THE QUALITY OF PLAY CENTER ACTIVITIES AND CHILD DEVELOPMENT OF EARLY CHILDHOOD EDUCATION IN CHINA

By

XIAOLIN LIU

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Researcher	XiaoLin Liu
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Principle Supervisor	Dr. Jian-Hao Huang
Co-Supervisor	

Has been approved by

(Dr. Hugo Yu-Hsiu Lee) Chairman of the Committee

(Dr. Yi-Jian Huang) Committee Examiner

(Dr. Ren-Cheng Zhang) Committee Examiner

(Dr. Renee Chew) Committee Examiner

(Dr. Jian-Hao Huang) Principal Supervisor

Approved by the DPU China-ASEAN International College

(Dr. Chun-Shuo Chen) Dean of China-ASEAN International College

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Author: XiaoLin Liu

Thesis Supervisor: Jian-hao Huang

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ABSTRACT

As one typical form of play, play center activities are commonly used in early childhood education programs. This study aimed to explore the quality of the play center activities and examine the association with child development outcomes, which based on a sample of 584 children in 48 kindergartens of Guangdong Province in China. The Activities subscale of the Chinese Early Childhood Environment Rating Scale (CECERS) was used to measure the quality of the play center activities. Chinese Version of Peabody Picture Vocabulary Test-Revised (PPVT), the Test of Children Mathematics Achievement (TCMA), Head-Toes-Knees-Shoulders task (HTKS), and the Social Skills Improvement System Rating Scales (SSIS) were used to measure child language, math, executive function, and social skills development. Descriptive statistics and Hierarchical Linear Model (HLM) analysis were conducted to data analysis. Results revealed that the overall quality of play center activities, as well as the quality of materials and space, opportunity and time, design and

organization, are all at moderately low levels in China. HLM analysis results showed that design and organization of play center activities significantly predict children's language, math, and social skills development after controlling for child level variables.

Keywords: Quality of play center activities; child development; early childhood education; China

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CHAPTER 1

INTRODUCTION

1.1 Rationale of research

Early education experience provides children daily nursing, learning and play environment and opportunities, which aims to enhance their cognitive and social development. Now there is substantial research showing that good quality education can involve children in stimulating and cognitive promoting activities to enrich their development (Spodek & Saracho, 2006; Sylva, et al., 2006; Mwaura, Sylva, & Malmberg, 2008). In childcare institutions, children are often exposed to a variety of experiences, from creative activities (role play and art for example) to manipulative activities (blocks and fine motors for example), and to learning activities (emergent reading and scientific exploration for example). They engage all their senses during the process of different kinds of activities, developing their cognitive, fine-motor skills, and social interactions (Holt, 2010).

Play is an essential vehicle for language, math, cognitive, self-regulation, and social skills promotion (Copple & Bredekamp, 2009). It is a common assumption that play is the basic activity in early childhood education. As a general and prevalent form of play, play center activities in kindergartens has attracted the attention of researchers and practitioners (Duncan & Tarulli, 2003; Zigler, Singer, & Bishop,

2004; Catron & Allen, 2007; Hirsh-Pasek, Golinkoff, Berk, & Singer, 2009). In kindergarten practice, children can freely choose centers, operate materials autonomously, and independently determine the speed and difficulty of materials at the level of children's abilities when participating in play center activities. Although this child-led play activities are commonly used in the kindergarten in China from urban to rural areas, However, studies on the quality of play center activities in China were lack of scientific quantitative research, and whether play center activities are sufficient quality to improve children`s development outcomes need further evaluation.

While the international studies generally focused on the quality of early childhood education and improvement of child development outcomes, a number of studies have proved that early childhood education with high quality can predict child development outcomes (Burchinal, Peisner-Feinberg, Pianta, & Howes, 2002; Sabol, Hong, Pianta, & Burchinal, 2013; Burchinal, et al., 2008). Quality measures, such as the Early Childhood Environment Rating Scale-Revised (ECERS-R) (Harms, Clifford, & Cryer, 2005) and the Classroom Assessment Scoring System (CLASS) (Pianta, La Paro, & Hamre, 2008) were widely used in many countries to evaluate whether early childhood education programs get a sufficient quality to improve child development outcomes (La Paro, Thomason, Lower, Kintner-Duffy, & Cassidy, 2012; Gordon, et al., 2015). Studies have suggested that proven measurement can be used to evaluate

the quality of play center activities and verify the relationship between play center activities and child development.

As is emphasized “play is the basic activity in preschool education” in the political contexts by the Ministry of Education in China (2001), these child-led play activities are commonly used in the kindergarten in China from urban to rural areas. Studies find that there are some problems with play center activities, and the practice needs to be improved (Yang, 2011; Yang & Deng, 2012; Xu & Zhao, 2014; Chen & Li, 2015). Moreover, there are few empirical studies on the quality of play center activities in China (Luo, 2014; Chen & Li, 2015). The purpose of this study is to explore the quality of play center activities, and its influence on child development outcomes need further discussion.

This research is also consistent with my research interest and concern about the quality of early childhood education. Some large-scale quantitative studies have conducted in early childhood education quality in China, such as a sample of 933 children of 163 classes in 88 kindergartens study in Zhejiang Province on preschool quality using CECERS (Hu & Li, 2012; Li, Hu, Pan, & Fan, 2014; Hu, Zhou, Li, & Roberts, 2014), and a more in-depth quantitative study using a sample of 589 children of 59 classes in Guangdong Province of China (Hu, Mak, Neitzel, Li, & Fan, 2016; Hu, Dieker, Yang, Y., & Yang, N., 2016; Hu, et al., 2017). As an essential part of preschool education quality, how do play center activities going in the Chinese kindergartens? Are they effective in promoting children`s development? This research

aims to present the situation of play center activities and child development outcomes in kindergartens in China, and explore the relationship between the quality of play center activities and child development by using the general quality measurement and child development assessment, so as to help practitioners better improve play center activities.

1.2 Objectives of the research

As mentioned above, past research has not provided a clear picture of play center activities and the effects of them versus child development outcomes in China. The quality of preschool education and activities children engaged in preschool days are involved with different demographic characteristics (Magnuson, Meyers, Ruhm, & Waldfogel, 2004; Early, et al., 2007). The children can get different experiences in different fields and class characteristics. For example, children in private/rural kindergarten may system different experiences from public/city kindergarten, children may have different performance in the big/small sized classroom. Individual children from low socio-economic status and parental education background families may be systematically different from other students in the same class. Therefore, this study considered multi-level models, including family socioeconomic status (SES), gender, and age as a means to unravel different levels of influence.

Accurate and reasonable measurement of the quality of play center activities can not only provide references for preschool teachers to evaluate play

center activities, but also make teachers clear the critical issues of how to carry out play center activities and what to pay attention to. The purpose of this study is to explore the quality of play center activities in kindergartens of China， and the relationships between the quality of play center activities and child development:

(1) Present the quality of play center activities in kindergartens by using practical measurement tools in China；

(2) Present the child development outcomes in language, math, executive function, and social skills by individual assessment，and analyze differences between child characteristics and child development outcomes；

(3) Analyze the associations between the quality of play center activities and child development outcomes in language, math, executive function, and social skills while controlling child characteristics.

The research questions that guided this study are as follows：

(1) What are the current level of quality and three components of play center activities (material and space, opportunity and time, design and organization)?

(2) What is the current level of child development outcomes in language, math, executive function, and social skills in the kindergartens in China? Are there differences between child characteristics and child development outcomes?

(3) what extent play center activities (material and space, opportunity and time, design and organization) predict children`s development outcomes, after controlling for children demographics (gender, age, pretest, family SES?

1.3 Significance of Research

The overall intent of this study was to use the empirical study to detail children`s usage of play center activities of play in kindergartens and use the prevalent global measurement of Activities subscale of the Early Childhood Environment Rating Scale-Revised (ECERS-R) to explore the quality of play center activities in China. Informed researches have shown the high relationship between the early childhood education quality and development outcomes of children, as one of an essential and important form of children`s daily experience in kindergarten, what is the association between the quality of play center activities and child development outcomes? It enables to conduct more in-depth observation and analysis on the setting of play center activities in the context of China. Findings and implications will inform stakeholders on how to better support and enhance children`s play center and early learning activities.

(1) Present the current situation of play center activities in China

The focus of the research on play center activities is to improve the quality of play center activities in kindergartens. Both the discussion of the value of play center activities and the analysis of its current situation are ultimately aimed at improving the quality of play center activities and promoting the comprehensive and harmonious development of children. The quality evaluation is an important method to measure the quality of play center activities, but there are few studies on the evaluation of play center activities in kindergartens. Therefore, this study takes the

global widely used measurement method on the setting, conducting and teacher guidance of play center activities to present the real pattern of play center activities which aims for these activities quality evaluation. It not only deepens the relevant research on play center activities but also provides theoretical reference for the implementation of evaluation in kindergartens.

(2) Improve the practice of play center activities for better development

As an important part of children's life, play center activities are ubiquitous in kindergartens. Teachers' thoughtful guidance and grasp of play center activities depend on their correct understanding and evaluation of the current. However, the current evaluation of the quality of play center activities is often one-sided and arbitrary, and there is a lack of evaluation indicators that can be referred to objectively, leading to deviation in practice. Based on highlighting the vital value of play center activities, this study establishes the purpose of children's developmental evaluation, hoping to comprehensively evaluate play center activities in terms of planning, setting, and guidance, and provide some enlightenment for practitioners. On the one hand, it helps practitioners to understand and evaluate play center activities properly and makes play center activity evaluation more professional. On the other hand, it can provide specific directions for improving the design and implementation of play center activities and further improve the whole quality of play center activities.

1.4 Conceptual definitions

1.4.1 Play center activities

Play center activities is a form of play, which is the basic organization forms of kindergarten education. It is also called child-initiated activities or learning center activities in western countries, and which is called area activities, interest area activities in China. In this study, play center activities defined by Schweinhart (1997) was used, which is instigated by children`s innate motivation, curiosity and drive, and is sparked by observation, experience, or interest which gives children ownership of their learning.

In this study, play center activities involved are based on children's needs and educational purposes and provide children with free spaces, materials, and peers. Children can choose the activity area and content behind the designed function of teachers, and interact with peers and teachers to promote children's development in various aspects. The play center activities in this study refers to the area exclusive to the class (including classroom, class corridor, except outdoor areas).

1.4.2 Quality of early childhood education

Early experiences and childcare determine whether a strong or weak foundation is provided for children`s future health, learning, and behavior. For all children, the quality of early childhood programs is a vital factor. Early childhood education with a high quality should include suitable curriculum for children's development; experienced teachers; a safe environment; small class size, low ratio of

adults to children; and full participation of the family (Early, et al., 2007). In addition, the National Association for the Education of Young Children (NAEYC, 1989) believes that high-quality early childhood education is a safe and beneficial environment that can promote children's physical, cognitive, social, and emotional development (Bredekamp, 1987). The characteristics of high-quality early childhood education include highly skilled staff, small classes and high adult-child ratio, rich language environment, age-appropriate curriculum, stimulating materials in a safe environment, warm and responsive interaction between teachers and children (Shonkoff, 2007).

1.4.3 Child development

Child development refers to the sequence of physical, mental, verbal, and emotional changes from birth to the end of adolescence (Erikson, 1963). In this process, children think, move, feel and interact, and this all-round development and learning is crucial to children's life and future participation as social members (Bransford, Brown, & Cocking, 1999).

In research and practice, early child development frequently concerned and measured indicator including: physical skills, cognition, social interaction, and early learning skills such as language and math (Misson, et al., 2011; Joost de Laat, 2015; Zosh, et al., 2017), Language, math, social skills and some core cognition such as executive function were widely used in research.

1.5 Summary

In this chapter, firstly, the research background of this study was elaborated from the significance of high quality of early childhood education to children's development and the important value of play center activities in kindergartens to children's development. Secondly, the purpose and questions of this study are summarized by grasping the deficiencies of the research on play center activities and children's development in kindergartens in China. Thirdly, the significance and important value of this research are explained from theory and practice aspects. Fourth, the key concepts involved in this research are explained.

CHAPTER 2

LITERATURE REVIEW

This chapter first introduces the Developmentally Appropriate Practice as the theoretical foundation of this research. Secondly, by expounding the relationship between play, child learning, and child development in DAP, this chapter concludes that play center activities play an important role and value in the development of children. Thirdly, through the combing of the literature related to play center activities, it provides a reference for the development of play center activities in kindergartens, the role of play center activities in the development of many aspects of children, and the use of relevant measurement tools.

2.1 Theoretical framework: Developmentally Appropriate Practice

Developmentally Appropriate Practice (DAP) is a teaching method based on early childhood development and learning research, aiming to improve the quality of early childhood education (Bredekamp, 1987; Copple & Bredekamp, 2009).The framework aims to promote the best learning and development of young children and has been recognized as the basic educational concept of early childhood education in many countries.

2.1.1 Development and application of DAP

DAP was first proposed by National Association for the Education of Young Children (NAEYC) in the U.S.A. in 1987, and upgraded in 2009. Based on Piaget`s constructivist thinking and the stage theory of cognitive development (Berk & Winsler, 1995), DAP theory believes that early education should accumulate teaching methods to help children grow to the greatest extent, and use them to guide children to improve continuously in a way suitable for themselves (Britto, Engle, & Super, 2013). Besides, teachers should provide appropriate teaching environments, materials, and educational curriculum that suit the level of children`s development. Teaching decisions made by teachers should match children's age, individual development level, and cultural suitability.

DAP concept is not only used in western countries, but also in many Asian countries in the early childhood education reform, such as South Korea, Turkey and China (Tobin, Hsueh, & Karasawa, 2009). In recent twenty years, Chinese educational departments and practices have incorporated DAP into the national early childhood education framework (Zhu & Zhang, 2008).

2.1.2 Core aspects of DAP

Developmentally Appropriate Practice includes three core aspects: age appropriate, individual appropriate and cultural appropriate (Bredekamp, 1987; Copple & Bredekamp, 2009). Three core aspects above provide parents, teachers, and other caregivers a general idea of the activities, routines, interactions, and curriculum

that would be effective in preschool education. In general, developing suitability education for child development and learning should take the following factors into account:

(1) Characteristics of children.

First is the age of the child. It is found that kindergarten teachers should develop more appropriate behaviors than those in lower grades in primary school (Bredekamp, 1987). Compared with the teachers of older children, the teachers of young children believe that developmental and appropriateness education is more widely used.

Second is the gender of children. Boys are more active than girls, and boys spend more time on outdoor games than girls (Gleave & Issy, 2012). Ceglowski(1997) noticed that boys tend to play with friends far away from home, while girls tend to play with family members near home. With the development of children's cognition of gender roles, they show gendered behaviors. For example, children don't like to play games with children of the opposite sex.

Third is the previous experience of a child. The children are unique individuals with different interests, needs, and motivations. The previous experience of children is an important foundation for future development. Children's way of understanding the world, learning style, thinking style and so on affect the subsequent learning (McClelland, Acock, & Morrison, 2006; Roskos, Christie, & Richgels, 2003).

(2) Characteristics of teachers. Previous studies suggest that teachers' knowledge, specialty, experience, and educational beliefs have a great impact on their suitability education (McMullen, 1999; Barnett, 2003; Early, et al., 2007; Ashiabi, 2007; Epstein, 2014). Research has found that teachers who believe they have more influence on educational practice are more likely to design and organize appropriate educational activities and adopt more appropriate educational behaviors (Maxwell, McWilliam, Hemmeter, Ault, & Schuster, 2001).

(3) Characteristics of the external environment, such as family socioeconomic status and number of children. Children from poor families with less-educated parents start school with lower foundation levels of language, reading and math development (Barbarin, et al., 2001).

Second, classroom characteristics, such as class size, number of teachers present in class. Some studies have found that class size affects the type of teacher-child interaction. The more children in the class, the more likely teachers are to develop inappropriate ideas and behaviors (Barnett, 2003).

In this study, characteristics of children, characteristics of teachers exhibited in the class, and characteristics of the external environment were considered as vital factors for Developmentally Appropriate Practice in kindergartens.

2.1.3 Principles of child development and learning in DAP

National Association for the Education of Young Children (NAEYC) emphasizes the DAP as a philosophy or a way of working with young children. It is

not a curriculum or a set of standards that can be directly used in the early educational practice (Bredekamp & Rosegrant, 1992). Learning from 12 interrelated key principles of children`s development and learning, teachers and caregivers should consider and foster child development and learning in all domains. These principles emphasize individual variation in children's learning and development, and can help teachers provide curriculum based on play, flexibility and personal response for children's learning. In such learning, children's interests, enthusiasm, and exploration empower children to be independent, autonomous, and fully developed learners (Chi, 2009). The role of the teachers is generally considered to be to promote children's learning and development through skilled and supervised interaction, based on the needs of the child (McMullen, 1999; Graue, Clements, Reynolds, & Niles,2004; Epstein, 2014).

2.1.4 Understanding play and playful learning in DAP concepts

Play is a children's right and also a meaningful way to learn. In the NAEYC position statement on appropriate development of practice, play was also highlighted as one of 12 important principles. It is described as an important way for children to learn:

"Play is an important vehicle for developing self-regulation as well as for promoting language, cognition, and social competence. Children of all ages love to play, and it gives them opportunities to develop physical competence and enjoyment of the outdoors, understand and make sense of their world, interact with others,

express and control emotions, develop their symbolic and problem-solving abilities, and practice emerging skills." (NAEYC, 2009, p.14)

In a joint position statement, NAEYC laid out the value of play and intentional learning, which are important at any age and as part of appropriate developmental practices, are relevant to later learning (Copple & Bredekamp, 2009). So a pedagogy combined play and learning usually called playful learning or guided play is widely accepted in early childhood learning and development. Longitudinal studies have shown that playful learning strikes a balance between adult-initiated teaching and child-initiated play, which is most effective for children's cognitive and social development (Sylva, et al., 2006). In order to promote child development and learning and to play games in a developmentally appropriate way, practitioners and teachers must pay attention to the characteristics and needs of young children, the multiple impacts on development and learning, and the use of development knowledge to create respectful, safe, supportive, and healthy learning environments (Copple & Bredekamp, 2009).

Indicators of effective learning should include joint participation of children and adults, including joint participation in child-initiated or adult-initiated activities, and interaction in child-initiated play center activities. Zosh, et al. (2017) showed a continuum of playful learning framework for better understanding different development and learning ways for children (Figure 1.1). Between child-led free play and adult-designed direct instructions, there are other two ways for child leaning:

guided play and games. Guided play pointed much more child initiative activities with adult scaffolded environment and materials, while games pointed much more adult designed set rules, and child interests and needs also need to be considered. Playful learning involves a teacher and constraints for play, and the teacher's role is to create an environment that is proactive and responsive to the child's choices, interests, and learning patterns.

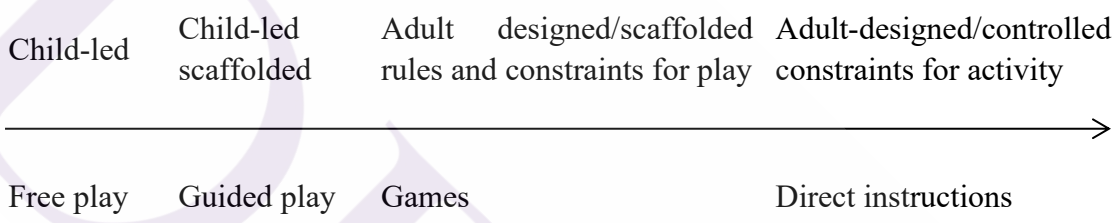

Figure 1.1 Continuum of playful learning

Source: Adapted from Zosh, J. M., Hopkins, E. J., Jensen, H., Liu, C., Neale, D., Hirsh-Pasek, K., ... & Whitebread, D. (2017). *Learning through play: A review of the evidence (White Paper)*. Retrieved from The LEGO Foundation website: https://www.legofoundation.com/media/1063/learning-through-play-web.pdf.

In summary, both DAP guidelines and practices indicate that play is an vital way for children to achieve appropriate development, and adults should provide adequate play opportunities for children. Teachers in most western countries have received this message well, accepting learning-centered play or play-centered activities as a practical curricular approach and translating DAP beliefs into daily practice. In this study, aspects of child individual characteristics, many developments

and learning outcomes, and learning environments about play are taken into consideration.

2.2 Play: An essential strategy for child development

2.2.1 Definition of play

Play is common in early and later childhood. Play is not only fun, it is also a powerful tool to help young children learn. There is no uniform definition of play, and existing theories tend to identify specific characteristics between play and other behaviors (Duncan & Tarulli, 2003; Gleave & Issy, 2012; Bohart, Charner, & Koralek, 2015). Researchers and theorists reach a consensus on the key characteristics of play as (1) meaningful; (2) joyful; (3) actively engaging; (4) iterative; and (5) socially interactive (Smith & Anthony, 2008; Gleave & Issy, 2012; Zosh, et al., 2017).

In a word, play should be an active activity for children, who can play an ownership and active role in their experiences, and teachers should recognize and trust children to have the ability, autonomy and agency for their playful learning. Children are "hands-on" learners who gain knowledge through interesting interactions with objects and people. They need a lot of physical practice to understand abstract concepts.

2.2.2 The importance of play to child development

There is a link between play and early childhood development, which has been a question explored by many psychologists and educational researchers. Both

empirical evidence and practices in early childhood education have recognized the benefits of play on child social and cognitive development. Research has shown the links between playing and basic skills such as oral language abilities, self-regulation, memory, social skills and academic success in school (Davidson, 1998; Clawson, 2002; Lindsey & Colwell, 2003; Johnson, Christie, & Wardle, 2005; Hirsh-Pasek, et al., 2009).

Play is one of the most important ways for children to acquire basic knowledge and skills. For this reason, the core of effective preschool education programs is to provide play opportunities and environments for children to play, explore and practice learning. Children practice skills through the games, and they try all kinds of possibilities, fixed hypothesis, and find new challenges and to gain a deeper study. Through playing, children show better language communication ability, a high level of interpersonal skills, use toys and materials creatively, develop imagination, divergent thinking, and problem-solving skills (Wood & Attfield, 2005). Play and playful activities contribute to the development of more complex forms of knowledge and skills.

