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What Evidence of Change Emerges When Students with Behavioral and Learning Challenges are Placed in an Early Childhood Montessori Environment in Rural China?

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Abstract

Under current circumstances, educational issues such as the achievement gap, non-cognitive development, Executive Function, and students with challenging behaviors, impact day-to-day classroom practices and reshape the results of education in a fundamental way. The purpose of this research was to utilize the Montessori environment and principles, as well as the "normalization" approach developed by Dr. Maria Montessori, to help students with behavioral and learning challenges find the balance of their mental developmental processes and maximize their academic achievement at the same time. This action research conducted focused-group case studies of the Montessori Normalization process for children possessing behavioral and learning challenges at a preschool in rural China. The research applied pre-and post-assessment for the 3-6-year-old participants to investigate the evidence of improvement. The assessment utilized indicators based on symptom guidelines for ADHD, ASD, Learning Disorders, and Learning Difficulties, published by the US Centers for Disease Control and Prevention (CDC). The study's findings indicate that the Montessori-guided early childhood education intervention had helped students with behavioral and learning challenges, thereby providing an alternative solution for addressing the challenge of the development gap. This research also suggested that Montessori-based classrooms provide a positive nurturing environment for gifted children with learning difficulties (exceptional learners) who confront challenges in a mainstream classroom.

Keywords: Development Gap, Non-cognitive Skills, ADHD, Executive Function, self-discipline, self-learner, Twice Exceptional Learner, Montessori, Opportunity Gap.

Introduction

The development of non-cognitive, soft skills, that facilitate sociability and adaptability to the change of life, is more critical than the development of cognitive skills, demonstrated as knowledge grasping, in the first few years of human life (Bütikofer & Peri, 2017; Tough, 2012; García, 2014). Gaining effective non-cognitive competencies requires the integration of cognitive skills and executive function (EF) skills. Given that executive function plays a central role in supporting children's learning, performance, and behavior, EF deficits lead to challenges in daily educational practices.

The *Normalization was first theorized by Maria Montessori* (Grebennikov, 2005; Frierson, 2021) and further developed by Standing. Standing provided strong evidence for effective teaching and parenting (Grebennikov, 2005). The Montessori Method and Normalization theory support a nurturing transformative process that not only provides the children with an environment that inspires and supports concentrated work but also releases children's capacity for autonomy and self-governance (Frierson, 2016; Lloyd, 2008). These processes are essential for the character-building of students with challenging behaviors both in the classroom and at home (Copple & Bredekamp, 2009).

This action research conducted focused-group case studies of the Montessori *normalization* process of children with established behavioral and learning challenges before attending our Montessori-based program. The purpose of this study is to answer two questions:

1. What evidence of change emerges when students with behavioral and learning challenges are placed in an early childhood Montessori learning environment in rural China?

2. What elements of the intervention do teachers identify as facilitating the emerging autonomy and self-regulation of the child?

The purpose of the research is to utilize the Montessori environment and principles, as well as the *normalization* theory developed by Dr. Maria Montessori, to help students with behavioral and learning challenges find the balance in their mental development process and maximize their academic achievement at the same time.

Literature Review

Achievement Gap

The achievement gap refers to the achievement difference in the demonstration of fundamental skills as measured by standardized testing between children who live in poverty and ones from affluent families (Williams, 2004; Dillard, 2019; Hill, 2017). The standard test scores indicate that by the time children attend kindergarten, there is a 60 percent academic achievement difference between the above two groups of children (National Association for the Education of Young Children/NAEYC, 2009). This gap becomes wider each year (Tavernise, 2012). Tough (2012) claimed that among mainstream academic interventions, there was no reliable method to help children navigate structural inequities and narrow their achievement gap. Exploring the solution for this challenge has been one of the primary tasks of this research.

Non-cognitive Skills

According to many research results, non-cognitive skills play critical roles not only in education but also in social life (García, 2014, Beckmann & Minnaert, 2018). In the interviews

Tough (2012) did in his case studies, the economists, educators, psychologists, and neuroscientists who conducted all kinds of education experiments, had repeatedly proved and argued in Tough's interviews, that the development of non-cognitive traits is more critical than cognitive knowledge in the early years of human life. Non-cognitive abilities, also called personality traits, soft skills, character skills, and social-emotional traits, are highly related to the developmental characteristics that can predict success in social and personal life (Heckman and Kauta, 2012). In the workplace, employers highly value non-cognitive skills, and there is clear evidence that people who have higher non-cognitive traits are more likely to be productive and get better-paid jobs (García, 2014).

Multiple researchers have argued that non-cognitive skills play a critical role in education (Heckman, & Kautz, 2012; García, 2014; Tucker-Drob et. al, 2016). These skills have a strong interdependent relationship with cognitive development and make an inseparable contribution to children's academic achievement and help to nurture a whole child effectively (García, 2014; Tough, 2012). Non-cognitive skills have been commonly defined as a pattern of thoughts, feelings, and behaviors. They are believed to be modified at school from a young age (Tough, 2012; García, 2014). The non-cognitive traits include critical thinking skills, problem-solving skills, persistence, creativity, emotional health, social skills, work ethics, community responsibility, self-control, self-regulation, academic confidence, teamwork, organizational skills, and communication skills (García, 2014). Starting at birth, children start to learn non-cognitive skills and this continues throughout schooling. The development of non-cognitive skills relies on support from parents and teachers. Thus the instruction and interaction teachers

and parents conduct with the children either facilitate or hinder children's development of non-cognitive skills (García, 2014).

Executive Functioning, ADHD, and mental disorders

According to the World Health Organization, mental health is as essential as physical health to everyone's overall well-being (https://www.who.int/health-topics/mental-health#tab=tab_1). Mentally healthy individuals can realize their potential, can cope with the everyday stresses of life, can work productively and fruitfully, and can contribute to their community. According to the standard of the Center for Disease Control and Prevention (CDC, 2020f), a mentally healthy childhood results in reaching developmental and emotional milestones and learning healthy coping and social skills. Mentally healthy children have a positive quality of life and can function well at home, in school, and in their communities.

Executive functions (EF) are the higher-order cognitive processes that are responsible for self-regulation, decision-making, and goal-directed non-cognitive behaviors, and represent a broad range of abilities, such as behavioral inhibition, shifting, emotional control, problems in initiation, working memory, managing current and future-oriented task demands, materials organization, and self-monitoring (Barkley, Edwards, Laneri, Fitcher & Metevia, 2001; Barkley & Fischer, 2011). During early childhood, EF tasks involve dynamic regions of the brain. As age increases, different areas become more specialized, especially in the case of responsive inhibition (Weyandt, 2005).

Weyandt (2005) summarized that EF deficits are found in subjects with ADHD in all age spans, from preschoolers to adults. EF deficits do not present a significant difference between

genders, and there is no apparent interdependence between EF abilities and intelligence. However, there is strong evidence of the correlation between EF deficits and other disorders. Some children who have ADHD will present EF deficits during their early childhood, but not all children with ADHD exhibit EF deficit symptoms. Children who have both ADHD and a learning disability most of the time show weakened EF abilities (Weyandt, 2005). Weyandt (2005) suggested that EF deficits are measurable when children are as young as preschool age.

ADHD children are often mainstreamed in the school system. Therefore, we can expect at least one child in every classroom to exhibit behavioral challenges (Goldrich & Wolf, 2019). ADHD is considered a neurodevelopmental disorder of the brain's self-management system (Goldrich & Wolf, 2019). Barkley (2017) argued that ADHD represents the extreme model distributing several highly correlated abnormal traits, including distractibility, insufficient sustained attention, and inadequate self-regulation. ADHD is diagnosed when the symptoms reach the point that they show significant evidence impairing the daily social functioning of the individual. The diagnostic criteria indicate that the child has to present several noticeable symptoms in more than two settings by twelve, and sometimes as early as four. The symptoms must have been consistently exhibited for at least six months (Goldrich & Wolf, 2019).

Mental and behavioral disorders have become one of the most critical developmental obstacles that impair children's cognitive and academic achievement (Williams, 2003; Rigoni, Blevins, Rettew, & Kasehagen, 2020). Educators and parents constantly confront challenges both inside the classrooms and at home with children's misbehavior (Grebennikov, 2005). A close analysis of recent research reveals data suggesting concerns about the quality and future of American education. According to 2016 data from the CDC (2022c), 13% of students 8-15 have

a diagnosable mental disorder. One in ten youths has a mental problem severe enough to impair their function at home and in the community. In every classroom, there is usually at least one student that teachers and administrators struggle to support. Challenging behaviors are easy to see but not easy to remediate.

The CDC (2022e) described mental disorders among children as severe challenges to children's learning, behavior, and emotional regulation. As the CDC (2022a) suggested, some children demonstrate severe and persistent symptoms and interfere with school, home, or social activities. When this happens, the child may be diagnosed with a mental disorder. Mental disorders not only reduce children's quality of life but also impact the lives of caregivers.

Interacting with children with challenging behaviors has become one of the most daunting tasks that teachers have to face daily. The CDC (2022c) lists Attention-deficit/hyperactivity disorder (ADHD), anxiety (fears or worries), and behavior disorders as the most commonly diagnosed mental disorders in children. According to most current surveys, cognitive, behavioral, and developmental disorders begin in early childhood, with 1 in 6 U.S. children aged 2–8 years (17.4%) manifesting mental, behavioral, or developmental disorders. 9.4% of children aged 2-17 years (approximately 6.1 million) have received an ADHD diagnosis in the US; 7.4% of children aged 3-17 years (approximately 4.5 million) have a diagnosed behavior problem; 7.1% of children aged 3-17 years (approximately 4.4 million) have diagnosed anxiety; and 3.2% of children aged 3-17 years (approximately 1.9 million) have diagnosed depression (CDC, 2022f). Learning and developmental disabilities, substance use, and self-harm are other childhood disorders and concerns that affect how children learn, behave, and handle their emotions at school and in other social surroundings.

The possibility of a non-medication supportive structure conducted in the preschool period to help reduce or prevent the severe symptoms shown in the later time has been discussed by researchers. For large numbers of ADHD children, as many as 6 out of 10 (62%), medication has become the standard treatment (CDC, 2020a). According to the CDC (2022c), one out of 20 US children, or approximately 3 million, are taking medicine for their ADHD each year. According to CDC (2022c), only a tiny portion of children aged 2-5, or about 388,000, were diagnosed with ADHD in the US. Goldrich et al. (2019) argued that the curriculum system in the traditional education model has failed to build a supportive structure for children with ADHD by eliminating play in preschool. The term *play*, the authors refer to the freedom to conduct activities that strengthen children's self-regulatory functions. Playing provides children opportunities to work on managing impulsive behaviors so that they can become self-disciplined. Playing occurs in an environment where children can communicate freely to practice social skills, internal dialog, and external conversation skills and sharpen their abilities to learn rules and interact in a meaningful and harmonious way daily (Goldrich & Wolf, 2019). Children with challenging behaviors need to strengthen their executive functions by practicing them in meaningful work, repeatedly.

The misconception about ADHD

One misconception about ADHD is that children cannot pay attention. However, it is reasonable that children do not have deficits in attention but rather a lack of ability to regulate their attention. In other words, children with ADHD cannot pay attention to tasks that do not

hold their interest or stimulate their motivation (Goldrich & Wolf, 2019). On the other hand, Goldrich & Wolf (2019) described that when ADHD children are very interested in one thing, they may become hyper-focused, which refers to a situation in which a person is deeply and intensely focused on one thing to the extent of shutting out outside stimuli. In such cases, the focus is so intense that the person can become lost in those activities for hours or even days.

Goldrich & Wolf (2019) spoke about misconceptions concerning ADHD. One such misconception is that there is a significant gender gap between girls and boys exhibiting ADHD. It turns out this misconception is due to the fact that girls present the symptoms differently from boys. That is to say, girls are more likely to internalize or mask their ADHD. Most of the time, girls display symptoms of inattention instead of hyperactivity-impulsivity. Thus, girls who have ADHD are often overlooked.

When confronted with ADHD children, teachers tend to conduct interactions based on their assumptions of the children's behavioral intentions (Goldrich & Wolf, 2019). The behaviors of ADHD children who have average or above-average IQ can be easily misunderstood as trying to play power games with adults. Yet, it is most likely that the children are struggling with plausible executive function（Goldrich & Wolf, 2019; Beckmann & Minnaert, 2018). Understanding the true intentions of children with ADHD symptoms helps educators and parents to support the children in overcoming their challenges more effectively.

Twice Exceptional Learners

Gifted students who also have learning disabilities (twice-exceptional) are often overlooked when students are evaluated either for giftedness or specific learning disabilities

(Beckmann & Minnaert, 2018). The concept of the existing high potential students who simultaneously struggle with academic tasks has been gradually drawing more awareness in the education field (Nicpon, Assouline, & Colangelo, 2013). How to define and identify G/LD students still lacks empirical evidence (Newman & Sternberg, 2004; as cited in Beckmann & Minnaert, 2018). As Beckmann et al. (2018) describe, these G/LD students are considered "twice-exceptional" because they statistically fall into the exceptional range for their cognitive, academic, or creative abilities and potential. Still, at the same time, they can fall in the lower end of the learning deficit area. Experience with children who presented challenging behaviors before the conduct of this action research showed that when subsequently provided with a Montessori supportive structure, these children all demonstrated different aspects of high potential for executive functioning and learning abilities. The results of these observations have been the inspiration for conducting this action research.

Conceptual framework and Optimal Experience theory

The failure of the traditional school system is due to two outdated models: running the schools like factories and treating children as empty vessels (Montessori, 2010; Lillard, 2017). In contrast, Montessori's normalization theory is supported by empirical evidence (Lillard, 2017). Her theory endorsed the release of children's capacity for autonomy and self-regulation by providing a prepared environment that nurtures independent learning and autonomous development (Frienson, 2016).

Rathunde (2001) called Montessori a visionary in both developmental psychology and

education because Montessori pioneered “child-centered” educational practices, promoted children’s rights to autonomy, recognized the psychological developmental stages of children, and believed in the key function of sensory and motor activities as a foundational base for children’s cognitive development. Rathunde (2001) recognized Montessori teaching principles of providing children with the right amount of necessary support to precisely match their full-potential-development needs as entirely consistent with contemporary Vygotskian perspectives on scaffolding and guided participation (Rogoff, 1990). Further Montessori principles include multi-age classrooms and peer tutoring systems (Carnegie Council on Adolescent Development), a reduced emphasis on academic testing (Sternberg, 1997; Rathunde, 2001), stimulating a wider range of student interests (Gardner, 2006; Rathunde, 2001), focusing on motivation and preparation for lifelong learning (Eccles, Wigfield, Midgley, Reuman, Iver & Feldlaufer, 1993; Rathunde, 2001), and many others that have become essential factors of current educational debates (Rathunde, 2001).

Children’s difficulties in experiencing autonomy are due to the lack of an external environment that supports them in practicing their internally inherited capacities for autonomy on a daily basis (Lillard, 2017). Research suggests that the degree of successful self-regulation depends upon the ability of the child to focus and sustain attention which in turn supports emotional self-regulation (Lloyd, 2008). Studies have shown that the ages between 2 and 7 are the critical development period of the executive attention network. To support this development, scholars have suggested the need to develop a curriculum to promote focused and sustained attention in preschool programs. (Frienson, 2016).

In the most recent edition of *The Handbook of Child Psychology* (Damon & Lerner, 2006), the importance of person-environment interaction for healthy human development has been emphasized in several theoretical chapters. One hundred years ago, Maria Montessori observed that when the environment was designed to promote concentration, children go through a transformative process, which she referred to as normalization (Lloyd, 2008). This involves the release of children's capacities for autonomy and self-governance (Frienson, 2016). Thus, Montessori's theory of normalization can be considered an applied theory of self-regulation (Lloyd, 2008).

Csikszentmihalyi's optimal experience theory and Ryan and Deci's self-determination theory provide the requisite guidance for developing a curriculum capable of nurturing multiple aspects of self-regulation and share a conceptual framework with Montessori's theory of normalization (Rathunde, 2001). Optimal experience theory places subjective experience, or more specifically, the flow experience, as an "optimal" experience at the center of developmental processes (Rathunde, 2001). The term *flow* is moments when a person is fully concentrated on a task at hand, relatively oblivious to the passage of time, and feeling clear about what needs to be done from one moment to the next (Csikszentmihalyi and Csikszentmihalyi, 1988; Csikszentmihalyi and LeFevre, 1989; Csikszentmihalyi, 1990). In *flow*, people's awareness is intertwined with their actions, and they do not feel self-conscious. They are motivated to do the activity just for the sake of doing it, and not because they will be compensated (Rathunde, 2001). At the same time, researchers observed that to obtain the status of *flow,* there are at least three prerequisites that have to be fulfilled. Firstly, the individual who conducts the activity has to have a clear goal for the task; secondly, the person can receive immediate and unambiguous

feedback from the activity; thirdly, the challenge level of the activity has to match the individual's skills (Mao, Pagliaro, Csikszentmihalyi & Bonaiuto, 2016).

Based on this researcher's past experience working with children in a Montessori-based environment, the phenomenon of *flow,* when accompanied by self-driven working motivation, aligns with the high-level capacities for autonomy and self-discipline that children demonstrated after completing the *normalization* process. Vice-versa, awarding and supporting children's internally inherited capacity for autonomy has been recognized as one of the key approaches to facilitating children pursuing meaningful tasks and accelerating their transformative process of *Normalization.*

Theoretical Framework

This research utilizes Dr. Montessori's theories of the Four Planes of Development and Normalization as the framework (Montessori, 1949/2010, 1948/2006, 1918/2007). Through her scientific experiments and observations, Dr. Montessori theorized that all children are born as *spiritual embryos* with inherent psychic capacities for self-construction and cultural adaptation (Montessori, 1996/2014). Children are equipped with an *absorbent mind* which drives their self-motivated experience-oriented passion for learning. The subconscious ability of the *absorbent mind* provides children with a high-quality capacity to memorize, coordinate, and utilize knowledge gained from their experience. Another distinguishing psychological trait all children inherit is *sensitive periods.* These periods correspond to special sensitivities to the acquisition of a determined developmental characteristic for accomplishing children's full potential (Montessori, 1949/2010; 1996/2014; Chattin-McNichols, 1998). From a newborn to an adult,

every human being goes through four different planes, or stages, of development (Chattin-McNichols, 1998). The first plane of development is from 0 to 6 years old, the second plane is from 6 to 12, the third plane is from 12 to18, and the fourth plane is from 18 to 24 (Montessori, 1949/2010; Chattin-McNichols, 1998). In each plane, the individual experiences a differentiated psychological development process that carries different mental and physical characteristics that are significantly different from the other, yet each plane lays the critical foundation for the following stages (Chattin-McNichols, 1998; Montessori, 1949/2010). Dr. Montessori summarized the unique characteristics of each plane. Her discovery has helped the public understand the natural laws of human development in a fundamental way (Lillard, 2017).

