

A Comparison of Playground Evaluation Methods to Inform Nature-based Playground Design

by

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Acknowledgement	4
Abstract	5
Chapter 1. Introduction	7
1.1 Issues of Concern and Background of Current Children's Situation and Needs	7
1.2 Statement of Purpose and Objectives	8
1.3 Study Limitations.....	9
1.4 Summary	10
Chapter 2. Literature Review	11
2.1 Introduction	11
2.2 Last Child in the Woods	11
2.3 Nature and Young Children: Encouraging Creative Play and Learning in Natural Environment ..	14
2.4 Play and Interplay	16
2.5 Design Guidelines of a Therapeutic Garden for Autistic Children	17
2.6 Conclusion.....	18
Chapter 3. Methodology.....	19
3.1 Overview and Introduction	19
3.1.1 Procedures for Doing Existing Playgrounds Evaluations.....	19
3.1.2 Procedures for Evaluation Results Analysis	19
3.1.3 Procedures for Identifying General Guidelines for Nature-based Playgrounds	20
3.2 Evaluation Criteria.....	20
3.2.1 Evaluation Metric One	21
3.2.1.1 Evaluation Metric One: Material - Form (Visual experience)	21
3.2.1.2 Evaluation Metric One: Material – Semblance (Visual Experience)	22
3.2.1.3 Evaluation Metric One: Material-Touch (Tactile experience).....	24
3.2.1.4 Evaluation Metric One: Degree of Context.....	27
3.2.1.5 Evaluation Metric One: Other Natural Elements	31
3.2.1.6 Evaluation Metric One : Graphic Design	32
3.2.1 Evaluation Metric Two	33
3.2.2.1 Evaluation Metric Two: Natural View and Green Landscape	33
3.2.2.2 Evaluation Metric Two: Opportunities for Children to Interact with Nature by Doing Certain Activities	34
3.2.2.3 Evaluation Metric Two: Sensory Experience.....	37

3.2.2.4 Evaluation Metric Two: Degree of Context.....	38
3.2.2.5 Evaluation Metric Two: Other Natural Elements.....	40
3.2.2.6 Evaluation Metric Two: Graphic Design.....	41
3.2.2 Existing Children Playgrounds Selection.....	42
3.2.3 Evaluation Methods	44
Chapter 4. Results and Discussion	45
4.1 Results for Playground One	45
4.1.1 Oaks Mall Children's Playground Evaluation One.....	45
4.1.2 Oaks Mall Children's Playground Evaluation Two.....	47
4.2 Results for Playground Two	49
4.2.1 Depot Park Children's Playground Evaluation One.....	49
4.2.2 Depot Park Children's Playground Evaluation Two.....	52
4.3 Results for Playground Three.....	54
4.3.1 Alfred A. Ring Park Children's Playground Evaluation One.....	54
4.3.2 Alfred A. Ring Park Children's Playground Evaluation One.....	56
4.4 Results for Playground Four	58
4.4.1 Woodland Discovery Playground Evaluation One	58
4.4.2 Woodland Discovery Playground Evaluation Two	61
4.5 Results for Playground Five.....	62
4.5.1 Teardrop Park Playground Evaluation One	62
4.5.2 Teardrop Park Playground Evaluation Two.....	65
4.6 Results for Playground Six.....	66
4.6.1 Tumbling Bay Park Playground Evaluation One.....	66
4.6.2 Tumbling Bay Park Playground Evaluation Two.....	70
4.7 Results Analysis	72
4.8 General Guidelines.....	74
Chapter 5. Conclusions	78
Bibliography	81

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Abstract

With our ever-changing society, an increasing number of children are addicted to indoor activities and spend insufficient time engaging in outdoor play due to several reasons, such as the urbanism (demolishing natural area for modern building construction), safety consideration, relevant environmental-friendly policy, the attraction of television, cell phones, and other electronic products.¹ According to the article Children: General Health, in the recent forty years, the number of children walking to school decreased from 48% to 13%. And also based on this article, parents frequently cite the proximity to the school, increased traffic, and general perception of anger as reasons for this decline.² Lack of outdoor activities can result in behavioral problems, a phenomenon described as nature-deficit disorder in Richard Louv's 2005 book, *Last Child in the Woods*. Thus, it is important to help children recover from or avoid nature-deficit disorder and provide an environment that helps them improve their physical, mental, emotional health, and other comprehensive abilities. As described by Louv, *Last Child in the Woods*, nature has a therapeutic effect on children and it is important to let children have more outdoor interaction with nature.³ Therefore, how to combine play with nature is an essential issue which should be addressed for children. To address this issue, first, the researcher collects the theoretical basis from the literature and other relevant resources to obtain an understanding about children's need and the therapeutic effect of nature. Second, the researcher evaluates and analyzes the existing playgrounds by criteria and graphics, and more detailed resources and theories are used as the basis for the evaluation criteria. Third, after completing the evaluation graphics and playgrounds selection, the evaluator conducts a comprehensive

evaluation and analysis and deduces results and general guidelines in terms of the context selection, equipment design, natural elements design and other principles, which is helpful for a nature-based children's playground design. Fourth, the evaluator provides further discussion for future studies to ensure that researchers can obtain more comprehensive, objective results for a nature-based children's playground.

Chapter 1. Introduction

1.1 Issues of Concern and Background of Current Children's Situation and Needs

According to the Last Child in the Woods, by Richard Louv, an increasing number of children suffer from nature-deficit disorder, and they have a variety of behavioral problems because of deficient interaction with the outdoor environment.⁴ First, in terms of physical problems mainly caused by a lack of outdoor activities, an increasing number of children are over-weight. Second, in terms of mental problems, children who suffer from nature-deficit disorder have difficulties in social, verbal, and nonverbal communication. Some children cannot filter and perceive their surrounding information, have trouble thinking independently, expressing themselves, or conveying information clearly. Moreover, they also lack a cognitive ability. Furthermore, it is also difficult for children who suffer from nature-deficit disorder to concentrate and they are more likely to be distracted, which is called attention deficit disorder, according to Kaplan and Kaplan.⁵ Third, regarding emotional problems, children who suffer from nature-deficit disorder are more likely to feel pressured, depressed, and cannot control or adjust their emotions well.⁶ These problems and issues for children have a negative influence on their health and growth.

It is also important to determine what causes children to have fewer outdoor activities which result in these behavioral problems. According to Louv, there are four main reasons which can explain why an increasing number of children tend to spend more time in the house rather than do outdoor activities. First, with the expansion of

environments, a lot of green space and the natural environment were destroyed and used to build modern commercial buildings and other infrastructures for urban life. Second, parents would like to protect their children, so because of safety considerations, they do not want their children to play outside and be under the risk of being hurt. Third, some natural areas are restored and protected by local environmental policy and children are forbidden to play in some certain natural areas because they may damage some natural resources. Fourth, with the development of science, children have more choices when they are at home, such as television, using cell phones, laptops, and many other electronic products.⁷ The above reasons have caused children to be trapped in the house rather than go out and interact with the natural environment. Based on this information and research, children should not only play, but also need to interact with the outside environment to avoid nature-deficit disorder. Therefore, it is significant to create a successful nature-based playground for children to solve these problems and give them more opportunities to interact with nature. These playgrounds can assist with maintaining physical, emotional, mental, psychological health for children, and help them recover from nature-deficit disorder.

1.2 Statement of Purpose and Objectives

The main goal of this project is to identify general guidelines for a nature-based children's playgrounds based on a detailed literature review, evaluation, and analysis of existing playgrounds. A second important goal is to create and compare two evaluation metrics, which may be used to assess the effectiveness of a playground in addressing nature-deficit disorder. The objectives of the project are threefold. The first step is to create a theoretical basis for analysis based on relevant literature and articles. Second,

based on the theoretical collection and analysis, the project should devise two different criteria and graphics based on different evaluation considerations, and then use these to evaluate the existing playgrounds and analyze the results of the playgrounds evaluation by a horizontal comparison. The reason of why the evaluator are creating two different sets of criteria is to evaluate the playgrounds in terms of different considerations and come up with a more comprehensive result. Third, the project should be able to develop further discussion and general guidance for a nature-based children's playground design.

1.3 Study Limitations

The project also includes some study limitations. There are six existing playgrounds evaluated by the criteria and graphics. Among the six existing playgrounds, three are located in Gainesville, so the playground evaluation and study are based on site visitation and observation. However, the other three playgrounds are out of Gainesville, so for these playgrounds, the evaluation depends on online or other literature resources collected and analyzed rather than visiting the sites because of the restriction of time and region. The evaluator is going to evaluate the parks outside of Gainesville even though the evaluator could not visit them because the project is going to analyze the playgrounds with a variety of context rather than just focus on one context and background.

Other limitations include that the evaluations are subjective and just based on one evaluator. To be more conclusive and objective, it would help to have another person test the evaluations to see if they come to the same conclusions. For example, other

landscape architecture students, researchers, and designers can test the evaluation and produce another conclusion and guidance for this topic to gain a more objective result based on the different evaluators.

1.4 Summary

To help children recover from nature-deficit disorder and improve their physical, mental, emotional health, and other comprehensive abilities, such as cognitive abilities, it is essential to provide therapeutic nature-based playgrounds to provide more opportunities for children to play and interact with the natural environment, so they can recover from behavioral problems and lead a more healthy and happy life. It is clear that playgrounds are one means of achieving this based on the background information. Therefore, to realize this goal, this project should accomplish the relevant research and analysis as what is illustrated and provide new general guidance and principles for a nature-based playground design in the future.

Chapter 2. Literature Review

2.1 Introduction

A thorough literature review is significant as it provides a theoretical basis for further research of the project. This project attempts to use the literature review to define project questions and background, analyze primary issues, identify children's basic needs and how to satisfy the children's need through landscape research and design. To accomplish these purposes, primary literature resources includes Last Child in the Woods by Richard Louv, Nature and Young Children: Encouraging Creative Play and Learning in the Natural Environment by Ruth Wilson, Play and Interplay by Paul Friedberg, and Design Guidelines of a Therapeutic Garden for Autistic Children by Bonnie B. Hebert. The researcher reviewed these literatures comprehensively, and selected the specific contents which were most helpful for this project.

2.2 Last Child in the Woods

Last Child in the Woods was written by Richard Louv. in April 2005. According to this book, children suffer from more physical and behavioral problems than before. With the development of society, kids are aware of more global issues to the environment, but their physical contact, their intimacy with nature is fading because of urbanism, safety consideration, relevant environmental-friendly policy, and addiction to electronic products. Such phenomena not only has a bad influence on children's physical health but is also harmful for their mental, emotional, spiritual, and psychological health. Thus, an increasing number of children suffer from nature-deficit-disorder (the behavioral problems result from a lack of outdoor activities). Based on this book, the main

symptom of nature-deficit-disorder includes lack of sense ability, low integrated competence, and other problems of mental and physical health.⁸ Thus, it is an essential problem for children and we must find effective ways to address it.