2.2.3 Related research on children`s development and play

Playing takes a central role in developing cognitive skills is widely known. Piaget and Vygotsky both emphasized the essential role of play in child development (Piaget, 1981; Vygotsky, 1978). Piaget believes that as one of the most important factors in cognitive development, play provides children with a wide range of activity

opportunities, interact with materials in the environment and build the knowledge of the world (Piaget, 1981).

2.2.3.1 Language development and play

Play is influential in children's language learning and communication skills. Children use language to communicate with their peers in the play, use different words and tones in their interactions and develop new vocabulary. Verbal communication in the play promotes the development of expressive vocabulary and their perception of the phonetic or conversational rules of language (Davidson, 1998). Play also improve children's oral and written language skills. For example, the language used in play encourages the development of the ability to consciously reflect linguistic operations and the orientations of language analysis, and thus promotes literacy development. This metalinguistic awareness helps children think about the words and expressions used in conversations. Children use words to communicate and learn how to manipulate the use, meaning and grammar of language. Clawson(2002) proposed that children can better understand every feature of language through play.

2.2.3.2 Math development and play

A common concern is that play provide excellent opportunities for learning math and science fundamental concepts and appropriate attitudes for supporting early math. The development of early math and early literacy skills are intertwined (McClelland, et al.,2007). When play is occured hand-on-hand with other subjects in constructive play and math play, Children would gain much problem solving

skills, including counting, marking, sorting, shaping, pattern mathematical operations and measures (Cross, Woods, & Schweingruber, 2009). The Independent Review of Mathematics Teaching in Early Years Settings and Primary Schools led by Department for Children, Schools and Families in the U.K. (DCSF, 2008), described play as an important means of effective early years pedagogy and emphasizes the importance of connecting, creatively recording, and effectively marking. Children learn how to recognize mathematics in their living environment, and then learning how to express more complex mathematical concepts, including measurement, counting, and reasoning during the early mathematics learning process in the play (Sarama & Clements, 2009).

2.2.3.3 Executive function and play

There is substantial evidence that play is a natural way to construct cognitive processes, assist learning, and even help solve more complex mental health problems (Sluss, 2005; Smith & Pellegrini, 2008; Sarama & Clements, 2009; Whitebread, Coltman, Jameson, & Lander, 2009).Executive function refers to a series of cognitive operations and strategies necessary to supervise and implement challenging tasks, such as advanced planning, inhibitory control, working memory, set-shifting, and intentional flexibility (Berk & Meyers, 2013). Numerous studies have confirmed that early childhood is the key period to lay the foundation of executive function (Gioia, Andrwes, & Isquith, 1996; Berk & Meyers, 2013; Carlson & White, 2013; Fuhs, Nesbitt, Farran, & Dong, 2014; Michel, Molitor, & Schneider,

2019). Vygotsky (1978) has pointed out that symbolic play helps develop self-regulation in young children, and some studies have shown a positive association between pretend play and executive function skills related to inhibition and self-control. Elias and Berk(2002) indicated that children's early imagination play has prompt and delayed effects on self-control. Berk and Meyers (2013) found that make-believe play is one of the multiple potential routes to executive function development with both parenting and school influences. Kelly, Dissanayake, Ihsen, and Hammond (2011) also indicated that executive function does appear to play a role in the symbolic play of young children.

2.2.3.4 Social development and play

Play lay the groundwork for the development of critical social skills. Through play, children learn to connect with others, share, negotiate and resolve conflicts, and learn self-promotion skills (Howes, Phillips, & Whitebook, 1992; Nikolakaki, 2012). In addition, play also teaches leadership and group skills. Children can use play as a natural tool to build resilience and coping skills as they learn to deal with interpersonal relationships, social challenges and overcome their fears. When young children play without external intervention, play gives them an opportunity to learn skills such as how to cooperate, share, negotiate, resolve conflicts and promote themselves in a team (Golinkoff, et al., 2006). When the play allows the child to start, the child can practice how to make decisions, how to act at their own pace, how to discover their areas of interest, and finally be fully engaged in the activity of their

choice. Playing in a rich environment can improve children's problem solving ability, thinking and adventure flexibility, and abstract thinking (Sluss, 2005). Play also allows young children to imitate and learn from more competent peers, which often encourages children to see a new perspective from challenging experiences, build social competence and build meaning (Haight, Black, Ostler, & Sheridan, 2006).

2.2.3 The measurement of child development

The movement of develop and improve child development indicators grew out of the social indicators movement of the 1970s. Initially, child development indicators focused on the health and education, social and emotional development of children. Nowadays, education reform movement from many countries puts more emphasis on improving the quality of education and student output, and then some of the research tools are gradually improved in order to help to measure the results of education reform efforts (Murphey, 2010; Joost de Laat, 2015; Zosh, et al., 2017). Several typical child development indicators are listed below.

2.2.3.1 Early Childhood Indicators

In order to measure the children`s development in many understandings and to answer what is the quality of childhood education, a large and complex Murphey (2010) divided large and complex early childhood indicators into two categories: child well-being indicators and contextual indicators.

(1) Child well-being indicators are the direct indicators to measure the development and welfare of young children. Including fine motor skills; A healthy

weight; Recognize sounds and letters; Vocabulary; Frequency of prosocial behaviors such as sharing, helping and cooperating; The frequency of aggression (Murphey, 2010).

(2) Contextual indicators describe the impact of family, school and community factors on children's health and development. Including parents' education level; Parents' language skills; Family poverty; The number of books at home; The structure of the family; Whether to provide and participate in high-quality early care and education (Murphey, 2010).

2.2.3.2 Multiple Indicator Cluster Survey (MICS)

multi-indicator cluster survey (MICS), supported by the United Nations children's fund (UNICEF), is a comparable estimate of socio-economic and cost-effective household sample survey programmes.The Multiple Indicator Cluster Survey (MICS), supported by the United Nations Children's Fund (UNICEF), is comparable estimates of the sample survey programs for socio-economic and household costs. It produces statistically reasonable international indicators, covering four different areas: literacy - numeracy, physical, learning, and social emotion (Zosh, et al., 2017). This measure is simple and basic. For example, the literacy-numeracy measure requires children to recognize at least 10 letters of the alphabet, read at least 4 simple words, know names and recognize numbers from 1 to 10 are considered to be developing normally.

2.3.3.3 Measuring Early Childhood Outcomes

According to the current research results, Joost de Laat (2015) proposed five categories of indicators to measure child development: Physical development; Executive function and self-regulation; Early math skills; Early literacy skills; Social-emotional development (Joost de Laat, 2015). Each indicator can choose proven effective measurement according to the research objectives and different objects.

2.3.3.4 Tracking children's development over time

As a set of research tools in a Longitudinal Study of Australian Children (Misson, et al., 2011), child development outcomes include 3 domain indicators: (1) Health/Physical includes Health and motor; (2) Social/Emotional includes internalization, extension and social competence; (3) Learning/Academic includes Language and literacy, numeracy and cognition (Misson, et al., 2011).

The child development indicators above try to make the education reform efforts much more effective, which suitable for the unique educational and cultural background of each country. Unfortunately, the child development indicator system in Chinese culture has not been established so far. According to the basic development domains and the average early learning level child can reach in preschool years, This study referred to the above measurement indicators and selected four indicators as the key and typical indicators of child development: (1) receptive language for early literacy skills; (2) early math skills for early math achievement; (3) executive function

for cognitive development; and (4) social skills for social-emotional development. One measurement scale or tool with good reliability and validity proven is selected for each indicator above.

2.3 Play center activities as an essential form of play

2.3.1 Definition of play center activities

Play center activities is the common form of play in the classroom, which is the basic organization forms of kindergarten education. For children, learning happens every day and everywhere. It occurs in different activities, including structured whole-group teaching activities and unstructured free play activities, group activities and routine/meals in early childhood programs (Duncan & Tarulli, 2003; Johnson, et al., 2005; Hirsh-Pasek, et al., 2009; Holt, 2010). These settings collectively comprise approximately 90% of the preschool day. Broadly speaking, kindergarten activities can be divided into three categories :(1) free play, in which children can choose what to do from specific areas and a variety of materials (e.g., center time); (2) teacher-assigned, during which young children participate in the activities selected by teachers together with the whole class, group, or individual activities; (3) meals/routines, for children engaged in individual or classroom activities (e.g., eating, using the bathroom, cleaning up, or transitioning between activities). Compared with other forms of activities, play usually occurs in the "corner game" or "central time" of early childhood activities, and effectively promote

children's development and learning ability. By choosing the play they enjoy, children can develop intellectual, social, emotional and physical abilities. (Davidson, 1998; Elias & Berk, 2002; Copple & Bredekamp, 2009).

In preschool, it is also called the guided play, or learning center activities in western countries, and it is called corner play, area activities, or interest area activities in China. According to the needs of children and the education teaching goal, some well-organized learning centers (i.e., dramatic play, blocks, fine motor, art, music, sand/water, science, math) full of stimulating materials and well-planned activities are set up in the activity room and corridor. In the childcare environment, children usually get a rich experience and a free atmosphere according to their wishes and their initiative choices. Play center activities, which emphasize the role and value of learning in supporting an educational environment, accepted by early childhood program practice in the past few decades (Davidson, 1998; Elias & Berk, 2002; Duncan & Tarulli, 2003; Johnson, et al., 2005; Hirsh-Pasek, et al., 2009). Preschool teachers in many countries have fostered the sense of this kind of play and endorsed child-initiated corner play as the practical curricular approach, which is the same in China (Yu, 2005; Zhu, 2007; Xu & Zhao, 2014; Huang, 2014; Hu, et al., 2015).

Play center activities, which emphasize the role and value of learning in supporting an educational environment, accepted by early childhood program practice. For instance, Effective provision of pre-school education (EPPE) is an early

childhood education programme funded by the U.K. government. Studies have shown a link between high quality educational services and better child development outcomes. In a large longitudinal study, the project explored teaching behaviors that link play to positive learning outcomes (Sylva, et al., 2007). The Early Years Foundation Stage in England (EYFS) in the U.K. is widely welcomed by the early childhood community because the curriculum and assessment emphasize well-planned experiences according to children's spontaneous play (indoor and outdoor). The program gives children time to focus on their play, creating and solving problems, and the interaction between children and adults. Children learning and development are stimulated by providing a wide range of creative and imaginative activities.

2.3.2 Setting of the play center

The classroom environment of the early childhood program is different from other primary and secondary schools. The most remarkable thing is that there are many distinct areas in the class, where children can freely choose their favorite areas and materials for activities. Regardless of the type of early childhood education program, the importance of activities in play center activities areas for child development is recognized. Many scholars and different early childhood programs have made specific divisions and different distinguished types of activity areas. Typical ones are as follows：

Montessori was the first educator to put forward and practice the play center activities. In Children's Home, Montessori divides the classroom into daily activities, life practice activities, teaching activities, sensory activities, and language activities. In these activity areas, relevant equipment, tools, and teaching guidance are placed according to playing content, basis activity level, and child development level (Camp, et al., 1997).

According to the children's interests and combined with the characteristics of activity materials, activity areas in the High-Scope program are baby's home, music area, sand-water area, block area, art area, quiet area, woodworking area, scientific exploration area, and so on. Moreover, the number and size of these activity areas can be adjusted according to the number of children and children's interests (Holt, 2010).

In the Spectral Project, eight activity areas are designed to visual arts, language, natural science, sports, society, mathematics, machinery, music, and construction areas according to children's physical, mental and developmental conditions and their unique personality (Gardner, Feldman, Krechevsky, & Chen, 1998).

In the NAEYC preschool program, a variety of play exist in preschool classrooms, such as object play, physical play, dramatic or pretend play, constructive play, and rule play. Each game has its own advantages and characteristics, and play obviously plays an important role in the physical, psychological, emotional, and social development of children (Bohart, et al., 2015).

In Early Childhood Education Rating Scale-Revised Version (ECERS-R), activity area was measured in 10 subscales: fine motor; art; music/movement; blocks; sand/water; dramatic play; nature/science; math/number; use of TV, video, and/or computers, and setting areas should promoting acceptance of diversity (Cryer, Harms, & Riley, 2003; Harms, et al., 2005).

In the kindergartens in China, some play centers such as role/drama, blocks, fine motor, language, mathematics, nature/science, music/rhythm, art, sand/water are considered as the common activity areas, The 9 items are all contained in the Activities subscale of the Chinese Early Childhood Environment Rating Scale (CECERS) (Li & Hu, 2012) to evaluate the preparation and implementation of play center activities.

In short, some of the most common learning areas in kindergarten classrooms are dramatic play, art, reading/language activities, blocks, science and math. The establishment and organization of these play center activities need to take the age, interests and abilities of children into account, and need to be changed accordingly.

2.3.3 Key components of play center activities

Good design and proper setting is the premise of play center activities. As Good and Nedler (1974) revealed, play center activities should provide a positive emotional atmosphere and enable children to develop self-confidence. Teachers should reduce restrictions on children so that children's exploration behavior is

encouraged; Fruitful materials and equipment adult-provided can help children develop their skills and gain different and meaningful cultural experiences. The idea of high quality of play can be used for understanding what the key components of high-quality play center activities are. High quality play includes more extended play periods; lots of realistic props; and unstructured, open materials (Copple & Bredekamp, 2009). Based on the existing literature and practice in kindergartens, this study proposed three key components as a foundation for a deep understanding of play center activities.

2.3.3.1 Sufficient space and materials

Sufficient space and materials are crucial elements in play center activities. It promotes classroom management and supports course objectives and their implementation (Catron & Allen, 2007). Sufficient space requires room for numbers of children to freely operation, without being restricted by the size, crowded conditions (Cryer, Harms, & Riley, 2003). Besides, the proper play center area environment in the classroom shows clear boundaries between areas of sufficient space to avoid interference between activities. There should be enough equipment and space for many children to use, and they should be free for young children to choose according to their own interests (Duncan & Tarulli, 2003). A wide range of materials and toys should be provided, including those familiar, natural, novel, and open materials to support the exploration of play. In many kindergarten classes, teachers

put large toys and materials with different functions in some divided play centers and corners, which is common and prevalent for children's development.

2.3.3.2 Adequate time and opportunitied provided

Providing adequate time and opportunities for activities is also important for play center activities. In general, it is necessary to provide adequate space, a variety of activities and materials, and to encourage children to move freely without being limited to a specific area (Holt, 2010). Children should have opportunities to play freely in the game center. Different from the traditional group-teaching in kindergartens, activities in different areas mean that the children can freely choose the area, independently operate the material and determine the speed and difficulty of materials at the level of children's abilities (Sylva, et al., 2007). Teachers should carefully prepare and organize structured activities to ensure that high levels of activity are carried out while providing children with adequate free play time..

2.3.3.3 Responsive interactions from teachers

All researchers agree on the role of teachers in play center activities. They believe that teachers could improve, enrich and expand children's play through effective strategy advice, participation and redirection (Henniger, 1993; Kneas, 1999; Duncan & Tarulli, 2003; Johnson, et al.,2005; Hirsh-Pasek, et al., 2009; Xu & Zhao, 2014; Hu, et.al, 2017). The effective interaction of teachers in children's play includes sensitive attention to child individual interests and needs, selective choice of when to participate, appreciation and respect of children's views, and recognition of their

abilities and efforts. On the other hand, if the teacher provides too much control, constraints, or interrupts, it usually damages the play activities. The teacher's role is responsible for providing children with a variety of activity materials, implementation, and positive guidance.

2.3.4 Play center activities in China

2.3.4.1 Understanding play in kindergartens of China

Since early childhood education and curricular reform in China, the scholars in China have absorbed play center philosophies and approaches to pedagogy and curriculum (Zhu & Zhang, 2008). Play is significant to children`s development and learning. Influenced by the concept of play center philosophies and curriculum reform, Teachers agree that support frameworks are important for developing and evaluating children's skills as learners and players. As the children follow their interests and actions, the teachers realize the need to understand the meaning of the play in the children's own terms, rather than focusing on pre-set learning goals. Therefore, an important teaching revolution is that play provides the opportunities and time for teacher teaching and child learning. The teachers recognized the importance of understanding children`s patterns of learning and interaction, which could inform their pedagogy and curriculum planning. In particular, they realized that children need more time to develop a sustained and higher level of play according to children`s themes and interests. However, the scholars and preschool education practitioners of China all recognize the importance of play for the optimal development of children, and promote free play in kindergarten curriculum and teaching, as well as regard the whole group teaching as the great significance of learning. Professionals support a balanced approach between teacher-led group teaching and child-led free play as the

best approach to get a high quality of early childhood education (Hu, et al., 2014; Hu, et al., 2015).

In fact, literature has shown the contradiction between the professional beliefs and educationl practices (Hu, et al., 2014). Studies in Hong Kong (Li, 2014) and Mainland China (Hu et al., 2015) showed that teachers in Chinese culture still insist on teacher-led rather than play-centered teaching methods, although these teachers might highly agree with the philosophy of Developmentally Appropriate Practices (DAP). Given the unique sociocultural and policy contexts of China, there are immense challenges in introducing the play-centered concepts into the way teachers teach, because of the deep-rooted social collective culture in China. This collective culture emphasizes obedience to the family, the collective and the country, which helps to explain the tendency of teachers to use group teaching rather than play-centered activities to organize daily life and activities. Therefore, due to the constraints of large class size and traditional subject-based learning practice, teachers in Chinese kindergartens tend to use whole-group teaching (Wang, 2009).

Kindergarten teachers in China do not attach importance to children's interest in learning; instead, professional practice is designed to cater to the teacher-initiated whole group teaching style that teachers like. However, the current development of play center activities in kindergartens is still not satisfactory, play center activities have not really been noticed, and they are just complementary to kindergarten classes. Many teachers still attach importance to whole-group teach in

their concept and despise play center activities. They think that a day without "whole-group teaching" is not fulfilled the task, while play center activities are dispensable. An in-depth look at China's play activities, it is found that kindergarten Teachers have the least interaction with children in unstructured activities such as free free play and play center activities (Wang, 2009). Due to the lack of teaching instruction in the daily nursing activities, teachers have little effective guidance and may not know how to make full use of embedded learning opportunities..

2.3.4.2 Current research on the quality of play center activities in China

At present, relevant researches mainly focus on a description of the current situation in practice. From the existing empirical research, the quality of play center activities of kindergartens in China mainly focuses on the time, the setting of activity materials, teachers' guidance and other aspects. It was shown that existing problems of play center activities including lack of time for free play center activities; a variety of materials but with incomplete autonomy of children, etc. Teachers` role is ambiguous and aimless, mainly to ensure that the activities can be carried out (Li, 2005; Han, 2013; Gu, 2016; Chen & Li, 2015).

Some researchers use descriptive statistics to present the quality of play center activities by measurement of self-designed questionnaires. Li (2005) made a preliminary analysis using a questionnaire survey of the play center activities in Guilin kindergartens. It is found the following problems in play center activities: teachers' guidance focuses on the impact of knowledge and the practice of skills, with

more regular training and less exploration of children's innovation and creativity; focus on the outcome of the activity and ignore the whole process of the activity. Liu and Gao (2013) studied the the quality of play center activities of 440 kindergartens in 22 cities of 11 provinces in China, and comprehensively investigated the quality of activity areas from the division and setting, provision and utilization of materials. Through the investigation and evaluation, it was found that the activity area was divided and set up at the medium level. 61.5% of the classes set up various activity areas for children, and nearly half of them have clear and appropriate division, but nearly 40% of the classes have weak division and setting. The equipment of all kinds of play materials is unbalanced, and important play materials are missing. The use of materials for sports, construction, art, language, and scientific activities are not well, and a number of classes are using elementary school works.

In recent years, the research on play center activities has been further deepened, and scientific measurement and scales are considered to evaluate the quality of play center activities, such as the Early Childhood Environment Rating Scale-Revised (ECERS-R) accepted in many countries (Gol-Guven, 2009). In China, some researchers have tried measuring the quality of play center activities by this scale. For example, Luo (2014) using the ECERS-R in Changsha, found that the quality of play center activity remains to be improved, especially the materials and the opportunity provided needs to be improved. In order to reflect the social and cultural context of China, CECERS revised and changed ECERS-R on the basis of strictly

following the ECERS-R principles (Hu, et al., 2014). Chen and Li (2015) used CECERS to study the play center activities of 933 children of 163 classes in 88 kindergartens in Zhejiang Province. The results showed that the overall quality of play center activities is not high; play center activities had a significant weak predictive effect on children's development results. In summary, through the use of CECERS, the current status of the play center in other regions remains to be further explored.

2.3.5 The measurement of play center activities

As an essential part of preschool education, the measurement of child-center activities should closely follow the development trend of preschool education quality measurement. In the past, there was a lack of effective and systematic indicators to measure early childhood development. Researchers have made great efforts to establish reliable and effective measures to focus on the input-outcomes and outcomes of investments in early childhood development education. Raikes, Britto, and Dua (2014) pointed out three core principles of the measurement framework for early childhood education and development: (1) measurement should emphasize the importance of input, output and child development results. (2) measurement should encourage attention to the improvement of children's experience and results. (3) measurement should consider different cultural backgrounds. Since children's development is contextually sensitive,

indicators in different contexts do not always have the same meaning, which can be adjusted appropriately.

According to the core principles of the above measurement framework, this study tries to find a measurement tool suitable for kindergartens in China. The ECERS-R has proven to be the proper instrument for measuring the quality of early childhood education in an international context, used in more than 20 countries of different socio-economic backgrounds around the world (Gol-Guven, 2009).In order to improve the cultural adaptability of the instrument, the Chinese Early Childhood Environment Rating Scale (CECERS) based on the strict adaptability of ECERS-R is adopted to measure the quality of kindergartens under the Chinese social and cultural background.

CHAPTER 3

RESEARCH METHODOLOGY

The present study examined (1) the actual level of the quality of play center activities in kindergartens of China, (2) and the actual level of child development outcomes, and (3) the link between the quality of play center activities and children`s cognitive and social outcomes. The existing data used for the present study were collected during the school years of 2015-2016. The data include parents' assessment, structural classroom observation, and children assessment. Parents' assessment and structural classroom observation data were collected in the spring of 2016. The pretest of children`s assessment data which used as the predictor variables was collected in the fall of 2015 and the children`s assessment data used as the outcome variable was collected in the spring of 2016. This chapter describes the research hypotheses, participants, procedures, measures, and data analyses used to examine the research questions.

