



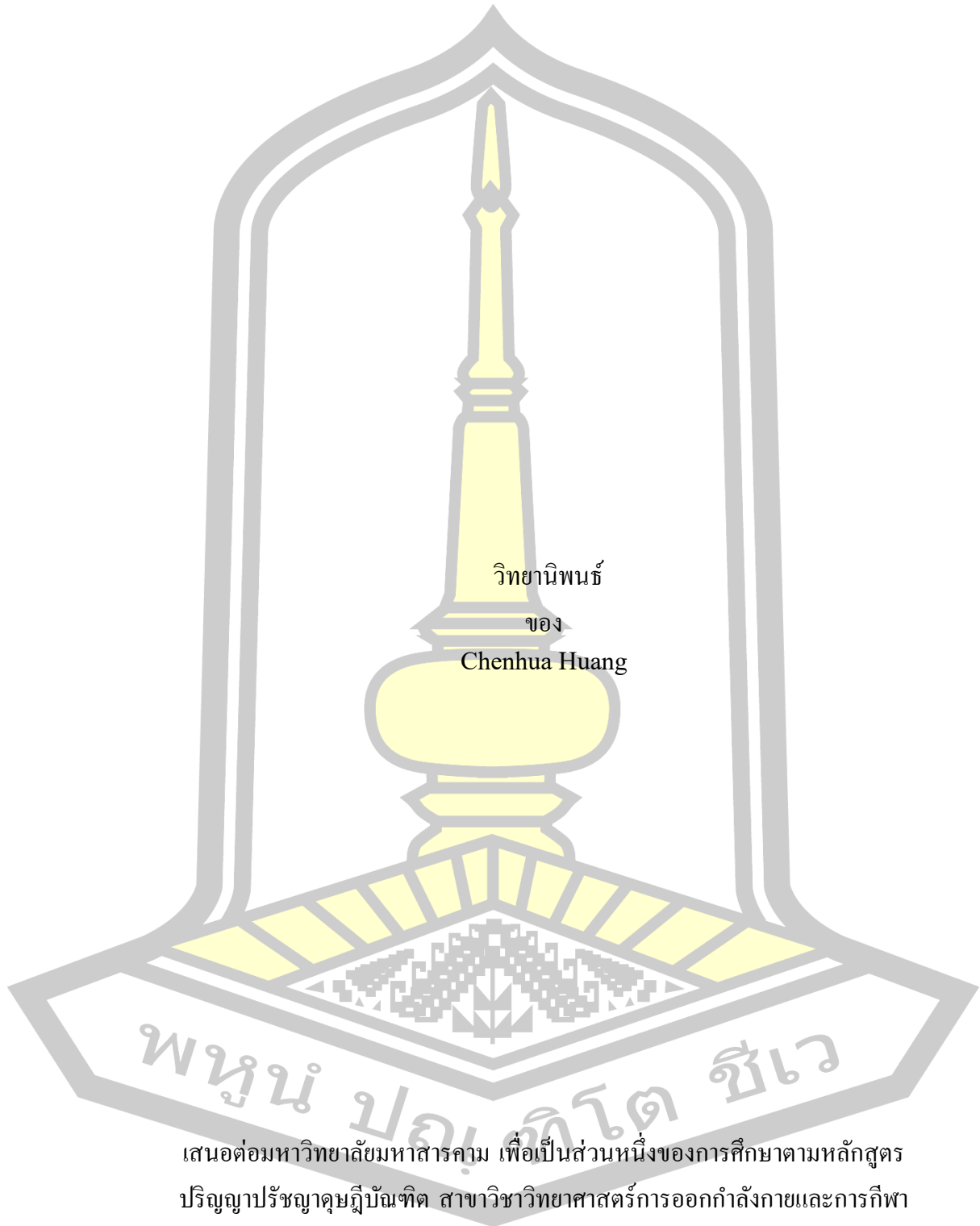
Kids' Athletics Program Development and Promoting for Physical Activity,
Fundamental Movement Skills, and Social-emotional of Chinese Children

Chenhua Huang

A Thesis Submitted in Partial Fulfillment of Requirements for
degree of Doctor of Philosophy in Exercise and Sport Science
December 2024

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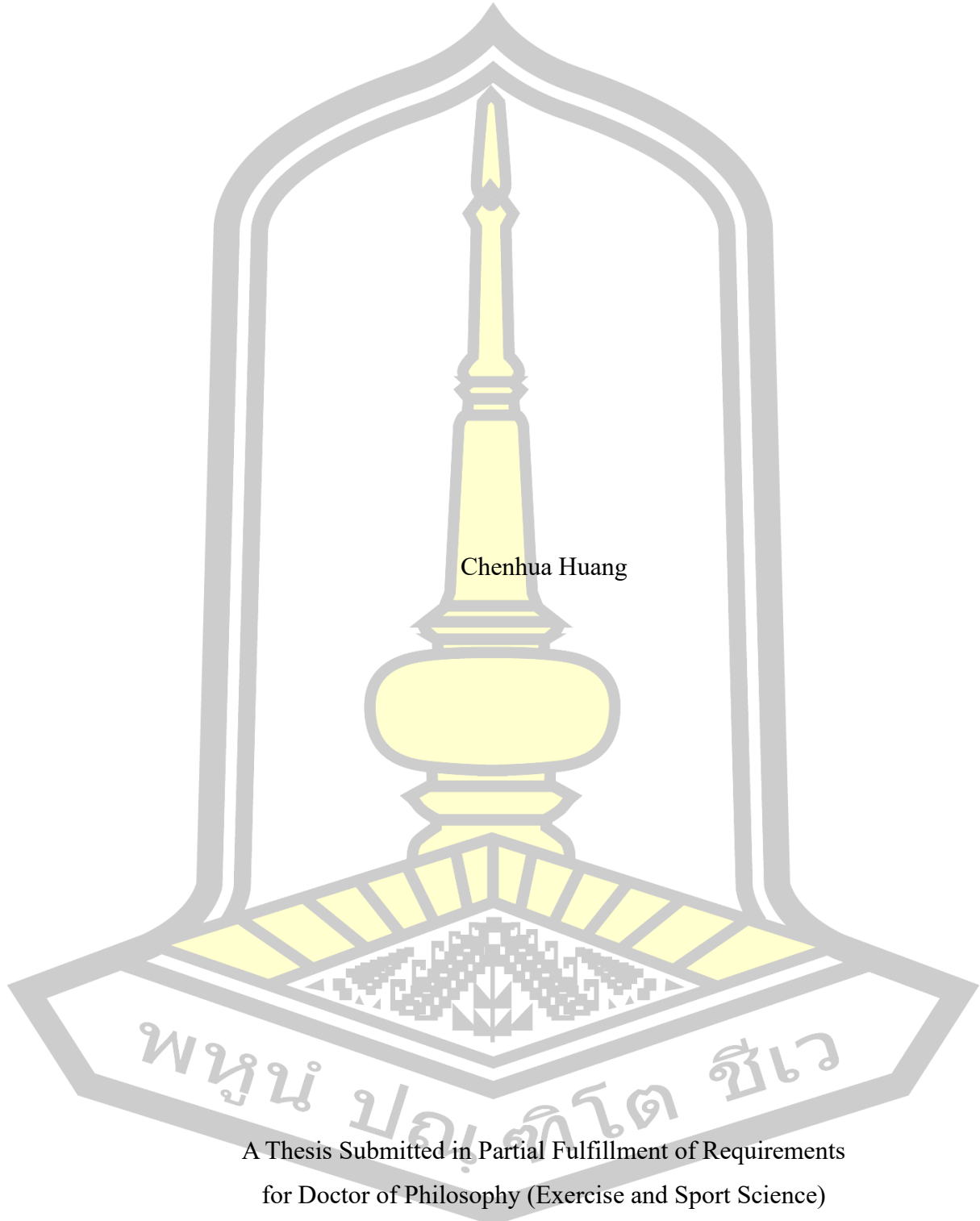