This study will focus on just the first plane of development. Dr. Montessori described the children in this first plane period as "psychic embryos," i.e., human children who share the same set of pre-coded psychological developmental tendencies and sensitivities (Montessori, 1949/2010). At the same time, children's internal development is significantly impacted by the external environment. In other words, children's subconscious feelings and their externalizing behaviors are directly connected. The external elements that affect children's feelings include other persons, the environment, and activities in the living surroundings, and these in turn can lead to negative behaviors. Simply put, children act out as a way to signal that they are struggling, yet, the adults often interpret children's challenging behaviors as trying to make trouble.

However, by the age of 3 significant numbers of children already show symptoms of behavioral disorders because adults lack knowledge of the children's natural needs and repress their behaviors. As Dr. Montessori (1955/2010) observed, all of these deviations are caused by

adults' unconscious mistreatment of children's internal needs. Dr. Montessori's analysis shows that more often than not, it is the adults who become the most critical obstacles in the children's developmental journey (Montessori, 1955/2010; 1970/1991, 1996/2014). Dr. Montessori's theories provide sufficient tools for a more effective analysis of some of the widely distributed non-cognitive problems that occur in early childhood, such as ADHD, ODD, and learning disorders. Besides discovering the cause of the behavioral *deviations* and defensive reactions which children demonstrated when their development of *hormic energy*, or life force energy, confronted roadblocks (Zener, 2006), Dr. Montessori (1918/2007) discovered the solution to the deviation problems and developed a transformative process called *normalization*. This is a term from anthropology referring to the process of becoming a contributing member of society, a process that nurtures the inherent, internal qualities belonging to all children (Zener, 2006).

The idea behind *normalization* is that when behaviorally deviant children find meaningful work that fulfills their spiritual development needs and leads them into a profoundly concentrated state, gradually, the symptoms of their disorders will naturally dissolve (Montessori, 1918/2007). The children will transform into *normalized* new beings who demonstrate a high standard of spirit and intellect (Montessori, 1918/2007, 1948/2006). This researcher has observed normalization both in children who have severe behavioral problems and in children who have minor symptoms. We gained positive evidence of the theory's effectiveness. This action research is systematically designed to fulfill the goal to establish a validating and reliable assessment system to instruct and monitor the teachers' practice of the theory in facilitating the transformative process of *Normalization* more effectively in the future.

Methodology

The assessment and measures of this action research address the limitations of existing multimodal treatments by focusing on building family-school partnerships, using components of conjoint behavioral consultation, and promoting family involvement in education through systematic “parent-child homework” interventions. In addition, similar to other multi-component interventions, the Family-school-partnership intervention incorporates a daily report log. Unlike most previous investigations, which evaluate the results with a comparison group controlling for nonspecific treatment effects, this research will compare each child's own ongoing behavioral transformation process, such as the quality and quantity of concentration or *flow*, the level of self-regulation, the changes in social interactions with peers and adults, and the reduction of misbehavior.

Conjoint Behavioral Consultation (CBC)

Strengthening parent-teacher relationships is critical to creating a context to resolve students' school problems (Sheridan & Wheeler, 2017). CBC is a structured problem-solving process in which parents and teachers work collaboratively through the stages of behavioral consultation. This model has been applied successfully to children who have a wide range of behavioral and educational problems, including youngsters with ADHD (Sheridan, Eagle, Cowan, & Mickelson, 2001).

Self-motivated Work Interventions

A particularly promising approach is supporting children's capacity for autonomy with

contingency contracting, which involves: (a) respecting children's desire for autonomy, guiding them to engage in self-motivated work following their own internal developmental needs, (b) evaluating performance in relation to each child's own capacity and stage of achievement, and (c) administering reinforcers contingent upon the realistic status of the child's stage of development. By giving children full opportunity to practice their own capacity for autonomy, such as assigning their own homework and gaining guided freedom to choose their own work, scheduling their own work time both at school and at home, hypothetically, the children will automatically transform into self-motivated learners and demonstrate high-quality self-regulation in completing their homework.

Daily Report Card (DRC)

The DRC is a behavioral intervention that involves teacher observation and report logs of school performance. The DRC requires teachers to evaluate students on one or more target behaviors at least once per day. At the end of the day, the teacher makes a note in an online school-family bulletin board for parental review. Parents are trained to set reasonable expectations for their child's performance and to reinforce proper parenting behavior when interacting with the child to support the child for goal attainment. Considerable evidence supports the effectiveness of the DRC (Vannest, Davis, Davis, Mason, & Burke, 2019).

A family interview and a school baseline assessment (Appendix A) will be completed before the research commences. The family interview will collect basic information about the child’s family background and early experiences. It will also collect information on parenting styles, the parent-child relationship, the symptoms of the child’s challenging behaviors, and

characteristics of the child's learning status. The information collected from the family interview will help to analyze the causes of the child's behavioral disorders. The classroom baseline assessment uses an observational procedure to allow the child to interact freely with Montessori work materials, peers, and adults in a Montessori environment under the guidance of an experienced teacher. This process aims to analyze the child's non-cognitive developmental level, strengths, and interests.

Based on the interview and assessment, a customized guide will be structured for teachers and parents to support the child's normalization process both at school and at home. The active participants in the project, the teachers, will record the children's behaviors in daily social and learning activities in the form of an observation log with pictures and videos as evidence. There will be regular online communication among the project instructor, the teachers, and the parents to record the child's overall changes in various social settings. At the end of each term of the study, family members complete another interview for evidence of the children's improvement and to discuss further questions.

Data analysis

This study was designed to explore the correlation between the implementation of the action research interventions and the evidence of change related to some of the educational issues that affect the day-to-day classroom practice in a long-lasting, significant way. Some of these main issues include 1) the achievement gap in the form of an opportunity gap; 2) non-cognitive skills as the key characteristics of building personalities; 3) executive function as a fundamental factor in effective learning; and 4) deviated behaviors of children as creating

significant challenges to classroom management. This research aims to utilize the Montessori environment and principles and the "normalization" approach developed by Dr. Maria Montessori to support students with behavioral and learning challenges to simultaneously find the balance in their mental development process, and maximize their academic achievement. This research sought to answer two questions: "What evidence of change emerges when students with behavioral and learning challenges are placed in an early childhood Montessori learning environment in rural China? And what elements of the intervention do teachers and parents identify as facilitating the emerging change in the child?

The introduction of the research subject

Figure 1 *Research Subject Summary*

	1st Semester		**2nd Semester**		**3rd Semester**		**4th Semester**		**Total**
No.	**1-2**		**3-16**		**17**		**18-29**		
Gender	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	
2.5-3y				1					**1**
3-4y				1					**1**
4-5y			2	2		1	2	1	**8**
5-6y				1			2	4	**7**
6y above		2	7					3	**12**
Total		**2**	**9**	**5**		**1**	**4**	**8**	**29**

1. Research subjects

This action research applied the Montessori normalization approach to a multi-age Montessori preschool environment, which hosted 34 children from two and half years old to six

and half years old. Twenty-nine of these children's caregivers permitted their children to participate in this research. Twelve children had been in the environment for more than three semesters; one child had been in the classroom for more than two semesters; fourteen of the total for more than one semester; two children were new to the program. Figure 1 also lists the age and gender distribution of the children in the class. Among the 13 girls, four of them are between four to five years old, two of these four 4-5-year-old girls are in their second semester in the New Montessori (NM) environment, and the other two are in their fourth semester, which means they participated in the pilot NM program from the very beginning. All of the boys and girls who had been in the NM class from the beginning of the program were voluntarily signed into the class by their caregivers.

2. The introduction of data analysis

The baseline assessment forms for each child were filled out by a caregiver and by a teacher trained in social studies. However, the form filled out by the caregivers showed that most adults did not have proper knowledge of their child's development goals and seemed not to understand the assessment principles. This is most likely due to these adults' low level of education. Therefore, only the assessment materials done by the teacher were used as valid quantitative data. The same teacher also filled out the assessment to evaluate the behavior changes after the children had participated in the study. The caregivers were interviewed to share information about parenting styles, their child's background while growing up, and psychiatric diagnosis information for ADHD, ASD, or any other behavioral or learning problems, as well as issues that occurred between the caregivers and the child that were related to the child's

behaviors or learning problems. This information helped the researcher find the possible non-cognitive causes of the child's challenging behaviors or learning disorders. The caregiver interviews also provided valuable information for planning individualized lesson interventions. At the end of each semester, the parents were interviewed to discuss their observations of their child's changes at home. These interviews provided qualitative data for the case study.

I tried to find the answers to the first part of the thesis question, "What evidence of change emerges when students with behavioral and learning challenges are placed in an early childhood Montessori learning environment in rural China?" by tracing the mental and academic developmental changes students experienced during their time in the Montessori classroom. Then this researcher compared the level of these Montessori-impacted non-cognitive skills and executive functioning, with the behaviors before the students were transferred from the traditional mainstream environment. The individual assessment (Appendix A) of this research adapted the indicators listed on the CDC website for analyzing children's behaviors related to ADHD, learning disorders, ASD, writing abilities, reading abilities, listening and communication abilities, mathematics skills, and non-verbal communication abilities. These indicators cover psychiatric characteristics related to noncognitive skills, executive functions, and deviated behaviors.

The quantitative analysis of the change was done by comparing the students' behaviors at the beginning of the intervention with their performance after participating in the environment. Because the NM environment held a multi-age class, each school year new students attended the program to fill up the seats left by the children who had graduated. This researcher investigated the evidence of the changes by first analyzing the development categories of non-cognitive

skills; then, the correlation between the changes and the length of time the children had been in the NM classroom. This researcher answered the second part of the thesis, “What elements of the intervention do teachers and parents identify as facilitating the emerging autonomy and self-regulation of the child?” via case study analysis. The analysis studied evidence of children’s improvement in non-cognitive skills, executive function, and deviant behaviors from teachers’ journals supported with photographs or videos. In addition, this researcher used case study reports and individual behavior assessments (Appendix A) done by the teacher.

3. The quantitative analysis of evidence for change

a. An overall analysis of changes

Figure 2-1 *Assessment Questionnaire Summary*

Category	Question Quantity	Average Number of Problems		Average Ratio of Overall Change
ADHD	18	Before	13	-88%
		After	1.6	
ASD	14	Before	6	-55.20%
		After	2	
Learning Disorder	8	Before	5	-79.00%
		After	1	
Communication Ability	3	Before	2	-79.30%
		After	0.3	
Reading Ability	5	Before	3	-63.50%
		After	1	
Writing Skills	9	Before	7	-43.10%
		After	4	

Mathematical ability	6	Before	3	
		After	1	-62.80%
Non-verbal Skills	6	Before	3	
		After	2	-30.70%
Total/Mean	**69**			**-62.00%**

The assessment includes eight categories of disorder symptoms: ADHD, ASD, Learning Disorder, Communication Abilities, Reading Ability, Writing Skills, Mathematical Ability, and Non-verbal Skills. The assessment questions come directly from the guidelines of the same category on the US CDC (2022b) website. The "Question Quantity" column in Figure *2-1* displays the total question distribution of each category. The assessment questions are answered by checking one of the "Yes, No, Other" tabs. Across all 69 questions, the answer "yes" indicates two different assessment results when checked in eight different categories. When questions in the ADHD section (see example in *Table1-2)* are marked as "yes," it indicates the child needs to change the behavior or improve the skill. For questions such as "Listening and Communicating Ability" (shown in Table1-1), a "yes" means the child has positive psychiatric skills that need to be kept.

Table 1-1 *Example of Assessment Questions*

ADHA	
Does the Child -	
1. Often fail to give close attention to details or make careless mistakes in schoolwork, work, or other activities?	Y / N
2. Often have trouble holding attention on tasks or play activities?	Y / N

3. Often not seem to listen when spoken to directly?	Y / N

Table 1-2 *Example of Assessment Questions*

Listening and communicating	
Is the child able to	
1. Follow instructions?	Y/ N
2. Express feelings?	Y/ N
3. Have a basic rational conversation with adults?	Y/ N

To find evidence of change, this study focused on analyzing the change ratio between the children's "before and after behaviors". First of all, the quantity (?) of the answers was sorted into categories, and the total numbers were calculated in two ways. One was finding out the total number of problems **all** the children had in each of the eight assessment categories both before and after participating in the program. Another way was to count the sum of issues **each** child had in each category both before and after joining the NM classroom. After arriving at the two groups of totals, the quantity of change was found by subtracting the sum of the "after" number from the whole of the "before" number to reveal the difference; the change ratio was calculated using the formula:

Change ratio = (total After - total Before) / total Before.

Because the formula calculated the decrease of behavior disorders, the ratio percentage is shown as a negative number. The change ratio and the reduction in disordered behaviors are positively correlated: the larger the percentage, the more significant the change. -100% means all

disordered behaviors recorded before the participation disappeared. 0% indicates that the child still holds the same amount of behavior issues. However, these are not necessarily the same problems as before. A positive percentage, such as the 100% change presented in Figure2-1, refers to an increase in behavioral issues. In this case, Child No. 7 showed a new symptom that wasn't observed before, "preferred not to be held or cuddled or might cuddle only when they want to." The cause of this behavior change needs to be investigated in future studies.

Figure 2-2 *Overall Change of 29 Children*

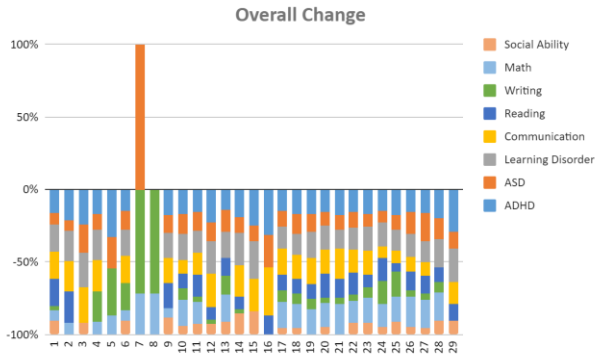


Figure 2-2 visually shows the overall view of the change the twenty-nine students had in all eight assessment categories. It demonstrated clearly that when children first joined the NM class, their baseline assessment showed that every one of them demonstrated different levels of developmental problems in more than one category. Figure 2-1 lists the average number of problems these children had in each assessment category both before and after. For example, the average ADHD symptoms of the twenty-nine children at the beginning of the program was 13 out of 18 issues, while the symptoms decreased to an average of below two after the children transferred to the NM classroom, with an average reduction ratio of 88%.

Figure 2-3 *Individual Overall Change Ratio*

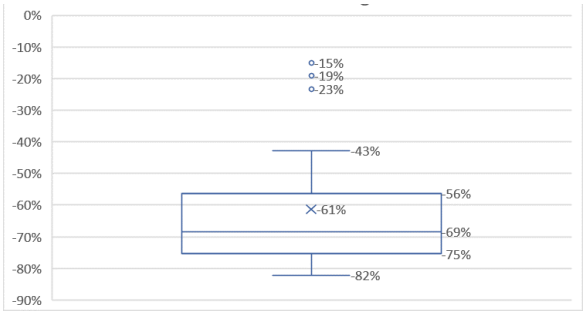


Figure 2-3 illustrates the average total-change percentage of the population of 29 children in eight categories of non-cognitive skills development. One of the 29 children gained the most significant average change of 88%. Of the three outliers who had the least average change ratios, two of them were the youngest, who had formally participated in the program for only one month when the assessment was conducted. One of them was around two and a half years old, while the other was under three when they had the assessment. The third outlier was Child No.7, who, in fact, had no symptoms in the ADHD, ASD, Learning Disorder, Listening and Communication, Reading, and Non-verbal categories, except in the Writing and Mathematical sections. Her change ratio dropped dramatically because she exhibited a new behavior pattern that fitted ASD symptoms as described earlier. The fact that the children in this research are multi-aged, and that they joined the NM program in different semesters gave the data analysis a more sophisticated perspective. A detailed investigation of these phenomena will be discussed as follows.

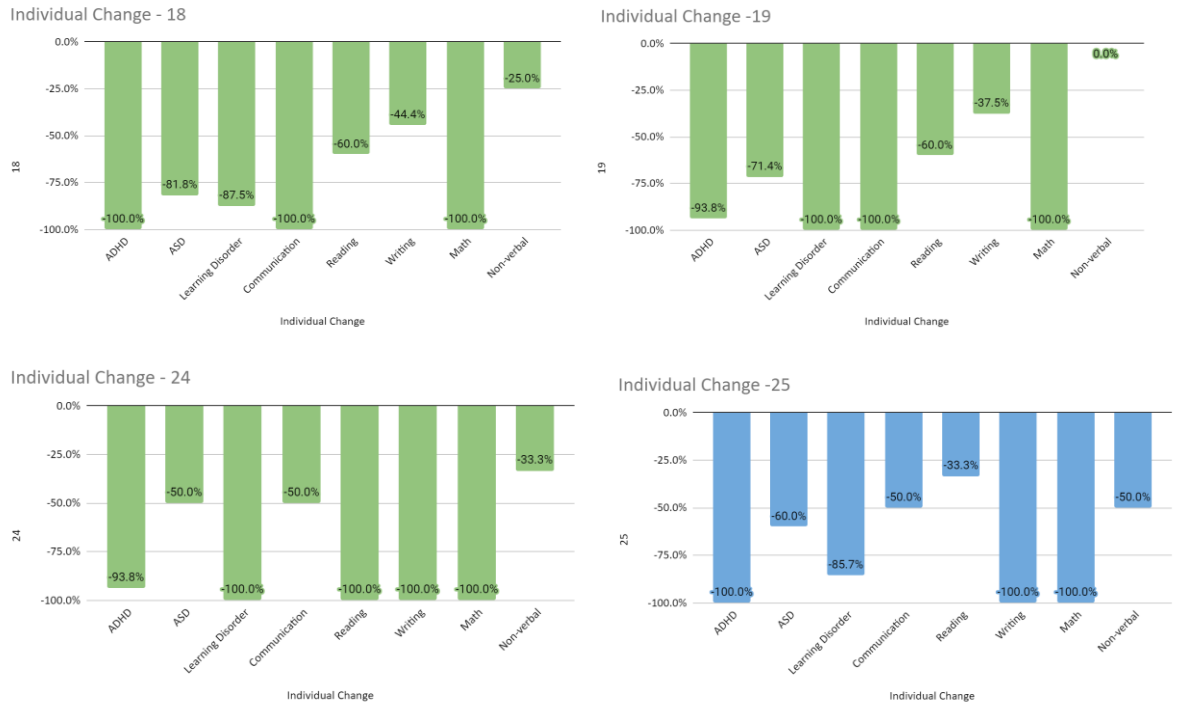
The pattern of the children's overall changes seems to reconfirm the strong evidence Weyandt (2005) had found of the correlation between EF deficits and a broad range of psychiatric disorders. The children represent a broad range of diverse psychiatric developmental

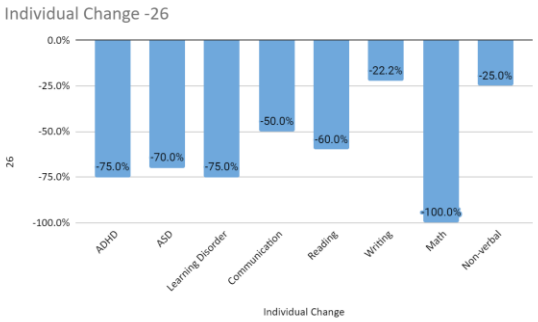
models, clinically diagnosed as ADHD, ASD, ADD child, children with challenging behaviors, G/LD (twice-exceptional) learners, and generally normalized ones (according to the Montessori standard). (The introduction of the students' backgrounds attempts to draw a full picture of the sample of the student population.)