3.1 Research hypotheses

It can be seen from the existing theories and research results that there is a certain relationship between the quality of play center activities and child development results. From the perspective of empirical research, this study would

explore the actual level of play center activities under the current situation of kindergarten education in China and the actual effect on children's development results through a variety of analytical methods. Further, Some teacher-level factors will be controlled to understand which variables at the class level have practical effects on the quality of play center activities. Based on the above research questions, the research framework is constructed as follows (Figure 3.1):

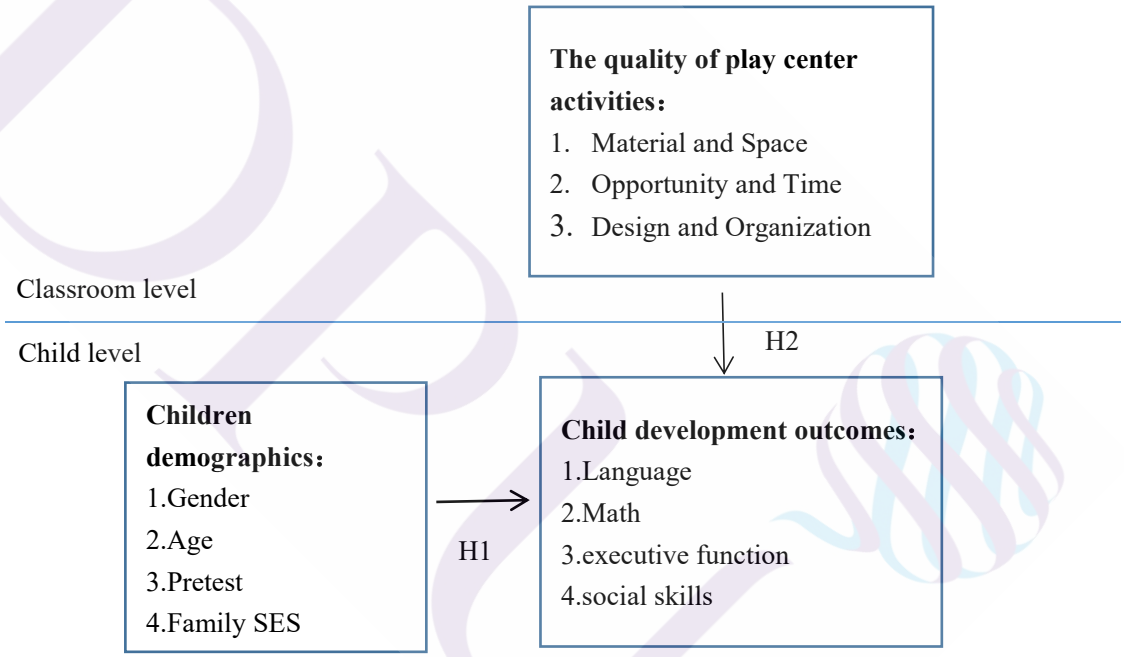

Figure 3.1 Research framework

Source: Wu, M. L. (2013. *The practice of Multilevel Modeling*. Taipei: Wunan Press.

The quality of play center activities is composed of three components of material and space, opportunity and time, design and organization, and medium scores will be gained by using CECERS in kindergartens. Language, math, executive

function and social skills development outcomes of children are at a moderate level in kindergartens of China.

H1: Children's demographics (gender, age) have significant differences in child development outcomes.

H2: While controlling children`s demographics (family SES, gender, age, pretest), the quality of play center activities will predict children`s development in language, math, executive function and social skills.

(1) While controlling children's demographics (family SES, gender, age, pretest), the quality of play center activities has positive predictability to children`s language development.

(2) While controlling children's demographics (family SES, gender, age, pretest), the quality of play center activities haspositive predictability to children`s math development.

(3) While controlling children's demographics (family SES, gender, age, pretest), the quality of play center activities has positive predictability to children`s executive function development.

(4) While controlling children's demographics (family SES, gender, age, pretest), the quality of play center activities has positive predictability to children`s social skills development.

3.2 Samples

The main subjects of the study were kindergartens and children in kindergartens in China. This study took place in the Guangdong Province, a representative province of economic and educational development in China. Guangdong is a relatively developed province in China with a population of more than 100 million. In 2017, the gross enrollment rate of preschool education in Guangdong reached 109.08%, and standardized kindergartens accounted for 74.57%. The number of kindergarten children per million people ranks first, accounts for 9.6% in China (Guangdong Provincial Department of Education, 2018).

Stratified random sampling was used to select the research participants. The researchers first selected Guangzhou, Zhongshan, and Zhaoqing, that represent the high, medium and low socioeconomic levels of Guangdong Province based on GDP per capita. 9-20 kindergartens are randomly selected in each region from the list of kindergartens provided by each district education bureau, and one K2 classroom is randomly selected for each kindergarten, with a total of 48 classrooms. 8-10 children were randomly selected from each classroom to participate in the child assessment, with a sample of 584 children.

The study included 16 urban and 32 rural kindergarten classrooms. Classroom sizes ranged from 17 to 56 (Mean = 36, SD = 7.32). The classroom child-teacher ratio in a classroom was 6 to 39.5 (Mean = 16, SD = 6) (Table 3.1). The number of participating children in the 48 sample classrooms was almost identical

in gender， ranging in age from 4.5 to 7.33 years old (mean age = 6.12, SD = 0.44) (Table 3.2).

Table 3.1 Descriptive statistics of the kindergarten background information

Variable		N	%
Region	Zhongshan	20	41.7%
	Zhaoqing	19	39.6%
	Guangzhou	9	18.8%
Location	Urban	16	33.3%
	Rural	32	66.7%
Funding Source	Public	12	25.0%
	Private	36	75.0%
Level	First class at provincial and municipal level	22	45.8%
	Standardized and unrated	26	54.2%

Table 3.2 Descriptive statistics of the classroom background information

Variable	N	M (SD)	Min	Max
Classroom size	48	36.00 (7.32)	16.50	56.00
child-teacher ratio	48	16.21 (6.00)	6.00	39.50

3.3 Measures

The information about the research tools and methods of data collection was listed in Table 3.3.

Table 3.3 Information of the measurement tools and data collection methods

Measures	Research tools	Data collection
Activities Quality	Activities in Chinese Early Childhood Environment Rating Scale (trial) (CECERS)	Observation
Language vocabulary	Chinese version of Peabody Picture Vocabulary Test-Revised (PPVT)	Child assessment
Math achievement	Test of Children Mathematics Achievement (TCMA)	Child assessment
Executive function	Head-Toes-Knees-Shoulders task (HTKS)	Child assessment
Social skills	Social Skills Improvement System Rating Scales (SSIS-RS)	Questionnaires

3..3.1 Observational measure on the quality of play center activities

Chinese Early Childhood Environment Rating Scale (CECERS) is an instrument to measure the quality of child-centered activities in China's social and cultural contexts (Li & Hu, 2012). The CECERS measures the quality of kindergartens in China on a 9-point scale of 1 (unqualified), 3 (unqualified), 5 (qualified), 7 (good) and 9 (excellent). The CECERS consists of 8 subscales and 51 items subordinate to it, and the 8 subscales are Space and Furnishings; Personal Care Routines; Curriculum Planning and Implementation; Whole-Group Instruction; Activities; Language-Reasoning; Guidance and Interaction; and Parents and Staff. This study uses the subscale of Activities (nine items). The subscale of Activities includes 9 items: (1) role/drama (3 items), (2) blocks (3 items), (3) fine motor (3 items), (4) language (4 items), (5) mathematics (3 items), (6) nature/science (3 items),

(7) music/rhythm (3 items), (8) art (3 items), and (9) sand/water (3 items), mainly evaluating the preparedness and implementation of play center activities. Each item includes three sub-items of material and space, opportunity and time, design and organization.

A comprehensive validation study examined various reliability and validity evidences of the CECERS scale, further supporting the cultural suitability of CECERS. A pilot study of the initial version of CECERS was conducted in 48 kindergarten classrooms in Zhejiang Province, with the reliability of the measurement, the Cronbach`s α values on the total scale and eight subscales ranging from 0.81 to 0.94 (Li, et al., 2014). A reliability of inter-rater evaluation ranged from .70 to .90 (overall mean of .77), and subscale level inter-rater reliability evaluation ranged from .85 to .94 (with the mean of .89), which indicated good inter-rater reliability (Li, et al., 2014). Expert validity was evaluated by 176 professional practitioners and academics in 2011, and it was found that the vast majority (over 90%) of reviewers considered CECERS to be more suitable as a cultural tool than the original ECERS-R, and reviewers supported the changes and modifications to CECERS from ECERS-R (Hu, et al, 2014). The above evidence indicates that CECERS is a reliable, effective and culturally appropriate tool for measuring the environmental and process quality of kindergartens in China (Li, et al., 2014).

For the particular study by using Activities Scale to measure the quality of play center activities, through the data analysis of the measurement results of this

research sample, the Cronbach`s α of the whole scale is .89, which shows good internal consistency. Meanwhile, the coefficients of the 9 items were all greater than .88 (between .88 and .91), with good internal consistency (Chen & Li, 2015). Data show that the Activities Scale can be used as a reliable measuring tool for the measurement of play center activity quality of childcare institutions, and each item can also reliably measure the quality of each area.

3.3.2 Measurement of language development of children

The version of the Peabody Picture Vocabulary Test-Revised (C-PPVT-R) was used to measure children's receptive vocabulary aged 3-12 years (Lu & H, 2005). The C-PPVT-R is an adaptation of the Peabody Picture Vocabulary Test-Revised (Dunn & Dunn, 1981) for Chinese children. Due to the reliability, objectivity and rapid implementation of the measurement, it is widely used as a standard test for child receptive vocabulary development (Cheng, Chen, Tsai, Shen, & Cherng, 2011). The test includes two copies of A (ages 3-8) and B (ages 8-12). Each copy contains 125 questions. Each question is presented with four pictures on a page. After listening to the vocabulary, the child points out one of the pictures. The scoring method is to find the starting point of the test according to the age of the subject, and take the interval of eight consecutive correct answers as the basic level. All questions below the basic level are deemed to be correct, and then go up to six wrong answers in eight consecutive questions, which is the highest level.

High reliability and validity were demonstrated in the sample of 880 children aged 3 to 12 years in Taiwan. The half reliability coefficient is between .90 and .97, the median is .95, and the retest reliability coefficient is .90. An exponential increase was shown in the validity analysis, and there were significant differences among the mean of each age group, which was consistent with the theory of intellectual development. Content validity demonstrated with the Wechsler Intelligence Scale for Children (Wechsler, 1991) was revised to mean that the correlation coefficient reached a significant level of .01. The correlation was .61 and .69.

3.3.3 Measurement of math achievement of children

The Test of Children Mathematics Achievement (TCMA) was used to assess math skills of children aged 3-9 years old (Xie, 2014). The TCMA includes 120 items with different starting questions for ages 3 to 9， measuring formal and informal math achievement dimensions of children's . The measurement consists nine scales: intuitive math, number rule, zero concept, addition concept, carry concept and addition and subtraction, subtraction concept, multiplication concept, division concept and mental arithmetic.

High reliability and validity were demonstrated in the sample of 570 children aged 4 to 9 years in Taiwan. The internal consistency reliability was .97 for all ages, and .94 to .98 for different ages. The inter-rater reliability is above .90. Content validity was demonstrated with monthly math scores of Grade 1 to Grade 3 in

elementary school, and the validity of grade 1 to grade 3 is .93, .94 and .91. Exploratory factor analysis of the nine scales can distinguish the questions with different difficulty levels, which are consistent with the difficulty level of this test (Xie, 2014).

3.3.4 Measurement of executive function of children

Executive function was assessed using the Head-Toes-Knees-Shoulders task (HTKS) (McClelland, et al., 2014). The children were given four commands: "touch your head," "touch your toes," "touch your shoulder," and "touch your knee," and asked to do the same or the opposite of each command (e.g., touch their head when told to touch their toes). This task requires children to integrate different aspects of executive function, including working memory (remembering and executing new rules when processing commands), inhibition (suppressing natural responses to test commands when initiating correct, unnatural responses), and cognitive flexibility (processing rule changes). The task consists of 30 items, each with a score of 0 (incorrect), 1 (self-correct), or 2 (correct). Self-correction is the correction of incorrect action and ends with correct action. The test has been successfully used in preschool children in China (Zhang, 2016).

3.3.5 Measurement of social skills of children

The Social Skills Improvement System Rating Scales (SSIS) is designed to assess possible behavioral deficits of students while they are in social interactions with others (Gresham & Elliott, 2008). The SSIS assesses three dimensions in

children aged 3-18 years: Social Skills; Behavior Problems and Academic Competence. Social skills subscale includes 7 subscales: Communication (7 items), Cooperation (6 items), Assertion (7 items), Responsibility (6 items), Empathy (6 items), Engagement (7 items), Self-Control (7 items). Parents rate how various true sentences are about them on a 4-point scale: “never, seldom, often, and almost always”.

Reliability and validity were calculated for the four dimensions： (1) Internal reliability: Cronbach`s α = .96. (2) Test-retest Reliability: correlation = 0.86. (3) Validity: internal structure correlation between the Social Skill scale and Problem Behavior scale was negative and moderate, ranging from -0.42 to -0.65. (4) Criterion validity: correlations between the SSIS scale scores and scores on established measures of social skills indicate convergent and divergent validity (Gresham & Elliott, 2008).

3.4 Procedure of data collection

3.4.1 Child demographics survey and assessment of child social skills

Parents of each child selected for the study received a packet containing a consent form, a letter explaining the research project, an informed consent form to be signed by the parents and a children's social skills questionnaire. After signing the informed consent form, the parents filled in the children's personal characteristics information and the family socioeconomic status questionnaire as the background

information of this study. The family SES questionnaire includes the income, education level and occupation of father and mother (Cohen, Doyle, & Baum, 2006). Parents also need to complete the children's social skills inventory. After completing surveys and evaluations, parents returned the research packages to teachers of the classroom, who then returned all the completed packages to the researchers.

3.4.2 Classroom observation using CECERS

To improve the reliability and effectiveness of the measurements, the research team assigned two raters to each classroom to use CECERS for classroom observation. Each observation lasted about 6 hours (generally 4 hours in the morning and 2 hours in the afternoon). Two raters observed and scored each classroom independently to consider the internal consistency of raters (Li, et al., 2014). After completing their own observations and ratings, they discussed their ratings and reached consensus scores on ratings for all items (Li, et al., 2014). In addition, during the nap time of the children, the classroom layout was observed and the teacher was interviewed for half an hour to collect information that could not be directly observed.

All raters have a master degree in psychology or education. Raters were well trained in scoring techniques before they began using the CECERS scale. The training consisted of several days of in-depth study of instrumentation and field rating practices including independent testing and group discussions of the results. Each rater was asked to show a weighted median kappa of 0.6 or higher consistent with the trainer's observations.

3.4.3 Child assessment

Child evaluations were conducted in a quiet room in the kindergarten while classroom observations were made. In order to improve the reliability of the test, raters received intensive training and continuous feedback from researchers in the practice. Before the assessment, raters spend a few minutes playing with the child to build rapport. Each child completed four tests, each of which took about five to 20 minutes. After finishing each test, each child was given a break of 5 to 10 minutes. At the end of the evaluation, the children were given a book to thank them for their participation.

3.5 Analytic approaches

The descriptive statistics and Hierarchical Linear Models (HLM) were used to analyze the data (Raudenbush & Bryk, 2002). The analyses were conducted in three phases to address three research questions separately:

In order to address the research Question #1, descriptive statistics of 10 variables of the quality of play center activities (including Material and Space, Opportunity and Time, Design and Organization, CECERS_Activities, Dramatic Play, Blocks, Fine Motor, Language, Math, Nature/Science) was conducted, including the mean, standard deviation and range. The score of CECERS_Activities was the average scores of 6 variables which were the specific quality of play center activities (including Dramatic Play, Blocks, Fine Motor, Language, Math, Nature/Science).

In the research Question #2, descriptive statistics of 4 variables of child development outcomes (including Language, math, executive function and social skills) were conducted, including the mean, standard deviation and range. Then T-test was used to analyze the influence of child variables (gender, age) on child development outcomes.

The research Question #3 focused on the association between the quality of play center activities (Material and Space, Opportunity and Time, Design and Organization) and children`s development outcomes while controlling children demographics (family SES, gender, age) and pretest scores as initial developmental levels. In order to address the research question, descriptive statistics of the children`s

outcome variables and sample demographics (family SES, gender, single child status and age) were employed at first, then HLM (Raudenbush & Bryk, 2002) were conducted. HLM procedures were selected for several reasons. First, when there are some missing data, the cases are not deleted directly in HLM as in simple linear regression so that more information can be salvaged. Second, HLM procedures were used because of the nested nature of the data (i.e., children within classrooms), which is accommodated by HLM techniques. When participants are clustered, the regression assumption of independent cases is violated, and parameter estimates may have a bias. By accounting for the dependence through estimating the variability of scores at classroom level, HLM can result in higher accuracy of parameter estimates and standard errors. We performed a series of HLM analysis steps to estimate the degree of association among variables measured at different levels (Raudenbush & Bryk, 2002).

Data were collected at two levels: child level (Level 1) and classroom level (Level 2). Level 1 variables included children`s pretest scores on the language (PPVT), math, executive function, and social skills which were used as the predictor variables, or covariates, as well as family SES, child gender and age. Level 2 variables were classroom activity quality variables which included material and space, opportunity and time, design and organization as predictor variables. Children`s language (PPVT), math, executive function, and social skills which were collected in the spring of 2016 were used as outcome variables.

For samples suitable for multilevel model analysis, Kreft and Leeuw (1998) recommend the 30/30 criterion. Due to time and financial constraints, the samples of 584 children in 48 kindergartens collected in this study did not meet the 30/30 sample size requirement. The study by Zeng (2017) explores the applicability of multilevel models with small sample sizes. The study indicates that when the ICC value is higher than .138, and there is partial missing value, the minimum feasible analysis sample unit number is greater than 10, and the total sample number is greater than 200. By using the Bayesian method, stable parameter coverage and statistical power can be obtained, and multilevel model analysis can be performed. Therefore, this study is suitable for analysis using HLM.

CHAPTER 4

RESEARCH RESULTS

This chapter answers the research questions and research hypotheses proposed in this study through data analysis. This chapter is divided into four sections, the first section is a basic descriptive statistical analysis; the second section is a descriptive statistical analysis of the quality of play center activities; the third section is a descriptive statistical analysis of child development; the fourth section examines the multi-layer linear model for predicting the role of play center activities quality in children's development.

4.1 Basic descriptive statistics of background variables

In this study, a K2 (4-5 years old) classroom was randomly selected from 48 sample kindergartens in three regions of Guangdong Province for classroom observation of the quality of play center activities and the development of sample children. Due to the long interval between pretest and post-test of children, there are some missing values of some pretest scores when collecting data. For the missing values in the study, the default case elimination method is adopted in the SPSS analysis. In the HLM analysis, the missing cases are not directly deleted, but Multiple

Imputation (MI) is used for analysis to obtain accurate Parameter estimates and reasonable standard errors (Newman, 2003).

The background variables in the study mainly include children's gender, age, family SES, children's development pretest scores (language, math, executive function, social skills). Descriptive statistics are shown in Table 4.1. Among them, gender is a category variable and is divided into boys and girls. The age is calculated by subtracting the month of birth from month of measurement and dividing by twelve months. The family socioeconomic status (SES) is the average score after calculating the standardized scores of the mother's occupation, father's occupation, mother's education level, father's education level, and family's annual income (Shi & Shen, 2007). Occupation is divided into five categories: (1) temporary workers, unemployed persons, non-technical personnel and farmers; (2) manual workers, self-employed personnel, technical workers; (3) general management personnel, general professional and technical personnel; (4) middle management personnel, professional and technical personnel; (5) professional senior management personnel, senior professional and technical personnel, and supervisors. The five types of occupations are assigned 1-5 from high to low, and then the standardized scores of the mother and father occupations are calculated. The level of education is divided into seven levels: elementary school, junior high school, high school or secondary school, junior college, undergraduate, master's degree, doctoral degree. The seven categories of education are assigned 1-7 from high to low, and then the standardized scores of

the education level of the mother and father are calculated. The annual income of the family is divided into nine grades: 2000 yuan or less, 2000-5000 yuan, 5000-10000 yuan, 10000-20000 yuan, 20000-30000 yuan, 30,000-50,000 yuan, 50,000 yuan - 80,000 yuan, 8,000-100,000 yuan, 100,000 yuan or more. The nine categories of income are assigned 1-9 from low to high, respectively, and then the standardized score of the family's annual income is calculated. The above five standardized scores are averaged, which is the score of SES.

There were 288 boys and 295 girls of the 584 children, and the ratio of boys to girls was the same. The maximum age of children was 7.33, the minimum was 4.50, and the mean was 6.12 (SD = 0.44). The difference of gender between individuals was significant ($p < 0.001$). The maximum value of family SES was 1.97, the minimum was -1.49, and the mean was 0.09 (SD=0.83). The difference of family SES between individuals was not significant ($p > 0.05$). The language score of children was measured at a maximum of 106, a minimum of 3, and a mean of 35.94 (SD=20.04), with significant differences between individuals ($p < 0.001$). The math achievement of children was measured at a maximum of 76, a minimum of 2, and a mean of 26.98 (SD=12.84), with significant differences between individuals ($p < 0.001$). The children's executive function were measured at a maximum of 60, a minimum of 0, and a mean of 31.80 (SD=18.59), with significant differences between individuals ($p < 0.001$). The children's social skills were measured at a maximum of

133, a minimum of 16, and a mean of 78.09 (SD = 22.13), with significant differences between individuals ($p < 0.001$) (Table 4.1).