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A Thesis Submitted in Partial Fulfillment of Requirements
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December 2024

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The examining committee has unanimously approved this Thesis, submitted by Mr. Chenhua Huang , as a partial fulfillment of the requirements for the Doctor of Philosophy Exercise and Sport Science at Maharakham University

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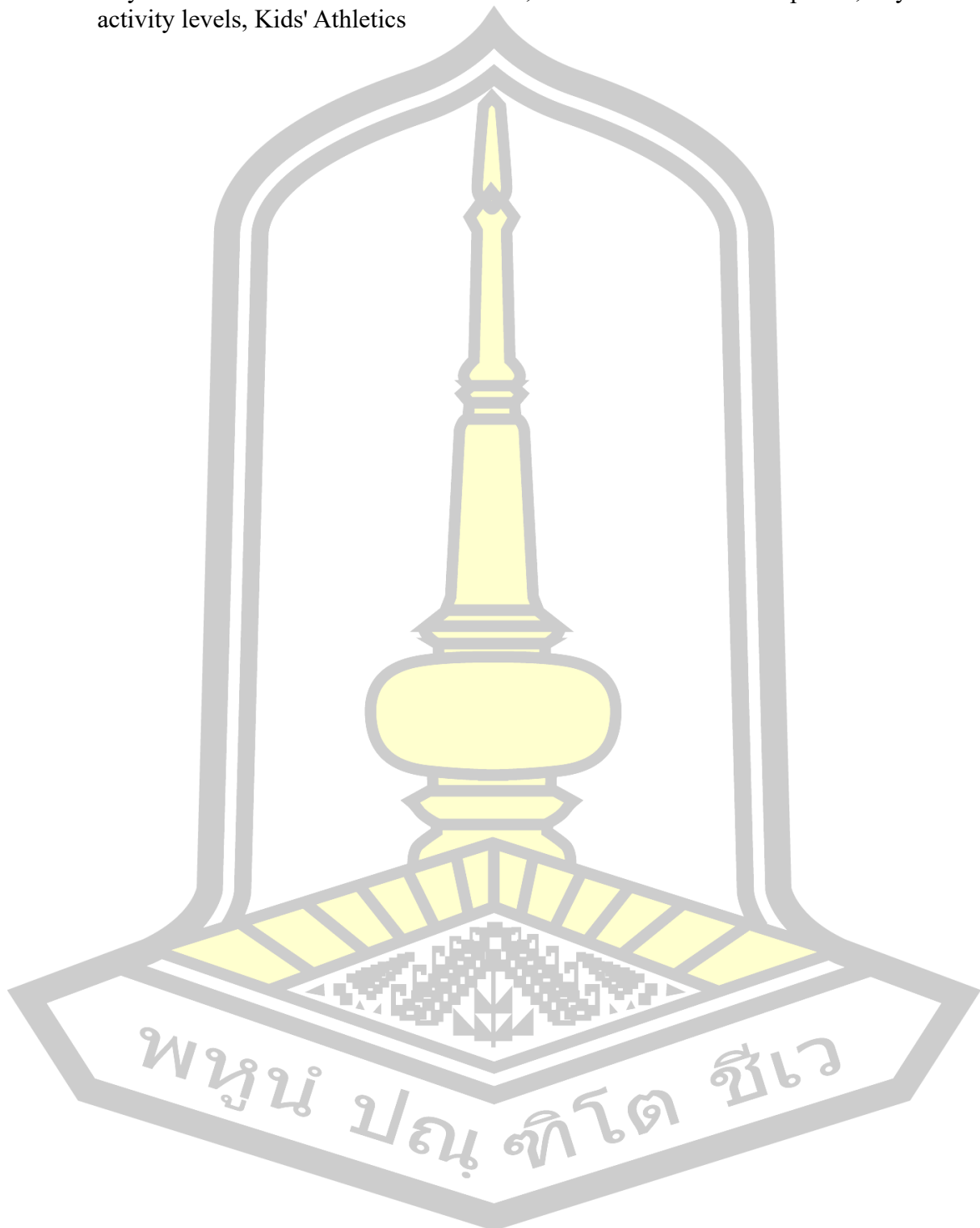
ABSTRACT

This study addresses the global concern of children's health and development, emphasizing their importance to a nation's future economic and social progress. Recognizing the critical developmental stage of children aged 7–10 in China, the study focuses on improving fundamental movement skills, social-emotional development, and physical activity through the Kids' Athletics program, developed by World Athletics. The program's effectiveness was evaluated using the Children's Fundamental Movement Skills Test (CFMST) to measure displacement, manipulation, and balance skills; a physical activity questionnaire for assessing activity levels and sedentary behavior; and the Social Emotional Ability Questionnaire to gauge social-emotional competencies. Structural equation modeling was employed to explore the relationships among these domains.