The book also states that nature can solve these problems and concerns for children effectively. *Last Child in the Woods* claims that nature has an important therapeutic effect for children, playing in nature can help children to relieve pressure and bad emotion, heal attention-deficit disorder, stimulate sense perception, and improve various competence for children. Therefore, what can be absorbed from this book, namely improving the relationship between children and nature is essential for children to heal or avoid nature-deficit disorder. Furthermore, for more detail, *Last Child in the Woods* mentions that Kaplan and Kaplan illustrate that children can pay more attention to what they do and avoid being distracted, after they spend time in nature, which is called attention restoration theory. According to Kaplan and Kaplan, too much directed attention leads to what they call “directed-attention fatigue”, marked by impulsive behavior, agitation, irritation, and an inability to concentrate. Instead, nature is the most effective method to heal these symptoms and improve students’ performance. Moreover, based on the research, the faculties in the office with beautiful natural views tend to provide lower pressure, more calmness and composure, and are easier to stay in a good mood than the faculties in the office without natural views. Some other professionals also developed similar perspectives that children would like to relax in the playground because the playground can act as a relief for them from the pressure of studying during the day. According to Cornell University environmental psychologists reported in 2003, a room with a view of nature can help protect children against stress,

and that nature in or around the home appears to be a significant factor in protecting the psychological well-being of children in rural areas. As assistant professor of design and environmental analysis in the New York State College of Human Ecology at Cornell, Ms. Nancy Wells mentioned: “Our study finds that life’s stressful events appear not to cause as much psychological distress in children who live in high-nature conditions compared with children who live in low-nature conditions.” Moreover, based on *Last Child in the Woods*, children with more nature near their homes received lower ratings than peers with less nature near their homes on measures of behavioral conduct disorders, anxiety, and depression. Based on the report, even in a rural setting with a relative abundance of green landscapes, more nature appears to be better when it comes to bolstering children’s resilience against stress or adversity.⁹ Thus, in general, nature has a very prominent therapeutic effect that can not only improve children’s physical condition, but also benefit their emotional health and other competence, children can understand, explore nature, and their surrounding environment spontaneously by pleasant play.

Furthermore, according to this book, nature-based intelligence is the eighth intelligence of humans and the core of naturalist intelligence is a human’s ability to recognize plants, animals, and other parts of the natural environment. According to a list of descriptors for children with the eighth intelligence, the characteristics of such types of children include having keen sensory skills, including sight, sound, smell, taste, and touch, readily available, heightened sensory skills to notice and categorize things from the natural world, like to be outside, or like outside activities such as gardening, nature walks, or field trips geared toward observing nature or natural phenomena, interested in and care about animals and plants, and so forth. Besides sensory effects, nature can

also stimulate the creativity of children when they play in the green environment. Nature can make children learn to imitate and create a connection between different things and it lets children explore, improve themselves, and help children promote their ability in various fields.¹⁰

In conclusion, *The Last Child in the Woods* provides information in terms of the problems and issues of current children's situations, the reasons behind these problems, information on how nature provides therapeutic benefits for children's mental, emotional, psychological health and integrated competence, and what therapeutic benefit children can get from nature. These theories and perspectives illustrated from *The Last Child in the Woods* are helpful for the project as they provide guidance to help the researcher understand children's issues comprehensively, and also determine how nature influences children's health, which can enlighten and provide information for the criteria and evaluation graphics for children playgrounds.

2.3 Nature and Young Children: Encouraging Creative Play and Learning in the Natural Environments

According to *Nature and Young Children: Encouraging Creative Play and Learning in Natural Environments* by Ruth Wilson in 2012, it is important to combine nature and play together, and let children participate in nature play. In terms of nature play for children, it includes things such as digging in the sand, running through a pile of leaves, or floating leaves and bark in a bucket of water. Based on this book, play with nature does not only mean **in** the nature, but also refers to play with natural environments and natural materials. Furthermore, this book comes up with a concept called authentic play,

which is considered the best kind of play for young children. The authentic play is fun, open-ended, self-directed, and freely chosen (Stephens, 2009). Authentic play occurs naturally when children and nature are brought together.¹¹

In addition to the discussion of the best play for children, *Nature and Young Children* also illustrated the benefits of nature play. In a review of the researchers on nature play, Erickson and Ernst (2011) identified four main benefits. First, nature play makes kids healthier by stimulating higher levels of physical activities. Second, nature play makes kids smarter by boosting brain development. Third, nature play makes kids feel better by fostering emotional well-being and strengthening social bonds. Fourth, nature play is good for the Earth by preconditioning children to care about the natural world later in life.¹²

Based on the analysis for these points of the book, in general, nature can benefit children's physical, mental, emotional health, which is similar to the points in the *Last Child in the Woods*. Moreover, this book also states that nature play not only benefits children, but is also good for the Earth and natural world, and it is a benefit with a bigger vision. This point is also similar to the *Last Child in the Woods* since it also discusses the eighth intelligence, and children with the eighth intelligence are more interested in natural environment. Therefore, based on these theoretical bases, play in nature is good for both children and the world.

Based on the *Nature and Young Children: Encouraging Creative Play and Learning in Natural Environment*, it allows the researcher to have a better understanding of how children play in nature and what benefits play can afford in general.

2.4 Play and Interplay

According to the book *Play and Interplay* written by Paul Friedberg in 1970, natural experience is significant for children, and the book also emphasizes that water play is one of the most important elements for children as it has a therapeutic effect for them. Furthermore, the book states an important concept called linked play. According to this book, linked play juxtaposes and ties different elements together and children can climb up and down, go through a variety of experiences on any mound, and enjoy moving from one mound to the next. The choice of what to do next becomes an experience which can help children think about the surrounding environment independently. Moreover, the more complex the playground, the more abundant the choices and the more enriched the learning experience.¹³

Based on the analysis of the main points of this book, linked play is an important point for a children's playground which can help children understand their surrounding environment and filter information by pleasant play, and such an ability is discussed in the background and concerns of children's situation, which means that linked play could fit well children's current problems. With the linked structure, when children climb up and down a mound, they can think about what they can do next and this process lets them try to understand the surrounding environment and make a choice by themselves. Thus, children can not only improve their physical health but also can enhance their mental health in this way. In the design of the criteria and graphics, described in this analysis it was determined essential to consider linked play as an important part of nature-based children's playground design. This might include using mounds, hills, or a variety of equipment for children to use that provide "linked" play experience. As what is

stated in the Play and Interplay, the more complicated the playground is, the better therapeutic effect it has. Therefore, this book provides a relatively more specific statement about how children play in a nature-based children's playground, which provides the researcher further ideas about nature-based play.

2.5 Design Guidelines of a Therapeutic Garden for Autistic Children

In addition to the therapeutic benefits for children's emotional, mental health, and comprehensive abilities reserved from outdoor play, which is described in the Last Child in the Woods and Play and Interplay, outdoor play also provides significant physical healthy benefits for children. The article, Design Guidelines of a Therapeutic Garden for Autistic Children by Bonnie B. Hebert Children on May, 2003 describes both the physical health and mental considerations in children's outdoor play, with a focus on autistic children. Based on this book, engaging in activities that stimulate the vestibular and proprioceptive system, such as swinging, rocking, and spinning can contribute to autistic children's recovery. These activities are not typically available indoors and are best experienced outside.¹⁴

Based on the analysis of this idea of Design Guidelines of a Therapeutic Garden for Autistic Children, physical activities can not only benefit physical health directly, but are also good for children's mental health because doing physical exercise in the outdoor environment can stimulate childrens' brains. Thus, for further research into the children's playground, the evaluator should also consider physical play as one of the important criteria for the children's playground design.

2.6 Conclusion

In conclusion, according to all the literature reviews and analysis, a nature-based playground is important for children to heal or avoid nature-deficit disorder, improve their physical, mental, emotional health, and enhance their integrated competence such as cognitive ability. Moreover, play in nature can also let children take care of the natural world which also benefits the Earth and world in the long run.

To create an effective nature-based playground, it is essential to study and analyze existing children playgrounds to determine what elements are most important. Thus, it is significant to use the theoretical basis to develop some systematic nature-based children playground criteria and graphics based on different considerations to define the concept and important design principles for a nature-based playground. Then, the project can evaluate and analyze different children's playgrounds based on the criteria and graphics. After the evaluation, the project will analyze the results of the evaluation to determine the final recommendations and general guidelines for a nature-based children's playground design based on a horizontal comparison of the evaluation of the existing playgrounds.

Chapter 3. Methodology

3.1 Overview and Introduction

3.1.1 Procedures for Evaluating Existing Playgrounds Evaluation

To accomplish a comprehensive evaluation for the existing playgrounds, first, it is significant to determine how many criteria and graphics should be prepared, and it is also important to determine and define the main goal and main direction of each of the evaluation metrics as the graphics should focus on different design considerations. The metrics are created based on relevant theory and will be used to evaluate playgrounds. The results of the evaluation should be reflected by grades, texts, and images.

3.1.2 Procedures for Evaluation Results Analysis

After completing the evaluation and getting the results, the next step is to compare the results. During the comparison and analysis, it is not only important to compare the results between the different playgrounds, but it is also important to provide a horizontal comparison between the same playground as each playground is evaluated more than once based on different graphics. Thus, the evaluator can determine the similarity and difference between the results, and can also find out what results are similar and have common points, which is helpful for the final guidance.

3.1.3 Procedures for Accomplishing the General Guidelines for a Nature-based Children's Playground Design

After the analysis of the results, the final step is to develop a general guideline for a nature-based children's playground design in the future. Furthermore, after providing the guidance, it is also necessary to discuss what has not been done and what can be done in the future research for a nature-based children's playground to accomplish more helpful results for this topic.

3.2 Evaluation Criteria

Two unique evaluation metrics were defined for this project. The first is called the Nature-based Children's Playground Equipment Design Evaluation, which mainly focuses on the nature-based equipment design for the playground. However, it does not mean that this metric only addresses the equipment issue and ignores other important considerations, but its main consideration is about the equipment design. The second evaluation metric is called the Nature-based Children's Playground Site Design Evaluation, which mainly focuses on the larger scale and landscape environment of the playground rather than each equipment. However, it also does not mean that this graphic only analyzes the landscape environmental part and address little about other considerations. This metric also includes some other important parts, such as children's certain activity experience, but it pays attention to a larger scale and considers the playground as a whole rather than focus on each piece of equipment.

The reason why the evaluator provides two different evaluation graphics is that the evaluator tries to analyze the playgrounds with a targeted evaluation. According to Last

Child in the Woods, the equipment mainly improves children's physical health while the landscape and green space mainly stimulates children's mental and emotional health such as creativity and cognitive ability. Therefore, it is difficult to address all these considerations well with graphics only. Thus, using two different graphics can help to come up with a more comprehensive evaluation results based on different considerations and preferences. Also, the first was designed entirely by the evaluator and the second was based entirely on Louv with the goal of validating the results from metric one --- using criteria from the literature review.

3.2.1 Evaluation Metric One --- The Nature-based Children's Playground Equipment Design Evaluation

The first evaluation metric, the Nature-based Children's Playground Equipment Design Evaluation, the Nature-based Children Playground Equipment Design Evaluation Graphic, and includes consideration of equipment design, degree of context, and other natural elements. There are five criteria which are described in the following section.

3.2.1.1 Evaluation Metric One: Material - Form (Visual experience)

According to the Last Child in the Woods by Louv in 2005, children who live in a rural area are more likely to be happy and with less depressed emotions than children who live in an urban area with limited natural scenery.¹⁵ So, what can the designers do for children in terms of nature-based equipment design, especially for the equipment located in a playground with an urban context? According to the Meaning of Lines, Developing a Visual Grammar by Steven Bradley, curved lines are softer than straight

lines. They sweep and turn gracefully between end points. They are less definite and predictable than straight lines. Curved lines express fluid movement.¹⁶ Therefore, based on the theory, curve lines are softer and reflect fluid movement and it may be better if the equipment in the playground applies more curved and organic forms to soften the unnatural environment in an urban areas.

During the evaluation for a children’s playground, playground equipment with more curved or organic forms received higher scores. In the scale used for this criteria, 0 refers to equipment consisting of primarily orthogonal forms, 1 was provided to equip with a mix of orthogonal and organic forms and a score of 2 was provided for equipment consisting primarily of organic forms.