Table 4.1 Descriptive statistics of background variables

Variable	*N*	*M*	*SD*	*Min*	*Max*	*t*	*df*
Age	584	6.12	0.44	4.50	7.33	339.57***	583
SES	551	0.09	0.83	-1.49	1.97	-0.06	550
PPVT Pretest	429	35.94	20.04	3.00	106.00	37.14***	428
Math Pretest	429	26.98	12.84	2.00	76.00	43.51***	428
Executive fun Pretest	429	31.80	18.59	0.00	60.00	35.44***	428
Social Skills Pre-test	425	78.09	22.13	16.00	133.00	72.76***	424

Note. $^{**}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

4.2 Reliability and validity test of scales

4.2.1 Reliability and validity test results of CECERS_Activities

The reliability and validity of the CECERS scale and the reliability and validity of the play center activities subscale (CECERS_Activities) in the scale have been confirmed in existing studies (Hu, et al, 2014: Li, et al., 2014). In the study, the use of the CECERS play center activities subscale for data collection strictly followed the use of the scale, and tested the reliability and validity of the scale.

4.2.1.1 Factor analysis result

Factor analysis was performed on 19 topics in six dimensions of the CECERS_Activities scale during the study. The extraction method uses the principal component analysis and the rotation method uses the Kaiser standardized maximum variance method. From the results, the title is consistent with the setting of the

dimension of the scale, and six factors are automatically extracted. The load of each factor covering the topic is the same as the original scale. The KMO value of the factor analysis was 0.93, and the Bartlett spherical test was significant. The eigenvalues of various factors are greater than 1, and the factor load is greater than 0.60. At the same time, the interpretation variability of the six dimensions of play center activities is 15.35%, 13.49%, 13.97%, 16.90%, 11.77%, 13.86%, and the total cumulative explanatory variation is 84.52. %, more than 40%, indicating that the scale has good validity.

Table 4.2 Factor analysis results of CECERS_Activities

Variable	Factor	Factor loading	Rotation Sums of Squared Loadings		Cronbach`s α
			Eigen-value	Percentage of Variance Explained %	
Dramatic Play	Material and Space	.93	2.92	15.35	.95
	Opportunity and Time	.96			
	Design and Organization	.96			
Blocks	Material and Space	.89	2.56	13.49	.88
	Opportunity and Time	.81			
	Design and Organization	.65			
Fine Motor	Material and Space	.84	2.65	13.97	.91
	Opportunity and Time	.84			
	Design and Organization	.83			
Language	Space and Books	.76	3.51	16.90	.87
	Supporting Materials	.78			

Table 4.2 Factor analysis results of CECERS_Activities (continued)

Variable	Factor	Factor loading	Rotation Sums of Squared Loadings		Cronbach`s α
			Eigen-value	Percentage of Variance Explained %	
Language	Opportunity and Time	.82			
	Design and Organization	.82			
Nature/Science	Material and Space	.92	2.63	13.86	.89
	Opportunity and Time	.89			
	Design and Organization	.76			
Total-Activities				84.52	.86

4.2.1.2 Confirmatory factor analysis results

First, the confirmatory factor analysis method was used to analyze the combined activity and difference validity of the play center activities subscales (CECERS_Activities). Composite Reliability (CR) is the structural reliability used to measure the internal consistency of the questionnaire items. The higher the CR value, the higher the consistency of the items. Bagozzi and Yi (1988) considered CR > 0.6, indicating that the scale has good structural reliability. Average Variance Extracted (AVE) shows the average variation of the dimensions of the topic in each dimension. Fornell and Larcker (1981) argue that AVE > 0.5 indicates that there is a discriminant validity between dimensions. From the results of confirmatory factor analysis, the compositional reliability (CR) of each dimension is greater than 0.6; the average

variation number (AVE) is greater than 0.5, indicating that the scale has good combination reliability and differential validity.

Table 4.3 Confirmatory factor analysis results of CECERS_Activities

Factor	Dimension	Standardized coefficient	Standardized coefficient of square	Standardized residuals	CR	AVE
Dramatic Play	Material and Space	0.93	0.86	0.14	0.92	0.78
	Opportunity and Time	0.92	0.85	0.15		
	Design and Organization	0.8	0.64	0.36		
Blocks	Material and Space	0.91	0.83	0.17	0.86	0.68
	Opportunity and Time	0.89	0.79	0.21		
	Design and Organization	0.64	0.41	0.59		
Fine Motor	Material and Space	0.86	0.74	0.26	0.91	0.78
	Opportunity and Time	0.88	0.77	0.23		
	Design and Organization	0.9	0.81	0.19		
Language	Space and Books	0.89	0.79	0.21	0.88	0.66
	Supporting Materials	0.91	0.83	0.17		
	Opportunity and Time	0.87	0.76	0.24		
	Design and Organization	0.5	0.25	0.75		

Table 4.3 Confirmatory factor analysis results of CECERS_Activities (continued)

Factor	Dimension	Standardized coefficient	Standardized coefficient of square	Standardized residuals	CR	AVE
Math	Material and Space	0.93	0.86	0.14	0.80	0.58
	Opportunity and Time	0.73	0.53	0.47		
	Design and Organization	0.58	0.34	0.66		
Nature/Science	Material and Space	0.98	0.96	0.04	0.85	0.67
	Opportunity and Time	0.91	0.83	0.17		
	Design and Organization	0.47	0.22	0.78		

Secondly, according to the results of the confirmatory factor analysis of the play center activities subscales (CECERS_Activities), the fit degree results of the model are compared with the model fit degree indicators of Chen and Wang (2010). The results showed that GFI, NFI, IFI, and CFI were all greater than 0.8, which was close to 0.9. The fit indices of the model reached the standard threshold (Hair, Anderson, Tatham, & Black, 1995). Absolute Fit Indices, Incremental Fit Indices, and Parsimonious Fit Indices of the research model basically meet the requirements, showing that the CECERS_Activities scale has good validity.

Table 4.4 Model fitness results of CECERS_Activities

Item	Evaluation Project	Standard	Test data	Model fit
Absolute Fit Indices	χ^2	p>.05	238.063(p＜.001)	fit
	χ^2/df	＜5	1.74	fit
	SRMR	＜.08	.09	acceptable
Incremental Fit Indices	CFI	＞.9	.86	acceptable
	IFI	＞.9	.87	acceptable
Parsimonious Fit Indices	PNFI	＞.5	.59	fit

Third, the reliability of the scale is tested. In order to ensure the internal consistency of the scorers, the scorers received a week of intensive study, group discussion and independent test before the official score, to ensure that the scores of the two scorers reached 0.85 or more before the test. In addition, Cronbach`s α was used in the study to test the consistency of all topics in the scale. Statistically speaking, Cronbach`s α > 0.7 is considered to be high confidence (Hair, Anderson., Tatham.,& William, 1995; Arbuckle, 1999). From the results, the Cronbach`s α of the play center activities subscales (CECERS_Activities) is .86, indicating good reliability. The six dimensions of the CECERS play center activities subscale: Cronbach`s α of the character zone, construction zone, fine action zone, language zone, math zone, and science zone are all greater than .80, indicating a good letter in all six dimensions. degree.

Table 4.5 Reliability analysis of six dimensions of CECERS_Activities

Variable	Cronbach`s α
Dramatic Play	.95
Blocks	.88
Fine Motor	.91
Language	.87
Math	.82
Nature/Science	.89

Because the six dimensions of the CECERS play center activities subscale are divided into three sub-dimensions: material and space, opportunity and time, design and organization and in order to better present the teacher's design, design and organization process for play center activities, this study reclassified and calculated the raw data according to the three sub-dimensions of material and space, opportunity and time, design and organization, and three new dimensions were obtained. The scale structure after the variables are reclassified and the average is calculated is shown in Table 4.6. The reliability test was re-examined for the new three dimensions of the scale. The results showed that Cronbach`s α was above .7, indicating that the new three dimensions also had good reliability (Table 4.7).

Table 4.6 Three dimensional item list of CECERS_Activities

Variable	Serial No.	Items in the original scale
Material and Space	1	Dramatic Play 30.1 Material and Space
	2	Blocks 31.1 Material and Space
	3	Fine Motor 32.1 Material
	4	Language 33.1 Books and Space
	5	Language 33.2 Language Supporting Materials
	6	Math 34.1 Material
	7	Nature/Science 35.1 Activities/Material
Opportunity and Time	1	Dramatic Play 30.2 Opportunity and Time
	2	Blocks 31.2 Opportunity and Time
	3	Fine Motor 32.2 Opportunity and Time
	4	Language 33.3 Opportunity and Time
	5	Math 34.2 Opportunity and Time
	6	Nature/Science 35.2 Opportunity and Time
Design and Organization	1	Dramatic Play 30.3 Design and Organization
	2	Blocks 31.3 Design and Organization
	3	Fine Motor 32.3 Design and Organization
	4	Language 33.4 Design and Organization
	5	Math 34.3 Design and Organization
	6	Nature/Science 35.3 Design and Organization

Table 4.7 Reclassified reliability analysis in three dimensions of CECERS_Activities

Variable	Cronbach`s α
Material and Space	.85
Opportunity and Time	.82
Design and Organization	.74

4.2.2 Reliability and validity analysis results of the Child Development Scale

The Children's Development uses the Chinese Version of Peabody Picture Vocabulary Test-Revised (PPVT), the Test of Children Mathematics Achievement (TCMA), Head-Toes-Knees-Shoulders task (HTKS), the Social Skills Improvement System Rating Scales (SSIS) four types of scales to test children's language, math, executive function, and social skills development. Because PPVT, TCMA, and HTKS are all tested, the difficulty and discrimination of the test are used for analysis. The Child Social Skills Scale (SSIS) uses Likert's four-point measurement, so exploratory factor analysis and confirmatory factor analysis were used to analyze the reliability and validity of the scale.

4.2.2.1 Difficulty and distinction of the Chinese Version of Peabody Picture Vocabulary Test-Revised (PPVT)

The Chinese Version of Peabody Picture Vocabulary Test-Revised (PPVT) uses the total score of the correct answering question to represent the degree of children's language development. A simple calculation of the difficulty of the test is to calculate the proportion of the average score of the correct answer (P value). Fbel and Frisbie (1991) pointed out that the difficulty of the test is divided into five levels: $P \geqq 0.80$ means extremely easy, $0.80 > P \geqq 0.60$ means easy, $0.60 > P \geqq 0.40$ means difficult to moderate, $0.40 > P \geqq 0.20$ means difficulty, $0.20 > P$ means extremely difficult. A difficulty between 0.3 and 0.7 is suitable. The degree of discrimination is to divide the subject's total score into high and low groups, the high group refers to

the highest score of 27% of all subjects, and the low group refers to the lowest score of 27% of all subjects. The difference between the high grouping and the low grouping difficulty coefficient is the degree of discrimination of the test (D value), and the formula is $D= P_H - P_L$. Ebel (1979) proposed that the degree of discrimination of the project is divided into four levels: $D \geqq 0.40$ means excellent, $0.40 > D \geqq 0.30$ means good, $0.30 > D \geqq 0.20$ means acceptable, and $0.20 > D$ means poor. Based on the analysis of the results of this questionnaire, the score of the PPVT questionnaire is 125 points, and the average score of the children is 52.32 points. The difficulty of the test is calculated by dividing the average value of the subject by the full score of the subject. The difficulty value of the test is 0.41, which is the overall questionnaire. Moderately difficult. The PPVT discrimination (D value) is calculated, $D= P_H - P_L =0.45$, and the overall discrimination of the questionnaire is good.

4.2.2.2 Difficulty and distinction of The Test of Children Mathematics Achievement (TCMA)

The Test of Children Mathematics Achievement (TCMA) uses the total score of the correct answering question to represent the child's mathematical development level. Based on the analysis of the results of this test, the TCMA questionnaire scored 120 points and the average score of children tested was 42.86 points. The difficulty of the test is calculated by dividing the average value of the subject on the title by the full score of the question. The difficulty value of the test is 0.35, and the overall difficulty is difficult. The TCMA discrimination (D value) is

calculated as the difference between the high group and the low group difficulty coefficient, D= P_H — P_L =0.29, and the overall degree of discrimination of the questionnaire is acceptable.

4.2.2.3 Difficulty and discrimination of Head-Toes-Knees-Shoulders task (HTKS)

HTKS uses the total score of correct response actions to represent the degree of child executive function development. Based on the analysis of the results of this questionnaire, the questionnaire scored 60 points, and the average score of children tested was 41.95 points. The difficulty of the test is calculated by dividing the average value of the subject on the title by the full score of the question. The difficulty value of the test is 0.70, and the overall difficulty is easy. The HTKS discrimination (D value) is calculated by the difference between the high group and the low group difficulty coefficient, D= P_H — P_L =0.55, and the overall discrimination of the questionnaire is acceptable.

4.2.2.4 Reliability and validity analysis of the Social Skills Improvement System Rating Scales (SSIS)

First, factor analysis was performed on SSIS. The results show that the KMO value of the factor analysis is 0.96, and the Bartlett spherical test is significant. The load of the 46 questions on the scale is significant, and the factor load is greater than .45, indicating that the scale has good convergence validity (Bentler & Wu, 1993). After extracting a factor, the total cumulative explanatory variation was

37.753%, which did not reach the 40% standard (Table 4.8). Therefore, the model fit degree is further tested. If the model fits well, representative validity is acceptable.

Secondly, the model fitness of SSIS is tested. The results show that both IFI and CFI are greater than .80, close to the .90 standard, and the fit indices of the model all meet the standard threshold (Hair, Anderson, Tatham, & Black, 1995), indicating that the Absolute Fit Indices, the Incremental Fit Indices, and the Parsimonious Fit Indices of the research model basically meet the requirements (Table 4.9).

Third, the analysis of SSIS reliability shows that SSISC Cronbach`s α is 0.96, indicating good reliability.

Table 4.8 Factor analysis results of SSIS

Factor	Factor loading	Rotation Sums of Squared Loadings		Cronbach`s α
		Eigen-value	Percentage of Variance Explained %	
socsk1	.45	17.37	37.75	0.96
socsk2	.48			
socsk3	.66			
socsk4	.53			
socsk5	.59			
socsk6	.53			
socsk7	.55			
socsk8	.66			
socsk9	.57			
socsk10	.63			
socsk11	.64			
socsk12	.47			
socsk13	.65			
socsk14	.66			
socsk15	.59			
socsk16	.66			
socsk17	.53			
socsk18	.70			
socsk19	.63			
socsk20	.70			
socsk21	.59			
socsk22	.62			
socsk23	.59			
socsk24	.60			
socsk25	.59			
socsk26	.69			
socsk27	.67			
socsk28	.68			
socsk29	.62			

Table 4.8 Factor analysis results of SSIS (continued)

Factor	Factor loading	Rotation Sums of Squared Loadings		Cronbach`s α
		Eigen-value	Percentage of Variance Explained %	
socsk30	.68			
socsk31	.51			
socsk32	.63			
socsk33	.66			
socsk34	.53			
socsk35	.60			
socsk36	.67			
socsk37	.62			
socsk38	.68			
socsk39	.65			
socsk40	.66			
socsk41	.63			
socsk42	.68			
socsk43	.68			
socsk44	.59			
socsk45	.57			
socsk46	.63			

Table 4.9 Model fitness results of SSIS

Item	Evaluation Project	Standard	Test data	Model fit
Absolute Fit Indices	χ^2	p>.05	3935.287（p＜.001）	fit
	χ^2/df	＜5	3.98	fit
	RMR	＜.08	.03	fit
	SRMR	＜.08	.07	fit
	RMSEA	＜.08	.07	fit
Incremental Fit Indices	CFI	＞.9	.87	acceptable
	IFI	＞.9	.87	acceptable
Parsimonious Fit Indices	PNFI	＞.5	.68	fit
	PGFI	＞.5	.65	fit

4.3 Descriptive analysis results of the quality of play center activities

4.3.1 Overall quality of play center activities

The overall quality of play center activities is calculated as the average of each item score. On the scale of 1 (inadequate), 3 (minimal), 5 (qualified), 7 (good), 9 (excellent), the overall quality rating for the 48 classrooms of K2 (4-5 years old) is slightly above minimal. The total average score is 4.28, which is higher than the minimum level of 3 points, but lower than the qualified level of 5 points, indicating that the overall level of play center activities is not high. The overall quality of play center activities in some sample kindergartens is judged from inappropriate (1 point) to maximum good level (7 points).

According to the Central Limit Theorem, the sample size is greater than or equal to 30, and the sample mean tends to be normally distributed, which is suitable

for statistical analysis (Wu & Tu, 2006). The Kolmogorov-Smirnov test results show that the sample data conform to the normal distribution ($p > 0.05$). The independent sample T-test results show that there are significant differences in the overall quality of play center activities between urban and rural, private and public, high and low level of kindergartens, which are manifested as follows: (1) The overall quality of play center activities in urban kindergartens is higher than that in towns and villages. (2) The overall quality of play center activities of first-class at provincial and municipal level is significantly higher than that of standardized and unrated kindergartens. (3) The overall quality of play center activities in public is significantly higher than that in private kindergartens (Table 4.10).

Table 4.10 Comparison of the overall quality of ECERS_Activities

Variable		*M*	*SD*	*t*
Location	Urban	3.64	1.18	-5.27**
	Rural	5.56	1.22	
Level	First class at provincial and municipal level	4.87	1.59	2.68**
	Standardized and unrated	3.78	1.22	
Funding Source	Private	3.97	1.37	-2.64**
	Public	5.21	1.52	

Note: $^{**}p<0.05$ $^{**}p<0.01$

4.3.2 Three dimensions quality of play center activities

Materials and space mainly involve the richness, safety and suitability of materials, space and equipment for center activities. In addition to fine motor activities, the lowest score of materials and space in each center is inappropriate for 1

point, indicating that materials and space in some kindergartens are not suitable for children's development requirements. The average score of materials and space in fine motor activities is the highest, reaching 5.67 points (Min=3, Max=9) higher than the qualified level, which indicates that all kindergartens attach great importance to the development of fine movement of children, and sufficient materials was provided. Secondly, the score of materials and space in blocks, math and language area reach 5 points or nearly 5 points (the qualified level), which indicates that there are enough materials supplied for 3-4 children to play at the same time. Unfortunately, the score of materials and space in the role play and science area is only about 3 points (the minimal level), which indicates that the amount of materials provided is very limited and cannot meet the needs of multiple children's activities.

Opportunity and time mainly examine how many opportunities (times) and time (length) of a child are free to choose and use the area materials and space. Except for fine activities, the scores of opportunity and time in each center of some sample kindergartens got the lowest inappropriate situation of 1 point, indicating that the opportunities and time of some kindergartens were not suitable for the requirements of children's development. The average score of opportunity and time in blocks, fine motor and math area is higher than 5 points (the qualified level), indicating that children have a special chance to play these games1-2 times per week (at least 30 minutes each time). The score of opportunity and time in the role play and

science area is just over 3 points (the minimal level), indicating that children only have opportunities special or scattered to play these games once a week.

Design and organization focus on the development suitability of the design and content of the corner activities, the teachers' supervision and guidance to the children, and the interaction with children. Except for science area, the lowest score of design and organization in each area all showed an inappropriate situation, indicating that the design and organization of some kindergartens were not suitable for the requirements of children's development. Design and organization average score in blocks, fine motor and math area received more than 5 points (the qualified level), indicating that the materials provided by the kindergartens for these areas are suitable for children's age and ability, and the guidance of teachers is basically appropriate. However, it fails to consider the correlation between activities and curriculum themes, and lacks individualized interaction and guidance with children. In contrast, the score of design and organization in role play is only higher than 3 points (the minimal level), which indicates that there is no obvious improper guidance from teachers, but not reached high quality instruction.

Table 4.11 Descriptive analysis of three dimensions quality of play center activities

Dimension	Variable	*M*	*SD*	*Min*	*Max*	*t*	*df*
		4.67	1.58	1.71	7.86	20.48***	47
Material and Space	MS-Dramatic Play	3.44	2.21	1.00	9.00	10.77***	47
	MS-Blocks	5.42	2.37	1.00	9.00	15.84***	47
	MS-Fine Motor	5.67	1.95	3.00	9.00	20.14***	47
	MS-Language 1	4.54	2.05	1.00	9.00	15.33***	47
	MS-Language 2	4.71	2.01	1.00	9.00	16.23***	47
	MS-Math	5.02	1.60	1.00	9.00	21.68***	47
	MS-Nature/Science	3.92	2.10	1.00	7.00	12.91***	47
		4.61	1.40	1.50	7.00	22.87***	47
Opportunity and Time	OT-Dramatic Play	3.40	2.43	1.00	9.00	9.61***	46
	OT-Blocks	5.19	2.39	1.00	9.00	15.01***	47
	OT-Fine Motor	5.54	1.91	2.00	9.00	20.08***	47
	OT-Language	4.81	1.82	1.00	9.00	18.34***	47
	OT-Math	5.21	1.81	1.00	9.00	19.94***	47
	OT-Nature/Science	3.52	1.92	1.00	9.00	12.68***	47
		4.67	1.41	1.00	7.50	22.86***	47
Design and Organization	DO-Dramatic Play	3.72	2.26	1.00	9.00	9.87***	35
	DO-Blocks	5.02	1.92	1.00	9.00	16.78***	40
	DO-Fine Motor	5.24	2.02	1.00	9.00	17.56***	45
	DO-Language	4.93	1.86	1.00	9.00	17.41***	42
	DO-Math	5.09	1.67	1.00	9.00	19.96***	42
	DO-Nature/Science	4.09	1.44	2.00	7.00	16.76***	34
Overall-Activities		4.28	1.49	1.00	7.00	19.87***	47

Note. $^{**}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

4.3.3 Six areas quality of play center activities

In terms of the quality of different areas, compared with the average of the overall quality of play center activities, fine motor activities got the highest quality of slightly higher than the qualified level (M=5.17, SD=1.91) , while the role/drama

activities has the lowest quality of slightly higher than the minimal level (M=3.15, SD=2.13) . The quality of blocks, language and math activities is relatively consistent, reaching more than 4 points (between the minimal and qualified level). In addition, the quality of science activities is above the minimal level (M=3.46, SD=1.89), and there are large differences between classes. The average quality of the six areas is between 3 and 5 points, showing that the average level of these kindergartens can reach the minimum level. However, except for the fine motor area, the quality of other areas is below 5 points, failing to reach the qualified level.