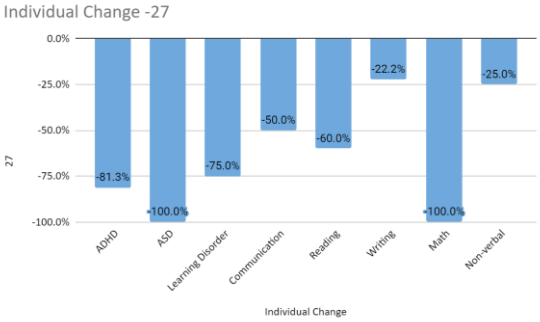
b. Data analysis by the length of time children participated in the program

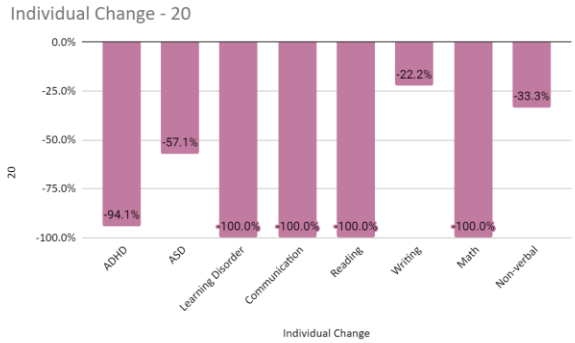
Children who participated in the first semester

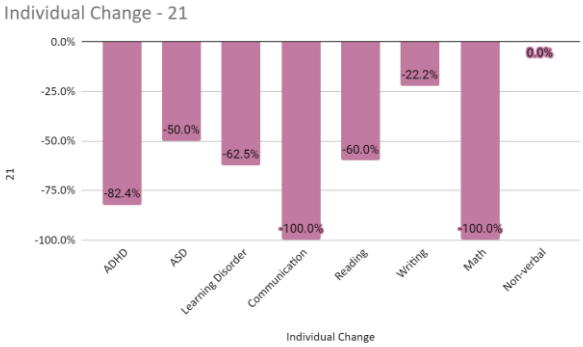
Figures 3-1 *Individual Changes of Students Who Participated in The Program's First Semester*

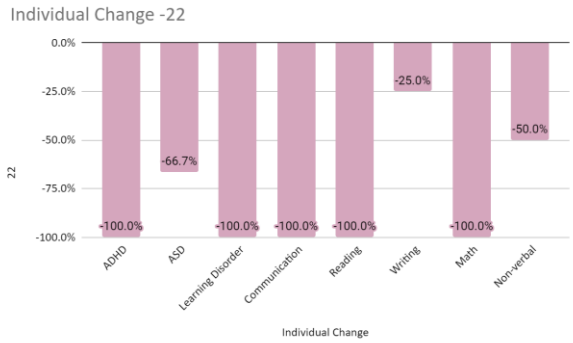


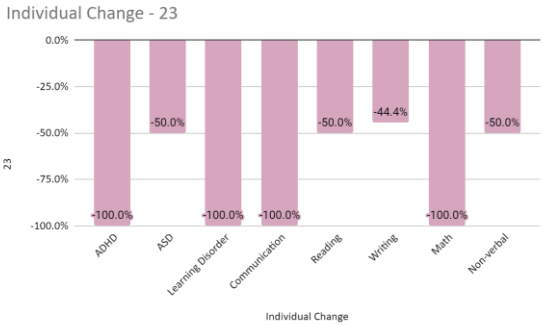

Individual Change -26
0.0%
-25.0%
-50.0%
-75.0%
-100.0%
26
-75.0%
-70.0%
-75.0%
-50.0%
-60.0%
-22.2%
-100.0%
-25.0%
ADHD
ASD
Learning Disorder
Communication
Reading
Writing
Math
Non-verbal
Individual Change

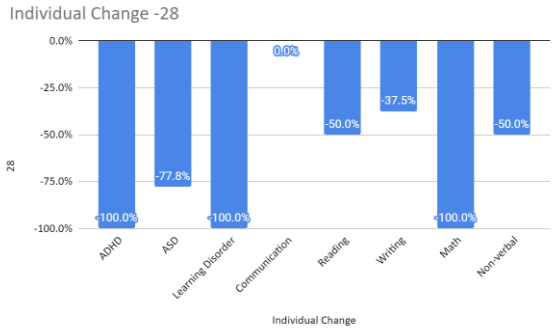

Individual Change -27
0.0%
-25.0%
-50.0%
-75.0%
-100.0%
27
-81.3%
-100.0%
-75.0%
-50.0%
-60.0%
-22.2%
-100.0%
-25.0%
ADHD
ASD
Learning Disorder
Communication
Reading
Writing
Math
Non-verbal
Individual Change

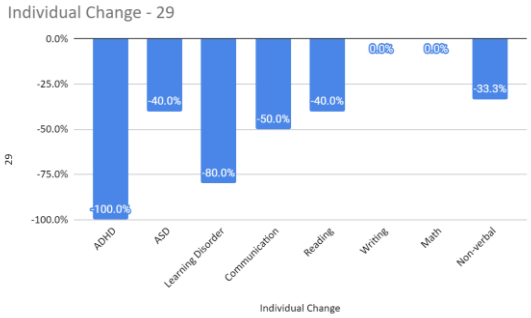

Individual Change - 20
0.0%
-25.0%
-50.0%
-75.0%
-100.0%
20
-94.1%
-57.1%
-100.0%
-100.0%
-100.0%
-22.2%
-100.0%
-33.3%
ADHD
ASD
Learning Disorder
Communication
Reading
Writing
Math
Non-verbal
Individual Change


Individual Change - 21
0.0%
-25.0%
-50.0%
-75.0%
-100.0%
21
-82.4%
-50.0%
-62.5%
-100.0%
-60.0%
-22.2%
-100.0%
0.0%
ADHD
ASD
Learning Disorder
Communication
Reading
Writing
Math
Non-verbal
Individual Change


Individual Change -22
0.0%
-25.0%
-50.0%
-75.0%
-100.0%
22
-100.0%
-66.7%
-100.0%
-100.0%
-100.0%
-25.0%
-100.0%
-50.0%
ADHD
ASD
Learning Disorder
Communication
Reading
Writing
Math
Non-verbal
Individual Change


Individual Change - 23
0.0%
-25.0%
-50.0%
-75.0%
-100.0%
23
-100.0%
-50.0%
-100.0%
-100.0%
-50.0%
-44.4%
-100.0%
-50.0%
ADHD
ASD
Learning Disorder
Communication
Reading
Writing
Math
Non-verbal
Individual Change


Individual Change -28
0.0%
-25.0%
-50.0%
-75.0%
-100.0%
28
-100.0%
-77.8%
-100.0%
0.0%
-50.0%
-37.5%
-100.0%
-50.0%
ADHD
ASD
Learning Disorder
Communication
Reading
Writing
Math
Non-verbal
Individual Change


Individual Change - 29
0.0%
-25.0%
-50.0%
-75.0%
-100.0%
29
-100.0%
-40.0%
-80.0%
-50.0%
-40.0%
0.0%
0.0%
-33.3%
ADHD
ASD
Learning Disorder
Communication
Reading
Writing
Math
Non-verbal
Individual Change

In the first semester of the study, the Montessori-based pilot classroom had 24 students from ages three to six. The students were made up of 100% “left-behind children.” These children had at least one parent absent from their daily lives due to having jobs in different cities all year long. This means the primary caregivers of these children are either single parents co-parenting with grandparents, or grandparents as the sole-caregivers. The lack of parental care plus the traditional teacher-centered teaching approach had produced strong evidence of EF deficits when these children first attended the pilot Montessori-based classroom. For example, at the beginning of the NM program, one student’s mom expressed deep concern about her son’s social development issues. During the baseline interview, the mom mentioned that her son used to be an outgoing child when he was younger, but because he “often talked excessively” (CDC, 2020) in his previous traditional classroom environment, his teacher once took a video of herself verbally “disciplining” the boy and sent it to the mom to warn the mom of her son’s undisciplined behavior. However, the mom noticed that her son not only disliked going to school but also started to exhibit severe social anxiety. As a 5-year-old he felt nervous and purposely avoided interacting with people outside of his family, no matter whether these people were adults or children. The mom decided to let her son drop out of school for a period of time. When the child transferred to the NM class, the NM teacher's baseline assessment reflected similar concerns about the boy’s social development. The teacher also reported that the boy was not willing to take challenges in learning, i.e., “whenever he was supposed to learn something new, he usually would say ‘I can’t do it.’ and whenever he confronted an obstacle, he looked unconfident and would ask for help right away instead of trying to figure out the solution by himself first.” After participating in the NM program, supported by the customized CBC

intervention, the child's social anxiety gradually disappeared, and the teacher reported that he started to show his quality as an above-average student.

Half (12) of the children who participated in the program in the first semester had continued their learning in the NM classroom in the fourth semester. There were four girls and eight boys in an age range from four to six. Each chart in Figures 2-2 demonstrates every child's change ratio in eight assessment categories. When these 12 children registered into the NM class, Nos.18. 19 & 24 were 5-year-old boys; Nos. 25, 26 & 27, were 4-year-old boys; Nos.20 & 21 were 4-year-old girls; Nos. 22 &23 were 3-year-old girls; Nos. 28 & 29 were 3-year-old boys. Figures 2-1 and 2-2 present the visual status of each child's starting point in the NM classroom and the evidence of their changes. At the beginning of the first semester, the average ADHD symptoms of these children were about 16, which is 3 points higher than the average of the whole group (13); and 5 points higher than the average of the other half of the group (11). Among the 12 children, 9 of them scored more than 16 ADHD symptoms at the beginning of the semester. This means 75% of the first-semester group had more than 89% ADHD symptoms; one of these nine children showed symptoms in all 18 questions. On the other hand, the average improvement ratio of the first-semester group was 93% at the time the post-assessment was conducted, which is 5 points better than the 88% improvement ratio of the whole class, and 9 points higher than the ratio average (84%) of the other half of the class.

The before-and-after assessment done by the teacher revealed that every child in the NM classroom had a declining number of behavior disorders and learning deficits. At the same time, a reading of the teachers' journals for each child revealed that each child accomplished their behavioral transformation at their own unique pace. That is to say, an observation of the journal

pictures along a weekly, monthly, and yearly period, showed that each child in the class became a perseveringly concentrated learner at different times via diverse Montessori tasks and NM interventions. Everyone had their own unique path of "normalization", yet the evidence is clear that every child made significant improvements.

The baseline interview of the caregivers showed that this group of left-behind children shared some common developmental challenges. Some children exhibited severe challenging behaviors, such as constantly running away from the classroom during indoor times, being physically violent toward peers, and having severe arguments with parents, (e.g., a 4-year-old used to yell "I'll kill you!" to his mom during a conflict), and most parents reported their child "tried to avoid doing homework". Figure 2-1, as confirmed by the teacher's assessment in the previous section, indicated that at the beginning of the first semester, children had low-levels of self-discipline and academic development.

However, at the end-of-the-semester parent conference, the children's caregivers gave enthusiastic feedback about the program. A mom of a three-year-old boy wrote in her comment: "My son has been surprising me all the time during this semester. He gets along with his elder sister better; he talks in a way I didn't think a -3-year-old could have done! One day, he told me the sandpile he had just made was "Himalayas Mountain" （related to an NM theme lecture about Asia); when we stepped out of the door another day, he claimed 'We are standing on the earth' (related to the NM theme lecture about the "Sun-Earth-Moon"); when I helped to clean his ears one night, he reminded me to be careful not to hurt his eardrum（耳膜） (a term he just learned in the theme lecture The Auditory Organs)."

The mother continued: “My third-grade daughter claimed that she had been learning new knowledge from her (3-year-old) brother every day. One day, she came home from school and told me what she learned from her younger brother and helped her find the answer to one of her test questions that day. My daughter claimed ‘If the whole preschool taught the children the same way as my brother’s class, every child in his school would grow up as a scientist or an engineer!’”

After the boy had attended the NM class for a year, at the parent conference, his mom shared with this researcher: “I just observed my son and his older sister (a third-grader) had made up a game by themselves. They would play rock, paper, and scissors. The one who won would then write down a Chinese character (writing Chinese characters is a first-grade-and-up skill according to the national standard).” This is very unusual because the parents and teachers had reported the boy had “a lack of learning motivation and autonomy in doing homework” just a few months previous.

Children who participated in the second semester

In the second semester, six new students joined the class. These children were chosen and transferred to the NM classroom by their teachers from other classes in the same school. These students were recognized by their teachers as the children who had the most challenging behaviors in their original classes. Besides constantly running away from their previous traditionally-managed classroom, according to reports from their former teachers, before these

children attended the NM environment, they also shared some other common symptoms matching with the CDC (2020) indicators of ADHD, such as

- *The child often has trouble holding attention on tasks or play activities.*
- *Often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (e.g., loses focus, side-tracked).*
- *Often has trouble organizing tasks and activities.*
- *Often avoids, dislikes, or is reluctant to do tasks that require mental effort over a long period (such as schoolwork or homework).*

One month after the six children transferred to the Montessori-based environment, the teachers from their original classes were invited for an observation visit to these children's new classroom. Every teacher was shocked and impressed by the dramatic change the children had made. In their reflection log, these teachers expressed how amazed they were when observing their former students demonstrating a highly autonomous self-learning status with a joyful attitude. Some of the teachers tried out one-on-one Montessori lesson presentations with their previous students, whose attention the teachers never could command inside their own classrooms before. The host teacher documented these harmonious moments with photos in her journal.

- One of the visiting teachers reflected in her comment log, "(after witnessing the changes undergone by the students) It seemed to me that we had been wasting our children's potential (with the traditional teaching approach)!"
- Another teacher wrote: "I can't believe the boy who never could sit (and learn) in my class (for two years) could change so dramatically (in only one month)!".

- Another teacher reported “After seeing the amazing result of the New Montessori intervention, I tried to use some of the NM principles (respect the dignity of the child and believe every child is intended to be the best self) with two of my students. It worked! The boys now have a closer relationship with me and a higher level of self-discipline. Instead of constantly running away from the classroom, hey can sit through my class now. I’m so happy and appreciative of what I learned (from the Montessori-based NM approach).”

Figure 4-1 *Individual Changes of Students Who Participated in The Program’s Second Semester*

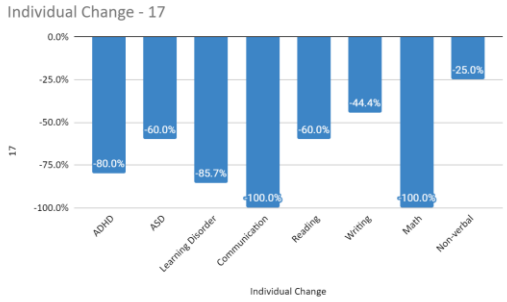


Figure 4-2 *Changes Undergone by A Student in the Program’s Second Semester*

ADHD	Before	15
	After	3
	Change	-80.00%
ASD	Before	5
	After	2
	Change	-60.00%
Learning Disorder	Before	7
	After	1

	Change	-85.70%
Listening & Communication Ability	Before	2
	After	0
	Change	-100.00%
Reading Ability	Before	5
	After	2
	Change	-60.00%
Writing Skills	Before	9
	After	5
	Change	-44.40%
Mathematical Ability	Before	1
	After	0
	Change	-100.00%
Non-verbal Skills	Before	4
	After	3
	Change	-25.00%

One of the second-semester-children, child No. 17, was in his third semester in the NM classroom and was five years old. As shown in Figure 4-1 and Figure 4-2, the boy had 15 ADHD symptoms out of the total 18 when he just attended the NM class. The number dropped to 3 when the assessment was taken, representing an 80% decrease. His ASD symptoms dropped from 5 out of the total of 14 to 2 out of the 14, which was calculated as a 60% decrease. His reading ability improved in the same ratio as the decreased degree in his ASD symptoms. His