Figure 1. Example of equipment consisting primarily of orthogonal forms (Pinterest)



Figure 2. Example of equipment consisting primarily of organic forms (GameTime, Nature-Themed Playground with Tube Slide)

3.2.1.2 *Evaluation Metric One: Material – Semblance (Visual Experience)*

In addition to the form (straight line or curve) of the equipment, the semblance is also a significant consideration because for nature-based equipment, other than the fact that it can mimic and evoke natural forms, it can also be designed like natural objects, such as trees, logs, animals or other plants and natural elements. Thus, for the criteria

to evaluate the semblance of equipment in a children’s playground, the equipment should look like natural elements even if the origin of the material does not come from nature because according to *Why Kids Need to Spend Time in Nature* by Danielle Cohen, to improve children’s health, the place for children to play must be a “green” environment — one with trees and leaves. Moreover, just a picture of greenery can benefit mental health.¹⁷ Thus, these theories and conclusion reflect the importance of a natural appearance — greenery or other natural images can help children maintain mental health.

For example, the equipment in Figure 3 is not created from wood, but its semblance can be considered as nature-based because its appearance looks like trunks in terms of its color, shape, and texture, so it provides a greenery and natural image for children and when they look at the equipment, they can have an interaction with natural elements visually which has a therapeutic effect for their mental health. Therefore, such types of equipment can be considered as nature-based because it provides a pleasant natural semblance and visual stimulation for children and allows children to enjoy natural images when they play. Figure 4 reflects the equipment provides no natural semblance.



Figure 3. Example of equipment with natural semblance (Photo by author)



Figure 4. Example of equipment without natural semblance (sheknows, How to keep your kids safe on the playground)

Thus, in terms of the appearance, the origin of the material (the initial status of the material before any artificial process) is not an absolute standard as the form and semblance of the equipment are more significant for children. The origin of the material is not a strict criterion provided the equipment mimics and evokes natural elements successfully and provides a natural visual experience for children.

During the evaluation of the semblance for the equipment, the equipment is scaled based on the greenery and natural image it provides — the more it resembles a natural element, the higher score it will receive, where 0 refers to a low-level for semblance, 1 refers to equipment that has some natural semblance and 2 refers to a equipment that strongly resembles a natural object.

3.2.1.3 Evaluation Metric One: Material-Touch (Tactile experience)

Tactile experience refers to when people touch objects physically, they will have a perception and acknowledgement for the objects they touch based on the pattern, hardness, temperature, and other experience of the objects. According to the *Multisensory Environments: The Benefits*, time spent in a multisensory environment has been shown to increase concentration, focus attention, improve alertness, awaken memories, and to improve mobilization, creativity, social relations and communications, and general awareness of the surrounding world. The varied optical, acoustic, olfactory, and tactile stimuli help hyperactive individuals concentrate and focus better.¹⁸ Therefore, what can be absorbed from this statement is that tactile experience also contributes to the multisensory environment, which can help children to improve their mental health and integrated ability. Furthermore, stated in *Encouraging Creative Play and Learning in Natural Environments* by Ruth Wilson, both play and nature are important for children.¹⁹

Thus, the designer should not only provide a tactile experience for children, but also needs to combine the tactile experience with nature, to provide a natural tactile experience for children to enjoy.

In terms of the tactile experience evaluation of the equipment, the evaluation is more strict than just the appearance to some extent because for visual effect, the designer can create man-made natural images and scenery for children to look, but for tactile sensation, it has to come from original natural elements, such as wood, plants, sand, water, rocks, and other natural elements because, for example, in the case of Figure 4, the equipment is man-made, with a trunk semblance; however, it is not made of wood, so the tactile experience is different from that of original wood — which includes temperature, hardness, and other tactile sensory elements — even if it is trying to create a wood pattern. Thus, for appearance, it can be considered as nature-based equipment but for tactile evaluation, it is not nature-based and deserves a relatively low score because it provides a limited natural tactile experience for children. Therefore, in terms of the evaluation for tactile experience, water, plants, wood, sand, and stone deserve a relatively high score because they can be found in original wild natural environments with little man-made processes. However, for the elements, such as plastics, concrete and other man-made materials, they should receive a relatively low scale as they have limited therapeutic effect and they hardly provide a natural tactile experience for children to interact with nature, improve their health condition, and comprehensive ability.

In terms of the evaluation for the tactile experience of an equipment, 0 refers to an equipment consisting of man-made materials and provide little natural tactile experience

(Figure 5), 1 means medium which for the equipment provides a natural tactile experience for children but is still limited (Figure 6), and 2 refers to the equipment which consists of natural materials (wood, stone, plants, sand) (Figure 7).



Figure 5. Example of equipment consisting of man-made materials and provide little natural tactile experience (landscape structures, Harry Thomas Sr Playspace)



Figure 6. Example of equipment provides a natural tactile experience for children but is still limited (Natural Playground at Montivavo , Chelsea Baker, 2017)



Figure 7. Example of equipment which consists of natural materials (Auburn University, Louise Kreher Forest Ecology Preserve)

3.2.1.4 Evaluation Metric One: Degree of Context

3.2.1.4.1 Indoor context

Indoor context refers to a playground built within an enclosed interior (Figure 8). As described in *Why Kids Need to Spend Time in Nature* by Danielle Cohen, the natural and greenery images can provide a therapeutic effect for children. Thus, an indoor playground is also helpful to some extent if it provides natural and greenery images for children even if it cannot provide as many real natural elements as in the outside context. For example, in the children's playground in Oaks Mall, Gainesville, there are equipment that mimic the appearance of trees and woods and let children enjoy the semblance, do activities and play in this area, even if it is an indoor playground. However, the therapeutic effect of an indoor playground can be restricted by its location because there is limited sunlight, breeze, fresh air, water, plants, and other natural elements for children to enjoy to some extent. Furthermore, according to *Last Child in the Woods*, nature-deficit disorder refers to the behavioral problems due to a lack of outdoor activities.²⁰ Thus, the outdoor context is one of the most important considerations which has a significant influence on children's health and helps children to recover from or avoid nature-deficit disorder while the indoor context cannot provide such a therapeutic effect as children are not able to interact with the outdoor environment in an indoor playground. Therefore, based on these considerations, the indoor playground is not highly recommended, but it still can be helpful for children's physical, mental, and emotional health to a limited extent.

During the evaluation for the degree of context, the indoor context deserves level 0 because of the limited therapeutic effect for children.



Figure 8. Example of indoor context of playground which is built within an enclosed interior (Photo by author)

3.2.1.4.2 Outdoor context--Unnatural Context

In terms of the outdoor context, it includes an unnatural context, semi-natural context and natural context.

Unnatural context refers to the outdoor playground which is located in an area with a modern and man-made network for people, such as a well-designed complicated road system, modern buildings, mixed-use architecture, and other modern urban elements. For example, in Figure 9, the playground is surrounded by a complicated road system, modern buildings and other city elements, so the context of this playground is considered in the unnatural context. Based on Last Child in the Woods, as what has been illustrated, children who live in urban areas are more likely to have emotional problems because they usually lack the opportunities to enjoy the natural environment unlike the children who live in a rural area.²¹ Thus, for the unnatural context such as the city environment, it has limited therapeutic effect for children.

During the evaluation for context, the outdoor unnatural context deserves a score of 1 because it provides limited natural surrounding environment for children even if it is outside.



Figure 9. Example of the playground with outdoor unnatural context (hMa | HANRAHAN MEYERS ARCHITECTS | DESIGN IS A FRAME TO NATURE, Aerial view of Teardrop Park showing green roofs and heliostats)

3.2.1.4.3 Outdoor context--Semi-natural Context

Semi-natural context refers to the surrounding environment of the playground which is relatively modern with advanced road systems, architectures, and a variety of infrastructure; however, it also includes many other natural elements and environments, such as green areas and water. For example, in Figures 10 and 11, the playground is located at the corner of a park, people can see the road systems and other infrastructure beside the playground, but people can also enjoy the natural scenery, such as the green landscape, a variety of planted species, a lake and rocks. Thus, the context of this children's playground can be considered as semi-natural as the context is a mixture of modern and natural elements. The semi-natural context provides a better therapeutic effect for children than the unnatural context because it affords more natural scenery.

During the evaluation for context, the outdoor semi-natural context receives a score of 2 because it provides a natural environment for children to enjoy even if it is not as much as some rural areas.



Figure 10. Example of playground with outdoor semi-natural context (The Gainesville Sun)



Figure 11. Example of playground with outdoor semi-natural context (Photo by author)

3.2.1.4.4 Outdoor context--Natural Context

Natural context refers to the playground which is located in the environment with abundant natural elements and limited man-made elements, like the rural area, natural habitat, and forests. For example, in Figure 12, the playground is built in a natural woodland forest with very limited man-made elements, so the context of this playground can be considered as natural.

During the evaluation for context, the outdoor natural context receives a score of 3 because it provides significant therapeutic effect for children's mental and emotional health.



Figure 12. Example of playground with outdoor natural context (James Corner Field Operations. The Woodland Discovery Playground)

3.2.1.5 Evaluation Metric One: Other Natural Elements

In addition to play equipment and context, there are also some other elements which also have important therapeutic effects for children even if they are not directly as part of the play equipment. As stated, according to the *Multisensory Environments: The Benefits*, time spent in a multisensory environment, the varied optical, acoustic, olfactory, and tactile stimuli help hyperactive individuals concentrate and focus better.²² Thus, other natural elements are also important as they provide a multisensory environment in terms of visual, tactile, or olfactory stimulation which benefit children's mental health. "Other natural elements" include plants, water, sand, stone, and rock.

For the evaluation of other natural elements, the more elements are provided and designed, the higher score the playground can receive, where 0 refers to a clear low-level for this criterion (with limited other natural elements), 1 means medium (there are some other natural elements provided but still not enough) and 2 refers to a high-level for this criterion (there are abundant natural elements, which provides a variety of experience for children to enjoy).

3.2.1.6 Evaluation Metric One: Graphic Design

Based on the analysis of the criteria, the first evaluation metric was created and used to evaluate existing children’s playground equipment, as shown in Figure 13.

Park Name:	Weight	Equipment 1	Equipment 2	Equipment 3	Overall Score	Notes
Material-Form (Visual experience, is the characterized by organic forms) Scale:0=primarily orthogonal forms, 1=orthogonal and organic forms, 2=primary organic forms	x1					
Material-Semblance (Visual experience, does it resemble a natural material) Degree of natural semblance:0=low, 1=medium, 2=high	x2					
Material-Touch (Tactile experience, does it provide a natural tactile experience)Degree of natural tactility: 0=low, 1=medium, 2=high	x2					
Degree of Context Scale: 0=Indoor context, 1=Outdoor-Unnatural context, 2=Outdoor-Semi-natural context,3=Outdoor-Natural context	x2					
Other natural elements (plants, water, sand, boulder and stone) Presence of natural elements :0=low, 1=medium, 2=high	x2					
Overall degree for each equipment					Overall Score (Out of 20)	

Figure 13. First evaluation metric (Graphic by author)

In this metric, the five previously described criteria are listed, including the form of the equipment, semblance of the equipment, tactile experience of the equipment, degree of context, and presence of other natural elements. It is necessary to have a weighting scheme for the evaluation, to reflect the degree of importance of the criteria. During the evaluation, the criteria which is more important should have a stronger influence on the evaluation results while the criteria with relatively lower importance will have a slight impact on the evaluation results. For the form of the equipment, its weight is 1 while the other criteria’s weight is 2 because form does not contribute in the same degree to a nature-based experience as the other criteria do. After the evaluator provides a scale for each separate piece of equipment based on the criteria, the next step is to multiple the scale with its weight respectively. Next, the playground can receive a score to reflect the overall score of the corresponding criteria. Next, the

evaluator should add these overall scores to obtain an overall result for the playground as a whole, which can reflect the degree of nature-based the playground is, based on the criteria of this first evaluation metric. The evaluator may then divide the overall score by the total possible points available in the metric to get the percentage score. For example, if a playground receives 10 points out of total of 20 possible points, the percentage score would be 50%.