Table 4.12 Descriptive analysis of play center qualities in different areas

Variable	*M*	*SD*	*Min*	*Max*	*t*	*df*
Total-Activities	4.28	1.49	1.00	7.00	19.87***	47
Dramatic Play	3.15	2.13	1.00	7.00	10.22***	47
Blocks	4.77	2.11	1.00	9.00	15.69***	47
Fine Motor	5.17	1.91	1.00	9.00	18.79***	47
Language	4.42	1.93	1.00	9.00	15.83***	47
Math	4.73	1.69	1.00	9.00	19.44***	47
Nature/Science	3.46	1.89	1.00	8.00	12.68***	47

Note. $^{**}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

4.4 Descriptive analysis of child development outcomes

A descriptive analysis of children's language, math, executive function, and social skills development results is shown in Table 4.12. The average children's language (PPVT) score is 52.32 (SD = 23.23), with a maximum of 114 and a minimum of 5. The single-sample t-test results showed a large difference in the

language scores of the samples (p< 0.001). The average score of children's math is 42.86 (SD=14.14), the maximum value is 102, the minimum value is 12, The single-sample t-test results showed a large difference in the language scores of the samples (p< 0.001). The average score of children's executive function test is 41.95 (SD=16.50), maximum 60, minimum 0. The single-sample t-test results showed a large difference in the executive function of the sample (p< 0.001). The average score of children's social skills is 83.35 (SD=23.14), the maximum is 138, and the minimum is 23. The single-sample t-test results showed that the social skills of the samples were significantly different (p< 0.001).

Table 4.13 Descriptive statistics of child development outcomes

Variable	*N*	*M*	*SD*	*Min*	*Max*	t	df
Language	584	52.32	23.23	5.00	114.00	54.43***	583
Math	584	42.86	14.14	12.00	102.00	73.26***	583
Executive Function	583	41.95	16.50	0.00	60.00	61.37***	582
Social Skills	551	83.35	23.14	23.00	138.00	84.56***	550

Note. $^{**}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

4.4.1 Analysis of the differences between gender in child development outcomes

A t-test was conducted on the differences in gender, language, math, executive function, and social skills development of children (Table 4.14). The results show that there are significant gender differences in the development of children's language, math, and social skills (P< 0.05), and the language scores of boys are higher than girls. The male scores of math are higher than that of girls, and the scores of

social skills scores are higher than that of boys. The gender difference in executive function is not significant.

Table 4.14 T-test of gender differences in child development results

Variable		*N*	*M*	*SD*	*t*
Language	Male	288	54.31	24.88	2.12*
	Female	295	50.25	21.26	
Math	Male	288	44.06	15.51	2.07*
	Female	295	41.63	12.53	
Executive Function	Male	288	41.13	17.11	-1.15
	Female	294	42.69	15.87	
Social Skills	Male	273	79.25	23.08	-4.16**
	Female	277	87.34	22.55	

Note. $^{**}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

4.4.2 Analysis of the differences between age and child development outcomes

In this study, the age of the child was calculated at the age of the month. In order to better analyze whether age is different between child development outcomes, the age of children is divided into three groups: 4 to 5 years old, 5 to 6 years old, and 6 years old or older. One-way analysis of variance (ANOVA) was performed on the differences in language, math, executive function, and social skills development among children of different ages. The results are shown in Table 4.15.

Table 4.15 ANOVA of age differences in child development results

Variable	Age	*N*	*M*	*SD*	*F*	Compare
Languange	1.4~5 years old	5	29.80	13.74	11.58**	3＞2
	2.5~6 years old	234	47.60	22.69		3＞1
	3.6 years old-	345	55.86	22.99		
Math	1.4~5 years old	5	29.00	15.22	37.25**	3＞2
	2.5~6 years old	234	37.39	13.99		3＞1
	3.6 years old-	345	46.78	12.85		
Executive Function	1.4~5 years old	5	23.40	20.59	9.31**	3＞2
	2.5~6 years old	234	39.26	17.11		2＞1
	3.6 years old-	344	44.05	15.62		
Social Skills	1.4~5 years old	5	77.60	18.15	7.71**	3＞2
	2.5~6 years old	219	78.76	22.76		
	3.6 years old-	327	86.52	22.98		

Note. $^{**}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

One-way analysis of variance (ANOVA) showed that there were significant age differences in children's language, math, executive function, and social skills development. After the use of Scheffe method for post-event comparison, language, math development, 6 years old or older > 5-6 years old; 6 years old or older > 4-5 years old; executive development, 6 years old or older > 5-6 years old, 5-6 years old > 4-5 years old; social skills development, 6 years old or older > 5-6 years old.

4.5 Analysis of the relationship between play center activities quality and child development

Since children are nested in the class, the independence assumption of random error between individuals is difficult to satisfy, and traditional statistical

analysis methods cannot be used. Therefore, HLM statistical methods are used to perform independent analysis for different hierarchical variables (Raudenbush & Bryk, 2002). Another advantage of using HLM analysis is that Multiple Imputation (MI) can be processed for missing values without the need to directly delete cases to facilitate full use of data (Newman, 2003).

4.5.1 Correlation analysis between variables

Before performing HLM analysis, the correlation between variables is first tested to determine which predictors can be included in the analysis. The results of gender and age differences in child development have shown that there are significant gender and age differences in children`s language, math, and social skills development, and there are significant age differences in children's executive function. Then age and gender can be considered for inclusion in the HLM analysis model. The following study further analyzes the correlation between child-level and class-level variables to determine which predictors can be included in the HLM analysis.

4.5.1.1 Variable correlation analysis at the child level

Correlation analysis of all variables (gender, age, pretest score, family SES, language, math, executive function, social skills) at the child level shows that gender, age, pretest scores, family SES and language, math, executive function, social skills and other variables have a low to medium degree of correlation (Table 4.16). In order to rule out the multi-collinearity problem of variables, using gender, age, pretest score, family social status at the child level as an independent variable, language, math,

executive function, and social skills are used as dependent variables for collinearity diagnosis test. The results show that each variable has a VIF value of no more than 5, and there is no multi-collinearity problem (Wu, 2010), and child-level variables can be included in the HLM analysis.

Table 4.16 Correlation matrix of child level variables

	Gender	Age	SES	PPVT Pre-test	PPVT	Math Pre-test	Math	Executive function Pre-test	Executive function	Social Skills Pre-test
Gender										
Age	-0.03									
SES	-0.02	-0.05								
PPVT Pre-test	-0.07	0.20**	0.60**							
PPVT	-0.09*	0.20**	0.60**	0.76**						
Math Pre-test	-0.10*	0.33**	0.34**	0.48**	0.51**					
Math	-0.09*	0.36**	0.32**	0.51**	0.51**	0.75**				
Executive function Pre-test	0.04	0.16**	0.40**	0.45**	0.44**	0.50**	0.46**			
Executive function	0.05	0.20**	0.14**	0.19**	0.24**	0.34**	0.34**	0.30**		
Social Skills Pre-test	0.13**	0.22**	0.18**	0.23**	0.25**	0.29**	0.24**	0.26**	0.08	
Social Skills	0.18**	0.18**	0.26**	0.25**	0.29**	0.29**	0.27**	0.26**	0.22**	0.48**

Note. $^{**}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Table 4.17 Collinearity diagnosis of child level variables

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinear Statistics	
		B	Std. Error				Tolerance	VIF
PPVT	(Constant)	-4.44	10.52		-.42	.67		
	Gender	-3.07	1.43	-.06	-2.14	.03	.99	1.01
	AGE	5.48	1.77	.10	3.10*	.00	.93	1.07
	SES	6.50	1.09	.23	5.98***	.00	.62	1.63
	Pre-test	.73	.05	.62	15.98***	.00	.59	1.69
Math	(Constant)	-6.72	6.80		-.99	.32		
	Gender	-1.21	.92	-.04	-1.32	.19	.99	1.01
	AGE	4.94	1.16	.14	4.26***	.00	.88	1.14
	SES	1.89	.58	.11	3.23***	.00	.87	1.16
	Pre-test	.74	.04	.67	18.62***	.00	.78	1.29
Executive function	(Constant)	-13.93	11.10		-1.25	.21		
	Gender	1.84	1.52	.06	1.21	.23	.99	1.01
	AGE	8.00	1.84	.21	4.35***	.00	.97	1.04
	SES	.60	.99	.03	.60	.55	.83	1.21
	Pre-test	.21	.05	.24	4.61***	.00	.81	1.24
Social Skills	(Constant)	9.83	14.59		.67	.50		
	Gender	6.36	2.02	.14	3.16*	.00	.97	1.03
	AGE	6.01	2.45	.11	2.45	.02	.94	1.06
	SES	6.02	1.22	.21	4.93***	.00	.95	1.05
	Pre-test	.42	.05	.40	8.89***	.00	.90	1.12

Note. $^{**}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

4.5.1.2 Variable correlation analysis at the class level

The correlation analysis between the variables (space and materials, time and opportunity, design and organization) and the results of child development at class level shows that there is a moderate to low correlation between these variables. However, the correlation coefficient between material and space, opportunity and

time reaches .90, and there may be problems of collinearity diagnostics, which requires a further test. Class-level materials and space, opportunity and time, design and organization as independent variables, language, math, executive function, social skills as dependent variables for collinearity diagnostics diagnosis. The results show that the VIF values of the variables are all less than 10, there is no multicollinearity problem (Wu, 2010), and the variables at the class level can be included in the HLM analysis (Table 4.18).

Table 4.18 Correlation matrix of class level variables

Variable	Language	Math	Executive Function	Social Skills	Material and Space	Opportunity and Time	Design and Organization
Language							
Math	.51**						
Executive Function	.22**	.34**					
Social Skills	.29**	.27**	.21**				
Material and Space	.50**	.23**	-.02	.26**			
Opportunity and Time	.48**	.25**	.01	.30**	.90**		
Design and Organization	.52**	.29**	-.01	.29**	.74**	.75**	

Note. $^{**}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Table 4.19 Collinearity diagnosis of class level variables

Model		Unstandardized Coefficients		Standard ized Coefficients	t	Sig.	Collinear Statistics	
		B	Std. Error				Tolerance	VIF
PPVT	(Constant)	-21.41	10.92		-1.96	.05		
	Material and Space	2.43	1.11	.16	2.19*	.03	.16	6.14
	Opportunity and Time	-.47	1.27	-.03	-.37	.71	.16	6.09
	Design and Organization	1.19	.82	.07	1.45	.15	.38	2.66
Math	(Constant)	-12.10	7.19		-1.68	.09		
	Material and Space	-.35	.73	-.04	-.48	.64	.16	6.13
	Opportunity and Time	1.48	.83	.14	1.79	.08	.17	6.07
	Design and Organization	.17	.53	.02	.32	.75	.38	2.62
Executive function	(Constant)	-8.45	11.63		-.73	.467		
	Material and Space	-1.88	1.21	-.18	-1.56	.12	.16	6.18
	Opportunity and Time	2.46	1.37	.21	1.79	.08	.16	6.10
	Design and Organization	-2.28	.88	-.20	-2.61**	.01	.38	2.61
Social Skills	(Constant)	-8.28	15.03		-.55	.58		
	Material and Space	-2.35	1.55	-.156	-1.52	.13	.16	6.16
	Opportunity and Time	5.31	1.77	.31	3.00*	.00	.16	6.13
	Design and Organization	2.00	1.11	.12	1.80	.072	.39	2.59

Note. $^{**}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

4.5.2 Centralization of variables and steps of HLM analysis

In order to avoid multi-collinearity among variables and to make the intercept reflect the differences in the development of children in different classes, the variables at the child and class level were also centralized. Child level variables (age,

pretest, and family SES) were calculated by group centering, while class level variables (material and space, opportunity and time, design and organization) were calculated by grand mean centering (Wen & Qiu, 2009).

According to the Hierarchical Linear Model analysis method proposed by Hox (2002), the following five steps were used. Step 1: One-way ANOVA with random effects model, also known as Model 0, to verify whether the level factor had a significant effect on the dependent variable. Step 2: Covariate model of Level 1 tested the influence of child-level explanatory variables on the dependent variables. Step 3: Fixed effects model of Level 2 tested the influence of the class-level explanatory variables on the group average. Step 4: Random coefficient model tested the influence of Level 2 on the slope of Level 1. Step 5: Complete model, both fixed and random effects were taken into account.

4.5.3 The predictive effect of play center activity quality on child language development

(1) Step 1: One-way ANOVA with random effects model

Before the Hierarchical Linear Model analysis, the intra-class correlation coefficient (ICC) was calculated by the one-way ANOVA with random effects model to test whether the cross-level effect existed. In this step, only the average of class β_{0j} and the child random error r_{ij} were used to explain the language score Y_{ij}. The average of class β_{0j} was the average of class γ_{00} plus the class error u_{0j}. The model was as follows:

Level 1: $Y_{ij} = \beta_{0j} + r_{ij}$

Level 2: $\beta_{0j} = \gamma_{00} + u_{0j}$

As results revealed, the reliability of the language average of class β_0 was 0.91 high, so that the intra-class correlation coefficient (ICC) can be performed. The overall average language score was 53.23, and the variance τ00 between classes was 250.99, which represented significant differences in the language performance of children in each class (χ^2= 522.24， *df*= 47， $p < 0.001$). The variance σ^2 between children was 288.38, ICC = $\tau_{00}/(\tau_{00} + \sigma^2)$= 0.465, indicating that 46.5% of the variance existed between classes. According to Cohen's (1988) criterion, when ICC ≥ 0.138, the inter-group variance of the dependent variable was not negligible. The analysis of language development should consider the differences between different classes. That is, it is suitable for HLM analysis and analysis can be continued in the next step. The deviance of Model 0 was 4899.95.

(2) Step 2: Covariate Model of Level 1

The focus of this step was to examine the effect of explanatory variables on the dependent variable at Level 1 . The explanatory variables of age, language pretest, and SES at child level were added to Level 1, and the average of class in Level 2 remain unchanged, The influence of class level on the slope of explanatory variables in child level was set as a covariant to understand the fixed effects. The model was as follows:

Level 1: $Y_{ij} = \beta_{0j} + \beta_{1j}(\text{gender}) + \beta_{2j}(\text{age}) + \beta_{3j}(\text{pretest}) + \beta_{4j}(\text{SES}) + r_{ij}$

Level 2: $\beta_{0j} = \gamma_{00} + u_{0j}$

$\beta_{1j} = \gamma_{10}$

$\beta_{2j} = \gamma_{20}$

$\beta_{3j} = \gamma_{30}$

$\beta_{4j} = \gamma_{40}$;

After adding all the variables to Level 1, the influence of gender, age, and language pretest on language development were all significant, and the fixed effects of them were -3.87(t = -2.62, df = 394, $p < 0.05$)，5.74(t = 2.65, df = 394, $p < 0.01$)，and 0.62(t = 11.35, df = 394, $p < 0.001$). The influence of SES on language performance was not significant. Excluding the SES and re-analyzing the model, the fixed effects of gender, age, and language pretest were -4.33, 6.11, and 0.63, all of them were significant. The average of class was 53.15 (t = 21.64, df = 47, p < 0.001), the random effects was 16.48 (df = 47, $\chi 2$ = 605.49, p < 0.001), and the reliability was 0.920, which can be analyzed in the next step.

(3) Step 3: Fixed effects Model of Level 2

While independent variables of Level 1 were removed, class level independent variables of material and space, opportunity and time, design and organization were added to Level 2. The model equation is:

Level 1: $Y_{ij} = \beta_{0j} + r_{ij}$

Level 2: $\beta_{0j} = \gamma_{00} + \gamma_{01}$(material) + γ_{02}(opportunity) + γ_{03}(organization) + u_{0j}

The results showed that the fixed effects of material and space, opportunity and time on the average language score of class were not significant (γ_{01} = 2.05, p = 0.428; γ_{02} = 1.08, p = 0.680), but the fixed effects of design and organization was significant (γ_{03} = 4.46，$p < 0.05$). The model deviance was 4955.76, and the reliability coefficient of the average of class was 0.850. The fixed effect of each variable was examined by one-by-one elimination method. After eliminating opportunities and time, the fixed effects of material and space on the average of class was not significant, but the fixed effects of design and organization was still significant (γ_{03} = 4.56，$p < 0.05$). The model deviance was 4958.11, and there was no decline compared with that before elimination. The reliability coefficient of the average of class was 0.85. Further eliminating the material and space variable, the design and organization variable had a significant impact on the average language score of class, the deviance of the model was 4965.47, and the reliability coefficient of the average of class was 0.853.

(4) Step 4: Random Coefficient Model

The explanatory variables at the class level were removed in step 3, and the child level explanatory variables of gender, age, and language pretest were added to Level 1. The random effects was added to the class level. that is, the slope of Level 1 variables were randomly changed in Level 2. The model was as follows:

Level 1: $Y_{ij} = \beta_{0j} + \beta_{1j}(\text{gender}) + \beta_{2j}(\text{age}) + \beta_{3j}(\text{pretest}) + r_{ij}$

Level 2: $\beta_{0j} = \gamma_{00} + u_{0j}$

$\beta_{1j} = \gamma_{10} + u_{1j}$

$\beta_{2j} = \gamma_{20} + u_{2j}$

$\beta_{3j} = \gamma_{30} + u_{3j}$

The gender had a significant impact on language performance, but random effects of gender was not significant (γ_{10} = -4.26, $p < 0.01$; u_1 = 5.05, df = 47, χ^2 = 62.73, p = 0.062). The age had a significant impact on language performance, but random effects of age was also not significant (γ_{20} = 5.96， $p < 0.01$; u_2 = 4.32, df = 47, χ^2 = 41.54, $p > 0.500$). The language pretest had a significant impact on language performance, but the random effects of pretest was not significant (γ_{30} = 0.66, $p <$ 0.001; u_3 = 0.11, df = 47, χ^2 = 50.35, p = 0.342). The influence of SES on language performance was significant, but the random effects of SES was not significant (γ_{40} = 5.60， $p < 0.001$; u_4 = 5.96, df = 46, χ^2 = 59.71, p = 0.086).

According to the level of significance, the variable with insignificant random effects was eliminated one by one. While the age was fixed first, the random effects of gender was not significant (u_1 = 3.75, df = 47, χ^2 = 56.41, p = 0.164) , and the random effects of language pretest was not significant (u_3 = 0.11, df = 47, χ^2 = 55.94, p = 0.174). Further eliminating the random effects of language pretest, the random effects of gender was still not significant (u_1 = 3.36, df = 47, χ^2 =51.95, p = 0.287). Therefore, the three significant variables of gender, age, and language pretest in Level 1 were all fixed effects rather than random effects. The reliability coefficient

of the average of class was 0.921, indicating that the parameters were stable and can be further analyzed.

(5) Step 5: Complete Model

According to the results of the four steps above, it was found that the gender, age and language pretest variables in Level 1 had an impact on child language development, and the slopes of the three variables had fixed effects at the class level. In class level, design and organization variable affected language performance. Therefore, the complete model was as follows:

Level 1: $Y_{ij} = \beta_{0j} + \beta_{1j}$ (gender)$+\beta_{2j}$ (age)$+\beta_{3j}$ (pretest) $+r_{ij}$

Level 2: $\beta_{0j} = \gamma_{00} + \gamma_{01}$ (organization) $+ u_{0j}$;

$\beta_{1j} = \gamma_{10}$

$\beta_{2j} = \gamma_{20}$

$\beta_{3j} = \gamma_{30}$

$\beta_{4j} = \gamma_{40}$

The fixed effects of gender, age, and language pretest were -4.33, 6.11, and 0.63, and design and organization of class level showed a significant impact on language performance after controlling the gender, age, and language pretest variables ($\gamma = 7.51$, $t = 6.07$, $p < 0.001$). The deviance of the complete model was 3488.71, and the reliability coefficient of the average of class was 0.863.

Table 4.20 Five-step Hierarchical Linear Models of language

	Explanatory Variable	Step1 Model 0	Step2 Covariate Model	Step 3 Fixed effect Model	Step 4 Random coefficient Model	Step 5 Complete Model
Dependent Variable		Language (PPVT)				
		Fixed Effect				
	Intercept γ_{00}	53.23***(2.40)	53.15*** (2.46)	53.25** (1.84)	53.15*** (2.46)	53.17*** (1.86)
Child Level	Gender γ_{10}		-4.33*** (1.48)		-4.33*** (1.48)	-4.33*** (1.48)
	Age γ_{20}		6.11*** (2.04)		6.11*** (2.04)	6.11*** (2.04)
	Pretest γ_{30}		0.63*** (0.05)		0.63*** (0.05)	0.63*** (0.05)
	SESγ_{40}					
Class Level	Materialsγ_{01}					
	Opportunitiesγ_{02}					
	Instructionsγ_{03}			7.01*** (1.24)		7.51*** (1.24)
		Random Effect				
	Gender u_{1j}					
	Age u_{2j}					
	Pretest u_{3j}					
	SESu_{4j}					
	$u_{0j}(\tau_{00})$	250.99***	271.90***	144.05***		149.93***
	R(σ^2)	288.38	202.95	288.41		202.97
	Deviance	4989.95	3518.84	4965.47		3488.71

Note. $^{**}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

4.5.4 The predictive effect of play center activity quality on child math development

(1) Step 1: one-way ANOVA with random effects model

In order to test whether the data is suitable for HLM analysis, one-way ANOVA with random effects model (Model 0) was firstly established. the model is:

Level 1: $Y_{ij} = \beta_{0j} + r_{ij}$

Level 2: $\beta_{0j} = \gamma_{00} + u_{0j}$

The reliability coefficient of the average of class was 0.866, indicating that the parameter estimation results were stable. In Model 0, the fixed effects of the intercept γ_{00} = 43.18 (t = 32.82, p < 0.001), indicating that the average math of the class was 43.18. The variance of child level σ^2 = 131.504, and the class level variance τ_{00} was 73.53 (df = 47, χ^2 = 356.26, p < 0.001). According to the intra-class correlation coefficient (ICC) calculation formula, ICC = 73.528/ (131.504+73.528)= 0.359, which was greater than 0.138, indicating that the variables of class level affected the math scores of child level. Therefore, HLM analysis can be further performed.