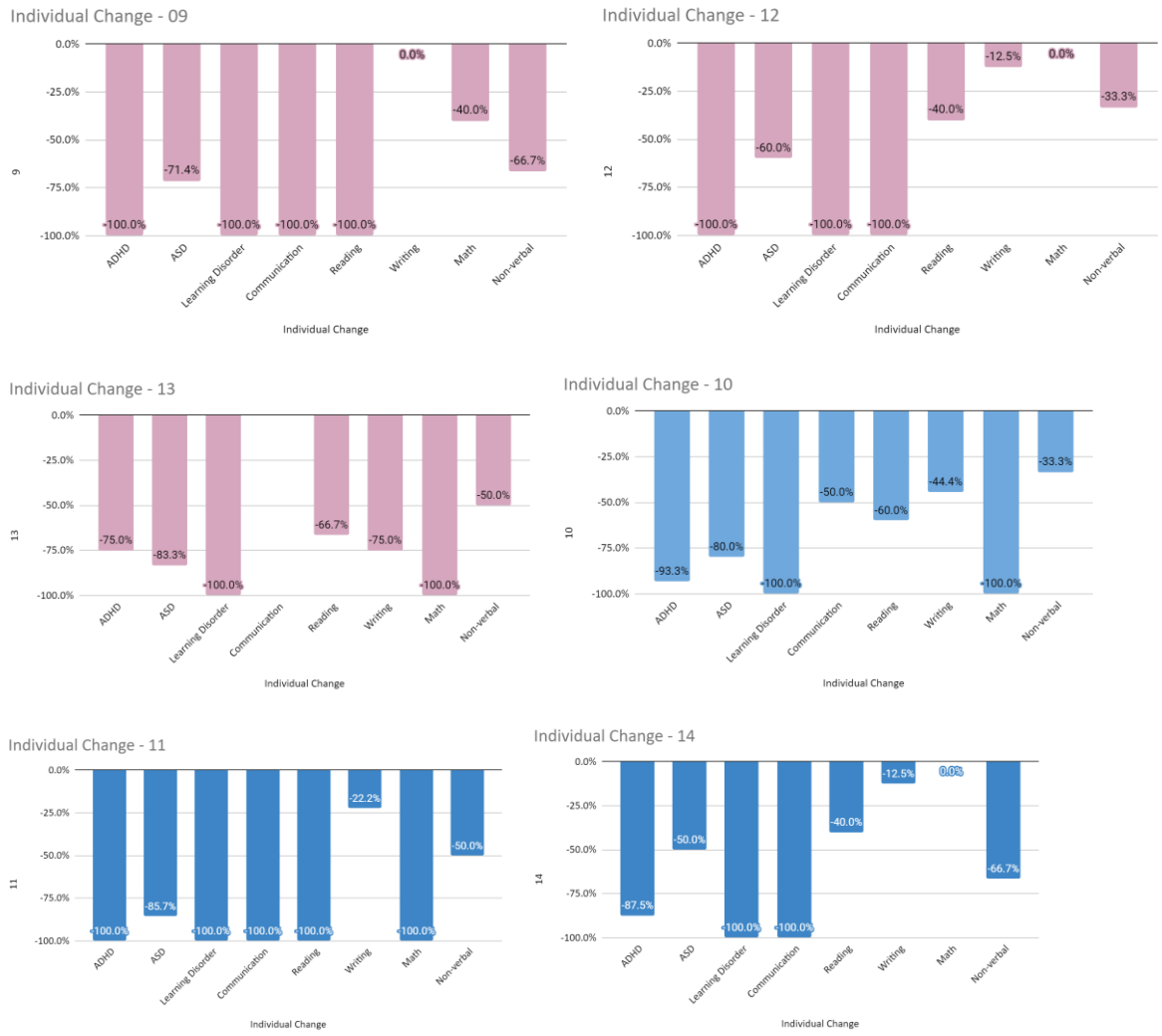
Learning Disorder decrease ratio is around 87%. Both of his Listening and Communication Abilities and Mathematical Abilities had improved by 100%. The least improved ability was Non-verbal Communication skills, with only 25% improvement. According to the assessment questions, the non-verbal skills the child needs to strengthen are “physical coordination; fine motor skills for writing; and using language appropriately in social situations”. His writing improvement ratio was the second least improved ability (44%), and the assessment showed that his writing difficulties included (CDC, 2020):

- *Having difficulty putting thoughts into writing;*
- *Having difficulty putting thoughts into logically expressive sentences for a general conversation;*
- *Writing text that's poorly organized or hard to understand;*
- *Having difficulty putting thoughts into logically expressive sentences for a general conversation;*
- *Have trouble with spelling, grammar, and punctuation;*

The difficulties child No. 17 had in writing and non-verbal abilities showed correlation. However, because the boy is only five years old, it is understandable that he has difficulties with his writing ability. Some other children younger than five also showed a low improvement status similar to this boy. In addition, he has one more year in the NM classroom to improve his language skills. The assessment helped the teacher to make a more precise individualized teaching plan for the child.

Children who participated in the third semester

Figures 5 *Changes Undergone by Students Who Participated in The Program's Third Semester*



At the beginning of the third semester, a new teacher from another class in the school was assigned to the NM classroom. Seven 6-year-old students transferred to the NM classroom to complete their last preschool year. These seven children together with one 5-year-old, and four 4-year-olds, made a total of 12 children who joined the class. Figure 5 presents the change ratio of each child who attended the NM classroom in the third semester. Because this was the first time the majority of the transferred students were not students with special behavior issues, their

data charts have some different characteristics from the other children's charts. The newly arrived 6-year-old children had fewer psychiatric problems and a more normalized presentation than the others as revealed in the baseline assessment. Most of the issues they had at the beginning of the semester disappeared by the time the post-assessment was conducted. The change ratio in ASD was 100%, combined with a 92% drop in ADHD symptoms and a 94% decrease in Listening and Communication difficulties. In contrast, the Reading and Writing abilities both exhibited a moderate improvement, with 68% for reading skills and 61% for writing.

Because the children who started the NM program at three years old were in their second school year at the time this research paper was completed, no child had yet completed the whole Montessori language curriculum. That these children had a low improvement ratio in the language abilities sections of the CDC assessment was understandable. This meant that the children still had space for improvement in these categories in future semesters.

The 6-year-olds who transferred to the NM class in the third semester had previously gained some Montessori learning experience in Math with their teacher in the original classroom using teacher-made Montessori math materials. However, when these children started their learning process in the NM classroom, they not only took advantage of the fully-equipped Montessori materials, they also displayed an explosion of non-cognitive development, such as critical thinking, autonomy, and independent learning abilities via the free work culture in the NM environment. Nurtured by the new learning materials and teaching philosophy, soon after these older children joined the NM class, some of them started to demonstrate a high degree of self-motivation to learn. Among them, four girls, especially revealed outstanding performances.

For example, after the four girls took the initial presentation on the addition of four-digit numbers, using concrete math materials - i.e., the golden beads– the teacher observed in her journal “Right after the initial presentation, the four children autonomously organized and repeated their team practice during the free-work period for a whole week, passionately.”

Also, this group of children showed well-rounded development quality in both cognitive and non-cognitive abilities. Their attitude toward taking on new academic challenges and learning deep-level knowledge and skills became more enthusiastic; they became happy, passionate, fast, autonomous, independent, creative, and tireless learners; and they conducted teamwork harmoniously and inspired each other constantly (as shown in the journal pictures). Very often, the teacher’s journal notes about these girls would be “when one girl started a task which elicited the other girls’ interest, then soon all of them would do the same task, or create a team for further exploration.” These children had become such active learners that they reshaped the teaching-and-learning model in the NM classroom. Their spontaneous explosive learning style provided the guidance for the teacher and this researcher to adjust the curriculum to match their newly-discovered learning needs. Thus, in the NM classroom, students frequently lead the teacher, rather than vice-versa.

One day, during the theme lecture, one child noticed that there were two chinese characters which shared the phonetic element “包”, so the teacher took a break from the theme-study and started to look for all the Chinese characters she and the children could think of that had the same phonetic element “包”. Eventually, they found eleven of them (包-跑泡刨雹炮苞胞抱饱咆鲍), made phrases out of them along the way, and by the end of the class, most of the children had memorized all the characters. A parent called the researcher that night and said “I

can't believe my son could still recognize all eleven characters when I tested him at home!" Before this accident, the teachers at school usually taught no more than three characters at a time. In the middle of the first semester, the new teacher and her previous students transferred to the NM class. Within two months, she claimed that "I'm very confident that I have already accomplished the grade-level goals for math as set by the school."

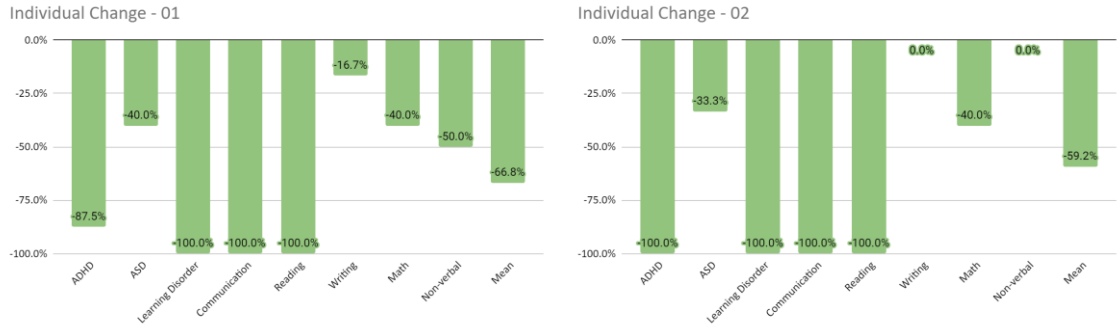
This new teaching-and-learning model, in which children's interests lead the teacher, supports children to reach their full potential on a daily basis. This phenomenon had constantly impressed their teacher so much, that after another impressive lesson presentation with the girls, the teacher wrote in her journal " It seems that whatever we teachers are willing to teach them, the children will be able to absorb ." In other words, she recognized that teachers with the traditional mindset far too often underestimate their students' abilities. Pictures 1 below present some of the energizing moments of the NM environment that the teachers caught in their journals.

When the children in the NM class were working on the addition of four-digit numbers using Montessori golden beads, the NM teacher ran into their peer students in the previous classroom struggling to grasp the abstract formula for two-digit-number addition, which was taught by their same struggling teacher. In a teacher meeting, the teacher who was still teaching with the traditional abstract approach tried to tell the NM teacher to slow down the fast-learning pace of the NM classroom. But the NM teacher made it clear that the outstanding performance the NM children accomplished "was simply due to the Montessori-based learning method that made the learning easier, and energized the children's autonomous learning interest."

A few weeks after the new teacher took over the NM class, a parent from her other class heard about the different learning quality of the two environments through a parent of a student in the NM class. She asked to transfer her daughter to the NM class. Her child became the 7th 6-year-old student who voluntarily transferred into the NM class in the third semester because of the approach's effectiveness. The teacher received more transfer requests from parents of students in her previous class, but because the NM class had reached the limit of its capacity, we had to turn down the request.

Children who participated in the fourth-semester

Figures 5-1 *Changes Undergone by Students Who Participated in The Program's 4th Semester*



In the fourth semester, four new students joined the NM classroom. Two of them were older than six and were in the last semester of their preschool year. The other two children were both under three at the beginning of the semester. Previously, at the beginning of the third semester, they had tried to join the class. But because they were too young at the time and the new teacher needed training, the two boys dropped out of the class within a month of registration and rejoined the class in the fourth semester.

The two older students transferred to the NM classroom in the middle of the school year at the request of the NM teacher. One of these two children transferred to the NM class from the traditional-setting class at the request of the new NM teacher. Because she noticed every time she passed by the boys' classroom, she found the boy either leaning on the desk, sleeping, or wandering around in the classroom, or running outside. Due to the results the new teacher had witnessed in the NM classroom, she thought the NM class might be a critical opportunity for the boy. The teacher urgently noted that "The boy shows no learning interest in his current class (the one applying the same traditional approach as the rest of the classes in the school). He only has one semester left before he goes to elementary school. If we don't take him into our NM classroom (and give him effective help), his whole learning process might already reach a dead-end before it formally starts." The teacher was so certain about what she claimed because obviously, the boy's teacher had given up on the boy by leaving him wandering around. As shown in Figure 5-2, the baseline assessment showed that when this boy just joined the class, he had 16 out of 18 ADHD symptoms, 6 ASD symptoms, 6 learning disorder issues, and 6 writing issues. His learning disorder, Listening and Communication ability, and reading skills improved 100% in around one month. He also eliminated 88% of his ADHD behaviors. Even though he still needed to make progress in other categories, the teacher found that he learned fast with the NM approach. This child seemed to provide additional evidence to our observation, that children demonstrating challenging behaviors in a traditional learning environment most of the time have higher than average learning gifts. The teacher's journal showed that he not only gradually turned into a good learner, but also exhibited a caring personality. He would volunteer to take

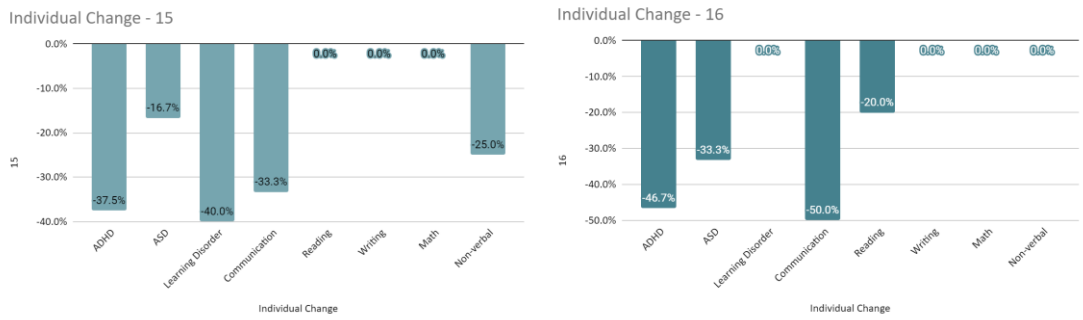
care of his younger classmates who were new to the environment at the beginning of the semester without being asked by anyone.

Figure 5-2 *Assessment Data of Child No. 1*

ADHD	Before	16
	After	2
	Change	-88%
ASD	Before	5
	After	3
	Change	-40.00%
Learning Disorder	Before	6
	After	0
	Change	-100.00%
Listening & Communication Ability	Before	1
	After	0
	Change	-100.00%
Reading Ability	Before	1
	After	0
	Change	-100.00%
Writing Skills	Before	6
	After	5
	Change	-16.70%
Mathematical Ability	Before	5
	After	3
	Change	-40.00%
Non-verbal Skills	Before	2

	After	1
	Change	-50.00%

Figures 5-4 *Changes Exhibited by The Two Youngest Students Who Participated in The Program's 4th Semester*



Besides the two 6-year-olds whom the NM teacher requested to transfer, two boys who were under three formally joined the NM class in the fourth semester. It is common for new preschoolers to show anxiety at the beginning of the school year. How to reduce the new students' anxiety to the lowest possible level was one of the goals this study had been exploring. In this case, the multi-age Montessori-equipped environment played a key role in assuring a positive adaptation to the NM environment. Because they were too young, the assessment skipped the categories of reading, writing and math skills for this research. As shown in Figure 5-4, both children made improvements within the first month with a similar pattern. The overall progress these two children made have ratios under 50%. One child made no change in Learning Disorder and Non-verbal Communication issues, while the other boy didn't show changes in his reading abilities.

Both children were under three at the beginning of the semester. The critical issue about them was that both of their moms were teachers at the school in the traditional classrooms. This fact created obstacles for the boys to adapt to the morning routine. Adaptation to the new classroom became more challenging when they could easily run into their mom on campus during the day. Being separated from their moms while knowing that their moms were nearby were triggers to increase their anxiety and make them cry. The NM teacher asked this researcher for advice after the boys' situation had demonstrated the same anxiety pattern for three days. Even though the teachers did a great job of making the children calm down as soon as possible, they would cry and be anxious again whenever they saw their mom during the day, which was very hard to avoid. To solve the problem this researcher made an individualized intervention for each boy. I required the two moms to prepare a backpack for their boy, so the boys could follow the same morning ritual as the other NM students. The problem was that these two boys would follow their mothers to their mothers' classroom rather than report to their own classroom. I requested the moms to establish a ritual, in which each would walk their child to the classroom and help them go through the same formal morning routine as the other children: i.e., coming to the classroom the first thing in the morning, putting away their backpacks, doing the morning greeting with the teacher and then entering the classroom for free-work. This researcher asked the NM teachers to welcome the new children at the classroom door, instead of looking for the children on the campus and taking them over from the mom's hand there. I suggested the mothers have a formal but respectful conversation with their sons during the weekend before the new routine would be established to familiarize their child with the routine that would start on the following Monday. For the boy who had his older brother in the same NM class, I suggested

the mother purposely take care of the older son's psychological needs about school issues first, so that he could be more willing to take responsibility as an elder brother. I also suggested the mom encourage the two brothers to go to the classroom together themselves. According to the teacher's journal, after applying the intervention, the boy who went to school with his older brother not only stopped crying the second morning after the new routine was established, he was smiling when the teacher saw him. She wrote in her journal "This morning I was busy giving presentations to other children and didn't notice when he came in with his older brother. When all of a sudden I discovered that he was already in the classroom, I saw him checking around the classroom with a smile on his face. " The teacher documented that the other two-and-half-year-old boy stopped crying on the morning of the third day. Pictures 5-4 to Pictures 5-8 present the boy's performance during the first month. Pictures 5-6 show that on the third day of school, he had already been an active participant inside the classroom. The teacher observed him listening to the NM theme lecture concentratedly for 30 minutes in the first week of school.

There are several reasons for the two boys' fast adaptation to their new school life. First, in a multi-aged Montessori classroom, teachers have more time to provide individual attention to each child because they have only a few new students at one time. Second, the older students who have already been in the class for several semesters function in the classroom independently, productively, and freely, creating a calm and welcoming environment for the newcomers. In addition, the busily working ones are also an excellent distraction, allowing the newcomers to shed their anxiety. Fourthly, in the freely interacting NM classroom older students set models for the newcomers, relieving some of the teachers' burdens. At the same time, the older ones are always willing to take care of the younger ones whenever the teachers need a

hand, thus reducing the time newcomers need to adapt and improve the older ones' social skills, while simultaneously building their confidence and self-discipline. Another important factor is the NM environment itself, equipped with plenty of hands-on and meaningful learning materials that attract the children's interest. Moreover, concentration on tasks helps to distract children from their anxieties. The high-quality books in the class library are also good tools. A teacher recorded one of the youngest children's first day "As soon as he parted from his mom, he started to cry. In order to distract him and calm him down, I took a book from the library corner and read it to him. In the beginning, he didn't stop crying, but when I turned to the page about birds, it raised his interest. Soon he stopped crying, started to read the book with me, and asked questions. Gradually, he was attracted by the content and read the book by himself for 30 minutes." For a child under three, on the first day of school, this predicted a good psychiatric foundation of *Normalization.* The teacher's journal proved this conclusion. As shown in Figures 5-4 to Figure 5-8, on the second day of school, he had already begun individual and collective tasks in a diverse range of subjects - math, science, and language.