3.2.1 Evaluation Metric Two --- the Nature-based Children's Playground Site Design Evaluation

The second evaluation graphic, the Nature-based Children's Playground Site Design Evaluation, includes the consideration for natural views and green landscape, opportunities for activities, sensory experience, degree of context, and other natural elements. The theory behind the criteria is mainly referenced from Last Child in the Woods.

3.2.2.1 Evaluation Metric Two: Natural View and Green Landscape

According to Last Child in the Wood, natural views have a therapeutic effect for children and other people. For example, based on Louv, the research has shown that subjects experienced significant decreases in blood pressure simply by watching fish in an aquarium. Moreover, according to Louv, Gordon Orians, professor emeritus of Zoology at the University of Washington, says such research suggests that our visual environment profoundly affects our physical and mental well-being. Therefore, based on these illustrations, natural views and visual experiences have significant therapeutic effects for children and other people's physical and mental health. Furthermore, according to Last Child in the Woods, green space fosters social interaction and thereby

promotes social support. A green landscape not only has a therapeutic effect for children but also provides an opportunity for them to have fun and interact with each other in the green space.²³ Thus, natural views and a green landscape (Figure 14) can be considered as important criteria for a nature-based children's playground evaluation.

During the evaluation and analysis of the playground, the more natural views and green landscapes the playground provides, the better therapeutic effect it has, and the higher the score the playground can receive, where 0 refers to the playground provides few natural views and green landscapes, 1 means the playground provides some natural views and green landscapes but they are still not enough, and 2 refers to playground has a lot of natural views and green landscapes which is enough and good for children to enjoy.



Figure 14. Example of playground with natural view and green landscape (Red Kite Days, South Stoke Park Playground)

3.2.2.2 Evaluation Metric Two: Opportunities for Children to Interact with Nature by Doing Nature-based Activities

According to Last Child in the Woods, a natural landscape, or at least gardens, can be therapeutic and restorative because they provide certain activity opportunities for

children which can benefit their health. Spending time in the garden, or digging can preserve people's health and digging in the soil has a curative effect on the mentally ill.²⁴

This research illustrates that nature has the power to shape the psyche. For example, the designer can provide a small hill, a mound for children because children interpret and give meaning to a piece of the landscape, and the same piece can be interpreted differently.²⁵ Thus, when the evaluator analyzes the playgrounds or the designers create the playgrounds, the elements such as a small hill, or a mound are good considerations because it is good for children's psychological health and motivates them to interpret and think spontaneously (Figure 16). The similar point is also stated in the Play and Interplay, which described that linked play juxtapositions and ties different elements together and children can climb up and down, go through a variety of experiences on any mound, and enjoy moving from one mound to the next. Also, the choice of what to do next becomes an experience which can help children think about the surrounding environment independently.²⁶ Both of the sources consider mounds as important elements for children's play because mounds can create a unique process to stimulate children to think and understand the environment by themselves.

Moreover, the Last Child in the Woods also states that designers can provide more opportunities for children to sit in, on, or under some equipment. (Figure 17) For example, when children sit under something, they have the sense of safety, so they can enjoy a natural view in a relatively private place and have a unique experience.²⁷



Figure 15. Digging sand can help children improve mental health (Мама Силвана, 2016)



Figure 16. A small hill, or a mound can improve children's psychological health and motivates children to interpret and think spontaneously (Playtime)



Figure 17. Children play on or under equipment (Pinterest, Map of Play)

In terms of the evaluation for opportunities for children to interact with nature by doing certain activities, 0 refers to limited opportunities to do nature-based activities, 1

refers to opportunities to do nature-based activities that are available but not enough, and 2 means a lot of opportunities are available to do nature-based activities.

3.2.2.3 Evaluation Metric Two: Sensory Experience

According to Last Child in the Woods, natural settings are essential for healthy children's development because they stimulate all the senses and integrate informal play with formal learning. A multisensory experience in nature helps to build the cognitive constructs necessary for sustained intellectual development, and stimulates the imagination by supplying the child with the free space and materials for children's architecture and artifacts. Nature spaces and materials stimulate children's limitless imaginations and serve as the medium of inventiveness and creativity, observable in almost any group of children playing in a multisensory natural setting.²⁸

Thus, it is important to provide a multisensory environment for children to stimulate their cognition ability by sensory stimulation, and in addition to a visual experience, tactile experience, and olfactory experience and so forth, are all important parts for children's play (Figures 18 and 19).



Figure 18. Multisensory environment (such as olfactory stimulation) has therapeutic effect for children's cognitive ability. (Telegraph, A young boy smells a daffodil)



Figure 19. Multisensory environment (such as tactile stimulation) has therapeutic effect for children's cognitive ability. (NSTA Blog)

In terms of the evaluation for the multisensory environment, the more multisensory experience is available for children, the higher the score the playground should receive. From a scale of 0 to 2, 0 refers to extremely limited multisensory experience for children to enjoy visual, tactile, olfactory stimulation, 1 stands for the multisensory experience is available for children to enjoy but still not enough, and 2 represents playground has a lot of multisensory environment for children to enjoy and improve their health condition.

3.2.2.4 Evaluation Metric Two: Degree of Context

According to Last Child in the Woods, it also illustrates the importance of context for a children's playground. From this book, play in natural settings can offer special benefits and children are more physically active when they are outside. Thus, outside play is preferable and effective than indoor play in terms of physical health. Moreover, based on this book, a natural context is the best environment for children to play. The studies compared preschool children who played every day on typically flat playgrounds to children who played for the same amount of time among the trees, rocks, and uneven ground of natural play areas. Over a year's time, the children who played in natural areas tested better for motor fitness, especially in balance and agility. The professionals found that children with more nature near their homes received lower ratings than peers with less nature near their homes in terms of measures of behavioral conduct disorders, anxiety, and depression. Furthermore, children with more nature near their home rated themselves higher than other children. Even in a rural setting with a relative abundance of green landscaping, more nature appears to be better when it comes to bolstering children's resilience against stress and other adverse emotions.²⁹ Therefore, for the playground context, the outdoor context is better than the indoor context and among the

outdoor context, the natural context is the most preferable as it provides a more natural experience for children to improve their physical, mental, and emotional health condition comprehensively.

During the evaluation for the context, 0 refers to an indoor context, 1 refers to an outdoor unnatural context, 2 represents an outdoor semi-natural context, and 3 stands for an outdoor natural context.



Figure 20. Example of indoor context of playground which is built within an enclosed interior (Photo by author)



Figure 21. Example of the playground with outdoor unnatural context (hMa | HANRAHAN MEYERS ARCHITECTS | DESIGN IS A FRAME TO NATURE, Aerial view of Teardrop Park showing green roofs and heliostats)



Figure 22. Example of playground with outdoor semi-natural context (The Gainesville Sun)



Figure 23. Example of playground with outdoor natural context (James Corner Field Operations. The Woodland Discovery Playground)

3.2.2.5 *Evaluation Metric Two: Other Natural Elements*

Based on Last Child in the Woods, other natural elements for a natural play area might include water, trees, bushes, flowers, long grasses, and sand (best if it can be mixed with water) (Figure 24). Furthermore, researchers have also observed that when children played in an environment dominated by play structures rather than natural elements, they established their social hierarchy through physical competence; after an open grassy area was planted with shrubs, the quality of play in what researchers termed “vegetative rooms” was very different. Children used more fantasy play, and their social standing became based less on physical abilities and more on language skills, creativity, and inventiveness. In other words, the more creative children emerged as leaders in the natural play area, and with these natural settings and elements, children have greater ability to concentrate.³⁰ Therefore, play equipment and other natural elements have different functions and therapeutic effects on children’s health. Equipment mainly has an influence on children’s physical health while other natural elements have a better impact on children’s mental health and other comprehensive ability.

In terms of the evaluation for other natural elements, the more natural elements the playground has, the higher the scale it will receive, where 0 represents a lack of other natural elements in the playground, 1 refers to those that have some natural elements but not still limited for children to use, and 2 represents an abundance of natural elements and children can enjoy them to improve their health.



Figure 24. There are natural elements in the play area which include water, plants, and sand (Tuft Eliot, Pearson Children's school, Nature Playground, Boulder Climb and Waterfall)

3.2.2.6 Evaluation Metric Two: Graphic Design

	Park Name:	Weight	Overall Score	Notes
1	Natural view and green landscape(Does the playground provide natural view for children to improve their health condition) Scale:0 =limited naturel view and green landscape, 1 = medium level of natural view and green landscape, and 2 = abundant natural view and green landscape.	x2		
2	Provide opportunities for children to dig the sand, contemplate in front of hills or mounds, or sit in, on, or under some equipments Scale:0 = limited opportunities to do certain activities, 1 = opportunities to do certain activities are available but not enough, 2 = a lot of opportunities to do certain activities.	x2		
3	Multisensory environment (including tactile and olfactory experience) Scale: 0 = limited multisensory experience, 1 = multisensory experience are available but limited, 2 = abundant multisensory experience	x2		
4	Degree of Context Scale: 0=Indoor context, 1=Unnatural context, 2=Outdoor semi-natural context,3=Outdoor natural context	x2		
5	Other natural elements (plants, long grasses, water, sand, rocks and stone, animals) Scale:0 = lack of other natural elements, 1 = have some natural elements but not enough and 2 =abundant natural elements	x2		
			Overall score (Out of 22)	

Figure 25. Second evaluation metric (Graphic by author)

As what is shown in the second graphic, (Figure 25), this evaluation graphic is created based on the second criteria. The format of the second evaluation graphic is similar to the first one, the only difference is that this format evaluates the playground as a whole rather than focusing on each equipment respectively. For the calculation of the second graphic, the evaluator should multiply the scale of each criteria with the weight respectively, then add the score of each criterion together to obtain the overall score based on the criteria. The evaluator uses the full score to divide the overall degree to get the percentage score of the playground, which reflects how successful the playground is in terms of nature-based design.

3.3 Existing Children's Playgrounds Selection

After designing the two evaluation criteria and graphics, the next step is to select the children playgrounds which should be evaluated. The main principle to select the playgrounds is that the selected playgrounds should be in different regions rather than be from the same area. Moreover, the playgrounds should also be in a different context which includes the indoor context, outdoor unnatural context, outdoor semi-natural context, and outdoor natural context as described in the criteria. Thus, the evaluator can obtain more objective and comprehensive evaluation results from these different playgrounds. Based on this principle, the evaluator selected six different playgrounds with different locations and contexts, which include: Oaks Mall Children's Playground (Indoor context, Gainesville, FL) (Figure 26), Depot Park Children's Playground (Outdoor semi-natural context, Gainesville, FL) (Figure 27), Alfred A. Ring Park Children's Playground (Outdoor natural context, Gainesville, FL) (Figure 28), Woodland

Discovery Playground (Outdoor natural context, Cordova, TN) (Figure 29), (Outdoor unnatural context, New York, NY) (Figure 30), and Tumbling Bay Park Playground (Outdoor semi-natural context, London) (Figure 31).



Figure 26. Oaks Mall Children Playground (Photos for the Oaks Mall)



Figure 27. Depot Park Children Playground (Gainesville Community Redevelopment Agency, Depot Park)



Figure 28. Alfred A. Ring Park (Photo by author)



Figure 29. Woodland Discovery Playground (Shelby Farm Park, Woodland Discovery Playground)



Figure 30. Teardrop Park (Flickr, Teardrop Park Playground)



Figure 31. Tumbling Bay Playground (Landscape Architect's Pages, Tumbling Bay Playground)

3.4 Evaluation Methods

The next step is to conduct the evaluations, and there are several considerations needed to be addressed, including safeguards for consistency and objectivity, and duration at each site. In terms of site visiting, the evaluator visits the site at the same time (2:00 pm) during the weekend, make notes based on the observation and pictures taken by the evaluator, which spend 2 hours per playground in average (depend on the scale of the playground). The evaluation should be equal and objective for every playground in terms of the observation process, evaluation process, and analysis process.