(2) Step 2: Covariate Model of Level 1

The explanatory variables of gender, age, SES, and math pretest were added to Level 1 at the child level. At the same time, the slope of the above four variables were set to fixed effects at the class level. The model equation is:

Level 1: $Y_{ij} = \beta_{0j} + \beta_{1j}$ (gender) + β_{2j} (age) + β_{3j} (pretest) + β_{4j} (SES) + r_{ij}

Level 2: $\beta_{0j} = \gamma_{00} + u_{0j}$

$\beta_{1j} = \gamma_{10}$

$\beta_{2j} = \gamma_{20}$

$\beta_{3j} = \gamma_{30}$

$\beta_{4j} = \gamma_{40}$

The results showed that the average math of class was significant (γ_{00} = 42.83, df = 46, t = 30.82, p < 0.001), and the random effects at the class level were

significant (u_0 = 9.24， df = 46, χ^2 = 603.04, p < 0.001). The fixed effects of gender, math pretest, and age on math scores respectively were -2.24 (t = -2.44, df = 394, p < 0.05), 0.70 (t = 15.54, df = 394, p < 0.001), and 4.86 (t = 4.50, df = 394, p < 0.001), which were all significant. However, the fixed effects of SES on math scores was not significant (γ_{40} = -1.06， t = -1.43, p = 0.153). The deviance was 2880.88.

Further eliminated SES, the average of class and random effects were all significant (γ_{00} = 42.66, t = 31.18, p < 0.001; u_0 = 9.20, df = 47, χ^2 =617.66, p < 0.001). The fixed effects of age and math pretest were respectively 0.69 (t = 15.65, df = 414, p < 0.001) and 4.78 (t = 4.62, df = 414, p < 0.001), which were all significant. The fixed effects of gender was significant (t = -1.98, df = 414, p < 0.05). The deviance of the model was 3017.26, but the deviance was no significant difference compared with the variables were eliminated before (df = 0, χ^2 =136.39, p > 0.50). The reliability coefficient of the average of class was 0.923.

(3) Step 3: Fixed effects Model of Level 2

While independent variables of Level 1 were removed, class level independent variables of material and space, opportunity and time, design and organization were added to Level 2. The model equation is:

Level 1: $Y_{ij} = \beta_{0j} + r_{ij}$

Level 2: $\beta_{0j} = \gamma_{00} + \gamma_{01}$ (material) + γ_{02} (opportunity) + γ_{03} (organization) + u_{0j}

The results showed that the average of class was 43.20 (t = 34.87, df = 44, p < 0.001), and the random effects was 7.90 (df = 44, χ^2 = 296.70, p < 0.001). Among the three variables, only design and organization variable had a significant impact on math scores (γ_{03} = 3.57, t = 2.53, df = 44, p < 0.05). The fixed effects of material and space, opportunity and time were not significant (γ_{01} = -1.37, t = -0.77, df = 44, p = 0.447； γ_{02} = 0.23, t = 0.14, df = 44, p = 0.888). The deviance was 4506.53.

Firstly, the opportunity and time variable was removed, and the impact of design and organization was still significant (γ = 3.59， t = 2.54, df = 45, p < 0.05), while the impact of material and space was still not significant (γ = -1.196，t = -0.891, df = 45, p = 0.378). The average of class was 43.20 (t = 36.26, df = 45, p < 0.001), the random effects was 7.79 (χ^2 = 5.04, df = 0, p > 0.500), and the reliability coefficient of the average of class was 0.84. The deviance was 4507.95, which was not significantly different compared with that before elimination of opportunity and time(χ^2 = 1.42, df = 0, p > 0.500).

Secondly, after the elimination of material and space, the impact of design and organization on math performance was significant (γ = 2.56, t = 3.50, df = 46, p < 0.001). The average of class was 43.213 (t = 36.090, df = 46, p < 0.001), the random effects was 7.79 (df = 46, χ^2 = 301.22, p < 0.001), and the reliability coefficient of the average of class was 0.843. The deviance was 4152.98, which was not significantly different compared with that before elimination of material and space (χ^2 = 5.04, df = 0, p > 0.500). Therefore, the model is:

Level 1: $Y_{ij} = \beta_{0j} + r_{ij}$

Level 2: $\beta_{0j} = \gamma_{00} + \gamma_{01}$ (organization) $+u_{0j}$

(4) Step 4: Random Coefficient Model

The explanatory variables at the class level in Step 3 were removed, and explanatory variables of gender, age and math pretest at the child level were added to Level 1. The random effects were added to the class level, that is, the slope of Level 1 variables were randomly changed in Level 2. The model was as follows:

Level 1: $Y_{ij} = \beta_{0j} + \beta_{1j}$ (gender) $+ \beta_{2j}$ (age) $+ + \beta_{3j}$ (pretest) $+ r_{ij}$

Level 2: $\beta_{0j} = \gamma_{00} + u_{0j}$

$\beta_{1j} = \gamma_{10} + u_1$

$\beta_{2j} = \gamma_{20} + u_{2j}$

$\beta_{3j} = \gamma_{30} + u_{3j}$

The average of class was 42.3 (t = 31.19, df = 47, p < 0.001) and the random effects was 8.92 (df = 47, χ^2 = 360.82, p < 0.001). The fixed effects of the three variables were all significant, and the random effects of age were not significant (u = 2.45, df = 47, χ^2 = 34.10, p > 0.500). The random effects of math pretest were not significant (u = 0.07, df = 47, χ^2 = 48.57, p = 0.409). The random effects of gender were also not significant (u = 5.45, df = 47, χ^2 = 49.65, p = 0.368). The model deviance is 3231.45 and the estimated parameter is 11.

The random effects of age were fixed and reanalyzed. The average of class was 42.63 (t = 31.20, df = 47, p < 0.001), and the random effects was 8.91 (df = 47, χ^2

= 356.88, $p < 0.001$). The random effects of math pretest were not significant (u = 0.09, df = 47, χ^2 = 44.37, $p > 0.500$), and the random effects of gender were also not significant (u = 5.34, df = 47, χ^2 = 71.38, $p < 0.05$). Next, the slope of math pretest was fixed, then the random effects of gender became significant (u = 5.34, df = 47, χ^2 = 71.38, $p < 0.05$). The average of class was 42.63 and the reliability coefficient of the average of class was 0.865. The reliability of gender was 0.345, which is low and not suitable for analysis of the influence of class level variables on gender slope.

(5) Step 5: Complete model

Combining the results of the four steps above, Level 1 contained three control variables of gender, age, and math pretest, but Level 2 only contained one variable of design and organization in the complete model. The age and math pretest were fixed at the class level, and the slope of gender was randomly changed at the class level. Because of low reliability, the influence of variables at Level 2 on the math pretest slope were not considered. The average of class was affected by design and organization variable in Level 2. Therefore, the complete model was as follows:

Level 1: $Y_{ij} = \beta_{0j} + \beta_{1j}$ (gender) + β_{2j} (age) + β_{3j} (pretest) + r_{ij}

Level 2: $\beta_{0j} = \gamma_{00} + \gamma_{01}$ (organization) + u_{0j}

$\beta_{1j} = \gamma_{10} + u_{1j}$

$\beta_{2j} = \gamma_{20\,j}$

$\beta_{3j} = \gamma_{30}$

The fixed effects of age and math pretest were 4.94 and 0.68, both of which were significant at the 0.001 level. The fixed effects of gender was -1.68 (t = -1.92, df = 47, p = 0.060) with significant margins. The random effects of gender was 2.91 (p < 0.001), the average of class was 42.66 (p < 0.001), indicating that the random effects of gender was significant. The fixed effects of design and organization on the average of class was significant (p < 0.001). The complete model had a deviance of 2997.35 and an estimated parameter of 4. The reliability coefficient of the average of class was 0.91, and the slope reliability of math pretest was 0.22.

Table 4.21 Five-step Hierarchical Linear Models of math

	Explanatory Variable	Step1 Model 0	Step2 Covariate Model	Step 3 Fixed effect Model	Step 4 Random coefficient Model	Step 5 Complete Model
Dependent Variable				Math		
			Fixed Effect			
	Intercept γ_{00}	43.18***(1.32)	42.66*** (0.83)	43.21*** (1.20)	42.63*** (1.38)	42.66*** (1.21)
Child Level	Gender γ_{10}		-1.73*** (0.80)		-2.73* (1.31)	-1.68* (0.87)
	Age γ_{20}		4.78*** (1.19)		7.52*** (1.59)	4.94*** (1.01)
	pretest γ_{30}		0.69*** (0.04)		0.21*** (0.04)	0.68*** (0.04)
	SESγ_{40}					
Class Level	Materialsγ_{01}					
	Opportunitiesγ_{02}					
	Instructionsγ_{03}			2.56*** (0.73)		2.77* (0.75)
			Random Effect			
	Gender u_{1j}				5.34*	
	Age u_{2j}					
	pretest u_{3j}					
	SESu_{4j}					
	$u_{0j}(\tau_{00})$	73.53***	84.67***	60.63***	79.19***	66.31***
	R(σ^2)	131.50	60.17	131.47	105.22	58.08
	Deviance	4521.51	3017.26	4512.98	3233.28	2997.35

Note. $^{**}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

4.5.5 The predictive effect of play center activity quality on child executive function

(1) Step 1: one-way ANOVA with random effects model

The Model 0 did not include any explanatory variables and the average of executive function of children was 41.70 ($t = 24.53$, $df = 47$, $p < 0.001$). The reliability coefficient of the average of class was 0.905, indicating that the parameter estimation results were stable. The variance of child level σ^2 was 155.75, and the class level variance τ_{00} was 128.19 ($df = 47$, $\chi^2 = 356.256$, $p < 0.001$). According to the intra-class correlation coefficient (ICC) calculation formula, the ICC was 0.45, which is greater than 0.138, and the analysis of next step can be performed. The deviance of Model 0 is 4634.59.

(2) Step 2: Covariate Model of Level 1

The explanatory variables of gender, age, SES, and executive function pretest were added to Level 1 at the child level. At the same time, the slope of the above four variables were set to fixed effects at the class level. The model equation is:

Level 1: $Y_{ij} = \beta_{0j} + \beta_{1j}$ (gender) $+ \beta_{2j}$ (age) $+ \beta_{3j}$ (pretest) $+ \beta_{4j}$ (SES) $+ r_{ij}$

Level 2: $\beta_{0j} = \gamma_{00} + u_{0j}$

$\beta_{1j} = \gamma_{10}$

$\beta_{2j} = \gamma_{20}$

$\beta_{3j} = \gamma_{30}$

$\beta_{4j} = \gamma_{40}$

The results showed that the age and executive function pretest significantly affected the executive function post-test results, and the fixed effects of them were 0.24 (t = 5.94, df = 394, p < 0.001) and 6.13 (t = 2.54, df = 394, p < 0.05). The fixed effects of gender and SES were not significant, they were 0.91 (t = 0.78, df = 394, p = 0.439) and 0.96 (t = 0.83, df = 394, p = 0.407). The model deviance was 3134.78.

First, the SES is removed. The model results showed that the effect of gender on executive function was still not significant (γ = 0.37, t = 0.33, df = 414, p = 0.738). the effect of execution function pretest and age were remained significant. The model deviance is 3281.17, which was no significant difference compared with the pre-elimination model (df = 0, χ^2 = 151.22, p > 0.500). After eliminating the gender, the fixed effects of executive functional pretest and age were 0.25 (t = 6.64, df = 416, p < 0.001) and 6.03 (t = 2.618, df = 416, p < 0.05), indicating that the fixed effects of them were significant. The average of class was 42.40 (t = 24.52, df = 47, p < 0.001), and random effects of the average of class was 11.53 (df = 47, χ^2 = 500.13, p < 0.001). The model deviance was 3295.68， and the reliability coefficient of the average of class was 0.906. In summary, the next step can be analyzed.

(3) Step 3: Fixed effects Model of Level 2

While independent variables of Level 1 were removed, class level independent variables of material and space, opportunity and time, design and organization were added to Level 2. The model equation is:

Level 1: $Y_{ij} = \beta_{0j} + r_{ij}$

Level 2: $\beta_{0j} = \gamma_{00} + \gamma_{01}$ (material) + γ_{02} (opportunity) + γ_{03} (organization) + μ_{0j}

The results showed that the three variables at class level had no significant influence on the average of class. After using the method of eliminating variable one by one to re-examine the model, the results still showed no significant effect of materials and space, opportunity and time, design and organization on executive function. In addition to the above three variables, there were other variables at the class level that affected executive function.

(4) Step 4: Random Coefficient Model

The explanatory variables at the class level in Step 3 were removed, and explanatory variables of gender, age and executive function pretest at the child level were added to Level 1. The random effects were added to the class level, that is, the slope of Level 1 variables were randomly changed in Level 2. The model is as follows:

Level 1 $Y_{ij} = \beta_{0j} + \beta_{1j}$ (age) + β_{2j} (pretest) + r_{ij}

Level 2:; $\beta_{0j} = \gamma_{00} + u_{0j}$;

$\beta_{1j} = \gamma_{10} + u_{1j}$

$\beta_{2j} = \gamma_{20} + u_{2j}$

The fixed effects of age and executive function were significant, it was 5.67 ($t = 3.14$, $df = 47$, $p < 0.001$) and 0.24 ($t = 6.75$, $df = 47$, $p < 0.001$), but the random effects of them were not significant. First, the slope of execution function

pretest was fixed, and the model is re-examined. The random effects of the age slope was still not significant. It indicated that there was no variable in the class level that affects the age and pretest slope of executive function. The model equation is as follows, the data results were shown in steps 2 and 3:

Level 1: $Y_{ij} = \beta_{0j} + \beta_{1j}$ (age) $+ \beta_{2j}$ (pretest)$+ r_{ij}$

Level 2: $\beta_{0j} = \gamma_{00} + u_{0j}$

$\beta_{1j} = \gamma_{10}$

$\beta_{2j} = \gamma_{20}$

Table 4.22 Five-step Hierarchical Linear Models of executive function

	Explanatory Variable	Step1 Model 0	Step2 Covariate Model	Step 3 Fixed effect Model	Step 4 Random coefficient Model	Step 5 Complete Model
Dependent Variable		Executive Function				
		Fixed Effects				
	Intercept γ_{00}	41.70***(1.70)	42.40*** (1.75)		42.40*** (1.75)	42.40*** (1.75)
Child Level	Gender γ_{10}					
	Age γ_{20}		6.03*** (1.63)		6.03*** (1.63)	6.03*** (1.63)
	pretest γ_{30}		0.25*** (0.04)		0.25*** (0.04)	0.25*** (0.04)
Class Level	SESγ_{40}					
	Materialsγ_{01}					
	Opportunitiesγ_{02}					
	Instructionsγ_{03}					
		Random Effects				
	Gender u_{1j}					
	Age u_{2j}					
	pretest u_{3j}					
	SESu_{4j}					
	$u_{0j}(\tau_{00})$	128.19***	132.85***		132.85***	132.85***
	R(σ^2)	155.75	117.27		117.27	117.27
	Deviance	4634.59	3295.68		3295.68	3295.68

Note. $^{**}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

4.5.6 The predictive effect of play center activity quality on child social skills

(1) Step 1: One-way ANOVA with random effects model

Model 0 was created first. The reliability coefficient of the average of class was 0.903. The variance σ^2 of child level was 294.95, and the average of class τ_{00} = 252.43. The ICC is 0.461, which is greater than 0.138, indicating that there were class-level variables that affected child social skills. The model had an intercept of 83.06 (t = 34.41, df = 47, p < 0.001), indicating that the average of social skills was 83.06. The model deviance was 4719.90.

(2) Step 2: Covariate Model of Level 1

The explanatory variables of gender, age, SES, and social skill pretest were added to Level 1 at the child level. At the same time, the slope of the above four variables were set to fixed effects at the class level. The model equation is:

Level 1: $Y_{ij} = \beta_{0j} + \beta_{1j}$ (gender) + β_{2j} (age) + β_{3j} (pretest) + β_{4j} (SES) + r_{ij}

Level 2: $\beta_{0j} = \gamma_{00} + u_{0j}$

$\beta_{1j} = \gamma_{10}$

$\beta_{2j} = \gamma_{20}$

$\beta_{3j} = \gamma_{30}$

$\beta_{4j} = \gamma_{40}$

The results showed that the influence of age and SES on child social skills was not significant. The fixed effects were 1.71 (t = 0.83, df = 390, p = 0.408) and 0.37 (t = 1.02, df = 390, p = 0.456). The model deviance was 3377.54.

When removed SES first, the fixed effects of age was still not significant (γ = 1.24, t = 0.67, df = 391, p = 0.504). The fixed effects of gender and social skills pretest were still significant. Further elimination of age, the fixed effects of gender and social skills pretest were 4.95 (t = 2.89, df = 408, p < 0.01) and 0.36 (t = 5.67, df = 408, p < 0.001) , indicating that the fixed effects of them were significant. The average of class was 82.80 (t = 32.87, df = 47), and the random effects of the average of class was significant (u = 16.83, df = 47, χ^2 = 538.98, p < 0.001). The reliability coefficient of the average of class was 0.91, and the deviance was 3518.32.

(3) Step 3: Fixed effects Model of Level 2

While independent variables of Level 1 were removed, class level independent variables of material and space, opportunity and time, design and organization were added to Level 2. The model equation is:

Level 1: $Y_{ij} = \beta_{0j} + r_{ij}$

Level 2: $\beta_{0j} = \gamma_{00} + \gamma_{01}$ (material) + γ_{02} (opportunity) + γ_{03} (organization) + u_{0j}

The results showed that the impact of the three variables on the average of class were not significant. The fixed effects were -0.59 (t = -0.17, df = 44, p = 0.863), 2.83 (t = -0.79, df = 44, p = 0.432), and 3.68 (t = 1.56, df = 44, p = 0.126). Using the elimination one by one, the material and space was removed first. The results showed that opportunity and time, design and organization were not significant. The fixed effects of them were 2.35 (t = 1.08, df = 45, p = 0.286) and 3.52 (t = 1.86, df = 44, p =

0.069). Then the opportunity and time was removed, and the fixed effects of design and organization became significant (γ = 5.24， t = 3.60, p < 0.001). At this time, the average of class was 83.11 (t = 38.53, p < 0.001), the random effects was 14.00 (df = 46, χ2 = 391.41, p < 0.001), the reliability coefficient was 0.878, and the deviance was 4703.79.

(4) Step 4: Random Coefficient Model

The explanatory variables at the class level in Step 3 were removed, and explanatory variables of gender, and social skills pretest at the child level were added to Level 1. The random effects were added to the class level, that is, the slope of Level 1 variables were randomly changed in Level 2. The model was as follows:

Level 1: $Y_{ij} = \beta_{0j} + \beta_{1j}$ (gender) + β_{2j} (pretest) + r_{ij}

Level 2: $\beta_{0j} = \gamma_{00} + u_{0j}$

$\beta_{1j} = \gamma_{10} + u_{1j}$

$\beta_{2j} = \gamma_{20} + u_{2j}$

The fixed effects of gender and social skills pretest were 4.48 (t = 2.62, df = 47, p < 0.05) and 0.43 (t = 6.06, df = 47, p < 0.001). The random effect of gender was marginal significant (u = 5.86, df = 47,χ^2 = 63.40, p = 0.055), while the random effects of the slope of social skills pretest was significant (u = 0.35, df = 47,χ^2 = 101.47, p < 0.001). After fixed the gender and re-examine the model, the random effects of social skills pretest was 0.34 (df = 47,χ^2 = 105.68, p < 0.001). The model

deviance was 3505.55. The reliability of average of classs and social skills pretest were 0.921 and 0.499.

(5) Step 5: Complete model

Combining the results of the four steps above, Level 1 contains gender and social skills pretest variables, and Level 2 contains one variable of design and organization in the complete model. The slope of gender was fixed at the class level, and the slope of social skills pretest is randomly changed at the class level. Because of its low reliability, the influence of Level 2 variables on the slope of social skills pretest was not considered. The average of class was affected by the design and organization variable in the class level. Therefore, the complete model was as follows:

Level 1: $Y_{ij} = \beta_{0j} + \beta_{1j}$ (gender) + β_{2j} (pretest) + r_{ij}

Level 2: $\beta_{0j} = \gamma_{00} + \gamma_{01}$ (organization) + u_{0j}

$\beta_{1j} = \gamma_{10}$

$\beta_{2j} = \gamma_{20} + u_{2j}$

The fixed effects of gender and social skills pretest were 4.64 (t =3.02, df = 407, $p < 0.01$) and 0.43 (t = 5.97, df = 47, $p < 0.001$). The random effects of social skills pretest was 0.35 (df = 47, χ^2 = 105.98, $p < 0.001$). The average of class was 82.80 ($p < 0.001$), and the random effects was significant. The fixed effects of design and organization on the the average of class was 6.01 (df = 46, t = 4.46, $p < 0.001$). The complete model had a variance of 3487.52 and an estimated parameter of 4. The

reliability coefficient of the average of class was 0.90, and the slope of social skills pretest reliability was 0.50.

Table 4.23 Five-step Hierarchical Linear Models of social skills

	Explanatory Variable	Step1 Model 0	Step2 Covariate Model	Step 3 fixed effects Model	Step 4 Random coefficient Model	Step 5 Complete Model
Dependent Variable		Social Skills				
		Fixed Effect				
	Intercept γ_{00}	41.70***(1.70)	82.80*** (2.52)	83.11*** (2.11)	80.04*** (2.25)	82.80*** (2.18)
Child Level	Gender γ_{10}		4.95*** (1.71)		4.65** (1.78)	4.64** (1.69)
	Age γ_{20}					
	pretest γ_{30}		0.36** (0.06)		0.43*** (0.07)	0.43*** (0.07)
	SESγ_{40}					
Class Level	Materialsγ_{01}					
	Opportunitiesγ_{02}					
	Instructionsγ_{03}			5.24*** (1.27)		6.01*** (1.27)
		Random Effect				
	Gender u_{1j}					
	Age u_{2j}					
	pretest u_{3j}				0.32***	0.35***
	SESu_{4j}					
	$u_{0j}(\tau_{00})$	252.43***	283.23***	196.09***	178.52***	212.70***
	R(σ^2)	294.95	233.27	294.88	206.82	204.24
	Deviance	4719.90	3518.32	4703.79	3505.55	3487.52

Note. $^{**}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

CHAPTER 5

DISCUSSION

According to the research results of Chapter 4, this chapter is divided into three parts to discuss. First of all, explain the current situation of the quality of play center activities in Chinese kindergartens. Secondly, present the situation of children's development and gender and age differences in children's development are discussed. Finally, explore the prediction of play center activities on the development of children's language, math, executive function and social skills after controlling the child level variables.