Data analysis by CDC assessment category

1. Analysis of changes in ADHD

Figure 6-1 *ADHD Symptom-change Before and After by Individual Child*

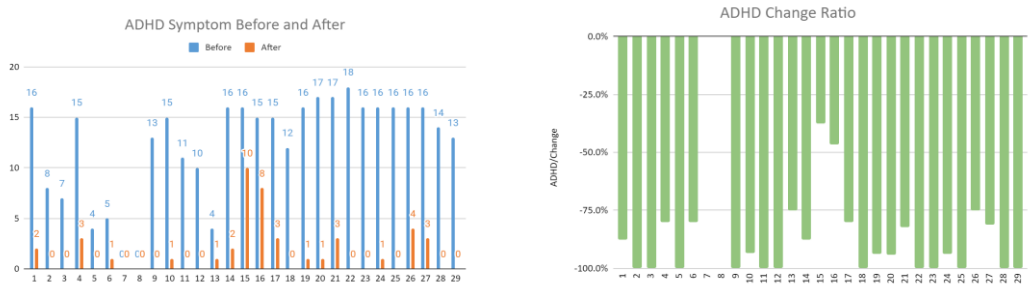


Figure 6-2 *The Mean of ADHD Symptom-change Before and After by The Whole Group*

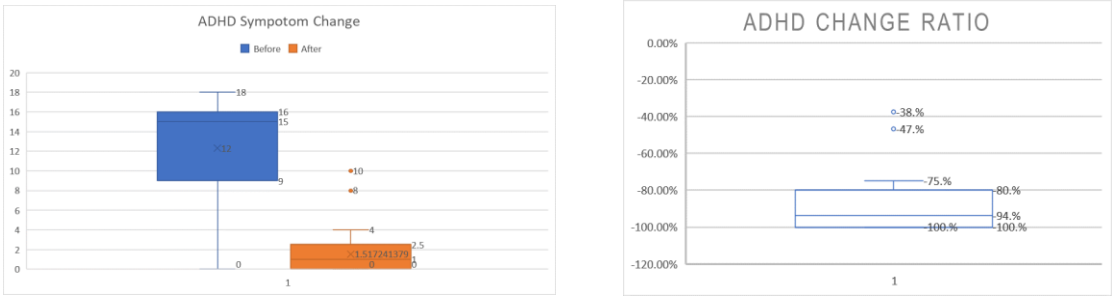
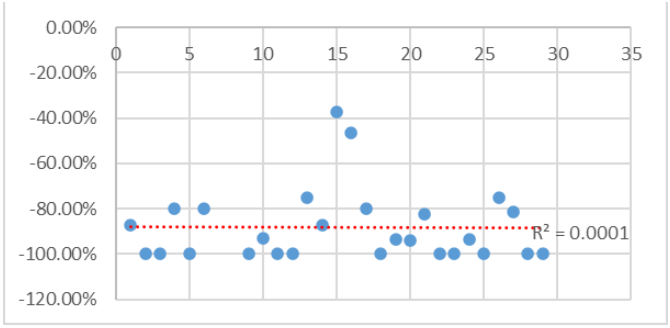


Figure 6-3 *The Correlation Between Length of Time in the NM Program and Changes in ADHD Symptoms*



As shown in *Figures 6-1*and *6-3*, almost all the children had ADHD symptoms at the beginning of their participation in the program, except students No.7 and No. 8, who had already *normalized* based on the Montessori assessment standard. That is 27 out of 29, or 93% of the students had ADHD symptoms at the beginning of the program. The average number of problems among these 27 children was more than 13. One child had “yes” to all 18 questions; 16 out of the 27 students had 15 or more “yesses,” which counted as almost 59% of the whole group with symptoms. In other words, with every two children registered in the class, one had an average of 13 out of 18 ADHD symptoms at the beginning of the transformation process; 59% of these “diagnosed” children demonstrated above 15 ADHD symptoms, which is calculated as an

average of 85% of the total symptoms. However, the decrease in the symptoms was significant, with an average of fewer than two symptoms left per child after learning in the environment. This result led to an average decrease-ratio of 88% per person. Half of the group gained a 94% to 100% symptom decrease. 75% of all the children had more than 80% of their behavior disorders disappear. More remarkably, the ADHD symptoms of 12 out of 27 children disappeared, yielding a 44.4% complete cure rate, which means almost half of the children with ADHD symptoms had no more clinically identified symptoms after being in the environment for a certain amount of time. The other 13 children had a more than 75% decrease ratio, which accounts for 48% of the 27 children. When we add these two groups of children together, the resulting percentage shows that more than 92% of the 29 children gained more than 75% improvement in their executive functions. The two boys who had the lowest improvement ratios of 46% and 37% respectively are the two youngest ones and formally participated in the program for only one month. Both of them were under three years old when the assessment was conducted. So, if we take out these two outliers, the average ratio of positive change for all the children will rise from 88% to 93%.

The investigation of the correlation ratio of the ADHD data led to an important discovery about this Psychiatric category. A correlation ratio of R^2=0,0001 indicates that there is almost no relevance between the ADHD-symptom-change ratio and the number of semesters children had been in the Montessori-based environment. This is because the children's data were listed in the order of how many semesters they had participated in the program (the most recently registered one on the left side of the chart and the one who had been in the environment the longest on the right). The data from teacher's journals, parents' interviews, and the school's other teachers'

observation reports repeatedly confirmed that the length of time a child was in a Montessori-material-equipped classroom did not necessarily correlate with behavior changes.

Theoretically, energizing the children's fundamental change and initiating their *normalization* process requires a sophisticated full-package approach that combines the factors of the Montessori materials that can fulfill both the children's mental and academic development needs, a self-learning classroom culture that respects the children's dignity, and believes in their full potentials, and most critically, the carefully designed individualized-teaching guidance delivered by teachers daily.

2. Analysis of changes in ASD

Figure 7-1 *ASD Symptom-change Before and After by Individual Child*

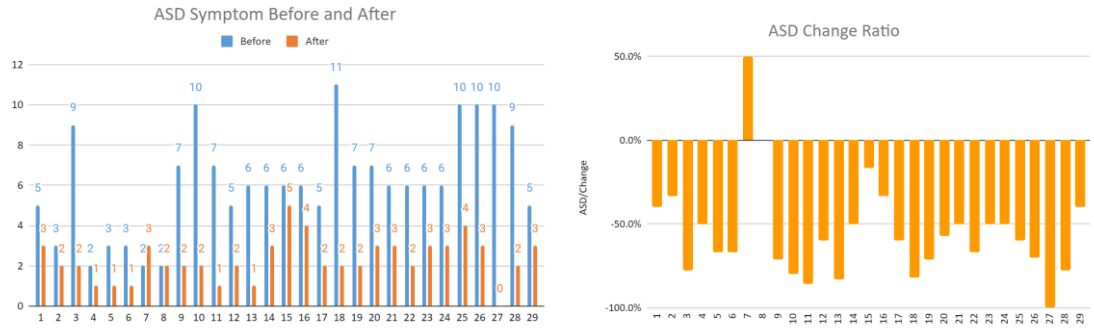
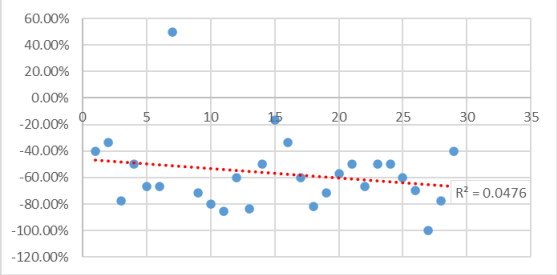


Figure 7-2 The mean of ASD symptom-change before and after by the whole group

Figure 7-3 *The Correlation Between Time Length in The NM Program and The Change of ASD Symptoms.*



As is demonstrated in Figure 7-1 and Figure 7-3, all 29 children presented an average of 6 ASD symptoms per person when first attending the NM class, with 12 as the most and two as the least. 28 children showed decreased disorder behaviors in the post-assessment; one had an increased change ratio. The average symptoms the children had dropped from 6 to 2. Half of them had a more than 55% percent decrease ratio. Some of the symptoms had a 100% drop ratio. Children who used to “avoid eye contact and wanted to be alone”; or “have trouble adapting when routine changes”; “not look at projects when a person points to them”; “be very interested in people but do not know how to talk, play, or relate to them.” don’t have these behaviors anymore. The number of children who “Have difficulty understanding other people’s feelings or talking about their feelings;” dropped from 21 to 1. The number of children who “Have trouble relating to others or not having an interest in other people" decreased from 22 to 2. The slope of the correlation between the length of semesters the children have been in the NM classroom and their behavior development goes down to the right from the children in their first semester to the ones in their fourth semester with an R^2 of 0.0476. It indicates that there is a low level of negative correlation between the two variables. This means the longer the children stayed in the NM environment, the more stable the reduction of their ASD symptoms could be.

Case study - Boy diagnosed with ADHD, ADD, and autism, and G/LD potential

Boy A's case allowed the researcher to test out how the Montessori-based method helped children with ADHD, ADD, Autism, and a possible Twice-Exceptional Learner. The evidence showed an apparent validity of the approach. Boy A was diagnosed with ADHD, ADD, and autism at the age of four and joined the class at the end of the second semester as a special-needs student when he was five. He stayed in the classroom until the end of the third semester. When the child first attended the class, he had most of the symptoms listed by the CDC as ADHD, Autism spectrum disorder, and learning disorder on a severe level. These symptoms include: often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (e.g., he couldn't take instruction when he first attended the class, but could only follow his own impulses, and often had trouble waiting his turn, when the adult gave him a presentation on conducting a Montessori task which had a sequence); he would often run about in situations where it is not appropriate, (e.g., when everyone was supposed to be in the classroom doing autonomous work, he would run out of the classroom or refuse to come into the classroom after the outdoor activities); had difficulty understanding other people's feelings or talking about his feelings, had trouble expressing his needs using typical words or motions (e.g. he would repeatedly yell "NO! NO!" and hug himself tightly with his arms whenever an adult, who he was not familiar with, wanted to interact with him and went close to him, or he was required to follow the group routine); he would constantly wander around the campus, either refusing to play with peers or interacting with peers aggressively (such as pushing them away, or even hitting peers). At the same time, he was isolated by his peers both at school and at home because of this disordered behavior. At almost five years old, the child did not properly know

how to use the bathroom. Instead, he would poop on the bedroom floor. He was also found standing while having a bowel movement. During the baseline assessment, the researcher noticed that Boy A liked reading cyclopedia books and was interested in activities involving logical factors. This indicated that the child might be a gifted child with learning disabilities or a Twice-exceptional student. After the boy joined the NM classroom, the researcher conducted a customized Conjoint Behavioral Consultation (CBC) intervention. Boy A's grandma sent videos of him a few days after he transferred to the NM class to share the evidence of changes she had observed. Gradually, Boy A's Executive Function improved. He was able to follow the teacher's instructions on work procedures, sit through most of the theme lectures, and start to interact with peers positively and adequately. Mom reported that he could play with peers when at home. He would tell his mother not to punish his younger sister when she didn't behave properly. This confirmed that he could now understand other people's feelings. He learned to use the bathroom independently. Mom said he even insisted on going to the men's room instead of the women's room when being out with mom, which proved that he was aware of his own gender and was able to express his own thoughts.

3. Analysis of change in learning disorders

Figure 8-1 *Learning Disorder Symptom-change Before and After by Individual Child*

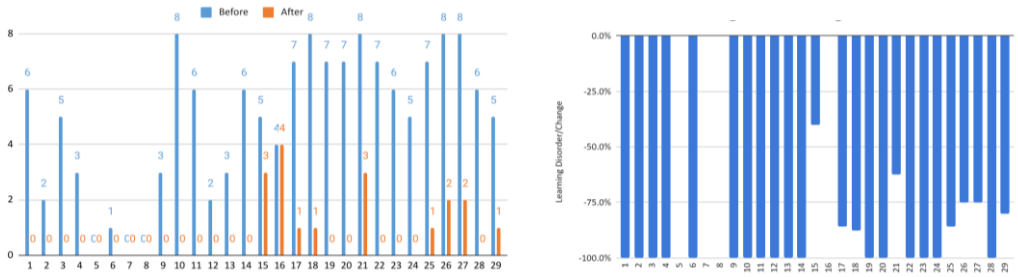


Figure 8-2 *The Mean of Learning Disorder Symptom-change Before and After by The Whole Group*

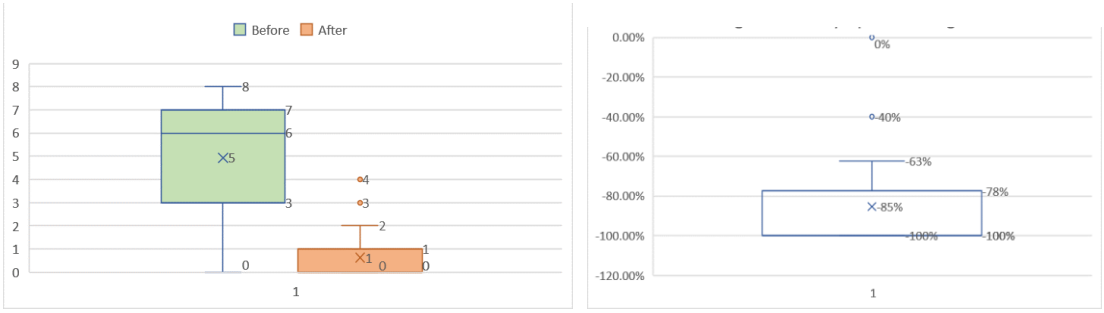


Figure 8-3 *The Correlation Between Time Length in The NM Program And Changes in Learning Disorder Symptoms*

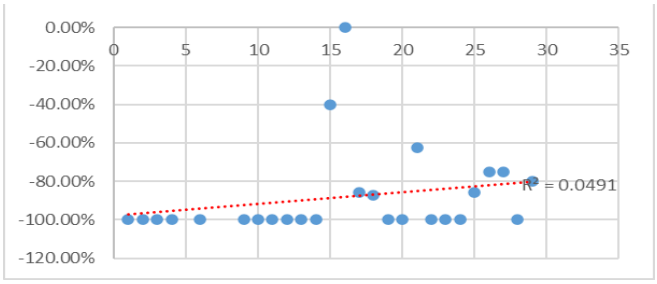


Figure 8-1 and Figure 8-3 indicate that the average number of disorder symptoms the children as a group have been experiencing are five out of the total eight indicators. 27 children out of the total 29 had different levels of learning difficulties, especially the ones related to homework. After attending the NM program, among the 27 diagnosed children, 17 of them gained a 100% improvement in their learning skills. The two outliers again were the two youngest ones. Some of the assessment questions were beyond their age level. However, even though these two young children had just been in the NM environment for one month, they only took around one week to adapt to the school life, demonstrating a high level of Executive Function, such as working on Montessori materials independently. The teacher recorded them

"sitting through 30-minute lectures with their older peers" in the journals. The one who had the lowest improvement ratio in the six-year-old-and-above group was the one we just discovered about one month before the assessment, that his learning deficit was caused by the fact that he is left-handed. But he wasn't allowed to use his dominant hand, which hurt his self-motivation toward learning. He had been coming to school late every morning and resisted learning activities. After a parent meeting, the cause of his psychiatric problem was found, and the obstacle causing his learning deficit was taken away. Since then, he made progress in catching up with his learning. The teacher's journal recorded him working autonomously on math and language, matching his age level.

The correlation chart of Learning Disorder assessment data indicates improvement in learning ability does not correlate with how long a child has been in the NM environment. Instead, when considering their ages and the length spent in the NM environment, combined with data from the teacher's journals, evidence shows that children's development in learning abilities is highly related to the Montessori-inspired intervention, supported by a well-prepared self-learning environment, individualized education plan, and thoughtfully designed curriculum.

The analysis of evidence for change in non-cognitive skills

Scientists and specialists have argued that compared to cognitive skills, non-cognitive traits play a more critical role in both academic and social development during the early years of human life (García, 2014, Beckmann & Minnaert, 2018, Tough,2012). In this research, we saw, repeatedly, that only after non-cognitive traits had been nurtured first by taking care of the children's psychiatric development needs, only then could the Executive functions be energized.

The behavioral disorders could then disappear or be treated effectively. Given this accomplishment, the child could then finally transform into a self-driven deep learner. The transformation process that this researcher has observed in this study aligns with Dr. Montessori's theory of *Normalization,* which also contended that non-cognitive ability has a strong interdependent relationship with cognitive development (García, 2014; Tough, 2012). In her Four Planes of Development theory, Dr. Montessori identified the first six years of human life as a psychic-embryo stage. She argued that adults need to take care of the children's psychological development first in order to release the children's full cognitive and non-cognitive development potential. The observations in this study have confirmed Dr. Montessori's argument. In the following section, this research will try to analyze how children's non-cognitive and cognitive development processes interact with each other interdependently to transform a child's executive function abilities and eventually change the child.

1. The development of Perseverance

Perseverance is one of the core non-cognitive skills. It refers to steadfastness in mastering a skill or completing a task; grit, the tendency to sustain interest in and effort toward very long-term goals, is one of the significant components of persistence. (APLNexted.com). In Dr. Montessori's （1918/2007） Normalization theory, she defined "concentrated repetition" as the key indicator of identifying a child's *Normalization* development level. In Montessori theory, children gain the non-cognitive skill of perseverance through repeatedly conducting concentrated work on freely and autonomously chosen Montessori work materials.