Chapter 4. Results and Discussion

4.1 Results for Playground One

4.1.1 Oaks Mall Children Playground Evaluation One

Location: 6275 W Newberry Rd, Gainesville, FL 32605

Oaks Mall Children's Playground located in the Oaks Mall shopping area, so the context of this playground is indoor. In terms of the equipment design, the equipment does a good job in form and semblance which provides natural and greenery images for children, such as trees, ponds, and animals. However, the material is man-made with an artificial tactile experience which does not provide a natural tactile experience for children at all and with limited therapeutic effect, based on the natural tactile environment. Moreover, because of the restriction of being indoors, the playground provides no other natural elements for the children to have a multisensory experience. Thus, in general, this playground receives a relatively low overall score in terms of nature-based design, since the indoor context is one of the main restrictions of this playground design for many parts, such as multisensory environment and other natural elements design. Based on the observation of the evaluator, there are many children who play in this area every day. However, the children who play in this playground can just have fun in there rather than gain effective therapeutic benefits and improve their physical, mental, and emotional health and comprehensive ability.

	Park: Oaks Mall Children Playground	Weight	Equipment 1	Equipment 2	Equipment 3	Overall Score	Notes
1	Material-Form (Visual experience, is the characterized by organic forms) Scale:0=primarily orthogonal forms, 1=orthogonal and organic forms, 2=primary organic forms	x1	2(x1)	2(x1)	2 (x1)	2 (x1)	All the equipments are mainly designed by curve
2	Material-Semblance (Visual experience, does it resemble a natural material) Degree of natural semblance:0=low, 1=medium, 2=high	x2	2 (x2)	2 (x2)	1 (x2)	1.7 (x2)	Equipment 1 and 2 imitate the appearance of canopy tree and wood bridge. For equipment 2, under the bridge there are "river", "stone", "gator", "turtle" which are designed with natural semblance. In terms of equipment 3, it is also linked and surrounded by natural semblance but for the equipment itself, it just a boat with pink color and does not do a good job in terms of semblance of nature.
3	Material-Touch (Tactile experience, does it provide a natural tactile experience)Degree of natural tactility: 0=low, 1=medium, 2=high	x2	0 (x2)	0 (x2)	0 (x2)	0 (x2)	For each equipment, the tactile experience is very different with what they imitate, with artificial tactile experience.
4	Scale: 0=Indoor context, 1=Outdoor-Unnatural context, 2=Outdoor-Semi-natural context,3=Outdoor-Natural context	x2	0 (x2)	0 (x2)	0 (x2)	0 (x2)	This playground is located in the shopping mall so it receives level 0 which refers to indoor context.
5	Other natural elements (plants, water, sand, boulder and stone) Presence of natural elements :0=low, 1=medium, 2=high	x2	0 (x2)	0 (x2)	0 (x2)	0 (x2)	There is no natural elements such as plants, water, sand, rocks which provides multi-sensory therapeutic environment for children because of indoor context limitation to some extent.
	Overall degree for each equipment		1.2	1.2	0.8	Overall Score: 5.4 (Out of 20)	Overall, this playground receives 5.4 which reflect how successful it is based on nature-based criteria.

Figure 32. Oaks Mall Children's Playground first evaluation (Graphic by author) Percentage score: 30%



Figure 33. Equipment 1 in Oaks Mall Children's Playground (Photo by author)



Figure 34. Equipment 2 in Oaks Mall Children's Playground (Oaks Mall, Soft Playground)



Figure 35. Equipment 3 in Oaks Mall Children's Playground (Rose in Oaks Mall, Gainesville)

4.1.2 Oaks Mall Children's Playground Evaluation Two

In terms of evaluation two for the Oaks Mall Children's Playground based on the second metric, the Oaks Mall Children's Playground provides a natural view, such as the artificial tree, pond or animal. However, the natural view looks fake and there is no green space for the children to use. For certain activities and experiences, the children can sit in the tree hole, sit in the boat, but they are not able to dig any sand or contemplate and interact with mounds and hills. In terms of the multisensory experience, the playground provides a very limited multisensory environment without any natural tactile or olfactory experience. There are no other natural elements compared to that discussed in the first evaluation.

	Park Name: Oaks Mall Children Playground	Weight	Overall Score	Notes
1	Natural view and green landscape(Does the playground provide natural view for children to improve their health condition) Scale:0 =limited naturel view and green landscape, 1 = medium level of natural view and green landscape, and 2 = abundant natural view and green landscape.	x2	1 (x2)	This playground provides natural view such as the semblance of trees and animals. However, it still lacks of green landscape and does not provide enough green scenery for children.
2	Provide opportunities for children to dig the sand, contemplate in front of hills or mounds, or sit in, on, or under some equipments Scale:0 = limited opportunities to do certain activities, 1 = opportunities to do certain activities are available but not enough, 2 = a lot of opportunities to do certain activities	x2	1(x2)	It does not provide opportunity for children to dig the sand, or contemplate in front of the hill and mound, but childern can sit in or on some equipments.
3	Multisensory environment (including tactile and olfactory experience) Scale: 0 = limited multisensory experience, 1 = multisensory experience are available but limited, 2 = abundant multisensory experience	x2	0(x2)	In addition to visual experience, it provides little natural tactile or olfactory experience for children as all these equipments are created by the same man-made material.
4	Degree of Context Scale: 0=Indoor context, 1=Unnatural context, 2=Outdoor semi-natural context,3=Outdoor natural context	x2	0(x2)	As an indoor context, it receives the lowest degree, 0.
5	Other natural elements (plants, long grasses, water, sand, rocks and stone, animals) Scale:0 = lack of other natural elements, 1 = have some natural elements but not enough, 2 =abundant natural elements	x3	0(x2)	It has no other natural elements for children to use.
			Overall Score: 4 (Out of 22)	

Figure 36. Oaks Mall Children's Playground second evaluation (Graphic by author) Percentage score: 18% (versus 30% from the first evaluation graphic)



Figure 37. Image of Oaks Mall Children's Playground: Tree with a hole, children can sit in there (Graphic by author)



Figure 38. Image of Oaks Mall Children's Playground: Children sit in the "boat" (Rose in Oaks Mall, Gainesville)

4.2 Results for Playground Two

4.2.1 Depot Park Children's Playground Evaluation One

Location: 200 SE Depot Ave, Gainesville, FL 32601

The Depot Park Children's Playground is located at the downtown area in Gainesville with the semi-natural context. There are a variety of plants, sand, rocks, groundcover with different colors, shapes, and textures which provides a multisensory environment for children to interact with nature. There are nine equipment in the playground in total, some of which are designed with very good semblance, such as a tree trunk and yellow rocks, which provide interesting natural images for the children. However, the equipment is not able to provide natural tactile experience for children because the material of the equipment is artificial, lacks a natural tactile impression even if the semblance of the natural image is successful. In terms of other equipment, they are not considered nature-based because they do not possess form, semblance, or tactile qualities that score high in the metric even if their structure may be creative and beautiful.

Park: Depot Park Children Playground	Weight	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Overall Score	Notes
Material-Form (Visual experience, is the characterized by organic forms) Scale: 0=primarily orthogonal forms, 1=orthogonal and organic forms, 2=primary organic forms	x1	2 (x1)	2 (x1)	2 (x1)	0 (x1)	0 (x1)	2 (x1)	2 (x1)	2 (x1)	2 (x1)	1.33 (x1)	For equipment 1.2.3.3.6.7.8.9, they are mainly designed by curve while equipment 4.5 are mainly created by straight line
Material-Semblance (Visual experience, does it resemble a natural material) Degree of natural semblance: 0=low, 1=medium, 2=high	x2	0 (x2)	0 (x2)	2 (x2)	0 (x2)	0 (x2)	0 (x2)	0 (x2)	2 (x2)	0 (x2)	0.45 (x2)	Only equipment 4 and 8 imitates tree trunk and stone respectively and with good semblance of natural elements.
Material-Touch (Tactile experience, does it provide a natural tactile experience) Degree of natural tactility: 0=low, 1=medium, 3=high	x2	0 (x2)	0 (x2)	1 (x2)	0 (x2)	0 (x2)	0 (x2)	0 (x2)	1 (x2)	0 (x2)	0.22 (x2)	Equipment 4 and 8 imitate natural elements carefully so their textures provides natural tactile experience to some extent. However, they cannot get level 2 for tactile experience as they cannot also imitate such as the temperature, hardness of the correspondent natural objective, and it is an limitation.
Degree of Context Scale: 0=Indoor context, 1=Outdoor-Unnatural context, 2=Outdoor-Semi-natural context, 3=Outdoor-Natural context	x2	2 (x2)	In terms of the context, there are road systems, man-made infrastructure beside the playground. However, as part of the Depot Park, there are also planting area, lake as part of the surrounding environment for the playground. Thus, the context is considered as a semi-natural context and receive level 2.									
Other natural elements (plants, water, sand, boulder and stone) Presence of natural elements: 0=low, 1=medium, 2=high	x2	2 (x2)	There are beautiful planting design, rocks, sands in the park which provide a pleasant multi-sensory environment for children to let them interact with nature by visual and tactile experience even if these elements are not part of the equipments.									
Overall degree for each equipment		2	2	3.2	1.6	1.6	2	2	3.2	2	Overall Score: 10.66 (Out of 20)	In general, the Depot Park Children Playground receives 10.66 as a degree based on nature-based criteria.

Figure 39. Depot Park Children's Playground first evaluation (Graphic by author)

Percentage score: 53%



Figure 40. Equipment 1 in Depot Park Children's Playground (Photo by author)



Figure 41. Equipment 2 in Depot Park Children's Playground (Photo by author)



Figure 42. Equipment 3 in Depot Park Children's Playground (Photo by author)



Figure 43. Equipment 4 in Depot Park Children's Playground (Photo by author)



Figure 44. Equipment 5 in Depot Park Children's Playground (Photo by author)



Figure 45. Equipment 6 in Depot Park Children's Playground (Photo by author)



Figure 46. Equipment 7 in Depot Park Children's Playground (Photo by author)

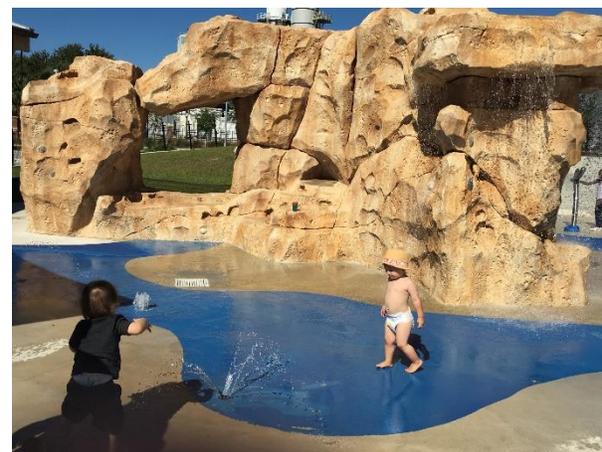


Figure 47. Equipment 8 in Depot Park Children's Playground (Photo to author)



Figure 48. Equipment 9 in Depot Park Children's Playground
(Photo by author)

4.2.2 Depot Park Children's Playground Evaluation Two

In terms of the evaluation based on the second metric, Depot Park Children's Playground provides a natural view and green space for children to enjoy, and for the entrance of the playground, the designer provides a long natural vista with a variety of plantings, rocks and water features. For certain activities and experiences, the children can do activities, such as dig in the sand, sit on or under some "mound", and enjoy a unique experience which can benefit their mental health and comprehensive ability. Compared to that analyzed in evaluation one, the playground includes a variety of natural elements which provide a multisensory environment for the children.