The intervention yielded significant improvements in fundamental movement skills, with all skills except walking on a balance beam ($p=0.076$) showing substantial differences ($p<0.05$). Weekly physical activity levels increased significantly, accompanied by a reduction in sedentary behavior, and the experimental group showed notable improvements in moderate-to-high-intensity physical activity ($p=0.028$) compared to the control group. Social-emotional development also improved across most dimensions, though the perception of others dimension ($p=0.38$) showed no significant change. Gender-specific results indicated boys had no significant changes in self-management, others' management, and collective management, while girls showed no significant differences in others' management.

The intervention model demonstrated strong fit and stability, confirming that enhanced fundamental movement skills positively influenced social-emotional development, increased physical activity, and reduced sedentary behavior. The findings underline the effectiveness of the Kids' Athletics program as a comprehensive approach to promoting holistic child development. They provide a practical framework for improving physical literacy, health, and education outcomes, contributing to high-quality physical education teaching and management practices.

Keyword : Fundamental movement skills, Social-emotional development, Physical activity levels, Kids' Athletics



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Chenhua Huang

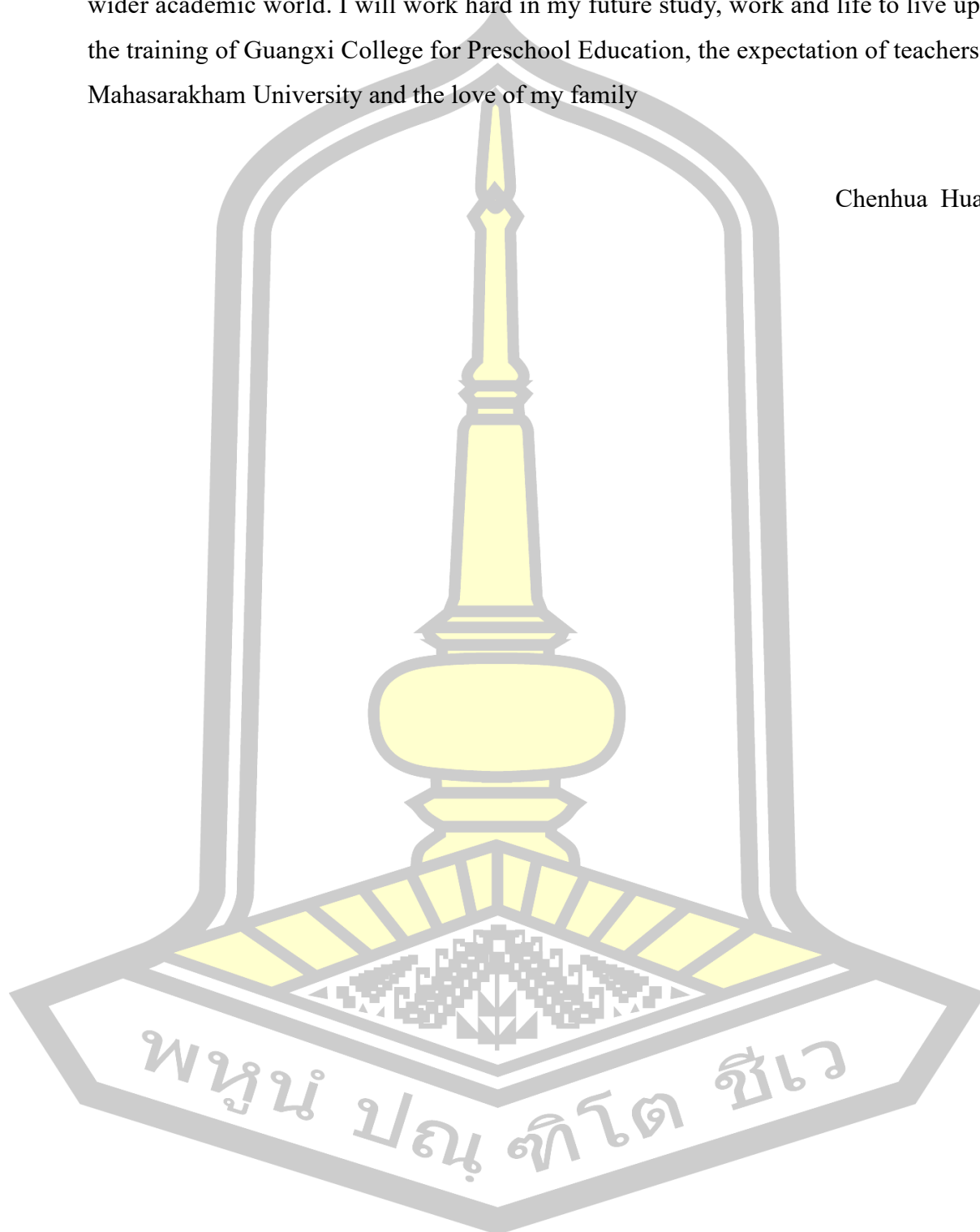
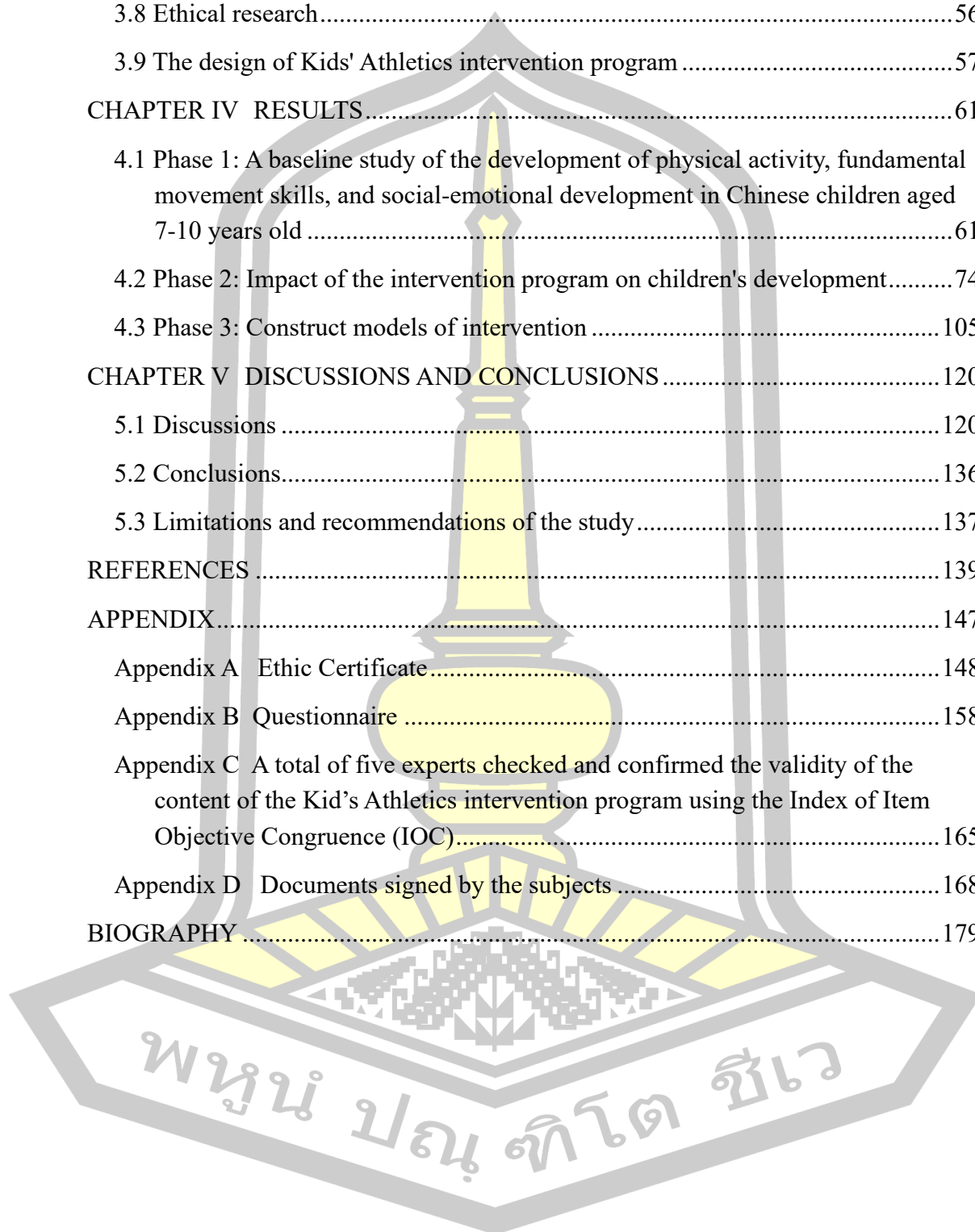