5.1 The current situation of play center activities

5.1.1 Overall quality of play center activities

The results showed that the overall quality of play center activities in China is between the minimum and qualified level, and there are significant differences between urban and rural, private and public, high and low level of kindergartens. The results are consistent with the existing descriptions of play center activities in China (Chen & Li, 2014; Luo, 2014; Hu, et al., 2015). The findings provide empirical support for teachers` beliefs about play center activities in Chinese cultural context (Hua, 2008; Zhu, 2007). In China, the combination of teacher-led whole-group

teaching and child-initiated free-play is considered as a proper way of early childhood education (Hu, et al., 2014). As a matter of fact, studies have shown that the teachers are more inclined to teacher-led play teaching approach rather than child-led free play although teachers might agree with the value of play center activities highly (Li, et al., 2014; Hu, et al., 2015). As the result of observation, compared with whole-group teaching of 2-3 hours, the time of play center activities is only 0.5-1 hour in the schedule of kindergarten, and even some of the kindergartens do not arrange any play center activities in the schedule. Although large class sizes (M = 36) and high student–teacher ratios (M = 16.21:1) in Chinese classroom are contributed to whole-group teaching rather than play center activities in kindergartens (Zhu, 2007; Wu, Young, & Cai, 2012), it also shows that the play center activities in practice are not ideal as approval in concept. Different from the studies in other countries, play center activities in China show obvious differences between urban and rural, private and public, high and low level of kindergarten. These significant differences are mainly due to the urban-rural education quality disparity in China (Hu, et al., 2014). Public institutions are more likely to be concentrated in urban areas, and they usually get a higher level of quality due to more funding resources from government and other public sectors, while most private and rural programs have a much lower level of quality. The results remind policymakers to pay more attention to the urban-rural disparity in early childhood education, and take continuous measures to reduce the

urban-rural differences so that young children can have access to a balanced education.

5.1.2 materials and space quality of play center activities

Materials and space quality of play center activities is between the minimum requirements and qualified level, and shows significant differences between urban and rural, private and public, high and low level of kindergartens. Studies have revealed that the provision and preparation of materials also affect the activities and performance of young children. The richer the materials provided in the area, the more positive behaviors and less negative behaviors young children will have (Huang, Li, & Zhong, 2018). Similar to existing research findings, play center activities in Chinese kindergartens also lack sufficient space and materials (Xu & Zhao, 2014; Huang, 2014; Chen & Li, 2014). The large size of classes in China leads to insufficient space for the play centers. Meanwhile, the lack of investment and experience makes it difficult for teachers to combine children`s interests with material characteristics (Yang, 2011; Chen & Li, 2014). Some typical problems of improper space and materials have been presented in the existing research, including (1) The environment and setting of play center is relatively fixed; (2) The placement of materials is more casual; (3) The types and quantities of materials are not rich enough to allow a small group of children to participate (Han, 2013; Huang, 2014; Xu & Zhao, 2014). Therefore, it is suggested that kindergartens and teachers should design and arrange activity space properly. The creation of environments should consider the

individual development level and interest of children to ensure that the environment is meaningful to each children`s development through child observation, conversation, discussion, and other evaluation methods. Materials should be rotated regularly to maintain children`s interest so as to stimulate children`s curiosity of play constantly With providing multiple meaningful spaces and a variety of materials for children to practice specific skills, children are able to exercise self-regulation, self-control, initiative, and enthusiasm, so that their learning is relatively free from intrusion and direction of teachers.

5.1.3 Opportunities and time quality of play center activities

Opportunity and time quality of play center activities is below the quality level and shows significant differences between urban and rural, private and public kindergartens. This is consistent with the research results of decreased time and opportunities for children for free play in other studies. Compared with previous generations, children were more involved in studies and learning activities, and the time and opportunities for free play were significantly reduced, which is the same in China (Howes, et al., 1992; Isenberg & Quisenberry, 2002; Ma, 2014). Moreover, compared with free play at least one-third of the prekindergarten hours in the U.S.A., there are not enough opportunities and time for free play in the daily schedule in Chinese kindergartens, which has shown by past research (Yang, 2011; Chen & Li, 2014; Wu & Shao, 2016). According to the survey results by Wu and Shao (2016), some play center activities are only arranged for half an hour in entry and departure

time, while some are crowded out by other activities such as transitions and waiting sessions. Most teachers do not allow children to choose their activities independently for the convenience of management. Under the high control of teachers, the lack of sufficient time in play center is a common problem in play center activities in China. Therefore, for most kindergartens, it is necessary to respect the right to play and significantly increase the opportunities and time of play in kindergarten. Considering the tendency of group teaching in Chinese kindergartens, experts and professionals suggest that children should have at least one hour of free play time every day when they are provided with sufficient play materials, and that kindergartens with conditions can arrange two to three hours of free play time (Liu, 2004; Huang, 2014; Hu, et al., 2015).

5.1.4 Design and organization quality of play center activities

Design and organization quality of play center activities is between the minimum requirements and qualified level and shows significant differences between urban and rural, private and public, high and low level of kindergartens. It is observed that kindergarten teachers interact minimally with children during play center activities, while the organization and instruction of teachers has proven to be a crucial reason for a high level of play in practice (Nikolakaki, 2012).,However, there is a general lack of guidance and organization from teachers in play center activities (Wu & Shao, 2016; Gu, 2016), or teachers lack adequate guidance strategies (Henniger, 1993; Duncan & Tarulli, 2003; Johnson, et al., 2005; Han, 2013; Hu, et al., 2015).

Hirsh-pasek, et al. (2009) pointed out that child-led free play often requires the teachers flexible and skilled in teaching with full experience of instruction, but Chinese kindergarten teachers seem to lack appropriate guidance because they either do not realize it or do not know how to use embedded learning opportunities. Therefore, teachers should accurately understand the importance and value of play first, which should not only remain in the concept but should also be implemented in educational practice. Then teachers need to be able to support children`s learning in a variety of ways, including observing, building scaffolding, supporting peer interaction, helping them follow the rules, stay safe, and document their learning. A variety of tips and support can also be used to help children advance the play. Teachers can use language prompts (verbal conversations in play scenes), role model prompts (showing children how to interact with toys or other children), and action prompts (guiding the child through the action). In general, teachers need to acquire sufficient practical skills to implement child-centered developmentally appropriate play (Hu, et al., 2014). Professional development work should be provided for kindergarten teachers to improve the quality of child-centered play and learning.

5.2 The current situation of children's development

5.2.1 The current situation of language, math, executive function, and social skills development

The present status of child development varies with the research tools and the cultural background of children, and also varies with the age of children. Due to the lack of relevant research of PPVT, TCMA, HTKS, and SSIS measurement in Chinese cultural background, this research only described the measurement results of these scales.

Research showed that the language (PPVT) average of children was 52.32, the average of math was 42.86, the average of executive function was 41.95, and the average of social skills was 83.35. Independent sample t-test results showed that children's language, math, executive function, and social skills development had significant individual differences. The main reason is the sample of children is K2 (4-5 years old) from high, medium, and low development of different regions and locations, and the age of sample child differs from 4.5 years old to 7.33 years old. There is no unified standard of quantitative comparison objectively.

5.2.2 Gender differences in child development outcomes

The results of this study showed that there are significant gender differences in the development of language, math and social skills. The results are as follows:

There were significant gender differences in the language performance of children, and boys were higher than that of girls, indicating that the receptive vocabulary ability of boys were significantly better than that of girls. The findings contradict the popular belief that the language development of girls is better than boys. Bornstein, Haynes, & Painter, (1998) showed that the vocabulary ability of girls was higher than boys. Hammer, et al. (2010) showed that girls have higher letter recognition ability than boys in preschool. More research results showed that there was no difference in language development between boys and girls (Burchinal, et al., 2000; Basilio, Puccini, Silva, & Pedromonico, 2005; Matthews, et al., 2009; Duncan et al., 2017). A possible explanation is that the studies adopted different measurement tools of language development of children, or explored the different aspects of language development. This study focused on the receptive vocabulary but not other aspects of language development in the sample of K2 children. As receptive vocabulary ability for boys being higher than girls, it may need to be further discussed by qualitative research or combining qualitative and quantitative research.

There is a significant gender difference in child math achievement, and math performance of boys is higher than girls, which is consistent with the common belief that the math performance of boys is better than girls (Sylva, et al., 2004; Melhuish, et al., 2008; Ludwig, 2015; Cimpian, Lubienski, Timmer, Makowski, & Miller, 2016) . Melhuish, et al. (2008) found in a British government research project that girls with low birth weight (compared with boys) and lower level of occupation,

education or income of parents were significantly and independently correlated with lower math achievement in kindergartens. Cimpian, et al. (2016) in a large study in the U. S. found that the gender gap is small when children start school, but through third grade it widens to all levels of ability. The study found that teachers perceive that girls' math abilities may be significantly lower than boys', and this bias was partly responsible for the girls doing worse. Past research showed that early math achievement determines strongly predicts how good at math children can be during later elementary and middle school. Therefore, the gender difference in child math achievement deserves attention.

There were significant gender differences in the social skills of children, and girls were higher than that of boys, indicating that the social ability of girls was significantly better than that of boys. This result is consistent with the research of Crombie (1988), Walker (2005) and others. Crombie (1988) found that there are indications that boys and girls acquire different social skills, values and goals. Walker (2005) studied the gender differences of children's prosocial behaviors, aggressive or destructive behaviors, shy or withdrawn behaviors on social behaviors related to peers. Results indicated that, after controlling for age, boys are more likely to aggressive or disruptive behavior and girls are more likely to prosocial behavior.

There was no significant gender difference in child executive function, which was consistent with the findings of Wei & Xing (2018). Wei & Xing (2018) conducted a follow-up study on the executive function and language ability of

Chinese preschoolers, and found that there were no significant gender differences in three aspects of executive function of children -- inhibition control, working memory and attention transfer. Some studies have also shown that there may be gender differences in some parts of the executive function. Matthews, Ponitz, & Morrison (2009) show that girls outperformed boys in behavioral self-regulation. However, no significant gender differences were found on the five academic achievement outcomes, including general knowledge, expressive vocabulary, letter–word identification, applied problems, and sound awareness. This also supports the results of this study. Gender differences in executive function do not seem to be significant, which can be further studied in different dimensions, different measurement tools, and different cultural backgrounds.

In summary, many studies are supporting that gender is an important influencing factor of child development differences. The findings of this study on gender differences in child development can provide support for existing literature. Some studies have also revealed that there are many reasons for differences in child development, and even if there are gender differences in child development, it should be carefully explained (Davis-Kean, 2005). In this study, gender was taken as a control variable at the child level to exclude the influence of gender on children's development. In addition, stratified sampling was adopted in this study, and only K2 class children were selected. The influence of gender on child development found in this study may be underrepresented, which is worth further exploration.

5.2.3 Age differences in child development outcomes

The results showed that there were significant age differences in children's language, math, executive function and social skills development. In terms of language development, children over 6 years old are significantly better than children aged 5-6 years old or 4-5 years old. In math development, children over 6 years old are significantly better than children aged 5-6 years old and 4-5 years old. In terms of executive function development, children over 6 years old were significantly better than children aged 5-6 years old and 4-5 years old, and children aged 5-6 years old were significantly better than children aged 4-5 years old. In terms of social skills development, children over 6 years old are significantly better than children aged 5-6 years old. The results are consistent with the research results of Basilio, et al. (2005) and Hammer, et al. (2010), indicating that the older children performed better on language, math, executive function and social skills development. Sylva, et al. (2006) proved that the age of young children is a factor influencing early reading, general mathematical concepts and nonverbal reasoning performance. Basilio, et al. (2005) showed that children's age and mothers' education level had significant influences on children's language development. Hammer, Farkas,& Maczuga (2010) showed that preschool children's letter recognition ability was affected by age and other factors. Moretti, Kuroishi,& Mandra (2017) believed that there was a statistically significant correlation between children's receptive vocabulary performance and age, and older children performed better in the test. McClelland, et al. (2014) considered the

influence of age as a background variable on children's mathematical achievement, and age can affect mathematical achievement. Walker's (2005) study also showed the correlation between age and peer sociability of preschoolers, such as prosocial behavior, aggressive behavior, shyness or withdrawal behavior.

It is also worth noting that, just like gender, the existing studies mostly take age as the background variable to control the development of children, and rarely particularly discuss the impact of age on the development of children. However, age has been widely recognized as an important influencing factor of children's development, especially preschool children.

5.3 The predictive effect of play center activities on child development

The purpose of this study is to explore whether play center activities at the class level can predict the development of language, math, executive function and social skills after controlling variables at the child level. Therefore, A Hierarchical Linear Model analysis is used, and the research results are discussed in detail as follows.

5.3.1 The predictive effect of play center activities on language development

The results of this study showed that gender, age and language pretesting at the child level significantly affect children's language achievement. After controlling these two variables, class level design and organization significantly predict language achievement, but materials and space, opportunity and time have no predictive effect

on language development. In other words, effective measures taken by kindergarten teachers to guide the kindergarten play center activities can help children better develop language skills. This result partially verifies the research hypothesis.

First, gender at the child level can significantly influence children's language performance, which is consistent with the existing research results (Bornstein, Haynes & Painter, 1998; Burchinal, et al., 2000; Basilio, Puccini, Silva, & Pedromonico, 2005; Matthews, et al., 2009; Duncan et al., 2017), see 5.2.2 for details. Age at the child level can significantly affect children's language performance, which is consistent with the previous research results (Basilio, et al., 2005; Hammer, et al., 2010; Sylva,, et al., 2006; Moretti, et al.,2017), see 5.2.3 for details.

Second, language pretest at the child level can significantly affect child language performance, which is consistent with the following findings (Byrnes, Wang, & Miller-Cotto, 2019; Hammer, et al., 2010; Duff, Reen, Plunkett, & Nation, 2015). For example, Byrnes, et al. (2019) argued that prior knowledge plays an intermediary role in family and classroom factors in promoting literacy and mathematical development in children. Children with higher levels of prior knowledge are more likely to process new information effectively than their peers. Duff, et al. (2015) demonstrated a significant longitudinal relationship between pre-literacy vocabulary knowledge and subsequent reading. According to the research of Ebert, Lockl, Weinert, Anders, Kluczniok, and Rossbach (2013), kindergarten and family learning environment have an influence on the initial vocabulary of children.

Third, after controlling for individual variables, only design and organization can predict child language development, which is consistent with the following findings (Howes, et al.,1992; Ebert, et al., 2013). Howes, et al. (1992) demonstrated a key variable between play and language development in a series of intervention studies: teacher support. Especially in play center activities, teacher support for child active learning is an ideal way to develop language skills. In the study of Ebert et al. (2013), it was found that the quantity and quality of language, the frequency of the co-reading, the sensitivity of adults in reading between adults and children, were positively correlated with child language ability. Specific language in teacher-child interaction, meaningful intensive reading or teacher-child interaction is related to the language development of children.

5.3.2 The predictive effect of play center activities on math development

The results of this study showed that children's gender, age and math pretest significantly affect children's math performance. After controlling for these three variables, design and organization at class level significantly predict math performance, but materials and space, opportunity and time have no predictive effect on math development. In other words, kindergarten teachers take adequate measures to guide the kindergarten play center activities that can help children better develop mathematical ability. This result partially verifies the research hypothesis.

First, the gender significantly affects children's math performance, which is consistent with previous research results (Sylva, et al., 2004; Melhuish, et al., 2008;

Ludwig, 2015; Cimpian, et al., 2016), see 5.2.2. The age significantly affects math performance, which is consistent with the research results (Basilio, et al., 2005; Hammer, et al., 2010; Sylva, et al., 2006; McClelland, et al., 2014) as shown in 5.2.3.

Second, children's pretest scores significantly affect children's math scores. This is consistent with previous research results. Howes, et al. (1992) pointed out that young children at play begin to learn essential math skills such as counting, equality, addition and subtraction, estimation, planning, patterns, classification, and measurement， and these informal understanding provides a foundation on which formal math can be built. Byrnes, et al. (2019) showed that children's propensities (i.e., prior knowledge, self-regulation, and executive function) largely mediate the role of family and classroom factors in promoting cognitive development in the areas of literacy and math. Children with more advanced knowledge and abilities (e.g., prior knowledge and working memory capacity) are more likely to process new information effectively than their less advanced peers.

Third, after controlling for individual variables, only the design and organization of play center activity quality can predict children's mathematical development. Dearing, McCartney, and Taylor (2009) point out that high quality including (a) high levels of language stimulation, (b) access to developmentally appropriate learning materials, (c) a positive emotional climate with sensitive and responsive caregivers, and (d) opportunities for children to explore their environments leads to good math and reading scores, especially for disadvantaged children. An

experimental study by Arnold, Fisher, Doctoroff, and Dobbs (2002) also found that, when teachers in experimental classrooms incorporated math-relevant activities into their daily routine during circle time, transitions, mealtime, and small-group activities. Experimental children scored significantly higher than control children on a standardized test of math ability and enjoyed math activities more than the control children. These mean that teachers who create a good environment, provide stimulating materials suitable for child development and respond sensitively to children can help children achieve better mathematical achievements.

5.3.3 The predictive effect of play center activities on executive function

The results of this study showed that age and executive function pretest at the child level affected the executive function results of children, and the slope of these two variables was fixed at the class level and was not affected by the class level variables. In other words, the materials and space, opportunity and time, design and organization of play center activities did not predict the development of child executive function.

This result is different from the research hypothesis and existing research results. Previous studies have found that play is significantly correlated with the development of executive function in children. Executive function, as a high-level indicator of cognitive development, affects children's language and math development and is closely related to academic achievement in kindergarten (Blair & Razza, 2007; McClelland, et al., 2007; Dilworth-Bart, 2012; McClelland, et al., 2014; Fuhs, et al.,

2014; Duncan, McClelland & Acock, 2017). Compared with other types of play, there has been much research on the correlation between pretend or role play and child executive function, and the relationship between the two is more significant (Carlson & White, 2013; Carlson, White, & Davis-Unger, 2014; Shaheen, 2014). This study did not find a significant effect of center play on the executive function development, because the relationship between role play and executive function was not discussed separately. The other explanation is, programs with active play components may be more successful in eliciting improved executive function because of the social motivation aspects of learning (Shaheen, 2014). However, the overall quality of play center activities in kindergartens in China is not high, which fails to play a role in promoting the development of the executive function.

5.3.4 The predictive effect of play center activities on social skills

The results of this study showed that gender and social skill pretest at the child level significantly affected child social skills. After controlling for these two variables, the design and organization of play center activities significantly predicted children's social skills, but materials and space, opportunities and time did not predict child social skills. In other words, valid measures of kindergarten teachers to guide kindergarten play activities can help children better develop social skills. This result partially verifies the research hypothesis.

First, gender at the child level significantly affects child social skill achievement. This is consistent with the research results of Crombie (1988), Walker (2005) and others, as shown in 5.2.2.

Second, after controlling for individual variables, only design and organization can predict the development of child social skills. Studies have shown that interaction among teachers, children, and peers plays an important role in the development of children's social skills. Isenberg and Quisenberry (2002) indicate that play with others gives children the opportunity to match their behavior with others and to take into account viewpoints that differ from their own. Thus, play provides the rich experience children need to learn social skills; become sensitive to others' needs and values; handle exclusion and dominance; manage their emotions; learn self-control; and share power, space, and ideas with others. Howes, et al. (1992) point out that learning in a formal school environment, children must be able to regulate their behaviors and emotions and communicate and engage with others in socially appropriate ways. By using ECERS-R, children in classrooms rated as good or very good in caregiving were more likely to be securely attached to teachers, and were orient to both adults and peers. Bagby, Rudd, and Woods (2005) also showed that teacher interactions influence the language and social-emotional development of young children from low-income backgrounds.

CHAPTER 6

CONCLUSION

Based on the research conclusions, this chapter proposes research recommendations, research limitations and research prospects. It is divided into four sections: the first section is the conclusion; the second section is the research proposal; the third section is the research restriction; the fourth section is the recommendation for the follow-up study.

6.1 Conclusion

Through descriptive statistical analysis and Hierarchical Linear Model analysis, the following research results were obtained of this study:

1. In terms of the quality of play center activities, the overall quality of China's kindergarten play center activities, as well as the quality of material and space, opportunity and time, design and organization were all at moderately low levels.

2. In terms of the outcome of child development, there were individual differences in children`s language, math, executive function, and social skills development. There were significant gender and age differences in the development of children's language, math, and social skills, and there were significant age differences in children's executive function.

3. In terms of the role of play center activities in child development:

(1) Child-level gender, age and language pretest significantly affect children's language performance. After controlling these two variables, class level design and organization significantly affect children's language performance.

(2) Children's gender, age, and math pretest significantly affect children's math scores. After controlling these three variables, class level design and organization significantly predicts children's math scores.

(3) Child-level age and executive function pretest affect individual executive performance outcomes, and the slopes of these two variables were non-random at the class level and were not predicted by class-level variables.

(4) Child-level gender and social skills pretest significantly affect children's social skills scores. After controlling these two variables, class level design and organization significantly predicts children's social skills.

6.2 Research suggestions

Based on literature research and research results, this study proposes the following recommendations for effectively improving the quality of play center activities:

6.2.1 Expand play center activities space and enrich play center activities materials

The study found that the material and space quality of play center activities are at a medium to low level, as shown by the relatively fixed environment and setting of play center activities, the placement of materials is relatively random, and the types and quantities of equipment and materials are not rich enough. The material in the play center activities is a tool in play center activities and a material condition for early childhood activities. Studies have shown that the richer the material in the active area, the more positive behaviors of young children; on the contrary, the positive behaviors of young children can be decline and the negative behaviors rise (Huang, Li, & Zhong, 2018). In response to questions about the activities and spatial quality of kindergarten activities, the following recommendations are made:

First, environmental creation should consider the level of development and interest of children. Before and after creating an environment, teachers must ensure that the environment is meaningful to the development of each child through child observation, dialogue, discussion, etc., and improve the purpose of creating the activity area.

