendly for children with disabilities • Only one child could enjoy at a time.	• Not friendly for children with disabilities • Only one child could enjoy at a time. • Risk in the space of the red marked circle	• Not friendly for children with disabilities • Only one child could enjoy at a time.
Opportunities	1. Could designers consider better way to incorporate an activity for children with disabilities into climbing equipment? 2. Could designers develop the equipment which multiple children play at the same time.			

Table 5.5 Comparative Product Chart of Climbing Play

The next comparative product chart (see Table 5.5) is also for climbing play to seek more perspectives with the same play. Part of them is simply, modern shape styles, which make products look more clean and beautiful. This point also is referred in the ideation process for developing the concept.
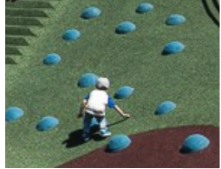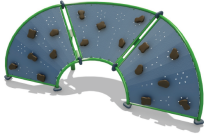
PRODUCT COMPARISON Existing Products	Mobius Climber 3-Panel	Climbing	Wrinkle Wall Mogul	Discover Cave with Primary Grips
Strengths	● Suitable for multiple ages children ● Visually appealing structural	● Suitable for multiple ages children ● Visually appealing structural	● Suitable for multiple ages children ● Visually appealing structural	● Suitable for multiple ages children ● Visually appealing structural
Weaknesses	● Not friendly for children with disabilities	● Not friendly for children with disabilities	● Not friendly for children with disabilities	● Not friendly for children with disabilities
Opportunities	1. Could designers consider better way to incorporate an activity for children with disabilities into climbing equipment? 2. Could designers develop the equipment which multiple children play at the same time.			

Table 5.6 Comparative Product Chart of Climbing Play

PRODUCT COMPARISON Existing Climbing House Products	PRODUCT 1	PRODUCT 2	PRODUCT 3	PRODUCT 4
Strengths	● Multiple levels for different ages children	● Multiple levels for different ages children	● Multiple levels for different ages children	● Multiple levels for different ages children
Weaknesses	● Not friendly for children with disabilities	● Not friendly for children with disabilities	● Not friendly for children with disabilities	● Not friendly for children with disabilities
Opportunities	1. Could designers consider better way to incorporate an activity for children with disabilities into climbing equipment? 2. Could designers develop the equipment which multiple children play at the same time.			

Table 5.7 Comparative Product Chart of Climbing House Play

The last comparative product chart (see Table 5.8) is looking how both of them use

sensory play with different multi-senses into play equipment. Particularly, shadow play from

GameTime is an innovational idea to combine science, art and physical together for children to enjoy different and unique experiences than other sensory play. So, I was inspired from this and consider developing other way of shadow play in the ideation process.
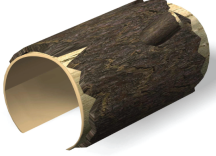
PRODUCT COMPARISON Existing Products	Log Crawl Tunnel	Sensory Wall	Shadow Play	Sensory Dome
Strengths	• Nature element appeal this site which is chosen at the first step	• Offer various touching ways for children to touch and feel	• A unique play activity that doubles as playful art, climbing and sliding under shadow	• Multiple pathways for children to crawl on, through, around and over
Weaknesses	• Not friendly for children with disabilities	• Not friendly for children with disabilities	• Not friendly for children with disabilities	• Not friendly for children with disabilities
Opportunities	1. Could designers consider better way to incorporate an activity for children with disabilities into climbing equipment? 2. Could designers develop the equipment which multiple children play at the same time.			

Table 5.8 Comparative Product Chart of Sensory Play

5.4 The Ideation Process

5.4.1 Multi- Sensory Concern

After the above steps, there are several points that could be considered in the concept, including gross and fine motor skills, climbing play, spinning play, sensory play, natural elements, shadow play and simple forms for this play space. Based on analysis of existing play space, for visual aspect, I apply the Game time acrylic panels to capture the sunlight and cast color shadows inside while children are walking or running in the tunnel. These activities would offer children rich experiences that encourage their cooperative and social play for children's

skills. Even children who do not walk or run inside could also climb the outside layout to see

inside with colorful fillets. There are multiple high levels of shadow placement for different

people to use, and it is also compliant with ADA standards to appeal to people who use

wheelchairs.

5.4.2 Accessibility

5.4.2.1 Ergonomics Concern

With deciding to develop concepts of climbing play, sensory play, and multi-senses, at

this step it is necessary to determine to provide more safety environment for children at this site.

According to this site's current surfacing researching, because the ground of this play space is

covered with wood mulch, pea gravel, and few grasses, that is great condition of surfacing, so

that changes should keep the original surfacing. However, other aspects still need to have more

attention paid, as following.

ADA compliant

- The pathway with two wheelchairs has to be 60 inches at least.

- Height of the incline ramp should be at maximum 12 inches.