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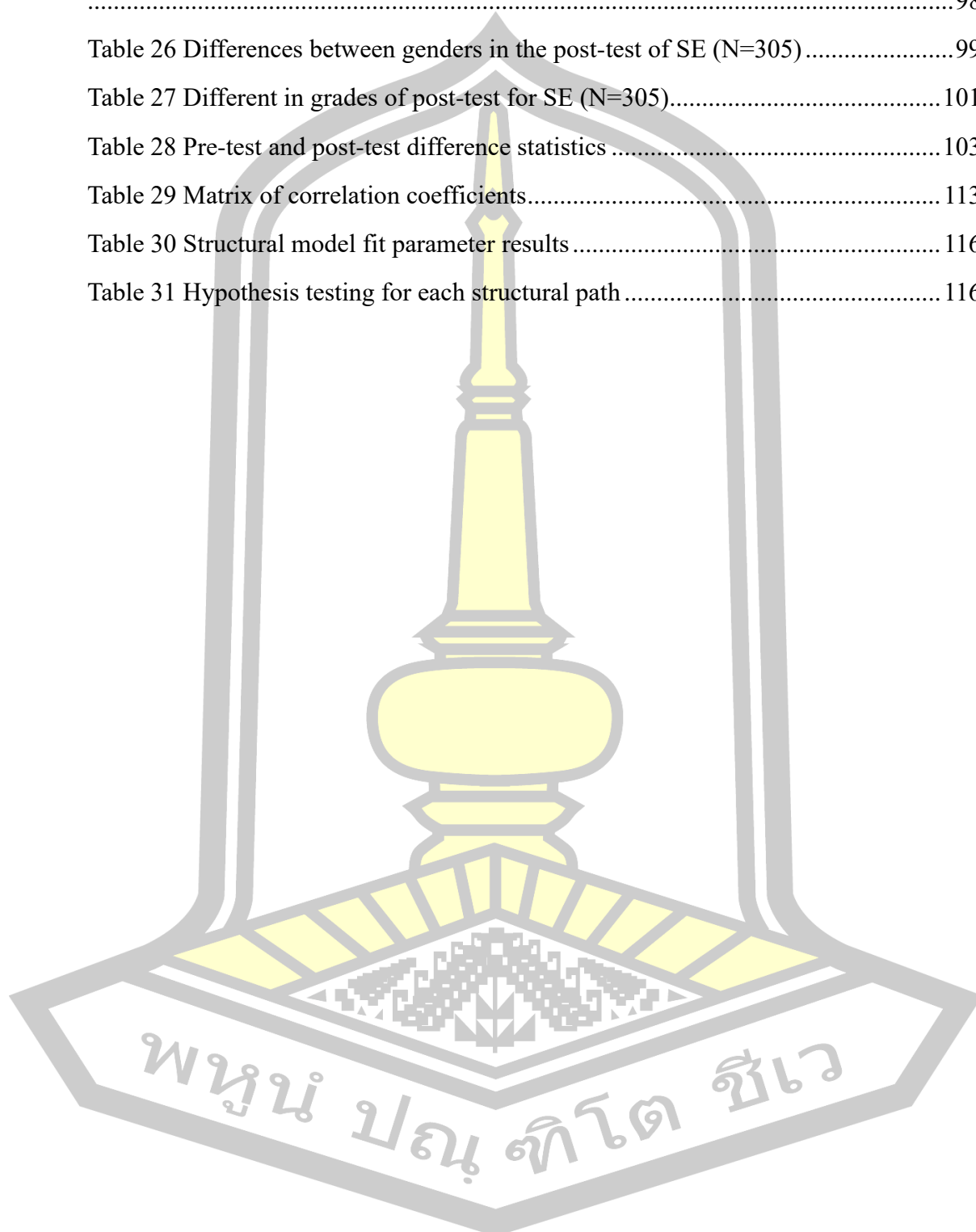
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CHAPTER I