Figure 49. Beautiful natural environment of Depot Park Children's Playground (Photo by author)



Figure 50. Surrounding environment of Depot Park Children's Playground (Photo by author)



Figure 51. Green space of Depot Park Children's Playground (Photo by author)



Figure 52. Children dig the sand in Depot Park Children's Playground (Photo by author)



Figure 53. This equipment in Depot Park Children's Playground is designed like a mound and let children play on it or sit in it to have a more private space (Photo by author)

	Park Name: Depot Park Children Playground	Weight	Overall Score	Notes
	Natural view and green landscape(Does the playground provide natural view for children to improve their health condition) Scale:0 =limited naturel view and green landscape, 1 = medium level of natural view and green landscape, and 2 = abundant natural view and green landscape. 1	x2	1 (x2)	This Playground provides natural views such as rocks, plants, green landscape and so forth. But the majority of the equipments do not provide a natural view.
	Provide opportunities for children to dig the sand, contemplate in front of hills or mounds, or sit in, on, or under some equipments Scale:0 = limited opportunities to do certain activities, 1 = opportunities to do certain activities are available but not enough, 2 = a lot of opportunities to do certain activities. 2	x2	2(x2)	This playground provides opportunities for children to dig the sand, contemplate and think in front of some mound-like equipment and can also sit on, in, or under the equipmments.
	Multisensory environment (including tactile and olfactory experience) Scale: 0 = limited multisensory experience, 1 = multisensory experience are available but limited, 2 = abundant multisensory experience 3	x2	1(x2)	In addition to visual experience, the playground provides various tactile experience for children such as the texture of plants, sands, water and so forth. But as the majority of the equipments, they do not provide enough natural tactile experience.
	Degree of Context Scale: 0=Indoor context, 1=Unnatural context, 2=Outdoor semi-natural context,3=Outdoor natural context 4	x2	2(x2)	In terms of the context, there are road systems, man-made infrastructure beside the playground. However, as part of the Depot Park, there are also planting area, lake as part of the surrounding environment for the playground. Thus, the context is considered as a semi-natural context and receive level 2.
	Other natural elements (plants, long grasses, water, sand, rocks and stone, animals) Scale: 0 = lack of other natural elements, 1 = have some natural elements but not enough, 2 =abundant natural elements 5	x2	2(x2)	The playground includes plants, water, sand, rocks and other natural elements for children.
			Overall Score:16 (Out of 22)	

Figure 54. Depot Park Children’s Playground second evaluation Percentage score: 73% (Versus 53% of the first evaluation graphic)

4.3 Results for Playground Three

4.3.1 Alfred A. Ring Park Children’s Playground Evaluation One

Location: 1801 NW 23rd Blvd, Gainesville, FL 32605

In terms of the context, the Ring Park Children’s Playground located in a natural area with a forest, natural habitat, creek and such types of natural context provides a good environment for children to have an intimate interaction with nature. However, for the playground design, it is not considered as nature-based in general because in terms of the two equipment in the playground, the design of the equipment is very simple and

consists of rigid straight lines without curves to soften the environment and provide a fluid impression. Furthermore, the equipment is with no semblance to natural and greenery image and also provides no natural tactile experience for the children. Moreover, in terms of other natural elements, there is no planted species, water, sand, or rocks in the playground for children to enjoy the natural environment. Thus, the therapeutic effect for children to improve their mental, emotional health, and integrated competence is limited, if based solely on the equipment design.

Park: Ring Park Children Playground	Weight	Equipment 1	Equipment 2	Overall Score	Notes
Material-Form (Visual experience, is the characterized by organic forms) Scale:0=primarily orthogonal forms, 1=orthogonal and organic forms, 2=primary organic forms	×1	1 (x1)	0 (x1)	0.5 (x1)	Equipment 1 is designed with curves in terms of certain part while equipment 2 is designed by straight line.
Material-Semblance (Visual experience, does it resemble a natural material) Degree of natural semblance:0=low, 1=medium, 2=high	×2	0 (x2)	0 (x2)	0 (x2)	None of these two equipment has a natural semblance.
Material-Touch (Tactile experience, does it provide a natural tactile experience)Degree of natural tactility: 0=low, 1=medium, 2=high	×2	0 (x2)	0 (x2)	0 (x2)	Both of the equipment does not provide natural tactile experience.
Degree of Context Scale: 0=Indoor context, 1=Outdoor-Unnatural context, 2=Outdoor-Semi-natural context,3=Outdoor-Natural context	×2	3 (x2)	3 (x2)	3 (x2)	This strip park's context is natural which includes forest, creek, and other natural species which provides a natural habitat for human beings.
Other natural elements (plants, water, sand, boulder and stone) Presence of natural elements :0=low, 1=medium, 2=high	×2	1 (x2)	1 (x2)	1 (x2)	There are various natural elements in the context. However, in terms of the playground itself, it just includes trees and grass and not designed as a pleasant multi-sensory environment. Thus, it receives level 1 in terms of other natural elements.
Overall degree for each equipment		1.8	1.6	Overall Score: 8.5 (Out of 20)	Overall, it receives 8.5 as a degree based on nature-based criteria.

Figure 55. Ring Park Children’s Playground first evaluation (Graphic by author) Percentage score: 43%



Figure 56. Equipment 1 in Ring Park Children’s Playground (Photo by author)



Figure 57. Equipment 2 in Ring Park Children’s Playground (Photo by author)



Figure 58. Natural context of Ring Park Children's Playground (Photo by author)

4.3.2 Alfred A. Ring Park Children's Playground Evaluation One

As stated in the first evaluation of Ring Park, the playground is located in a natural context which has therapeutic benefits for children's health. However, in addition to the existing natural context, in terms of the playground itself, there is little green space of the playground for children to use when they play in here. The design for natural elements are limited and provides little multisensory environment for the children to improve their cognitive ability. For nature-based activities, there are no opportunities for children to dig in the sand, sit in, on or under the equipment or play with linked hills or mounds. Thus, it is difficult for the playground to stimulate children to think spontaneously, improve children's mental health, and competence from interacting with the playground.

Park Name: Ring Park Children Playground	Weight	Overall Score	Notes
Natural view and green landscape(Does the playground provide natural view for children to improve their health condition) Scale:0 =limited naturel view and green landscape, 1 = medium level of natural view and green landscape, and 2 = abundant natural view and green landscape. 1	x2	1 (x2)	This Playground provides little natural view and green landscape by its design. However, it is surrounded by plants so when children play in it, they can see the green scenery because of these vegetation.
Provide opportunities for children to dig the sand, contemplate in front of hills or mounds, or sit in, on, or under some equipments Scale:0 = limited oppotunities to do certain activities, 1 = oppotunities to do certain activities are available but not enough, 2 = a lot of 2	x2	0(x2)	This playground provides limited oppotunities for children to dig the sand, contemplate or other activities because of the unwell-designed equipmnets.
Multisensory environment (including tactile and olfactory experience) Scale: 0 = limited multisensory experience, 1 = multisensory experience are available but limited, 2 3 = abundant multisensory experience	x2	0(x2)	In addition to visual experience, it playground provides limited tactile or other sensory environment for children)
Degree of Context Scale: 0=Indoor context, 1=Unnatural context, 2=Outdoor semi-natural context,3=Outdoor natural 4	x2	3(x2)	This park's context is very natural which includes forest, creek, and other natural species which provides a natural habitat for human beings.
Other natural elements (plants, long grasses, water, sand, rocks and stone, animals) Scale:0 = lack of other natural elements, 1 = have some natural elements but not enough and 2 5 =abundant natural elements	x2	0(x2)	There is littlenatural elements in this playground.
		Overall Score:8 (Out of 22)	

Figure 59. Ring Park Children's Playground second evaluation (Graphic by author)

Percentage score: 36% (Versus 43% of the first evaluation graphic)



Figure 60. Creek nearby Ring Park Children's Playground (Photo by author)



Figure 61. Forest nearby Ring Park Children's Playground (Photo by author)



Figure 62. Design of Ring Park Children's Playground without multisensory environment, and other elements for children (Photo by author)

4.4 Results for Playground Four

4.4.1 Woodland Discovery Playground Evaluation One

Location: N Pine Lake Dr, Cordova, TN 38018

The Woodland Discovery Playground located in the Woodland forest provides a natural context for the playground and lets children play in nature. There are six equipment in the playground. Few of the equipment are designed with natural semblance; however, they occur within a natural setting and provide a tactile experience as some of them are designed from wood and are combined with trees, other plants, rocks, and sands which provide opportunities for children to interact with nature by play. Nevertheless, some other equipment is designed with limited natural elements.

Park: Woodland Discovery Playground		Weight	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Overall Score	Notes
1	Material-Form (Visual experience, is the characterized by organic forms) Scale:0=primarily orthogonal forms, 1=orthogonal and organic forms, 2=primary organic forms	x1	0 (x1)	0 (x1)	0 (x1)	2 (x1)	1 (x1)	1 (x1)	0.67 (x1)	The equipment 1,2,3 are designed with straight lines, 5,6 are created by both straight line and curve. And equipment 4 are designed with curve.
2	Material-Semblance (Visual experience, does it resemble a natural material) Degree of natural semblance:0=low, 1=medium, 2=high	x2	2 (x2)	1 (x2)	0 (x2)	1 (x2)	1 (x2)	0 (x2)	0.84 (x2)	Equipment 1 is created on the tree which is made by wood and be consistent with trees, and it provides a unique image and experience for children and let them interact with wood and trees at high place. Equipment 2,4,5 are not made by natural elements totally and do not create a semblance for natural image. However, they are designed with natural elements such as plants, rocks, sand respectively which provide natural image for children and let them interact with nature. In terms equipment 3, it has no semblance of nature and with no natural element to provide natural image.
3	Material-Touch (Tactile experience, does it provide a natural tactile experience)Degree of natural tactility: 0=low, 1=medium, 2=high	x2	2 (X2)	2 (x2)	0 (x2)	1 (x2)	1 (x2)	0 (x2)	1 (x2)	
4	Degree of Context Scale: 0=Indoor context, 1=Outdoor-Unnatural context, 2=Outdoor-Semi-natural context,3=Outdoor-Natural context	x2	3 (x2)	The Woodland Discovery Playground is surrounded by woodland forest so the context is natural and receives level 3.						
5	Other natural elements (plants, water, sand, boulder and stone) Presence of natural elements :0=low, 1=medium, 2=high	x2	2 (x2)	The playground is designed with plants, rock and stone, and sand, which provides a multi-sensory environment for children.						
Overall degree for each equipment			3.6	3.2	2	3.2	3	2.2	Overall Score: 14.34 (Out of 20)	The playground receives 14.34 as a degree based on nature-based criteria.

Figure 63. Woodland Discovery Playground first evaluation (Graphic by author)

Percentage score: 72%



Figure 64. Equipment 1 of Woodland Discovery Playground (Shelby Farms Memphis, Tennessee)



Figure 65. Equipment 2 in Woodland Discovery Playground (Shelby Farms Memphis, Tennessee)



Figure 66. Equipment 3 in Woodland Discovery Playground (Shelby Farms Memphis, Tennessee)



Figure 67. Equipment 4 in Woodland Discovery Playground (Shelby Farms Park, Woodland Discovery Playground)



Figure 68. Equipment 5 in Woodland Discovery Playground (Carefree in Memphis, Tennessee)



Figure 69. Equipment 6 in Woodland Discovery Playground (James Corner Field Operations, Woodland Discovery Playground at Shelby Farms Park)

4.4.2 Woodland Discovery Playground Evaluation Two

In terms of the natural view and green landscapes, the playground provides trees, plants, and rocks, and lets children enjoy the natural setting. For certain activities and experience, children can dig in the sand in the playground. But there is no small hill or mound available for children to have a linked play. The playground also provides a multisensory environment by a variety of planted species, and rocks so the children can have a visual, olfactory, and tactile experience to improve their cognitive competence.