When observing children working in the NM classroom, the concentrated facial expressions children displayed seemed to prove that the children had an intuitive knowledge that these Montessori materials carried certain meaningful qualities that could fulfill their overall development needs. One teacher from another traditional class in the school reported that the school principal once brought two 4-year-old boys from her class who "ran around the campus all the time and refused to stay inside the classroom" to visit the NM classroom. After that time, she said: "Whenever the boys saw the principal on campus, they would beg her to take them back to the NM classroom again. Every time their request was rejected, they would return with tears". At the beginning of the second semester, I saw how an unsettled 6-year-old boy became a concentrated worker when introduced to the Montessori metal inset activity which develops writing muscles. Another time, the Montessori numeral box, a Montessori math material designed for four-year-old, turned a crying three-year-old into a concentrated little scholar, even though the girl didn't know how to tell 1,2,3 apart. But when I utilized the advantage of the multi-aged environment of the Montessori classroom and introduced an older child to help the little girl make the arrangement of the numbers, the girl devoted herself to the task and repeated it until the end of the morning section. She totally forgot to cry. In the study, children continually proved that they know when, which and how the Montessori material would work for them the best. Because of this observation, the NM teachers were trained to recognize the children's development needs as the guide to conducting interventions. The principle of the intervention is to respect children as independent-learners first; to trust children to develop their unique full potential; to give children the autonomy to practice making their own decisions in their learning process; and to help the children become individuals who can think and act independently,

creatively and confidently. Whenever the adults followed these principles, the child she worked with would be easily turned into a significantly self-motivated learner. If the adults ignored the principles, they would frequently see children produce challenging behaviors. Here is a good example. In the NM classroom, at the beginning of one semester, the teacher reported a strong-willed 3-year-old boy always wet his pants. She asked the researcher to help provide a solution. The researcher suggested that the teachers and caregivers change their way of communicating with the boy. Instead of constantly telling the child, "Please go use the bathroom, now." I suggested the adults treat the child respectfully and truthfully by saying, "You can use the bathroom whenever you feel you need to." The difference is that this latter expression gives the autonomy and responsibility back to the child. I had a feeling that's what his subconscious had been "fighting" for, like the children in most of the cases I had confronted before. I also prepared Plan B for the teacher, which was teaching the boy to read the clock and take responsibility to set up his bathroom ritual independently. After the adult took my advice and tried Plan A, the boy's behavior changed soon. However, one day the teacher accidentally went back to the old way and reminded the boy he should use the bathroom. To her surprise, the boy said, "It's time to pee in my pants!" and then he wet his pants again. The teacher taught her a "lesson" and the accident never happened again. After the boy's psychiatric needs were fulfilled, he turned from one who "often acted as if driven by a motor" who could not sit through the group learning section quietly, into a calm, absorbed, and highly efficient self-learner. He presented high-level perseverance in academic study and showed fast-paced non-cognitive and cognitive development progress. At the end of the semester, during a parent conference, his mom told the teacher "I thought he might not learn much in the semester, but I was so shocked when I found out that he

knew everything his older sister learned!" The three-year-old's six-year-old sister had been learning in the same NM classroom with him. After being in the classroom for one year, constantly observing and learning from the older children, the boy started to demonstrate strong self-motivation in working and learning. He frequently chose to do high-level academic work such as multiplication using Montessori materials. This boy provides a valuable case of a twice-exceptional learner. It is also a classic example that confirms how the Montessori-guided approach helps children to strengthen their perseverance trait, as a lifelong trait.

In the NM classroom, evidence showed that when the "Normalization" transformation procedure was accomplished, a "new" child was born with significant developmental qualities, such as:

- Being able to conduct meaningful academic learning activities for a long-concentrated time and to repeat the work constantly for weeks and months until they grasped it. The journal photos recorded:
    a. A three-year-old observing six-year-olds doing addition, subtraction, multiplication, and division using Montessori math tools in the first semester, the next year, when they turned into 4-year-olds, these young learners had already been willing to conduct the same math work in a passionate manner;
    b. Two and half-years old were caught in photos working on the Geometry Box that teaches the nature of geometric shapes;
    c. A two-and-half-year-olds manipulated the Binomial Blocks that embed the binomial formula;

d. A four-and-half-year-old had learned the concept of the decimal system using the Montessori Golden Beads and Number Boards of 1-9999;

e. Different ages of children worked on World-map-puzzles that taught the political boundaries of each country in the world, eager to learn the nature and culture of each continent, such as the national flags, the customs, the typical animals, and the history;

f. A four-year-old was able to tell in which city his dad was working, and in which province his teacher's hometown was located. In one journal picture, one 3-year-old, one five-year-old, and one six-year-old teamed up to study the function of the human body using an Anatomical Model in a cyclopedia book.

- Showing perseverance in the learning process. Children who had shown low interest in learning when they just transferred to the NM class, started to dedicate longer time to completing work, showed more confidence in taking on challenges, and were more persistent when facing obstacles. They offered to look for a solution by themselves instead of waiting for the adults to help.
- Being autonomous. Some children autonomously assign work for themselves that requires persistence, especially in writing and math. After the children joined the NM classroom for a few months, it became a usual scene for the teachers to observe children autonomously choose challenging academic tasks and complete them in high quality or beyond the teachers' expectations. In her journal, one of the teachers who used to teach in the traditional way recorded a Montessori four-digital multiplication presentation she gave to a group of six-year-old girls. At the end of her journal, she wrote: "The children

proved to me that whenever we are willing to give them more knowledge, they are always able to take it!" The children often asked the teacher to give them permission or support to do more language or math work. An impressed mom told the researcher, "Today my son not only did the homework all by himself, but when I went upstairs to check him out, I was so surprised to see that he was working on a math game I had bought him a year ago, but which he never touched before!"

Another intervention used to foster the children's non-cognitive skills is honoring their autonomy. Instead of assigning homework to the children, the NM teacher builds "ownership" of the assignment to the children with a guideline. For example, the teacher would decide on the minimal amount of homework, such as "finish at least ten subtraction questions." At the same time, the students were allowed to choose the ten questions from the question box by themselves." To the teachers' surprise, the children who "resist doing homework or activities that involve reading, writing, or math, or consistently can't complete homework assignments without significant help" (a symptom of learning disorder according to the CDC website) became passionate about doing academic tasks such as math and writing.

2. The development of creativity

Creativity is a non-cognitive skill that is defined as the production of novel and useful ideas. Contemporary researchers generally agree that most individuals are capable of creating creative work in some domain (APLNexted.com). Montessori-guided teaching principles in the NM environment nurtured a culture for students to feel comfortable making errors while exploring. Research proved that when children fear failure, it kills the children's creativity and

weakens their risk-taking ability. Self-correction functions designed in most of the Montessori materials and working procedures allow the children to gain knowledge of the fundamental concepts and build up creative thinking abilities independently. At the same time, well-designed theme lectures deliver a broad perspective and global vision to the children, helping them build up a well-rounded personality and wisdom.

In one case, the teacher noticed that one 6-year-old boy had figured out his own self-designed procedure for laying out the one-hundred-board after conducting plenty of repetitions. He laid the tens first on the right side and then organized the remaining numbers in order along each line. This demonstrates a higher level of logical thinking and creativity. In these cases, perseverance performed a critical role in developing cognitive and non-cognitive skills. In another case, three six-year-old girls challenged themselves to make a rule for locating a randomly-drawn number on the Montessori "One-hundred-board" which helps children to grasp the order of numbers from 1 to 100. All of these children showed significant confidence in their creative attitude. The respectful and supportive culture of the NM classroom had nurtured the children's confidence, which in turn, laid the foundation for their creativity.

The types of creativity demonstrated by the children in the NM class were diverse. Sometimes it was a discovery, such as noticing the structural patterns of Chinese characters and using that finding to boost the speed of learning vocabulary. At other times, it was a new way of thinking or a unique perspective on the world, just as a boy used his artistic skills to express his understanding of his learning, for example:

- He turned a fire drill at school into a drawing. When his mom asked why he was so interested in drawing all kinds of "violent" scenarios, he told his mom he wanted to make

the scene look as dangerous as possible so that people would take it seriously, for the hope they would be more cautious and not take unnecessary risks;

- He used his artistic skills to communicate his concern about social issues (e.g., he created a drawing called “protecting the earth”);
- He made social connections with people he cared about (e.g., he made a paper bouquet for his teacher on Teacher’s Day, and a birthday card for his grandpa; he made paper models for his playmates; he made a paper purse for his mom which had the weather report inside.

In the parents’ interview, parents, who mostly had just completed junior-high educations, reported how amazed they were when they heard their children using big words or scientific terms in their daily-life conversations. The parent of the two and a half-year-old wrote in the family CBC log “Even though my son is the youngest in the class, he has made a tremendous improvement since he joined the project. It seems that he has learned a lot from his older peers. I’m constantly surprised and impressed by what he talks about.” The parents were so impressed because they would never imagine that a 3, 4, 5, or 6-year-old village child could understand such significant terms or have such sophisticated thoughts.

Case study - the evidence of the development of creativity

- *Picture 1:* Right after a Montessori-inspired theme lecture on “Living and Nonliving things (生物与非生物），” the teacher documented the case of a 6-year-old girl who came up the idea to make a chart of “Living and Non-living things.”. This shows a high level of abstract thinking, which is a fundamental ability of the creative mind;

Picture 1 *A Child's Creative Work Inspired by NM Theme Lecture:*

"Living And Nonliving Things"

- A girl's mom shared in the parent's conference: "When we were watching a news report about damage caused by a severe flood, my daughter, on observing cars being whirled away by the water, claimed that "we should design cars that can fly, so when there is a flood in the future, the car can fly up and escape the risk."
- The mother continued, "One day, when my daughter was helping me with housework, she told me that when she grew up, she would invent a robot to help me with the housework. She said her robot would also be able to help the doctor to do surgery. But then she said something that amazed me. She said her robot would definitely be wireless and charged with green energy. She explained that a wireless robot surgeon would be safer than a robot connected to a cord, because it wouldn't be affected if the power went off in the middle of the surgery, 'That would be fatally dangerous,' she said." (The green energy idea connects to the theme lectures in environment protection and green energy).

Addressing the development gap

The development of executive function

Laying out an effective way to foster children's Executive Functions (EF), is the key to address the challenge of the development gap. This is because children's Executive Function status is the indicator of their non-cognitive abilities and therefore decides the quality of the children's short-term and long-term academic development results (Tough, 2012; Barkley, 1997, 2001; Barkley & Fischer 2011). Children with challenging behaviors need to repeatedly strengthen their executive function by practicing it in meaningful work. The Montessori-guided NM environment in this study intends to create an optimal learning environment that can fulfill this developmental need of children. The data analysis done in an earlier section suggested that a Montessori-based environment, equipped with learning materials that can fulfill the children's academic development needs, played an essential role in helping children develop a positive executive function. However, in addition to providing a well-prepared classroom environment, the adults were also instructed to follow the four principles of "Respect, Belief, Autonomy, and Independence" for adult-child-interaction summarized by this researcher, based on the Montessori philosophy. These teaching and parenting principles are meant to fully satisfy the children's psychological development needs.

From the beginning of the research, these four terms have been used to analyze the causes of children's challenging behaviors, formulate a Montessori-guided treatment plan for both teachers and parents, and guide the teachers' and parents' practice. "Respect" means conducting positive interactions with children, i.e., respecting them as individuals with dignity. This principle requires that adults interact with children as respectfully and equally as they do with

other adults. The focus of "Belief" requires the adults to believe every child has unique potential and is born as a qualified and efficient self-learner. The principle of "Autonomy" requires the teacher and parents to respect the children's right to be autonomous, which means instead of having the adults make decisions for the children, the adults should observe and follow the children's needs for self-learning and give the children a choice for when and how to learn, work, and play whenever it is possible. The principle of "Independence" informs the final goal of teaching, which is helping children to gain the cognitive and non-cognitive skills to become individuals who can think and act independently.

The intervention of helping children to improve their executive function is a comprehensive approach that combines elements of a Montessori-based environment, Montessori-guided teaching, and parenting methods. The following case studies will demonstrate how the intervention of this research worked and will identify some of the indicators that demonstrate changes in the children.

Case study - A boy who suffered a strained parent-child relationship.

Boy A's grandma registered him into the pilot program after learning about the environment's Montessori method, hoping it would help cure her grandson's deviated behaviors. When boy A first attended the class, he showed little interest in learning and social interaction. During the theme lecture, he would sit on the floor instead of on a chair as the rest of his classmates did and seemed to pay no attention to what the teacher talked about. He was also not willing to interact with his peers. His mom reported that he was the same at home. Because his parents worked in distant cities, the significant caregivers were his grandparents. He could only

see his dad a few times a year and the mom most of the time only once a week. Also, the relationship between the child and parents was on the edge of breaking due to a lack of effective parenting. The mom had ended her weekly home visit with mixed feelings of frustration, regret, and helplessness. Mom's conduct not only did not help solve the problems but also pushed their relationship to a more tense level.

The Self-motivated Work Interventions were used to help the caregivers to gain confidence in their child's potential by guiding them to "discover and appreciate" boy A's strengths and the work he was passionate about, so the caregivers could transform their focus from trying to "fix" boy A's misbehaviors to making an effort to strengthen the unique abilities boy A had. Based on the Montessori principle of "letting the child lead", and assisted by the teacher on-site, the researcher found boy A's interests were in the artwork. Via artwork, the researcher guided the teacher to build a positive relationship with the child first. Then utilizing a mixed-age environment, the teacher helped boy A build positive interactions with his peers. At the same time, the mom started to notice the positive behavior changes boy A showed, e.g., she was very touched when her son, for the first time, left a voice message to her on his own, telling her he was looking forward to her weekly home-visit. This, in turn, motivated the mom to want to learn more Montessori-based parenting methods from the researcher so she could practice them at home. Via the Conjoint Behavioral Consultation (CBC) method, the researcher built up a daily communication system with the mom, so she could report boy A's behavior improvements at home as well as her own parenting practice.

Picture 2 *The Candy Trains Drew Before the CBC Intervention*

Ever since the CBC system was set up, boy A's behavior and personality showed continual positive transformations. There was evidence of both cognitive and non-cognitive improvements. When the CBC system was just established, Boy A's mom shared a series of drawings he did. The drawing skills and the content of the sketches demonstrated that as a child of four years and ten months, his cognitive level might reach the average range according to the mainstream standard. However, according to the Montessori standards, it was very clear the child's real potential had not fully developed yet. At the same time, when the mom asked the boy in the video what his drawing was about, he had difficulty responding to the question besides confirming that what he drew was trains. Eventually, he accepted his mom's suggestion and gave the name "candy train" to his picture. This also showed that boy A's non-cognitive ability of critical thinking, social skills, and creativity needed to be developed. Three months later, the mom showed another series of drawings he had done inspired by the content he learned from theme lectures in the Montessori-based class. The videos showed that he had used more sophisticated techniques and that his critical thinking skills had improved. He could clearly describe all the details of time, location, and situations he presented in his pictures.

Picture series 3 - *Boy A's Drawings After the CBC Intervention Had Been Conducted*

Picture 3-1: *Travel by High-speed Train*

This chalk drawing demonstrated a high-speed-rail trip Boy A had with his parents. The mom took a video of him explaining all the details he sketched in his drawing. The topic of his picture was inspired by a NM theme lecture he learned at school titled "transportation tools." The train was running across a viaduct into a tunnel in the picture. He added other types of flying vehicles in the sky. He drew snowflakes in his picture, even though they had traveled on a warm spring day. But obviously it reflected what he had learned in another NM theme lecture named "Knowing the weather". Different from the "candy train" he drew several months ago, this drawing exhibited a more mature, conscious, and realistically-engaged mind. The content of the picture also indicated that he had become a devoted learner at school. All of a sudden, he seemed to have found his passion for learning. Under the instruction of the researcher via the CBC approach, the mom's active involvement accelerated the change in a dramatic way.

Picture 3-2 *First Drawing of An Airplane*

The boy's drawing skill improved at a surprising pace. His drawing in Picture 8-2-2 suggested that his non-cognitive development seemed to help pave the path of his cognitive development.

Picture 3-3 *The Scenery of a Crash Landing*

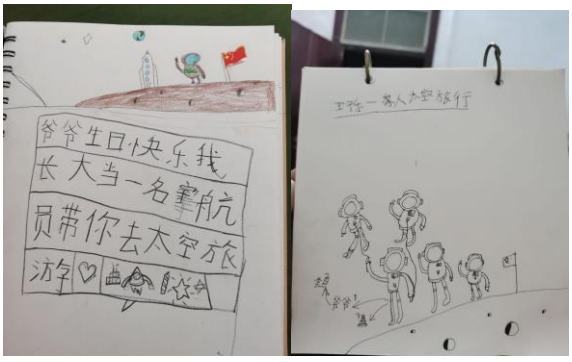
After taking the theme lecture "Travel around the world by air," he asked his mom to find more videos about airplanes. This confirmed that he was an active self-learner. He was quite impressed by a video about the successful emergency landing of a commercial aircraft. He drew the scene with essential details, such as dropped oxygen masks hanging over the airplane windows and a zoomed-in frame showing how the captain pulled the emergency brake (a sequence he may have learned from the encyclopedia books he read in the classroom library). Another month later, he drew a series about the installation of wind turbines, which included the procedure from transporting the parts of the turbines to the location in the mountains, the installation, and the completed turbines standing on top of the mountains using perspective to reveal the distances of near and far objects. One day, when his mom took him to watch a movie about firefighters, she was amazed that he sketched the scene in the film in the dark on the sketchbook he brought with him.

As he gradually gained confidence through his strong and passionate work in art, boy A was also making significant progress in self-motivated learning in academic areas, aided by the sophisticatedly-designed Montessori materials. He also improved his social skills with peers. At the end of his second semester in the NM classroom as the topic of the Montessori-inspired theme lectures transitioned into more scientific subjects, boy A's interest in science increased. He started to conduct scientific experiments, launch water rockets, and build mini-power stations

in the yard at home. More impressively, boy A built up his leadership skills among his peers as time passed.

At home, the parent-child relationship was completely transformed. Mom and son became best friends, as the mom claimed. Boy A's dad started to participate in parenting work regularly using online communication tools. Meanwhile, via the theme lecture, the boy became highly interested in aviation. One day after his mom helped him explore the topic of the moon, he told his mom that he would become an astronaut one day and bring her rocks from the moon and Mars as gifts. On his grandpa's birthday during the third semester, boy A drew a birthday card for his grandpa and promised in writing that he would take his grandpa on a space trip when he became an astronaut. When dad, mom, and grandma all requested to join the trip, he drew another painting to add them all in. When there was not enough space on the "ground", he came up with the solution to connect mom and grandma to a safety rope and let them "fly" in the space. These incidents all show that boy A had attained a high level of non-cognitive abilities in creativity and social skills.

Picture 3-4 *A Determined Future Astronaut*



Picture 3-5 *A Responsible Global Citizen*

The most significant evidence of boy A's change was that he gained more and more profound thoughts that sometimes seemed beyond his age level. After taking a theme lecture

about “garbage sorting,” boy A drew a picture that included a spaceship, a radio telescope, the earth (all of these subjects were from theme lectures taken in the class), a smiling face, and a crying-face. He told his mom the smiling face represented his happiness when he was able to take the spaceship to outer space to observe the stars. However, when he got to outer space and looked down, he saw Earth fully covered by garbage and cried. He asked his mom to teach him to write “protect” under the earth he drew.