INTRODUCTION

1.1 Background

Physical activity and health promotion are an essential research field of public health and sports science. Scientific research evidence consistently shows that physical activity (PA) is both essential and beneficial for children to maintain and improve their health. For example, many studies have shown that PA can improve emotional and cognitive abilities, reduce depression and anxiety symptoms, and improve the well-being of children and adolescents. The concept that is expressed in the sense of making use of the literature in our work is physical activity, and it's one of the most basic human functions. National and international organizations have expressed the human health benefits of physical activity, which is accepted worldwide. Sleep, sedentary behavior, and physical activity—collectively called as movement behaviors—have received increased attention for their health benefits to preschool-aged and school-age children's development. Although regular PA is very important, and more and more scientific literature (Valerie et al.,2017; Scott et al.,2020) proves that PA is beneficial to the health of children, many young people do not reach the recommended level of PA. Public health surveillance of PA is the first and most essential step in promoting PA among children, which can measure and inform us about the hidden deficits of youth in terms of PA. To improve the previous incomplete, local, intermittent, or absent surveillance in China.

During a 24-hour day, each given period is spent in either sedentary behavior, sleeping, light-intensity physical activity (LPA), or moderate-to-vigorous physical activity (MVPA) (Pedišić et al.,2017). It has been well documented that all of these time-use components across a 24-hour spectrum may be significantly associated with health. Systematic reviews of isolated movement behaviors have concluded that more sleep, more physical activity, and less sedentary behavior have numerous health benefits for aspects of physical, cognitive, and social-emotional development in children.

Sedentary behavior has become the fourth largest factor in the rise in human mortality (WHO,2020). The increased use of sedentary time on weekends is due to the opportunity to engage in more sedentary behavior than on weekdays. Sedentary behavior in children themselves is influenced by several factors, such as economic status, parental education, and the environment (Setyoadi et al., 2015). Primary school children are at an advanced age after passing through the golden age (early age), so activities are needed following the age of growth and development (Burhaein, 2017). Baharudin & Hartoto (2016) added that in the childhood period, when children are very active in carrying out activities, one of them is sports activities. It is known that children and youth have significantly less natural or "voluntary" movement, further less personal social contact with peers during free time, and, last but not least, a worsened health-related state mainly to metabolism, cardiovascular, and locomotor systems. Bielik, Hamar, Penesová, Babjaková, Antala, Labudová & Kovács (2017) point to serious facts that speak of a sedentary way of using free time among school-age children practically throughout the afternoon, i.e., from the time they arrive from school to the rest of the day. The World Health Organization recommends at least 60 minutes and an average of 60 minutes per day of moderate-to-vigorous intensity for people of this age (WHO, 2022). Sports activities in children are affected by mobility. In addition, children's sports activities are very close to the game. The game is considered mandatory as a means of physical development and movement for children (Hashanah, 2016). Children tend to do movement activities, like playing, even though they still look straightforward (Rubiyanto, 2014). The world of children is playing, while the game is an activity carried out by everyone, including children. Children tend to love this type of game, which is challenging and involves many friends as a form of social interaction with their peers (Rumini, 2014). As physical education becomes the only "source" of movement for many children, we consider its function, especially in primary education, to be increasingly important. Due to the current situation, physical education at the first level must compensate as well as possible for the mentioned negative influences of today's times.

However, considering that a change to one movement behavior within 24 hours would necessitate compensation from another movement behavior(s), the health benefits of movement behaviors in isolation may be misleading. For instance, if an

intervention successfully increased a child's physical activity by 30 minutes daily, there would need to be 30 minutes less across the other movement behaviors. Thus, it is necessary to consider using a simple and exciting comprehensive exercise to promote primary school students' health comprehensively.

Fundamental movement skills are a series of basic movements and behavioral patterns in early childhood. They usually require the combination of two or more limbs. Their proficiency is essential for children and adolescents' physical activities and sports participation (Stodden et al.,2008; Lawson et al.,2021). Fundamental movement skills include mobile skills such as walking, running, and jumping and control skills such as throwing, catching, hitting, and kicking (Safuddin et al.,2021). They are not only the only way for children to develop their movements but are also regarded as unique sports in the future and the cornerstone of skill learning (Clark et al.,2002; Wang,2022). However, fundamental movement skills do not develop naturally with age (Clark,2005). Their mastery often requires a describable and observable process from unfamiliarity to proficiency (Goodway et al.,2019). Moreover, during the sensitive development period of children between 3-12 years old, only by receiving timely and practical guidance can you achieve the level of proficiency you deserve. The primary school is a period of rapid physical and mental development for children. It is also a sensitive period for developing children's fundamental movement skills. Studies have shown that developing children's basic motor skills can promote their physical fitness, physical activity, body perception, and other aspects of development.

Although the importance of fundamental movement skills is evident, recent research has found that the proficiency of fundamental motor skills among children aged 6 to 10 worldwide has not reached the ideal level, and the development of fundamental movement skills among Chinese children also lags (Li & Diao,2013; Tao et al.,2021). The current academic research on fundamental movement skills focuses on the development level, influencing factors, measurement and evaluation, and the relationship between physical activity and physical health. However, these must be based on accurately quantifying fundamental movement skill proficiency. However, relevant research is still insufficient (Xu et al.,2023).

Results from the China 2022 report card on physical activity for children and adolescents show that the rates of meeting the PA guideline decreased gradually with age from primary school (58.5%) to secondary school (53.7%), and finally to upper secondary school (35.5%) (Liu et al., 2023). Essential reasons include academic pressure and sports activities that are not interesting, difficult, and do not have enough venues for activities. In addition, the athletics games have the characteristic of being easy to carry out and will provide children with the opportunity to make the most of the beneficial practice of Athletics in terms of Health, Education, and Self-fulfillment.