Second, the setting of the activity area should be adjusted according to the change of the theme and the transfer of children's interest to stimulate the enthusiasm of the children. In the design of play center activities, in addition to the material, space and content of the game should be suitable for the age, ability, experience and

cultural background of the child, it should also consider the integration of play center and recent curriculum themes, other play center activities, and group teaching activities to help young children gain overall curriculum experience.

Third, improve the openness of materials. When teachers provide materials for young children, they should provide more raw materials and less finished materials. Providing low-structural materials can stimulate the interest of young children to explore and promote the development of imagination and creativity in the interaction of children with materials. Materials should be rotated periodically to keep children interested.

6.2.2 Provide sufficient game time and opportunity

The study found that the time and opportunity quality of play center activities were below the level of eligibility. Children only have 1-2 special and scattered opportunities to play center games every week. The time and opportunity of play center activities are occupied by collective teaching, transition time and so on. Adequate time is the guarantee for the development of play center activities, and it is also an important way to satisfy children's interest in exploring and developing their independent personality. To this end, make the following recommendations:

For most kindergartens, in order to improve the quality of play center activities, it is necessary to increase the opportunities and time of early childhood activities. In the play center activities of kindergartens, teachers should first provide sufficient time for young children. Only when sufficient time is available, young

children can be more independent, free and fully engaged in play center activities. Considering the tendency of Chinese kindergartens to focus on group teaching, experts recommend that children have at least one hour a day, preferably two to three hours of free play time, and have sufficient material support (Liu, 2004; Huang, 2014; Hu, et al., 2015). In addition to the fixed time of collective activities every day, as long as it is a non-collective activity, teachers should give young children the freedom to choose play center activities and respect the child's dominant position in play center activities.

6.2.3 Optimize the design and organization of teachers on play center activities

The study found that the design and organization quality of play center activities is below the qualified level. HLM analysis found that the design and organization of play center activities have a significant predictive effect on children's language, math, and social skills development. Therefore, teachers are advised to pay attention to the role and value of play center activities, clarify the role of teachers in play center activities, and improve the strategies for teachers to organize and guide play center play.

First, teachers should establish a correct understanding of the game. In China, teacher-led collective teaching and child-independent play center games are considered the right way to early childhood education (Hu, et al., 2014). In fact, teachers should not only agree with and recognize the value of play center activities, but also implement the concept of "game as the basic activity" in educational practice.

Teachers should fully respect children, respect their individual independence, and let children choose their own areas of interest in activities, so that they can move freely in the region. Teachers should not restrict their personality and interests too much based on management convenience. They should try their best to create a free and relaxed play center activities environment so that children can play freely, gain experience and learn knowledge from it.

Second, in the guidance of play center activities, teachers should think deeply about their role in play center activities and what they should do. Ashiabi (2007) believed that teachers should play multiple roles of instructor and playmate when playing games. As children's game partners, teachers should participate in the game as equals, abide by the rules of the game, and pay attention to the common exploration and communication with children. As instructors, teachers need to observe children purposefully according to the established goals in activities, and provide targeted guidance according to the functions and characteristics of different types of play center activities.

Third, teachers need to support children's learning in various ways, including observing, building game brackets, supporting peer interaction, helping them obey rules, keeping safety and recording their learning. Teachers can use a variety of tips, such as language tips (dialogue in game scenes), example tips (to show children how to interact with toys or other children), and action tips (to guide children to complete their behavior). In conclusion, teachers need to acquire more practical

skills to guide children's play to promote the development of children's play (Hu, et al., 2014). Therefore, game-related training should be provided to kindergarten teachers to improve the quality of play center activities.

6.3 Research limitations

In this section, the limitations of research samples, research contents and research methods are explained as follows:

6.3.1 Study sample

The research took place in Guangdong Province, where China's economy and society are developed. The research results can not be extended to other areas of China, especially those with a low level of social and economic development. Due to the limitation of workforce and time, only children in kindergarten middle class were selected in sampling, which could not be inferred to other age groups.

6.3.2 Research Contents

The acquisition of research data for children and classes takes a lot of time and workforce. The reason is that the observation of play center activities quality needs strict training, and each kindergarten should be scored for 4-6 hours after meeting the scoring requirements. For the measurement of children's language, math, executive function and social skills development, due to the age limitation of children, it is impossible to obtain information in the form of children's self-report, but through a one-to-one test. The results of the study are highly dependent on the applicability of

the scale. Furthermore, this study focuses on the impact of play center activities quality on child development, and how many factors at the kindergarten, family, and teacher levels influence child development have not yet been explored.

6.3.3 Research objects

The study is aimed at younger children. To ensure that no harm is caused to the development of young children, researchers must first obtain the informed consent of study from parents and kindergartens before formal research. One semester between the pretest and the post test, while the children have the phenomenon of changing kindergartens, so some data of pretest and post test are missing. Children's Social Skills Questionnaire is filled out by parents. If parents' education level is not high, single-parent or inter generational upbringing families may result in lower accuracy of the questionnaire because parents have no time or can't fill it out by themselves.

6.3.4 Research methods

Although the CECERS research tool used in this study has been proved to have good reliability and validity, from the existing research, the ECERS-R Chinese-based CECERS scale also shows its inherent characteristics. Studies have confirmed that the ECERS-R scale is a reliable tool for assessing the quality of preschool education, with more focus on structural quality rather than process quality (Sylva et al., 2006; Burchinal, et al., 2011). To further study the process of play center activities, other scales, such as The Classroom Assessment Scoring system (Pianta, et

al., 2008), can be used to obtain more evidence of the validity of the procedural quality of play center activities.

6.4 Suggestions for future research

This study is limited to human and time reasons and has limitations in research. For example, in the study sampling, the sample subjects only selected the K2 children in the three districts of Guangdong Province, and could not infer to other age groups. The research concerned the factors affecting children's language, math, executive function, social skills development at the child level and class activity level, and does not further explore the structural factors of family, teachers and classes. Based on the above limitations, it is hoped that future research can be considered in the following points in order to have different research results and gains.

6.4.1 Research object aspects

In this study, only 48 public and private kindergartens in the high, middle and low economic and social development areas of Guangdong Province were sampled. Future research can be expanded and changed in the research object:

(1) Expand the scope of the research: In the sampling, we can consider the balance of different regions and different types of kindergartens, and increase the proportion of public kindergartens, provincial and municipal parks, and rural kindergartens. On a play center scale, the expansion of the economically developed Guangdong Province to the less developed provinces of the central and western regions has made research more representative.

(2) Children of different ages selected in the study: This study is only for K2 children, and it is difficult to infer other age groups when considering the interpretation of research results. It is not known whether there will be differences in the quality of activities in different age groups, small class, middle class, and large class, and the influence on the development of young children. Therefore, future research can also compare children of different ages.

6.4.2 Variable selection aspects

In understanding the factors affecting the performance of children's language ability, this study only discusses the factors at the child level and class level that affect the development of young children. In terms of child-level variables, the variables selected include child gender, age, family SES, and pretest scores for child development. Variables at the class level are the three variables of space and material, opportunity and time, design and organization In the future related research topics, different variables can be adjusted and added for further exploration.

(1) Child level: In view of the findings of previous studies, the degree of education, occupation, and mother's participation in family education in family SES can predict the outcome of children's language, math, and executive function development (Bornstein, et al.,1998; Ebert, et al., 2013). Therefore, child-level variables can be adjusted to include the mother's educational level and the mother's participation in family education to explore the impact on child development. In the study of gender differences in child development outcomes, a combination of

qualitative research or qualitative and quantitative research can be combined to explore the relationship between child gender and child development.

(2) Class level: The structural factors of the class, including class size and student-teacher ratio have been considered as important indicators affecting the quality of preschool education (Ebert, et al., 2013; Huang, et al., 2018). By directly affecting the quality of preschool education, it directly or indirectly affects the outcome of child development. Therefore, the role of variables such as class size and student-student ratio in child development outcomes can be further discussed. In addition, the teacher's factors - teachers' teaching age, academic qualifications, professional background, and whether they have teacher qualifications are also important indicators affecting preschool education (Barnett, 2003; Early, et al., 2007; Burchinal, et al., 2008; Hu, et al., 2014; Hu, et al., 2015). How these teacher-related factors influence the outcome of child development and which are more critical factors deserve further analysis.

6.4.3 Research methods

This study uses CECERS as a measurement tool for play center activities. In order to further study the procedural quality of play center activities, other scales can be used, such as The Classroom Assessment Scoring system (CLASS, Pianta, et al., 2008), to obtain more evidence of the effectiveness of play center process procedural quality. In the measurement of child development outcomes, other research tools can be borrowed and compared to find a series of scales that are more

suitable for children in Chinese culture and better reflect children's development outcomes.

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APPENDICES

Appendices I: Chinese version of the Peabody Picture Vocabulary Test-Revised (PPVT)

The scoring table

Name of kindergarten：
Class:
Name of child:
Child gender:
Subject number :(fill in first)
Test time: year month day

1. Picture vocabulary test (6 of 8 questions in a row are wrong, end the test) Please record the child's choices in the response column (1/2/3/4). If the response is wrong, cross out the rear figures

No.	word	The standard answer	reaction	error
1	Bus...	(4)		£
2	Tire...	(3)		△
3	Bed...	(3)		⊙
4	Hand...	(1)		◇
5	Ship...	(2)		Ω
6	Snake...	(4)		£
7	Light.....	(4)		△
8	Drum...	(3)		⊙
9	Elbow...	(4)		◇
10	Accidents...	(2)		Ω
11	Knee...	(4)		£
12	Empty...	(3)		△
13	Bandage...	(4)		⊙
14	Tricycle...	(2)		◇
15	Tear...	(4)		Ω
16	Chest...	(1)		£
17	Cage...	(1)		△
18	Helicopter...	(2)		⊙

19	Fence...	(4)		◇
20	Measurement...	(2)		Ω
21	Square...	(4)		£
22	Envelope...	(2)		△
23	Tool...	(4)		⊙
24	Feather...	(1)		◇
25	Diving...	(2)		Ω
26	Hook...	(3)		£
27	Fur...	(4)		△
28	Yawn...	(1)		⊙
29	Bird's nest...	(1)		◇
30	Vegetables...	(4)		Ω
31	Claws...	(4)		£
32	Forest...	(3)		△
33	Tap...	(2)		⊙
34	Capsule...	(2)		◇
35	Stick...	(4)		Ω
36	Shoulder...	(3)		£
37	Tambourine...	(1)		△
38	Stir...	(2)		⊙
39	Drop of water...	(2)		◇
40	Bark...	(2)		Ω
41	Sailing...	(1)		£
42	A group of...	(3)		△
43	Stem...	(3)		⊙
44	Tie.....	(2)		◇
45	Brakes...	(1)		Ω
46	Pat...	(1)		£
47	Framework...	(1)		△
48	Coil...	(1)		⊙
49	Disappointed...	(4)		◇
50	Clip...	(2)		Ω
51	Engineer...	(2)		£
52	Cooperation...	(4)		△
53	Steamer...	(2)		⊙
54	Destruction...	(4)		◇
55	Tubular...	(1)		Ω
56	Light.....	(1)		£

57	Frightened...	(4)		△
58	Communication...	(4)		⊙
59	Coast...	(3)		◇
60	Transparent...	(3)		Ω
61	Cane...	(4)		£
62	Island...	(1)		△
63	Isolated...	(1)		⊙
64	Burning...	(1)		◇
65	Quiet.....	(3)		Ω
66	Fragile...	(3)		£
67	Rose...	(1)		△
68	Weasel...	(2)		⊙
69	Surprised...	(3)		◇
70	Ivory...	(1)		Ω
71	Arch...	(4)		£
72	Corn leaf...	(1)		△
73	Friction...	(1)		⊙
74	Carpenter...	(2)		◇
75	Crawler...	(2)		Ω
76	Twigs...	(2)		£
77	Parallelogram...	(1)		△
78	Fatigue...	(3)		⊙
79	Spherical...	(2)		◇
80	Waterfall...	(4)		Ω
81	Kiss...	(3)		£
82	Syringe...	(2)		△
83	White-hot...	(4)		⊙
84	Ghost...	(4)		◇
85	Archery...	(2)		Ω
86	Fence...	(4)		£
87	Walk...	(2)		△
88	Meditation...	(2)		⊙
89	Anger...	(3)		◇
90	Chain...	(4)		Ω
91	Citrus...	(3)		£
92	Cornea...	(2)		△
93	Anatomy...	(3)		⊙
94	Vertical...	(3)		◇

95	Inflation...	(3)		Ω
96	Outside the house...	(1)		£
97	Business...	(1)		△
98	Carrion...	(3)		⊙
99	Deng...	(3)		◇
100	Arrogant...	(3)		Ω

Total score of picture vocabulary test:

Appendices II: Behavior Rating Inventory of Executive Function-Preschool Version

(BRIEF-P)

Head - foot - knee - shoulder

The first, second and third parts

Table A - extended edition： Task guide: after establishing a positive and friendly relationship with a child, say or read out the instructions in bold. Underlined words need special emphasis. During the task, the subject is seated or standing, and the child should stand three feet away from the subject. If the child scores 4 or more on the first part, the second part of the test is administered. If the child scored 4 or more on the second part, the third part of the test was administered.

Part one: introduction

Let's play a game now. The game has two parts. First, follow me. Touch your head

Touch your head; Wait for children to touch their heads.

That's great! Now touch your feet.

Touch your feet; Wait for children to touch their feet.

Repeat the instructions and act until the child can correctly imitate your actions.

Part one: practice

Now we're going to have some fun. You're going to tell me the opposite. When I say touch your head, touch your feet, not your head. When I say touch your feet, go touch your head. Remember, what I said, you do the opposite.

If the child responds correctly: give positive feedback every time the child does an exercise correctly.

** if the child reacts incorrectly on any of the items in the exercise section, provide up to 3 additional explanations before the formal test begins:

Continue with the first formal test. No more explaining anything about testing. Do not provide any feedback during the test.

Part one: testing

Let's keep playing the game. You do the opposite of what I said.			
	error	**Self correcting**	**correct**
1.Touch your head	0 (reactions other than feet)	1	2 (foot)
2.Touch your feet	0 (reactions other than feet)	1	2(head)
3.Touch your feet	0 (reactions other than feet)	1	2(head)
4.Touch your head	0 (reactions other than feet)	1	2 (foot)
5.Touch your feet	0 (reactions other than feet)	1	2(head)
6.Touch your head	0 (reactions other than feet)	1	2 (foot)
7.Touch your head	0 (reactions other than feet)	1	2 (foot)
8.Touch your feet	0 (reactions other than feet)	1	2(head)
9. Touch your head	0 (reactions other than feet)	1	2 (foot)
10.Touch your feet	0 (reactions other than feet)	1	2(head)

Total score：

If the child scores 4 or more, proceed to the second part

If the child scores below 4 points:Thank you for playing games with me today!

Part 2: introduction

Ok, we've finished the first part of the game, so let's add the second part. Now you have to touch your shoulders and knees. First, touch your shoulder.

Touch your shoulder; Wait for children to touch their shoulders.

Now touch your knee.

Touch your knees; Wait for children to touch their knees.
Repeat the instructions and act until the child can correctly imitate your actions.

Part 2: practice

Ok, now let's have some fun. You do the exact opposite of what I said in the previous game. But this time, touch your knees and shoulders. When I say touch your knee, you touch your shoulder, when I say touch your shoulder, you touch your knee.

If the child responds correctly: give positive feedback every time the child does an exercise correctly.
** if the child reacts incorrectly on any of the items in the exercise section, provide up to 2 additional explanations before the formal test begins.

Now that you know all the quests, let's play them together. You keep saying the opposite, but you don't know what I'm going to say.

I will say four words:
If I say touch your head, touch your feet.
If I say touch your feet, touch your head.
If I say touch your knee, you should touch your shoulder.
If I say touch your knee, you should touch your shoulder.
Are you ready? Let's get started.

Proceed to the second part of the formal test. No more explaining anything about testing. Do not provide any feedback during the test.

Part two: testing

	error	Self correcting	correct
1.Touch your head	0 (reactions other than feet)	1	2 (foot)
2.Touch your feet	0 (reactions other than head)	1	2(head)
3.Touch your knees	0 (except shoulder reaction)	1	2 (shoulder)
4. Touch your feet	0 (reactions other than head)	1	2(head)
5.Touch your shoulder	0 (other than knee reactions	1	2 (knees)
6.Touch your head	0 (reactions other than feet)	1	2 (foot)
7. Touch your knees	0 (except shoulder reaction)	1	2 (shoulder)
8.Touch your knees	0 (except shoulder reaction)	1	2 (shoulder)
9.Touch your shoulder	0 (other than knee)	1	2 (knees)
10.Touch your feet	0 (reactions other than head)	1	2(head)

Total score： →

If the child scores 4 or more, proceed to part 3

If the child scores below 4 points:Thank you for playing games with me today!

Part three: introduction

In the last few missions, you performed very well! Now let's change the rules of the game.

When I say touch your head, you should touch your knees.
When I say touch your knees, you touch your head.
When I say touch your shoulder, touch your foot.
When I say touch your foot, touch your shoulder.

Ok? Let's give it a try.

If the child responds correctly: give positive feedback every time the child does an exercise correctly.

** if the child reacts incorrectly on any of the items in the exercise section, provide up to 2 additional explanations before the formal test begins.

Part three: practice

	error	Self correcting	correct
E1. If I say: touch your head, what should you do?	0 (other than knee)	1	2 (knees)
E2. If I said: touch your shoulder, what should you do?	0 (other than feet)	1	2 (foot)
F1. Touch your head	0 (other than knee)	1	2 (knees)

F2. Touch your shoulder	0 (other than feet)	1	2 (foot)
F3. Touch your feet	0 (except shoulder reaction)	1	2 (shoulder)
F4.Touch your knees	0 (other than head reactions)	1	2(head)

If the child responds verbally, say, "can you show me?"

Continue with the third part of the formal test. No more explaining anything about testing. Do not provide any feedback during the test.

You're doing great! Let's play it a few more times.

Part three: testing

	error	**Self correcting**	**correct**
1.Touch your shoulder	0 (other than feet)	1	2 (foot)
2. Touch your head	0 (other than knee)	1	2 (knees)
3.Touch your knees	0 (other than head reactions)	1	2(head)
4.Touch your feet	0 (except shoulder reaction)	1	2 (shoulder)
5.Touch your feet	0 (except shoulder reaction)	1	2 (shoulder)
6.Touch your knees	0 (other than head reactions)	1	2(head)
7.Touch your shoulder	0 (other than feet)	1	2 (foot)
8. Touch your head	0 (other than knee)	1	2 (knees)
9. Touch your head	0 (other than knee)	1	2 (knees)
10.Touch your shoulder	0 (other than feet)	1	2 (foot)

Total score：

Calculate the total score: add up the "total points" for each section. The total score is 60 points.

Total score:_____

Thank you for playing games with me today!

Appendices III: Social Skills Improvement System Rating Scales (SSIS-RS)

Did your child show any of the following behaviors in the past two months? Please choose the most accurate of the four choices in "never," "occasional," "often,"or "almost always" "now" and complete the form.

In addition, do you think this behavior is important for the child's development? Please choose the most accurate option in "not important", "important", "very important" and complete the form.

Note: each question needs to answer two aspects, first answer the situation of the behavior, then is the importance of the behavior.

E. g. Be able to get along well with other children. If this behavior occurs frequently and you think it is important to your child's development.

The title	Never	occasional	Often	Almost always	not important	important	very important
Be able to get along well with other children			√		1	2√	3

Questionnaire start:

The title	Never	occasional	Often	Almost always	not important	important	very important
1. Express feelings when feel wronged					1	2	3
2.Follow family rules					1	2	3
3. understand how you feel					1	2	3
4.Know how to say "thank you"					1	2	3
5.Ask adults for help					1	2	3
6.Be careful with other people's belongings					1	2	3
7. Listen to your instructions carefully					1	2	3
8.Try to make others feel better					1	2	3
9. Join a game or activity started by someone else					1	2	3
10. Be able to take turns					1	2	3

speaking							
11. Don't be afraid to ask questions					1	2	3
12.Spend time with your family					1	2	3
13. Forgive					1	2	3
14. Can speak in appropriate tones					1	2	3
15.Don't be afraid to speak up for others					1	2	3
16.Perform well without adult supervision					1	2	3
17. Follow your instructions					1	2	3
18.You understand how others feel					1	2	3
19. Engage with peers					1	2	3
20.Can communicate with others with appropriate body language					1	2	3
21. When you have disagreements, resolve them peacefully					1	2	3
22.Respect other people's property					1	2	3
23.Make friends easily					1	2	3
24.Can say "please" in polite					1	2	3
25.Would challenge unfair rules					1	2	3
26.Takes responsibility for your actions					1	2	3
27.Can work independently					1	2	3
28.Comfort others					1	2	3
29. Interact well with other children					1	2	3
30. Be able to give proper response when someone is having a conversation or activity with him/her					1	2	3
31. Able to calmly handle teasing					1	2	3
32.Keep your word					1	2	3
33.Be able to accept criticism without feeling uncomfortable					1	2	3
35. Praise and affirm yourself without boasting					1	2	3
34.Be able to accept criticism without feeling uncomfortable					1	2	3
35.Praise and affirm yourself without boasting					1	2	3

36.Compromise in the face of conflict					1	2	3
37. Follow the rules when playing games with others					1	2	3
38. Care about others					1	2	3
39. Offer to invite people to events					1	2	3
40. Make eye contact when talking					1	2	3
41. Tolerate a partner when he or she is annoyed					1	2	3
42. Take responsibility for your mistakes					1	2	3
43. Reach out to adults					1	2	3
44. Respond appropriately when pushed					1	2	3
45. Dare to stand up for yourself when are being treated unfairly					1	2	3
46. Learn to handle disagreements calmly					1	2	3