Public Handbook of Playgrounds Compliant

- The highest climbing for 2 to 5 years old should be 32 inches

5.4.2 Materials

- In the choosing material step, for easier and effective manufacturing, I

utilized existing materials from GameTime, colorful acrylic panels and recycled materials

for conserving water and eliminating waste - recycled polyethylene painted with natural color. Hand sculpted and hand painted GFRC log creates a natural and realistic looking play space by GameTime. Besides, the surfacing at this site is a good condition and safe ground.

5.5 Final Delivery

- **3D Rendering**

Figure 5.6 Product Rendering Image – Top View

Figure 5.7 Product Rendering Image – Back View

Figure 5.8 Product Rendering Image – Right View

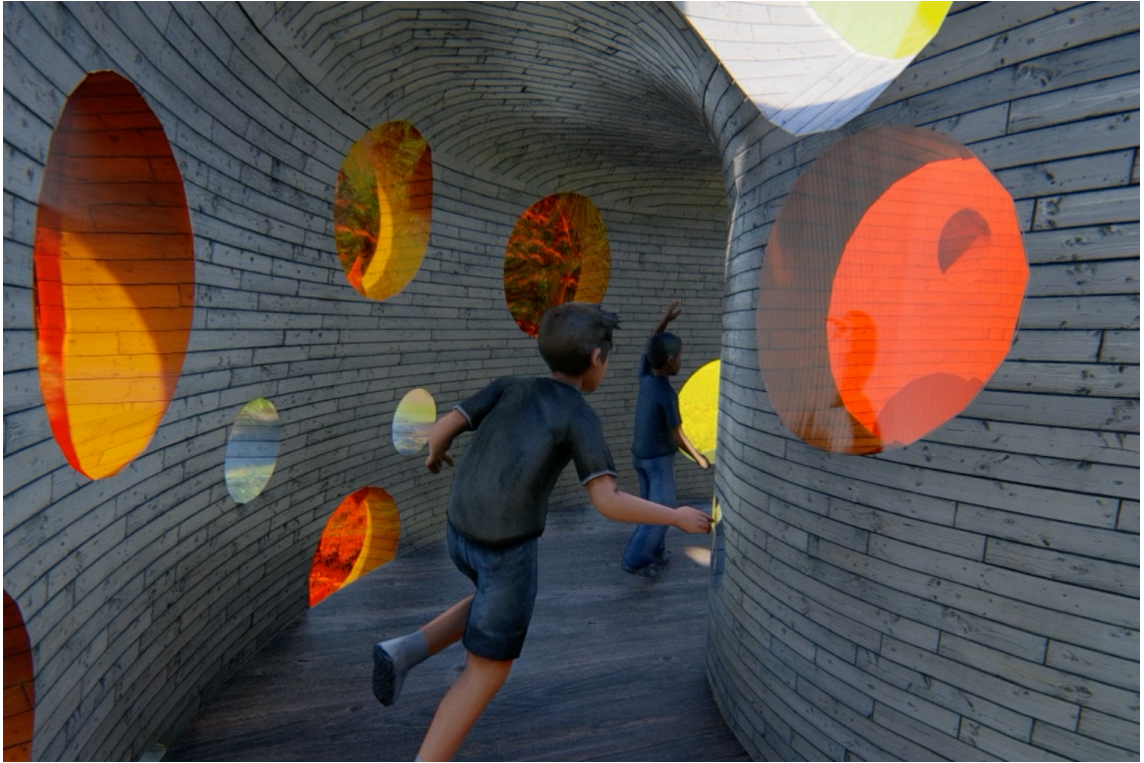Figure 5.9 Product Rendering Image – Front View