The benefit of a Multi-age environment in fostering autonomous work and free communication

An analysis of the teachers’ journals (see Picture 8-4 and Picture 8-9 below) proves that the learning model in the NM classroom significantly increased the children’s self-motivation toward independent learning. One of the unique characteristics of the Montessori-based class is its multi-age environment supported by the principle of autonomous work. In the NM classroom, the children had at least two hours of self-directed work time in the morning. During this time, children were free to pick tasks according to their own will and interest. This freedom included choosing what to work on, who to work with, how long to work for, and where to work. They could walk around the classroom and communicate with peers freely. Children learned from the teacher’s one-on-one or group presentation, and they also learned through observing peers’ working processes or the teacher’s presentation with other peers. Sometimes children made up a learning team spontaneously when they discovered mutual learning interests. However, a lot of the time the children simply learn by manipulating the materials and using the self-correction function embedded in the Montessori materials to improve their skills and accomplish their self-learning process based on their autonomous needs. No matter which kind of learning method the

children took, their choice was spontaneously inspired by the environment combined with their own interests as learners. Besides giving planned lessons for the core courses, one-on-one or in small groups, most of the time the teachers walked around the classroom to give guidance or support whenever required by the children or whenever they thought it was needed. The teachers' photo-journals showed:

- A 5-year-old practiced spelling with a 6-year-old;
- A 5-year-old taught a 4-year-old the formation of two-digit numbers, 11-99;
- A 4-year-old, a 5-year-old, and a 6-year-old learned about human anatomy with the teacher. (This type of learning team was formed spontaneously. One child asked the teacher to present the lesson, while other children were attracted naturally because of curiosity.)
- A 4-year-old taught a 6-year-old how to do the Addition-Snake game, a Montessori math learning activity for addition. The teacher wrote in her journal:" I was teaching the 4-year-old Addition Snake-game, she grasped the game rules after observing my presentation. The 6-year-old showed interest and observed the presentation. When the 6-year-old mentioned that she wanted to learn the game too. I encouraged the 4-year-old girl to be the 'teacher' for the 6-year-old. The little teacher was very patient and presented the game procedure in a very professional manner."
- A 4-year-old guided a 2-and-half-year-old to feel and learn the moveable alphabet, a Montessori learning tool for teaching spelling;
- A 6-year-old showed a 2-and-half-year-old how to build a Roman Arch Bridge. Both children were new to the environment; one was the oldest of the class, while the other was the youngest. In her journal the teacher mentioned that the older child voluntarily took responsibility to take care of the younger child on the first day of school. The teacher wrote "when the older boy saw the younger child was crying because this was his first day of school, the older boy came over and offered to take his younger peer to go play. After I asked the younger boy's permission, they went away together happily."
- A 6-year-old taught a 3-year-old to build the Binomial Block. Usually, the younger ones are more willing to learn from their older peers. This method of learning might reduce pressure on children. The journal photos and the teachers' descriptions confirm this peer-teaching format leads to a harmonious learning experience for both children, which improves the children's social

ability. When teaching, the older child not only has the opportunity to review her mastery of the task but also strengthens her leadership skills and builds up her confidence.

- An older brother taught his younger brother to work on Cylinder Sets. The older brother had been in the environment for three semesters, while the younger brother had just joined the program. Learning together in a formal education environment provided siblings from the same household a unique experience as a family;
- A 5-year-old and a 6-year-old made a partnership to learn division, then they took turns to practice. They decided to take turns rather than fight over who would go first, which reveals a high degree of social skills.

The multi-age learning environment of the NM classroom also provides children with a real-world social experience daily, which helps to improve children's non-cognitive abilities, which in turn leads to an effective solution for addressing the development gap. First of all, unlike the traditional single-age classroom, the learning materials prepared in the NM classroom are for multi-age development needs. Secondly, the individualized curriculum of the NM class is conducted according to each child's own learning pace, which also fulfills the different learning needs among children of the same age. These two arrangements guarantee children of all ages the opportunities to develop their full potential so that no one could be left behind. For examples, from the teachers' journals draw a brief picture of what this researcher observed as following:

- After observing a 6-year-old peer practicing drawing concentric circles (6th-grade elementary math) using a compass, a 4-year-old girl was inspired to do the same task using her own compass. When the older girl noticed her younger peer didn't know how to do it, she then volunteered to help the younger one and did it patiently.
- A 4-year-old boy imitated his older sister's use of the compass.

The third benefit the intervention of this study provided to these village children was the top-level development resources that the mainstream system cannot deliver. For example, the

hands-on Montessori math learning materials have been proven to help children learn abstract math concepts easily and at a younger age than the mainstream recognizes. Especially when these learning materials are supplied in a multi-age environment, their effectiveness is multiplied. The most common views seen in the NM classroom that highlight the unique benefit of a Montessori-guided environment were observed by the teachers as follows:

- On 04/2021 Boy A (4 years and 3 months old at the time) observed a 5-year-old working on a Montessori addition-board for practicing addition with addends from 1-10.
- On 03/2022, when he was five years and two months old, he was recorded doing his math work independently.
- Also, as a 4-year-old, the same boy was seen learning the structure of the decimal system with a four-digit number (1111) while he observed his same-age peer getting a presentation. During the same period, the learning goal the school set for his peers in the traditional classroom was being able to recognize the numbers 1-10.
- The boy's mom shared in her interview at the end of the first semester, when her son was 3 years old, "My 10-year-old daughter has been very impressed by what her younger brother learned at school. She said 'I can always learn something new every day from my brother.' One day she came home from school and told me that she had had a test at school that day. There was one question she couldn't answer at first, but then she remembered a conversation she had with her younger brother which helped her find the answer to the test question." This means some of the academic ability the children gain in the NM classroom has reached or even surpassed the 3rd-grade-level of the mainstream public education system.

A mom of two siblings, who both studied in the NM classroom, reported that she tested her 3-year-old son at the end of the first semester, and she "was surprised that he remembered almost all the content his older sister had learned on the NM theme lectures!" At the end of the third semester, when the boy was around 4, the mother reported that even though she never required her son to do any homework as other parents did, to her surprise again, "when his dad came home for the holidays, the son volunteered to read his textbook to his dad. And he actually read the whole 30 pages (which proved that he had learned all the characters taught at school)". Because he is in a multi-age classroom with his older sister, this means that he had reached the same academic level in language as his 6-year-old peers, at the age of four. The boy's mom is the teacher's assistant in one of the traditional classes of the same preschool. She told the NM teacher, "Compared to the children in our class, I have no doubt that my son has a much higher academic development level."

The analysis of the development gap

The Learning assessment of this research covers five aspects: Listening and Communicating; Reading; Writing; Math; and Non-verbal Communication. The questions are as follows:

Listening and communicating

Is the child able to

- Follow instructions?
- Express feelings?
- Have a basic rational conversation with adults?

Reading

Does the child fail to

- Read at a typical pace?
- Understand what they read?
- Recall accurately what they read?
- Make inferences based on their reading?
- Spell correctly?

Writing

Does the child exhibit:

- Slow and labor-intensive handwriting?
- Slow and labor-intensive pen holding activity?
- Handwriting that is hard to read?
- Random, disordered patterns in drawing?
- Difficulty putting thoughts into writing?
- Difficulty putting thoughts into logically expressed sentences for a general conversation?
- Written text that's poorly organized or hard to understand?
- Poorly-organized expression?
- Trouble with spelling, grammar, and punctuation?

Math

Does the child have difficulty in

- Understanding how numbers work and relate to each other?
- Calculating math problems?
- Memorizing basic calculations?
- Using math symbols?
- Understanding word problems?
- Organizing and recording information while solving math problems?

Non-verbal skills

Does the child have difficulty in

- Interpreting facial expressions and nonverbal cues in social interactions?
- Using language appropriately in social situations?
- Physical coordination?
- Fine motor skills, such as writing?
- Attention, planning, and organizing?
- Higher-level reading comprehension or written expression?

Figures 9-1 to 13-2 demonstrate the analysis of these five areas. The charts showed positive behavioral changes when the assessment was conducted. Because the five aspects in this assessment section are related to academic learning skills such as reading, writing, and math, considering the multi-age population in the NM environment, the data analysis of this section involved more variables than the other three categories, and thus may require continued study in future.

Take the example of writing and reading. The Montessori education system has higher reading and writing ability standards than the traditional preschool standards. The Montessori standards are summarized as Comprehensive Reading and Creative Writing. This means that after having studied in a Montessori-guided preschool program for at least three years, most children would be able to write narrative stories, know how to write science reports in a basic format, and know how to do sentences analysis. Teaching reading and writing in preschool is not encouraged in China, because the government has concerns about adults putting too much pressure and too great a workload on young children. This sort of pressure has led to some concern among mainstream educators about the negative impacts on children's psychiatric

development in general. However, these concerns relate to the teaching approach based on the traditional mainstream principles. When we were using the Montessori-guided approach to teach language, we observed the same phenomenon that Dr. Montessori saw more than a century ago. Children seem to have a natural passion for reading and writing from the ages of three to six. Teachers' journals recorded many moments during the school years in which children of different ages autonomously chose to work on the pre-reading and writing self-learning materials Dr. Montessori and her team designed, such as three-period-lesson cards (a type of picture cards for learning specialized vocabulary), and sand-paper alphabets and movable alphabets. In one journal, a teacher wrote about a child who "asked me to give him a piece of paper He said he wanted to practice writing the Chinese characters the class had just learned in the theme lecture. While he was doing his writing, it drew another boy's attention, so his peer joined him. They enjoyed the writing so much that, after they finished one piece of paper, they asked for more paper. Eventually, each of them finished writing three pieces of paper! They looked thrilled and proud of themselves." In another journal, the teacher recorded a boy who suddenly had such a strong passion for writing that he took his writing book with him during the outdoor recess. When the other children were playing in the sandbox, he sat on the side of the sandbox doing his writing practice concentratedly. Another student noticed what this boy was doing and asked the teacher if he could do his writing too. Children in the other examples listed in this paper and in the teachers', journals also provided strong evidence that the NM intervention had inspired children's interest in language learning and strengthened their abilities. Children in the NM classroom not only know how to write the characters, but most importantly, they are able to use high-level vocabulary, do effective communication, and express deep thoughts. The reports from

parents who had been surprised or impressed by their child's ability at self-expression provided reliable evidence about the quality of change the NM intervention had accomplished with the children.

In the NM classroom, children gained improvement either through a self-learning process or through the guidance of teachers. At the same time, there was clear evidence showing that each child accomplished their behavioral transformation process at their own unique pace. That is to say, when observing the journal pictures along a weekly, monthly, or yearly period, the pattern shows that each child in the class became a perseveringly concentrated learner at different transforming times via diverse Montessori tasks. Everyone had their path of the "normalization" process, yet the evidence is clear that all the children had been making progress at different levels. The teacher's journal showed how much two 4-year-olds enjoyed their math learning process: "During today's free work period, two 4-year-old girls took a math presentation from the teacher - The Introduction of the Decimal System. Both of the girls were highly interested in the lesson. They followed the instructions throughout the whole process and showed a clear understanding of the concepts of thousand, hundred, ten, and unit. When they completed the "magic slate" and formed the number 1111 together, they enjoyed it so much that they couldn't help clapping their hands and cheered, 'It's so much fun!'"

Another group of journal pictures give a whole concept of a 3-year-old's diverse learning experiences. In the pictures, a 3-year-old was observing his older brother learning fractions fully engaged. Fractions are sixth-grade-level math according to the Chinese public school curriculum. In another photo, he was building the Binomial blocks.

a. Analysis of changes in Listening and Communication abilities

Figure 9-1 *Listening and Communication Ability-change Before and After by Individual Child*

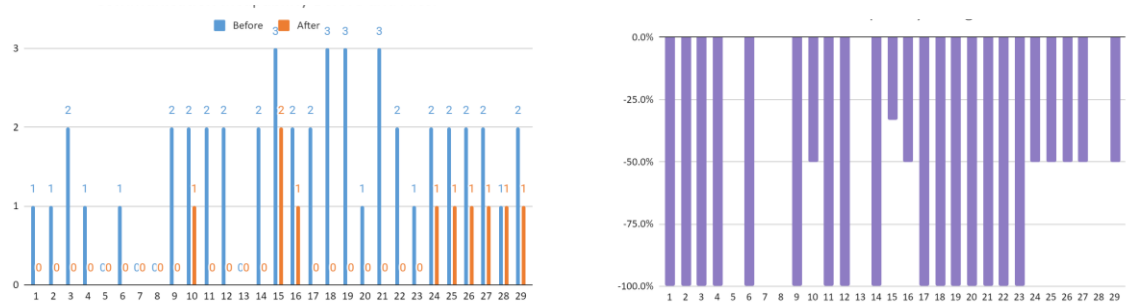


Figure 9-2 *The Mean of Learning Disorder Symptom-change Before and After by The Whole Group*

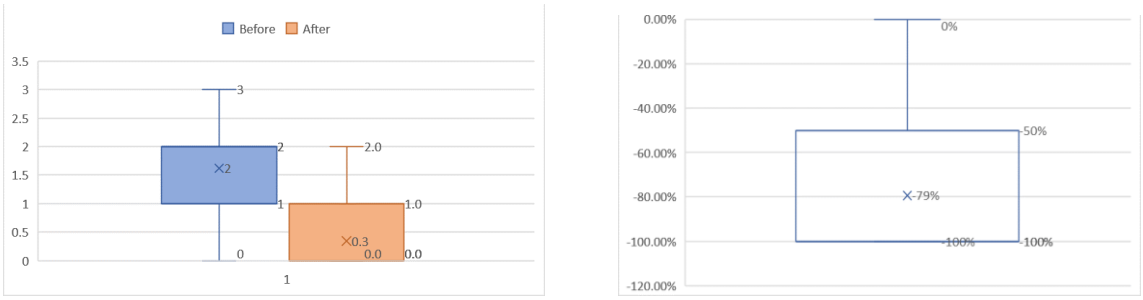
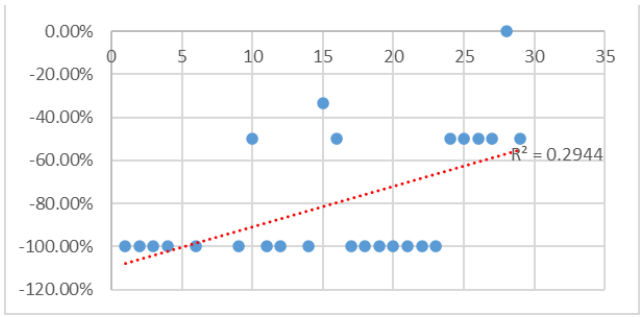


Figure 9-3 *The Correlation Between Time Length in The NM Program And The Change of Listening and Communication Abilities*



b. Analysis of changes in reading skills

Figure 10-1 *Learning Disorder Symptom-change Before and After by Individual Child*

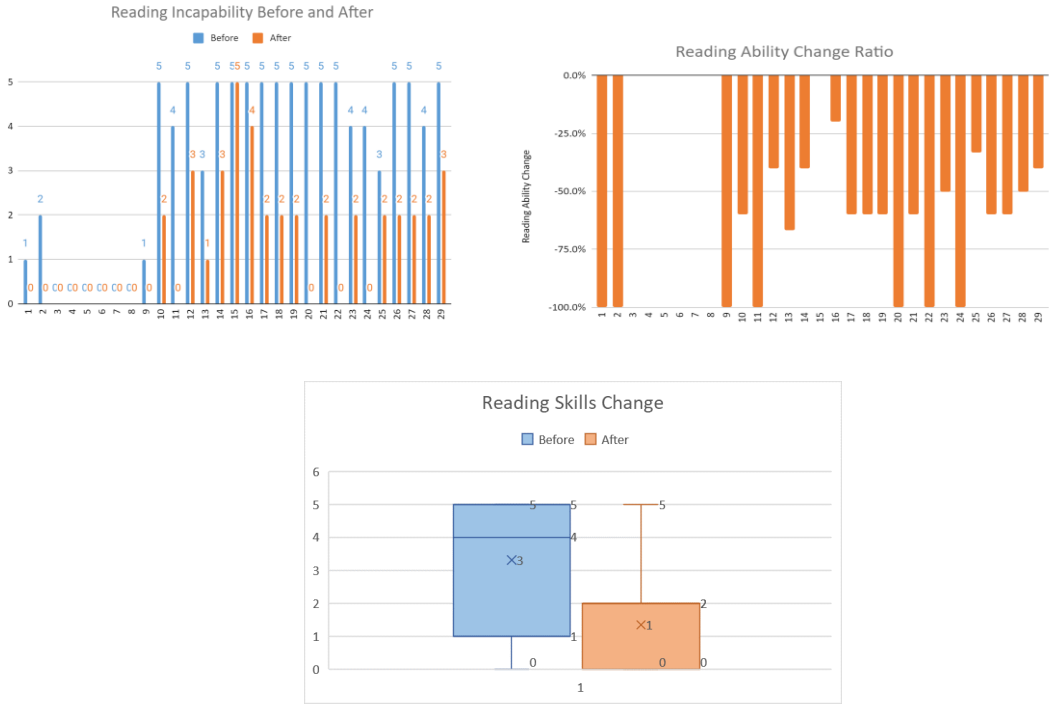
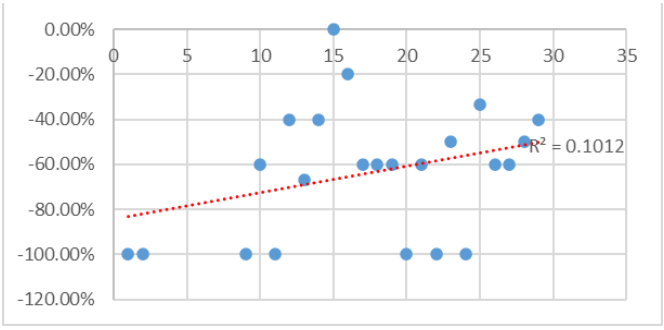