Kids' Athletics is a sports program designed to introduce basic movements to children, providing them with a foundation for physical activity (IAAF Kids' Athletics, 2002). Traditional athletics, as experienced in junior and senior categories, often lack the variety and enjoyment required for younger children. Initially, athletics for preschool and early school-aged children was a scaled-down version of adult athletics, insufficiently adapted to meet their developmental needs. To address this gap, the "IAAF Kids' Athletics" working group launched an initiative in 2001 to create a more engaging, fun, and diverse form of athletics specifically for children. National athletics associations across the world have widely embraced this initiative.

Kids' Athletics is designed for children aged 4 to 14, providing an inspiring, high-quality physical activity experience. As the basis of an experimental program in primary education, Kids' Athletics supports of the International Association of Athletics Federations (IAAF), promoting athletics and making it accessible to children and their families worldwide. The program has flourished in numerous countries across five continents. The process of carrying out the Kids' Athletics program always focuses on the goal of promoting the development of children's fundamental movement skills. It follows the principles of fun, repetition, intermittency, gradual progression, and attention to individual differences in the development of balance, agility, coordination, responsiveness, rhythm, spatial awareness, proprioception, and bilateral movement to form teaching cards that provide materials for teachers' teaching and students' learning.

Chinese children between the ages of 7 and 10 have just experienced the “play-based” education in kindergarten, where most of the time is spent in the form of games to promote the development of fundamental movement skills, and have a

certain foundation of physical activity; entering the first grade of elementary school is the time for them to transition from kindergarten play to organized physical education, and there is a certain increase in academic pressure, there is a need to bridge the physical activity gap between their preschool and school-age years.

As they grow older, in the second-grade stage, their academic pressures increase, posing new challenges to their physical activity and social-emotional development. As they enter third grade, they are faced with the development of fundamental movement skills that link to the development of specialized movement skills. Therefore, the study of physical activity, fundamental movement skills, and social-emotional development of children aged 7-10 years is an important way to promote the continuous improvement of their health through movement intervention based on the actual characteristics of their age development.

In conclusion, by using the intervention of Kids' Athletics, we can give full play to the intervention program's ability to make up for the shortcomings of other intervention methods in integrally promoting physical health, mental health, social adaptation, and moral health, and to demonstrate its influence effects on the development of fundamental movement skills, physical activity, and social-emotional development, to practically promote the healthy development of Chinese children aged 7 to 10 years old.

1.2 Objectives

The main objective of this research is to verify and point out the influence of Kids' Athletics and athletics movement games on the general physical performance of children aged 7- 10 through the creation and inclusion of an athletic program.

(1) To study the fundamental motor skills, physical activity and social-emotional characteristics of 7–10-year-old Chinese students and their differences by gender and grade level.

(2) To compare the experimental and control groups' effects on fundamental movement skills, physical activity, and social-emotional development before and after implementing the Kids' Athletics program intervention.

(3) To confirm the impact of the research hypotheses on children's fundamental movement skills, physical activity, and social-emotional development through interventions utilizing the Kids' Athletics program.

1.3 Research Problem

(1) What is physical activity, fundamental movement skills, and social-emotional characteristics in children aged 7-10 years?

(2) What is the relationship between physical activity, fundamental movement skills, and social-emotional development?

(3) How effective are interventions on movement behaviors, physical fitness, and social-emotional development in 7-10-year-old children?

(4) What factors are included in the children's health promotion model formed after using the Kid's Athletics intervention?

1.4 Research hypothesis

(1) Baseline data on physical activity, fundamental movement skills and social-emotional development will provide an accurate pre-test benchmark. Following the intervention, the experimental group will show significant improvements in these areas compared to the control group.

(2) The Kids' Athletics program intervention will lead to a statistically significant improvement in fundamental movement skills, physical activity levels, and social-emotional development among students aged 7-10 in the experimental group compared to the control group.

(3) Through the comparison before and after the experiment and the comparison between the experimental group and the control group, the Kids' Athletics of the children in this study have a noticeable effect.

(4) The Kids' Athletics program will have a significant impact on forming a comprehensive children's health promotion model, incorporating fundamental movement skills, physical activity, and social-emotional development.

1.5 Significant of Study

The healthy development of children is a global priority, emphasized by international organizations and national policies under the "health first" ideology. Despite efforts to improve children's health through supportive policies and social development, the effect is still unsatisfactory. Whether the health status of primary school students can be prevented from declining again is a current concern of all parties. This highlights the urgent need to explore multiple factors influencing children's physical activity and social-emotional development. Existing research on movement behaviors tends to focus only on physical aspects, neglecting the integrated relationship between physical activity, fundamental movement skills, and social-emotional growth. FMS, such as walking, running, and jumping, are essential for improving children's physical health, reducing sedentary behavior, and enhancing their overall coordination and social skills, critical elements of social-emotional development.

Programs like Kids' Athletics, one of the most significant grassroots sports initiatives, aim to address these issues by promoting fundamental movement skills and specialized sports training in children aged 7-10. Updated in 2021 to be more flexible and inclusive, the program has been adopted by over 100 member federations, reaching more than 13 million children globally. It focuses on developing children's fundamental movement skills while fostering physical activity and social-emotional development, particularly by improving their emotional intelligence, relationship-building skills, and self-management abilities. Research is needed to investigate how movement behaviors, physical fitness, and social-emotional development interact and to create comprehensive interventions that promote holistic child development.

1.6 Related concepts and definitions

1.6.1 Kids' Athletics

Kids' Athletics, supported by the International Association of Athletics Federations (IAAF), this initiative was designed to develop, promote, and make athletics more accessible to children and parents worldwide. As seen in junior and

senior categories, traditional athletics often lacks the variety and fun needed to engage children of preschool and early school age. In the past, athletics for younger children was merely a scaled-down version of adult athletics and did not adequately meet their developmental needs. To address this, the "IAAF Kids' Athletics" working group launched an initiative in 2001 to create a fun, engaging, and diverse form of athletics tailored for children. This approach has since been embraced by many national athletics associations worldwide.