Figure 70. Natural context of Woodland Discovery Playground (The Architects Newspaper, The Memphis Movement)



Figure 71. Plants, rocks and other natural settings in Woodland Discovery Playground (Category Archives: Tennessee)

	Park Name: Woodland Discovery Playground	Weight	Overall Score	Notes
1	Natural view and green landscape(Does the playground provide natural view for children to improve their health condition) Scale:0 =limited nature view and green landscape, 1 = medium level of natural view and green landscape, and 2 = abundant natural view and green landscape.	x2	2 (x2)	The playground includes natural views such as trees, other plants, rocks, and so forth to provide a natural image for children.
2	Provide opportunities for children to dig the sand, contemplate in front of hills or mounds, or sit in, on, or under some equipments Scale:0 = limited opportunities to do certain activities, 1 = opportunities to do certain activities are available but not enough, 2 = a lot of	x2	1(x2)	This playground provides opportunity for children to dig the sand, or sit on some equipments and other elements. However, it provides few hill or mound for children to improve their mental health.
3	Multisensory environment (including tactile and olfactory experience) Scale: 0 = limited multisensory experience, 1 = multisensory experience are available but limited, 2 = abundant multisensory experience	x2	2(x2)	In addition to visual experience, it provides different sensory experience by the various texture and tactile impression of plants, woods, sands and so forth.
4	Degree of Context Scale: 0=Indoor context, 1=Unnatural context, 2=Outdoor semi-natural context,3=Outdoor natural context	x2	3(x2)	The Woodland Discovery Playground is surrounded by woodland forest so the context is natural and receives level 3.
5	Other natural elements (plants, long grasses, water, sand, rocks and stone, animals) Scale:0 = lack of other natural elements, 1 = have some natural elements but not enough and 2 =abundant natural elements	x2	1(x2)	The loose parts in this playground includes plants, sand, rocks and so forth. But it has no water for children which is important for children's play and health improvement.
			Overall Score:18 (Out of 22)	

Figure 72. Woodland Discovery Playground second evaluation (Graphic by author)

Percentage score: 82% (Versus 72% of the first evaluation graphic)

4.5 Results for Playground Five

4.5.1 Teardrop Park Playground Evaluation One

Location: Warren St, New York, NY 10005

Teardrop Park Playground is located in New York City, in an area with unnatural context. However, in this playground, there are a variety of natural elements which include different types of planted species, rocks, stones, water, and sand. Such a design provides an interesting, unique, and beautiful natural environment for the children to enjoy and also makes a contrast between the modern city. In terms of the equipment design, it combines curves and straight lines together, and it also pays attention to the combination with nature, such as rocks, mounds, little hills, sand, and water, which provides opportunities for children to play with nature intimately. The

equipment is not designed with natural semblance; however, it is even better than natural semblance as it uses the original natural material to reflect a real natural and green imagery. Because of the application of a variety of natural elements, the equipment provides different natural tactile experiences for the children to improve their cognitive ability. In general, this playground design is nature-based and successful, even if it is in an unnatural context.

	Park Name: Teardrop Park Playground	Weight	Equipment 1	Equipment 2	Equipment 3	Overall Score	Notes
1	Material-Form (Visual experience, is the characterized by organic forms) Scale:0=primarily orthogonal forms, 1=orthogonal and organic forms, 2=primary organic forms	x1	1 (x1)	2 (x1)	1 (x1)	1.3 (x1)	In terms of equipment 1, the children's slide is mainly designed by straight lines but the rocks surrounds the slide and provide curves which soften the equipment and provide natural image for children. For equipment 2, it is designed with rocks, stones which provides curves visually. Equipment 3 is mainly designed by straight lines, however, the straight lines form a big long curve as a whole which makes the wall looks more soft even if it consists of straight lines.
2	Material-Semblance (Visual experience, does it resemble a natural material) Degree of natural semblance:0=low, 1=medium, 2=high	x2	2 (x2)	2 (x2)	1 (x2)	1.7 (x2)	For equipment 1, it is designed with rocks which has already provide a natural image for children and let them enjoy the natural image. And such kind of design is even better than semblance because it is created by natural elements and looks more real than semblance. Equipment 2, this area provides rocks, stone, water which offers a natural image for children. For equipment 3, it uses stone to provide a natural image but as a whole, the wall and straight line let the natural stone lost its original shape to some extent so the natural image is weakened to some extent.
3	Material-Touch (Tactile experience, does it provide a natural tactile experience) Degree of natural tactility: 0=low, 1=medium, 2=high	x2	2 (x2)	In terms of tactile experience, all of the equipments deserve a high degree because they all made by natural elements such as water, rocks, so they provide different kind of natural tactile experience for children to play.			
4	Degree of Context Scale: 0=Indoor context, 1=Outdoor-Unnatural context, 2=Outdoor-Semi-natural context, 3=Outdoor-Natural context	x2	1 (x2)	This project is located in the New York City which is a very modern, advanced, complicated urban area. Thus, the context of the playground is unnatural.			
5	Other natural elements (plants, water, sand, boulder and stone) Presence of natural elements :0=low, 1=medium, 2=high	x2	2 (x2)	For other natural elements, the Teardrop Park does a really good job because it includes a variety of plants, water, sand, boulder and stone and provides a multi-sensory environment for children, and stimulate children by visual, tactile experience and give them a lot of opportunity to feel and interact with natural environment.			
	Overall degree for each equipment		3	3.2	2.6	Overall Score : 14.7 (Out of 20)	In general, the Depot Park Children Playground receives 14.7 as a degree based on nature-based criteria.

Figure 73. Teardrop Park Playground first evaluation (Graphic by author) Percentage score: 74%



Figure 74. Equipment 1 in Teardrop Park Playground (Steven Greer, 2013)



Figure 75. Equipment 2 in Teardrop Park Playground (Michael Geffel)



Figure 76. Equipment 3 in Teardrop Park Playground (Teardrop Park, NYC)



Figure 77. Outdoor unnatural context of Teardrop Park (Beautiful New York, Teardrop Park)

4.5.2 Teardrop Park Playground Evaluation Two

In terms of the evaluation by metric two, the natural view and green landscape in the playground provides a contrast with the modern city. Children who live in New York City lack the opportunity to interact with nature or play freely, and this park provides a good change for them to enjoy the natural environment in this busy modern area. For activities, the children can not only dig in the sand, but also can climb the rock and hill, which can stimulate them to understand the natural environment by themselves and also improve their imagination.

	Park Name: Teardrop Park Playground	Weight	Overall Score	Notes
	Natural view and green landscape(Does the playground provide natural view for children to improve their health condition) Scale:0 =limited naturel view and green landscape, 1 1 = medium level of natural view and green landscape, ×2		2 (×2)	The playground is designed with plants, rocks, sands and so forth, which provides natural view for children to interact with nature.
	Provide opportunities for children to dig the sand, contemplate in front of hills or mounds, or sit in, on, or under some equipments Scale:0 = limited opportunities to do certain activities, 1 = opportunities to do certain activities are available but not enough, 2 = a lot of 2 opportunities to do certain activities. ×2		2(×2)	Children can dig the sand, sit on the equipments and contemplate in front of the hill. So the design provides a variety of opportunities for children to enjoy the play while also improve their health.
	Multisensory environment (including tactile and olfactory experience) Scale: 0 = limited multisensory experience, 1 = multisensory experience are available but limited, 2 3 = abundant multisensory experience ×2		2(×2)	In addition to visual experience, the playground also provides water, plants sands, rocks with various tactile experience for childern to improve their cognitive ability.
	Degree of Context Scale: 0=Indoor context, 1=Unnatural context, 2=Outdoor semi-natural context,3=Outdoor natural 4 context ×2		1(×2)	This project is located in the New York City which is a very modern, advanced, complicated urban area. Thus, the context of the playground is unnatural.
	Other natural elements (plants, long grasses, water, sand, rocks and stone, animals) Scale:0 = lack of other natural elements, 1 = have some natural elements but not enough and 2 5 =abundant natural elements ×2		2(×2)	The loose parts in this playground includes water, plants, sand, rocks and so forth, which creates therapeutic environment for children to improve their mental and emotional health.
			Overall Score:16 (Out of 22)	

Figure 78. Teardrop Park Playground second evaluation (Graphic by author)

Percentage score: 73% (Versus 74% of the first evaluation graphic)



Figure 79. Plan view of Teardrop Park (Flickr, Teardrop Park)



Figure 80. Children play with water in Teardrop Park (Summer NYC, Teardrop Park, 2007)



Figure 81. Equipment of Teardrop Park is designed with other natural element such as rocks, plants (NC State College of Design, Teardrop Park)



Figure 82. Unnatural context of Teardrop Park (Toddling Round New York)

4.6 Results for Playground Six

4.6.1 Tumbling Bay Park Playground Evaluation One

Location: London Legacy Development Corporation

Tumbling Bay Park is located in a semi-natural context, a large area of flat tarmac. One of the Olympic games concourses, located between the former athlete's village and the Velodrome and bordering the Village River Lea wetland basin. Near to the

playground, there is a natural long vista provided for people to enjoy the green scenery with a variety of planted species. There is large equipment for children to play on, which is mainly designed using straight lines; however, it does not influence its natural image as the equipment is designed with branches, wood, and plants, which not only provide a natural view for the children but also affords a natural tactile experience. Moreover, other natural elements are used to improve the natural atmosphere of the playground.

	Park Name: Tumbling Bay Playground	Weight	Equipment 1	Overall Score	Notes
1	Material-Form (Visual experience, is the characterized by organic forms) Scale:0=primarily orthogonal forms, 1=orthogonal and organic forms, 2=primary organic forms	×1	2 (×1)	2 (×1)	In terms of the form of the equipment, it is created by both curve and straight line, for the curve, it provides natural image which soften the design while for the straight part, it create a natural long curve in general rather than combine the lines rigidly.
2	Material-Semblance (Visual experience, does it resemble a natural material) Degree of natural semblance:0=low, 1=medium, 2=high	×2	2 (×2)	2 (×2)	In terms of the semblance, the equipment is designed by woods and provides a natural image successfully. It provides webs and woods for children to walk and climb and also combines woods together and makes it looks like a bird nest as a whole. Children can climb and sits in there, enjoy natural image and have a pleasant, intimate interaction with nature.
3	Material-Touch (Tactile experience, does it provide a natural tactile experience) Degree of natural tactility: 0=low, 1=medium, 2=high	×2	2 (×2)	2 (×2)	For the tactile experience, children can have a natural tactile experience by touching the wood and the wood is natural without man-made improvement so it keeps its original shape and texture.
4	Degree of Context Scale: 0=Indoor context, 1=Outdoor-Unnatural context, 2=Outdoor-Semi-natural context,3=Outdoor-Natural context	×2	2 (×2)	2 (×2)	For the context, the park located in a large area of flat tarmac. One of the Games concourses, located between the former Athlete's and the Velodrome and bordering the VillageRiver Lea wetland basin. The surrounding environmen of the park is natural and provides a long vista for people to enjoy green scenery with a variety of planting species.
5	Other natural elements (plants, water, sand, boulder and stone) Presence of natural elements :0=low, 1=medium, 2=high	×2	2 (×2)	2 (×2)	For other natural elements, it includes plants, sand, boulder and creates a multi-sensory environment for children and let them play in a nature-based environment.
	Overall degree for each equipment		3.6	Overall Score: 18 (Out of 20)	In general, the Depot Park Children Playground receives 18 as a degree based on nature-based criteria.