Figure 10-2 *The Correlation Between Time Length in The NM Program and The Change of ADHD Symptoms*



c. The change analysis of writing abilities

Figure 11-1 *Writing Incapability Change Before and After by Individual Child*

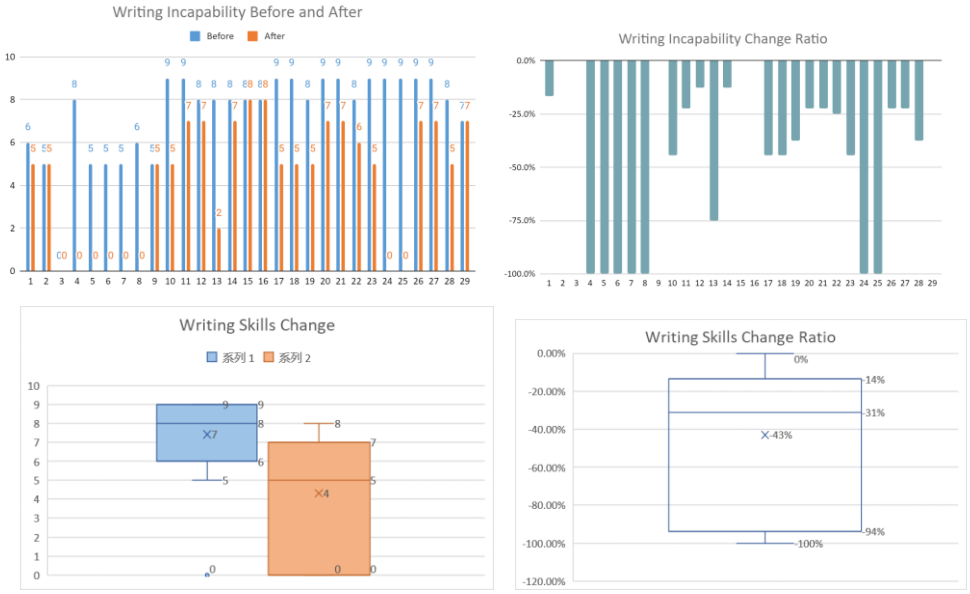
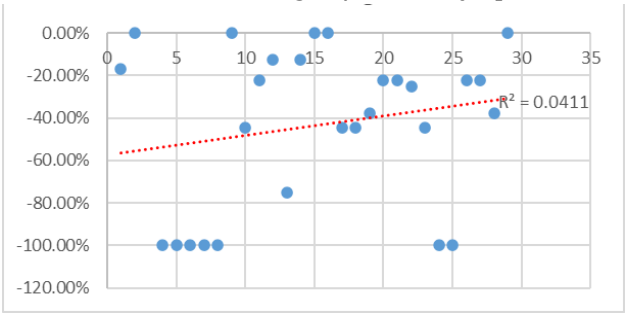


Figure 11-2 *The Correlation Between Time Length in The NM Program and The Change of ADHD Symptoms*



d. Analysis of changes in mathematical abilities

Figure 12-1 *Analysis of Changes in Mathematics Skills by Individual Child*

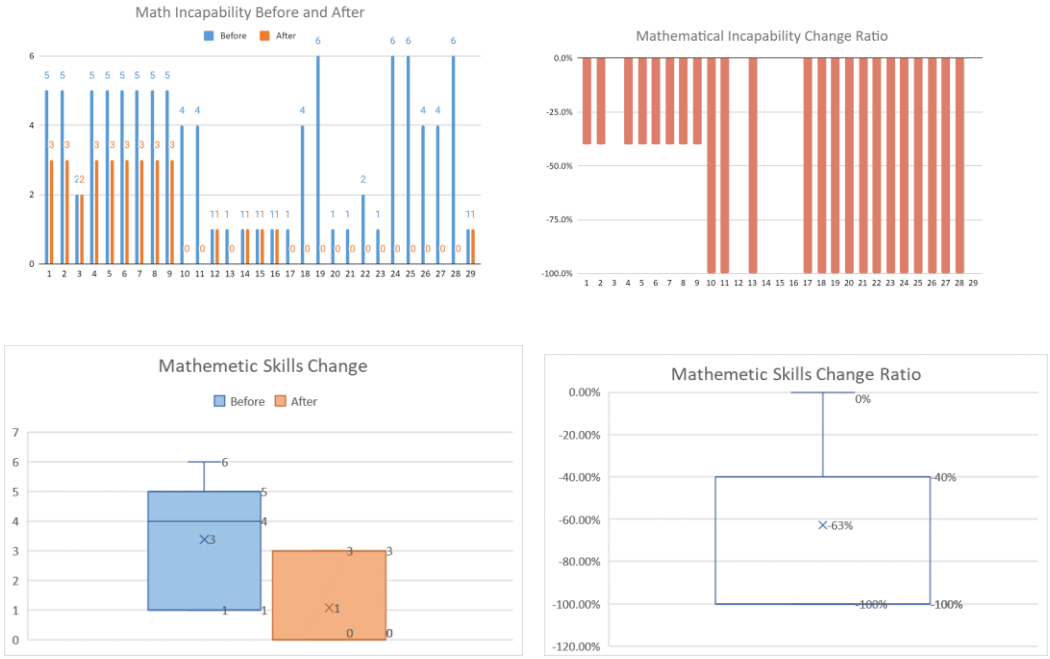
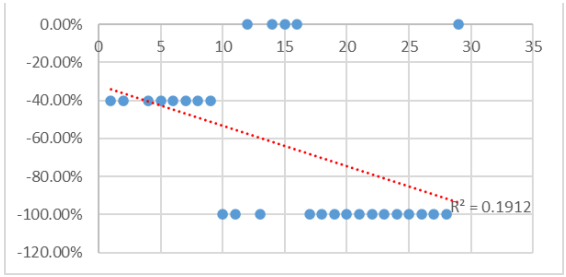
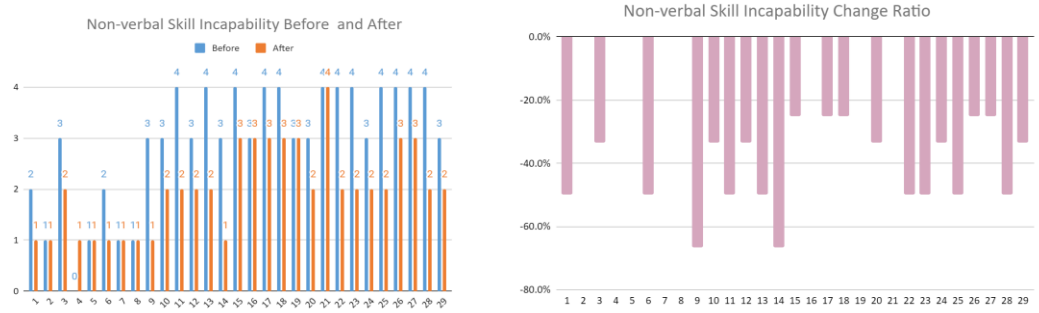


Figure 12-2 *The Correlation Between Time Length in The NM Program and Changes in Mathematics Ability*



e. Analysis of changes in non-verbal communication

Figure 13-1 *Analysis of Changes in Non-verbal Communication Ability by Individual Child*



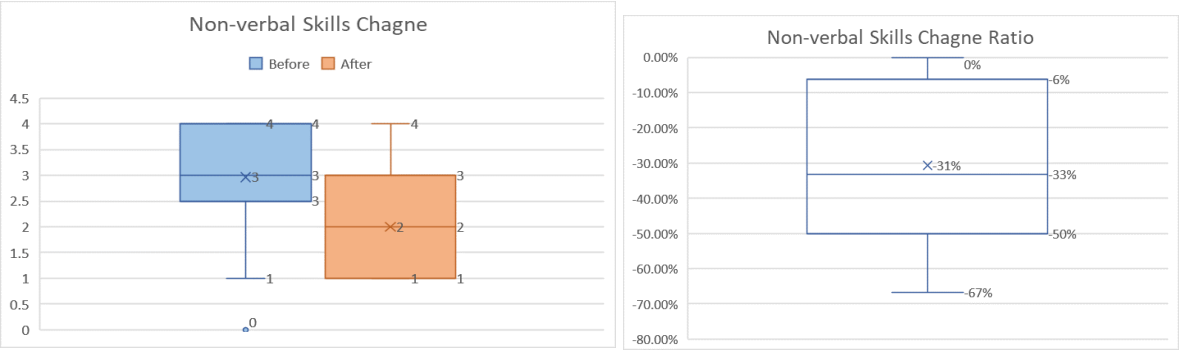
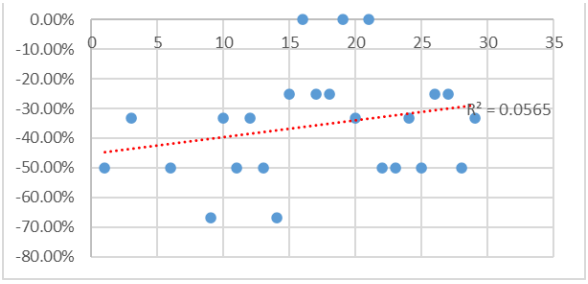


Figure 13-2 *The Correlation Between Time Length in The NM Program and Changes in Non-verbal Skills*



Conclusion and recommendations

The teachers' journals, the parents' reviews, and the analysis of the assessment statistics all provide considerable evidence to prove that the result of this research is significant. The intervention of this research recognized that "improving children's non-cognitive skills and executive function" is the core solution to transforming those with challenging behaviors into productive self-learners. The evidence confirms that the above conclusion is likely the reason for the positive results. By introducing a Montessori-based learning environment and Montessori-guided education methods to a preschool classroom in a rural Chinese community, this research

intended to test the hypothesis that “closing the opportunity gap” was the primary step to closing the development gap between children living in rural China and their city peers, using a series of effective parenting and teaching approach. When comparing children’s changes at the beginning and after they had attended the NM classroom, the data strongly confirmed that the Montessori-based environment and curriculum intervention gave the children in rural China an opportunity to discover their full potential. Participating in the program also helped these children obtain academic achievements equivalent to or more significant than most of their city peers or peers who study in the mainstream curriculum or higher grades. The children exhibit more sophisticated critical thinking abilities. They are capable of finding new or creative ways to solve problems or confront challenges in their learning process independently. The Montessori-based learning materials and teaching method supported, encouraged, and inspired the children’s autonomous interests in learning. Gradually, the learning metaphor in the NM classroom has transformed from teacher-led to child-led self-learning format. For example, the children frequently surprised the teacher with new thoughts or discoveries while taking an NM theme lecture or working on Montessori-guided materials. The teacher would then catch the interesting point the children had newly found and provide an extension lesson at this moment. The results of these simultaneous lessons were always beyond the teacher’s imagination. At the same time, instead of taking assigned homework from the teacher, children in the NM classroom had become the ones who structured their learning tasks autonomously and independently. Typically, in an NM classroom, very often, the teacher reported a child asking the teacher’s permission for him or her to do more writing practice. Or the teacher wrote in her journal about observing a child or a group of children working on a math project for days by their own will.

Even though there is strong evidence confirming that the Montessori-based intervention did bring significant changes to this group of children living in a rural Chinese community, further research needs to be done to design a universally practical solution to closing the development gap effectively.

Further research may include the analysis of how to build an effective teacher training system and an online teaching support system. The current Montessori-based method, when enhanced with technology, can accelerate the effectiveness of the New Montessori approach. Also, studies need to be conducted to obtain more evidence with a larger sample representing more diverse populations to prove that this intervention is an effective whole-child education solution for all children.

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Appendix A

Individual Assessment

Code: Date of Beginning:

Name		**Gender**	**M / F**	**Age**	**y m**
1. Attending Reason: ● Recommended by the teacher ( ) ● Registered by parents ( ) ● Other ( )					
2. Family Information					
Name	**Relationship**	**Age**	**Occupation**	**Main Caregiver**	**Other Information**
				Y / N	
				Y / N	
				Y / N	
				Y /N	

3. At Home

(Family Interview)

1) Interaction pattern with :
    - Caregiver
    - Siblings
    - Peers
    - Non-family adults
2) Parenting Style:
3) Behaviors at home:
4) Social behaviors:
5) Interest/ Hobby:
6) Strength:
7) Weakness:
8) Caregiver's Concern:

4. Behavior Assessment：

(Family Interview)

1) Diagnose (if there were any)

a) Mental disorder:

b) Physical (special need)

2) Daily observation:

Does the Child -

ADHA

a) Often fails to give close attention to details or make careless mistakes in schoolwork, work, or other activities. Y / N
b) Often has trouble holding attention on tasks or play activities. Y / N
c) Often does not seem to listen when spoken to directly. Y / N
d) Often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (e.g., loses focus, side-tracked). Y / N
e) Often has trouble organizing tasks and activities. Y / N
f) Often avoids, dislikes, or is reluctant to do tasks that require mental effort over a long period of time (such as schoolwork or homework). Y/ N
g) Often loses things necessary for tasks and activities (e.g., school materials, pencils, books, tools, wallets, keys, paperwork, eyeglasses, mobile telephones). Y/ N
h) He is often easily distracted Y/ N
i) Is often forgetful in daily activities Y/ N
j) Often fidgets with or taps hands or feet or squirms in their seat. Y/ N
k) Often leaves seat in situations when remaining seated is expected. Y/ N
l) Often runs about or climbs in situations where it is not appropriate or feeling restless. Y/ N
m) Often unable to play or take part in leisure activities quietly. Y/ N
n) It is often "on the go," acting as if "driven by a motor." Y/ N
o) Often talks excessively. Y/ N
p) Often blurts out an answer before a question has been completed. Y/ N
q) Often has trouble waiting their turn. Y/ N
r) Often interrupts or intrudes on others (e.g., butts into conversations or games) Y/N

Autism spectrum disorder (ASD)

s) Not point at objects to show interest (for example, not point at an airplane flying over) Y/ N

t) Not look at objects when another person points at them Y/ N

u) Have trouble relating to others or not have an interest in other people at all. Y/ N

v) Avoid eye contact and want to be alone. Y/ N

w) Have difficulty understanding other people's feelings or talking about their feelings. Y/ N

x) Prefer not to be held or cuddled, or might cuddle only when they want to. Y/ N

y) Appear to be unaware when people talk to them but respond to other sounds. Y/ N

z) Be very interested in people but not know how to talk, play, or relate to them. Y/ N

aa) Repeat or echo words or phrases said to them, or repeat words or phrases in place of ordinary language. Y/ N

bb) Have trouble expressing their needs using typical words or motions. Y/ N

cc) Not play "pretend" games (for example, not pretend to "feed" a doll). Y/ N

dd) Repeat actions over and over again. Y/ N

ee) Have trouble adapting when a routine changes. Y/ N

ff) Have unusual reactions to the way things smell, taste, look, feel, or sound. Y/ N

gg) Lose skills they once had (for example, stop saying words they were using)

Y/ N

Learning disorder

hh) Doesn't master skills in reading, spelling, writing, or math at or near expected age and grade levels. Y/ N

ii) Has difficulty understanding and following instructions. Y/ N

jj) Has trouble remembering what someone just told him or her. Y/ N

kk) Lacks coordination in walking, sports, or skills such as holding a pencil. Y/ N

ll) Easily loses or misplaces homework, schoolbooks, or other items. Y/ N

mm) Has difficulty understanding the concept of time. Y/ N

nn) Resists doing homework or activities that involve reading, writing, or math, or consistently can't complete homework assignments without significant help. Y/ N

oo) Acts out or shows defiance, hostility, or excessive emotional reactions at school or while doing academic activities, such as homework or reading. Y/ N

5. Learning Assessment

- Listening and communicating - Is the child be able to
  - Follow instructions? Y/ N
  - Express feelings? Y/ N
  - Have a basic rational conversation with adults. Y/ N

- Reading - Does the child fail to

pp) Read at a typical pace. Y/ N

qq) Understand what they read? Y/ N

rr) Recall accurately what they read? Y/ N

ss) Make inferences based on their reading? Y/ N

tt) Spell correctly? Y/ N

- Writing - Does the child exhibit:
  - uu) Slow and labor-intensive handwriting? Y/ N
  - vv) Show and labor-intensive pen-holding activity? Y/ N
  - ww) Handwriting that is hard to read? Y/ N
  - xx) Draw with disorder \ interrupting \ random pattern? Y/ N
  - yy) Difficulty putting thoughts into writing? Y/ N
  - zz) Difficulty putting thoughts into logically expressive sentences for a general conversation? Y/ N
  - aaa) Written text that's poorly organized or hard to understand? Y/ N
  - bbb) Expression is poorly organized / irrelative/ jumping around? Y/ N
  - ccc) Have trouble with spelling, grammar, and punctuation? Y/ N

- Math - Does the child have difficulty in:
  - ddd) Understanding how numbers work and relate to each other? Y/ N
  - eee) Memorizing basic calculations? Y/ N
  - fff) Using math symbols? Y/ N
  - ggg) Understanding word problems? Y/ N
  - hhh) Organizing and recording information while solving a math problem? Y/ N

- Non-verbal skills - does the child have difficulty in:
  - iii) Interpreting facial expressions and nonverbal cues in social interactions? Y/ N
  - jjj) Using language appropriately in social situations? Y/ N
  - kkk) Physical coordination? Y/ N
  - lll) Fine motor skills, such as writing? Y/ N
  - mmm) Attention, planning, and organizing? Y/ N
  - nnn) Higher-level reading comprehension or written expression, usually

appearing in later grade school? Y/ N

6. At School

(Teacher Interview if a transfer student)

1) **Daily behavior:(**please write down the details of the issue)
   a) Following rules: Y/ N
   b) Learning style:
   c) Concentration: strong/not strong
   d) Self-motivation: high/ low
   e) Independence: high/ low
   f) Self-discipline: high/ low
   g) Will: Strong/ not strong
   h) Challenges
   i) Difficulties:
   j) Practical life skills:
   k) Language
   l) Math
2) Social interaction with peers, adults, others
3) Interest

4) Strength

5) Weakness

6) Cases

7. Observation Assessment

(By research team)

Baseline Observation :

1) Is the child interested in books? Y/ N

2) What kind of book? Y/ N

3) How does s/he handle the book?

4) How does s/he behave when having the first-time experience in a Montessori environment:
   a) Can s/he follow the instructions? Y/ N

   Observation:

b) Can s/he watch the teacher's presentation patiently? Y/ N

Observation:

c) How does the child handle the materials? (Coordination) Y/ N

Observation：

d) How is the child's concentration level? Y/ N

i) The frequency of changing work.

ii) The time dedicated to each work

iii) What is his/her most exciting work? How long did the work last?

iv) Was there any work s/he repeatedly did the first time? Y/ N

v) What was his/her facial expression during the work? Concentrated right away/ happy/ distracted

vi) How did s/he react when facing obstacles during work?

vii) How did s/he react when he realized that he made a mist**ake?**

e) How does the child interact with peers in the environment?

Observation:

f) What Montessori work are the child's autonomous choices?

Observation:

- Practical life
- Sensorial materials
- Math
- Language
  - Spoken language
  - Reading
  - Writing
- Drawing
- Other

g) How long does the child work on each set of materials?

Observation:

h) How is hands-brain coordination in general?

Observation:

i) What is the level of persistence, how to react when facing a difficult task?

Observation

j) What is the level of will?

5) General information:

a) Is the child independent? Y/ N

b) Does the child have a strong will? Y/ N

c) What is the child's Strength?

d) What is the child's Weakness?

e) How are the child's practical life skills?

f) Special cases / observation

9. Observation Log

Daily Report Card (DRC)

Observation Log:

- **Date _____**
- **Teacher's Observation:**
- **Director's feedback/ instruction:**