The program is structured with clear developmental goals and is divided into three age groups. Each level includes specific content aimed at developing physical activities (such as running, walking, jumping, and throwing), enhancing basic sports skills (including running over obstacles, horizontal and vertical jumps, pole vaulting, and various types of throws), and fostering psychological traits like respect, determination, friendship, and pride. Research conducted by Tenen et al. (2015) demonstrated that Kids' Athletics effectively enhances elementary school children's movement skills. Rumini (2014) showed it as a solid foundation for developing athletic movements in children. Moreover, studies have shown that Kids' Athletics positively influences academic achievement, self-esteem (Suat et al., 2018) and helps improve psychological and motor skills in sedentary school children (Abhaydev et al., 2020).

This comprehensive framework is designed to promote children's physical and psychological health holistically. Kids' Athletics is the foundation for our experimental program in primary education.

1.6.2 Physical activity

Physical activity is defined as bodily activity produced by the contraction of skeletal muscles and also as activity at the level of basal metabolism, where there is an increase in the body's energy expenditure. The children's movement behaviors included total sleep, sedentary time, light-intensity physical activity (LPA), and moderate- to vigorous-intensity physical activity (MVPA). VPA is an activity that causes people to be out of breath, perspire, and experience extreme exhaustion, such as running, playing basketball and football, swimming, aerobics, or carrying a heavy

load. MPA are activities that cause people to mildly perspire and experience slight exhaustion, such as bicycling, playing table tennis and badminton, and dancing.

Children's physical activity can be measured by physical activity level evaluation for children and adolescents aged 7-18 years. The National Bureau of Disease Control and Prevention of China proposed the questionnaire drafted by many Chinese experts to form a health industry standard (WS/T 10008-2023). The document gives the physical activity evaluation tool, the physical activity time and intensity evaluation method, and the recommended amount of physical activity level for children and adolescents aged 7 to 18, which was implemented from May 1, 2024, and will be of great significance and value in promoting the physical activity development of Chinese children. The questionnaire was divided into two parts: one for the measurement of physical activity behaviors, where the respondents could give multiple answers to the 24 questions in the questionnaire for the items attended and the time spent, and the other part was for the measurement of sedentary behaviors, where the number of times and the time spent on nine questions such as watching TV, using the computer, and sitting and gossiping were investigated.

1.6.3 Fundamental Movement Skills

Fundamental Movement Skills (FMS) belong to the category of movement development. Movement development is a complex process spanning the entire life cycle. It is an integral part of physical development and constitutes the overall development of an individual with cognition, emotion, and sociality. In 1997, Wickstrom first proposed the term basic skills in sports-related fields and interpreted them as general motor skills used to achieve a specific goal in participating in sports activities, such as running, jumping, and throwing. With the in-depth research on children's motor development in various countries, rich research results have been achieved in this field. However, due to the different research purposes and cultures, scholars have deviated in describing of fundamental motor skills terms.

A review study by Logan et al. (2018) found that the terms “Fundamental Movement Skills” and “Fundamental Motor Skills” are more commonly used in

foreign countries, while the terms more commonly used in China include “gross motor development”, “basic motor skills”, and so on.

However, no matter what kind of expression it is, their definitions are similar. For example, Gallahue (1982) believes that basic motor skills are some organized basic movements, covering the combination of movement patterns of more than two parts of the body; Clark (1990) thinks that fundamental movement skills are the ability to coordinate the basic movements of the human body; The ability to perform everyday basic motor actions with a specific pattern while moving. Although current studies have different understandings of basic motor skills, scholars all define their concepts based on the theory of motor development. Logan et al. (2018) deeply analyzed the relevant literature and found that most of the studies have given definitions in common: 1) basic motor skills are the basis of complex motor skills; 2) State the specific skill categories that make up the basic motor skills; 3) Provide at least one specific example of the fundamental movement skills.

Based on the above theoretical results and the “Compulsory Education Physical Education and Health Curriculum Standards” promulgated by the Chinese Ministry of Education in 2022, this study believes that basic motor skills are the non-naturally occurring basic motor learning patterns of individuals and the basis for complex sports activities. The test of gross motor development is a commonly used measure of fundamental motor skills internationally. This study used the children’s fundamental movement skill test (CFMST) with Chinese children as the data norm to measure fundamental movement skills.

1.6.4 Social-emotional development

Social-emotional refers to the intersection of two crucial human development and functioning aspects: social and emotional skills and behaviors. It encompasses a range of abilities and competencies that individuals use to understand and manage their emotions, build and maintain positive relationships, and effectively interact with others in various social settings. Social-emotional development indicators were sociability, externalizing, internalizing, prosocial behavior, and self-regulation (i.e., cognitive, emotional, and behavioral self-regulation). Individual factors that influence

children's academic development also receive attention. Among them, social and emotional skills (Social and Emotional Skills) are considered critical factors influencing children's academic development (Durlak, 2011).

The specific role of children's individual development is as follows: First, social and emotional abilities affect children's cognition. A longitudinal study organized by the OECD showed that improving students' social and emotional abilities can help improve students' cognitive levels, especially in the primary education stage. Social-emotional abilities can achieve twice the result with half the effort in both the development of children's social-emotional abilities and cognitive abilities. Secondly, social-emotional abilities can regulate children's learning motivation, enable them to actively face academic difficulties, and improve academic behaviors, thereby positively affecting academic performance. Thirdly, social-emotional abilities enable children to understand and respect the behavior of others from a positive perspective and develop good teacher-student and peer relationships, which is conducive to children taking the initiative to improve the learning environment, obtaining support from others, and indirectly promoting children's academic development. Not only that, social-emotional skills can also promote school development. For school organizational development, social-emotional abilities help create a positive, harmonious, and mutually supportive working atmosphere and emotional environment, help achieve educational and teaching goals and improve school effectiveness.