Figure 5.10 Product Rendering Image – Inside View

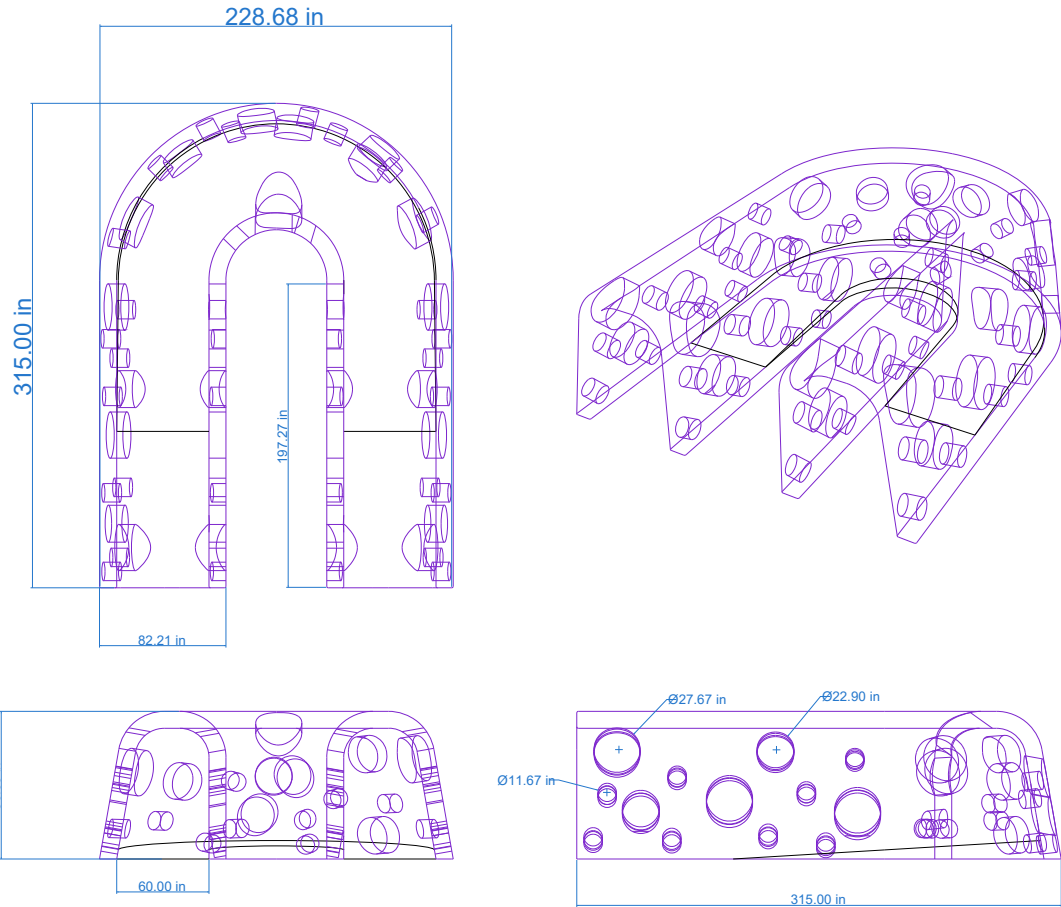Figure 5.11 Product Rendering Image – Inside View

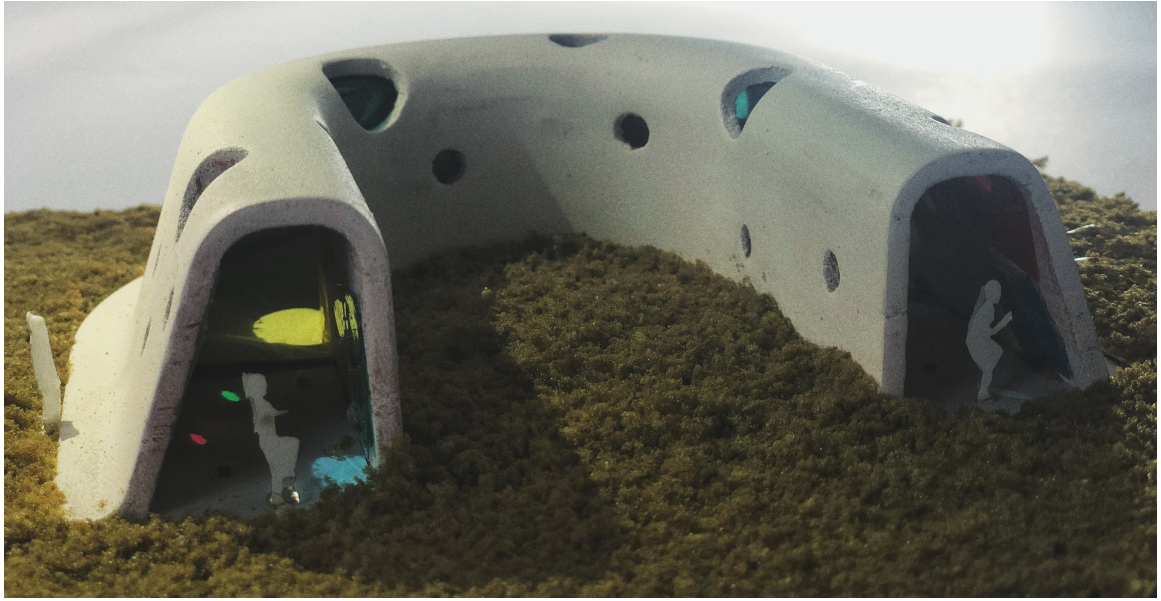- **CAD File**

Figure 5.12 CAD File

- **Scale Model**

Figure 5.13 Scale Model

Figure 5.14 Scale Model Details

- **Animation**

Figure 5.15 Animation

Chapter 6 Conclusion

6.1 Conclusion

The purpose of this thesis was to develop an approach to aid designers to create a better play environment to appeal to children's needs. Chapter One discusses the current problem behind this thesis. Chapter Two discusses theories of these areas and seeks to support the approach later. Chapter Three focuses on studies of current similar products. Chapter Four develops the approach outlined for this thesis. Chapter Five follows the approach to show an example project to prove this approach.

6.2 Further Development

For child development playful learning method into playgrounds, this research is focusing more on the study of children's skills in their development and the connection with playgrounds. There is already some research talking about the role of parents and teachers in the play system with children. But the scope of this study does not include evaluation, and it is suggested that designers should go through the evaluation process before releasing their design into market. It will be worth it to develop that unexplored field.

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