Figure 83. Tumbling Bay Park first evaluation (Graphic by author) Percentage score: 90%



LUC Copyright

Figure 84. Sketch of Tumbling Bay Playground's plan view (Erect architecture, Tumbling Bay Playground)



Figure 85. Natural vista in Tumbling Bay Playground (Outdoor Play Spaces for Children)



Figure 86. When children climb the equipment in Tumbling Bay Playground, they can overlook and enjoy natural scenery (LUC)



Figure 87. Nature-based equipment in Tumbling Bay Playground (Landscape Architect's Pages, Tumbling Bay Playground, Queen Elizabeth Olympic Park – Climbing Tower)



Figure 88. Nature-based equipment in Tumbling Bay Playground (Pinterest)



Figure 89. Nature-based equipment in Tumbling Bay Playground
(Erect architecture, Tumbling Bay Playground)

4.6.2 Tumbling Bay Park Playground Evaluation Two

In terms of the evaluation based on the second metric, the playground provides a beautiful natural view and green landscape for the children and other people to enjoy the nature, which includes a long green vista and other natural scenery as that illustrated in evaluation one. In terms of certain activities, the children can climb and walk on the equipment, and can also stand in the high points of the branches to enjoy

the natural view, which provides a very good opportunity for the children to play in nature. But there is no water, sand, mound or hill for the children to play.

Park Name: Tumbling Bay Playground	Weight	Overall Score	Notes
Natural view and green landscape (Does the playground provide natural view for children to improve their health condition) (Graphic by author) Scale: 0 = limited natural view and green landscape, 1 = medium level of natural view and green landscape, and 2 = abundant natural view and green landscape. 1	×2	2 (×2)	The playground provides abundant natural view and green space such as a long natural vista for children to interact with nature by enjoying the view and they can also interact with other children on the green landscape.
Provide opportunities for children to dig the sand, contemplate in front of hills or mounds, or sit in, on, or under some equipments Scale: 0 = limited opportunities to do certain activities, 1 = opportunities to do certain activities are available but not enough, 2 = a lot of opportunities to do certain activities. 2	×2	1 (×2)	Children can sit in or on the nature-based equipment and enjoy the natural view. However, children cannot dig the sand or contemplate in front of the hill or mound.
Multisensory environment (including tactile and olfactory experience) Scale: 0 = limited multisensory experience, 1 = multisensory experience are available but limited, 2 = abundant multisensory experience 3	×2	2 (×2)	In addition to visual stimulation, the woods and different plants provides a variety of natural tactile experience for children to improve cognitive ability.
Degree of Context Scale: 0 = Indoor context, 1 = Unnatural context, 2 = Outdoor semi-natural context, 3 = Outdoor natural context 4	×2	2 (×2)	For the context, the park located in a large area of flat tarmac. One of the Games concourses, located between the former Athlete's and the Velodrome and bordering the Village River Lea wetland basin. The surrounding environment of the park is natural and provides a long vista for people to enjoy green scenery with a variety of planting species.
Other natural elements (plants, long grasses, water, sand, rocks and stone, animals) Scale: 0 = lack of other natural elements, 1 = have some natural elements but not enough and 2 = abundant natural elements 5	×2	1 (×2)	The loose parts in this playground includes beautiful plants, long grasses for children to enjoy. But there is no water and also with limited rocks, sand for children to use.
		Overall Score: 16 (Out of 22)	

Figure 90. Tumbling Bay Playground second evaluation (Graphic by author)

Percentage score: 73% (Versus 90% of the first evaluation graphic)



Figure 91. Other natural elements in Tumbling Bay Playground (Landscape Architect's Pages, Tumbling Bay Playground, Queen Elizabeth Olympic Park – Balance Logs)



Figure 92. Nature-based equipment in Tumbling Bay Playground (Landscape Architect's Pages, Tumbling Bay Playground, Queen Elizabeth Olympic Park – Overview)

4.7 Results Analysis

After completing the evaluations based on two different metrics, the objective was to compare the results of the evaluations, analyze the common points and difference of the results, and the reasons resulting in such types of similarities and differences (Figure 93), which is helpful to provide general guidance for the design criteria of the nature-based children’s playground.

	Playground Name	Percentage Score of Evaluation One	Percentage Score of Evaluation Two	Average Percentage Score
1	Oaks Mall Children Playground	30% (6th place)	18% (4th place)	24% (6th place)
2	Depot Park Children Playground	53% (4th place)	73% (2nd place)	63% (4th place)
3	Alfred A. Ring Park	43% (5th place)	36% (3rd place)	40% (5th place)
4	Woodland Discovery Playground	72% (3rd place)	82% (1st place)	77% (2nd place)
5	Teardrop Park Playground	74% (2nd place)	74% (2nd place)	74% (3rd place)
6	Tumbling Bay Children Playground	90% (1st place)	73% (2nd place)	82% (1st place)

Figure 93. Results Comparison (Graphic by author)

In terms of the results of the evaluations based on two different metrics, a few differences are immediately evident. For the first evaluation, the Woodland Discovery Playground gets a 72% score and is placed third among the playgrounds while for the second evaluation, it obtains an 82% score and gains the highest score among the six playgrounds. For the Tumbling Bay Park Playground, it receives a 90% score in the first evaluation for first place while for the second evaluation, it receives a 73% score, similar to Teardrop Park and Depot Park. Depot Park receives a 53% score in evaluation one but it receives a higher percentage score, namely 73% for the second evaluation. For Teardrop Park, it receives almost the same percentage score in the second evaluation. In terms of the Ring Park Children’s Playground and the Oaks Mall Children’s Playground, they receive low percentage scores for both evaluations.

To analyze the results of the two evaluations and the similarities and differences between them, it is important to determine the common points and differences of these two evaluation criteria and graphics.

In terms of the common points, both criteria consider the context as a significant part for a nature-based children's playground and according to both evaluations, the outdoor natural environment is the most ideal context for children because it can stimulate children's physical activity and can improve children's mental, emotional health, and relieve pressure for children. Furthermore, both evaluations pay attention to the multisensory design emphasize the importance of providing visual and tactile stimulation for children to improve their cognitive ability. Moreover, both evaluations considered other natural elements such as the inclusion of plants, water, rocks, and sand to be important. These natural elements may not be part of the play equipment but they make a significant contribution to the therapeutic natural environment and especially play an important role in children's mental health.

In terms of the differences, the first evaluation focuses on the design for each equipment, which includes the form, semblance, and tactile impression of the equipment. But for the second evaluation, it pays more attention to how children use the equipment rather than the design format. For example, it does not mention the criteria of the equipment design, but it states that digging in the sand, contemplating in front of the hills or mounds, and sitting in, on, or under the equipment is good for children's health. Furthermore, compared with the first evaluation, the second evaluation considers the big picture of the playground rather than the specific design idea of the equipment. For example, it considers the natural view and green landscapes as important parts of the playground because the children can improve their health by enjoying a therapeutic natural view and they can also interact with others on the green landscapes.

Thus, based on the analysis, if the equipment of the playground provides a natural image using real natural elements or semblance, and also provides a natural tactile experience using the equipment, the playground is more likely to receive a high score in the first evaluation. If the children can do certain activities, such as digging in the sand, contemplating and thinking based on the interaction with mounds or hills, sitting in, on, or under the equipment, or there are abundant natural views and green landscapes in general, the playground is more likely to receive a high score in the second evaluation. If the playground provides a multisensory natural environment and uses a variety of natural elements, it is likely to get a high score for both evaluations. However, if the playground is located in an indoor context, or if the playground itself provides little multisensory environment, the playground is likely to receive a low score for both evaluations, like the Oaks Mall Playground and Ring Park Playground.

4.8 General Guidelines for Nature-based Playground Design

Based on the analysis and combination of the evaluation results, the evaluator devised a general guideline for a nature-based children's playground consideration and design.

First, in terms of the design context of the children playground, the outdoor natural context is the most preferable background as it can stimulate children's physical activity, and also improve their mental, emotional, and psychological health. (Figure 94)



Figure 94. Nature context of children playground (The Woodland Discovery Playground)

Second, natural elements design is essential for children's playground which includes plants, long grasses, sand, rocks, water, and animals.



Figure 95. Natural elements for children (Image by author)

Third, natural visual, tactile, olfactory, and other sensory experience are significant because a multisensory environment can help children to improve their cognitive competence.

Fourth, a natural view and open green landscaping has therapeutic effects on children's mental and emotional health and also provides opportunities to let children interact with each other in a nature-based environment.



Figure 96. Green landscape in children playground (Photo by author)

Fifth, for the equipment design, the designer should consider the form and semblance of the equipment since interaction with natural forms may benefit children's physical health. Organic forms are preferable to orthogonal lines, since curve can soften the environment, reflect fluid impression, and provide nature-based images for the playground. In terms of natural semblance, it can provide natural image for children to improve their physical, emotional health, which has important therapeutic effect.

Tactile experience is also an important consideration of nature-based equipment because when children use the equipment, it should provide different natural experiences for them which arguably cannot be replaced by the tactile experience in urban/suburban environments.

Sixth, digging in the sand, contemplating in front of the hills or mounds and sitting in, on or under the equipment to enjoy the natural view, can benefit children's mental and emotional health.



Figure 97. Children sit in "nest" (Magical Backyards)

Chapter 5. Conclusions

Based on the research conducted in this project, a nature-based children playground has significant therapeutic effects for children to help them recover from or avoid nature-deficit disorder and improve their physical, mental, emotional, psychological health and comprehensive ability, such as cognitive ability, social ability, and other competence. This project identifies general guidelines for the nature-based children's playground design in the future in terms of the context, equipment design, natural elements design, and other principles which have been illustrated in the last section.

Nevertheless, the results of this project are still limited to some extent. First, in addition to the evaluation results, it is also necessary to ask other evaluators to conduct evaluation to avoid subjectivity. Thus, the evaluators and researchers can obtain a more comprehensive, objective result based on different evaluations from different evaluators. Second, in the second evaluation metric, the criteria emphasize the therapeutic effect of hills and mounds. However, there may be alternative approaches to achieving the benefits of hills and mounds particularly in a place with flat topography. For example, the researcher may consider about can the same benefit be obtained via carefully design/placement of equipment. This idea represents a potential limitation to the applicability of metric two in different locations. Third, the combination of the two metrics may be more useful for evaluation in the future, or the improvement of metrics is necessary to gain a better result to some extent. For example, the metrics currently include some criteria which are similar or overlap. A potential improvement would be to remove the similar parts of the two metrics, so the evaluations may be more focused on

different topics, have less overlap (which results in possible overemphasis of a single criteria), and attain a more obvious contrast between the results and constitute a more comprehensive evaluation. Fourth, in terms of the new questions come from evaluation results, in the future, the evaluator can study the relationship between nature-based design and popularity because according to the result of evaluation, Oaks Mall Children's Playground receives low grade for both metrics because it lacks of nature-based sign, however, Oaks Mall Children's Playground is popular and there are a lot of children play in here. Thus, based on this phenomenon, a playground can be fun even though it has limited nature-based design. Therefore, it is meaningful to study the relationship between nature-based design and popularity of playgrounds to figure out how to create a playground which is not only popular but also with nature-based therapeutic effect for children. Thus, children can not only have fun in playgrounds but also improve their health condition. Fifth, according to evaluation, Alfred A. Ring Park (located in outdoor natural context) receives low score in terms of nature-based equipment design, which makes evaluator consider about that is it equally important for play equipment in a natural setting to exhibit natural design qualities – when compared to a playground in an urban environment, which is a good question for researcher to study and solve in the future. Sixth, in the future, the evaluator can think about how playground design may vary in very natural environments in contrast to urban environments. For example, how things like travel distance to a playground and the surrounding land uses may also impact the value of the nature-based experience. For example, there are many potential avenues for continuing the study of nature-based children playgrounds which may be explore in the future.

However, this study provides a starting point for analyzing and identifying the critical design elements within a playground which can contribute to and enhance the nature-based experience.

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