Currently, international research on students' social-emotional competence presents trends such as emphasis on educational policies and practices in various countries, full exploration of connotative frameworks, diversification of assessment and measurement methods, and multiple ways to cultivate and develop students' social-emotional competence (Wang & Chen, 2017). Like international trends, the development of students' social-emotional competence within China has received much attention, and a synergy of policy orientation, practice exploration, and academic research has clearly developed. In the policy area, China has repeatedly emphasized the enhancement of students' social-emotional competence, such as the Outline of the National Medium- and Long-Term Educational Reform and Development Plan (2010-2020), which emphasizes competence and all-around

development, and focuses on improving students' learning, practice, and innovation abilities, so as to enable students to learn how to behave and work, and to promote students' active adaptation to the society, which is intrinsically consistent with the development of social-emotional competence. This is inherently consistent with social-emotional competence.

The "Student Social Emotional Competence Questionnaire" compiled by the Ministry of Education-UNICEF "Social Emotional Learning (SEL)" project team (the project leader is Professor Mao Yaqing of Beijing Normal University) is measured by students' self-evaluation. The questionnaire uses the "Social Emotional Ability Questionnaire (Student Version)" compiled by the project team, which measures students' self-awareness, self-management, other people's cognition, other people's management, collective cognition, and collective management. Dimensions of social-emotional abilities. The scale is scored as an average, so the highest possible score for each dimension is 5 points, and the lowest possible score is 1 point.

The purpose of the assessment in the dimension of self-awareness is to show whether the student can identify and evaluate his/her own emotions, interests, values, and strengths, identify with the positive qualities of self-development, and maintain complete self-confidence. The self-management dimension aims to measure students' ability to regulate their emotions and behaviors, regulate their stress, motivate their will, and develop and maintain good emotional experiences and behavioral performance. In the dimension of others' perception, the aim is to measure students' ability to recognize and understand others' attitudes, emotions, interests, and behaviors, put themselves in others' shoes, and be willing to communicate with others actively. The others' management dimension measures students' ability to understand the thoughts, feelings, and behaviors of others, to respect differences, to learn tolerance, to resolve conflicts, and to establish and maintain friendly interpersonal relationships. The collective cognition dimension examines whether students have a collective consciousness, identify with collective norms, understand the relationship between the collective and the individual, and develop the civic behaviors needed by the collective and society. The collective management dimension measures students' compliance with collective norms, adjustment of the relationship between the collective and the individual, formation of a sense of belonging to the collective, and

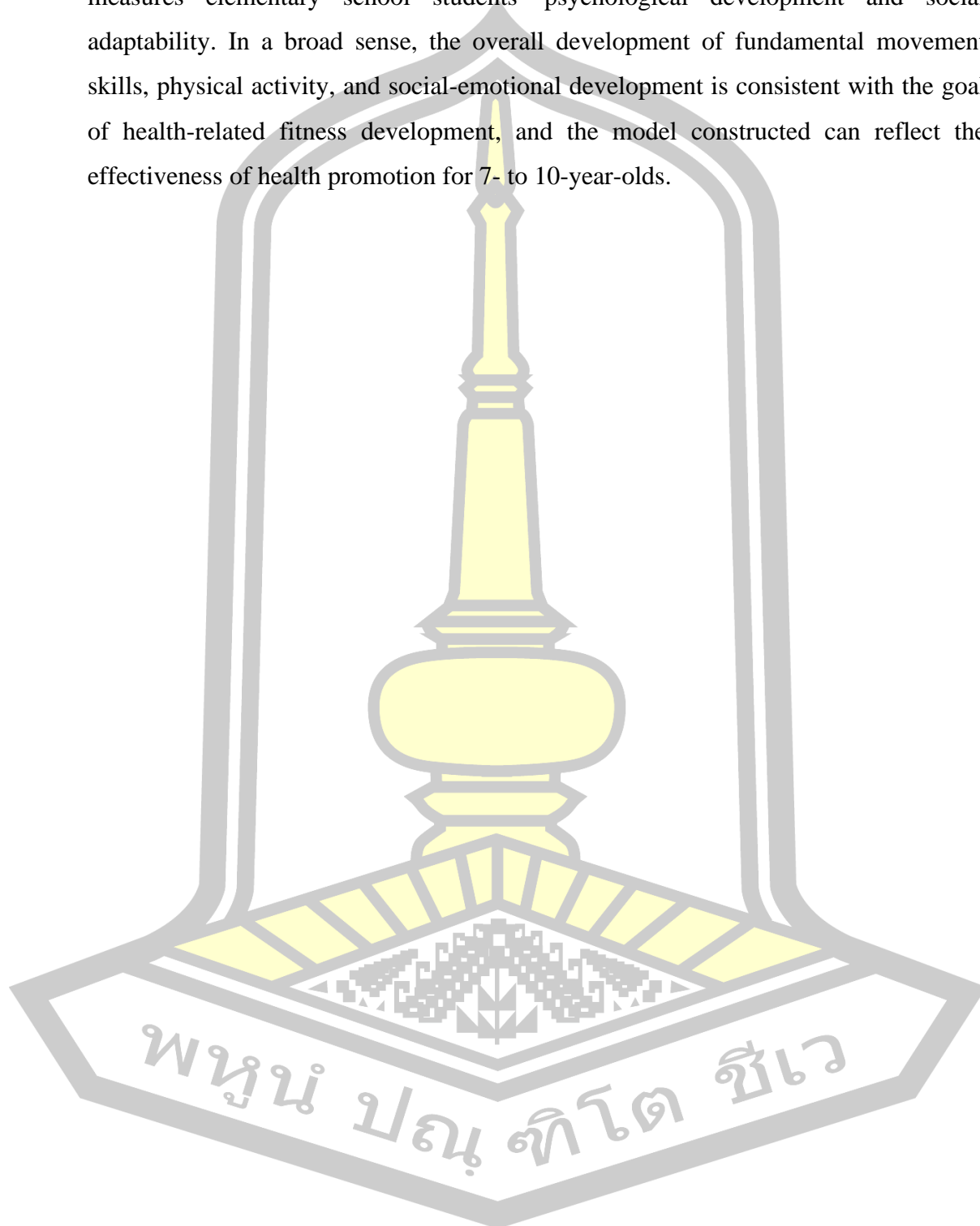
the development of good behaviors needed by the collective and society. The higher a student's score on each dimension, the better their social-emotional development.

1.6.5 Health-related fitness

The definition of "Physical fitness health" has been extensively studied in academia, and the research is not limited to sports but also involves other fields such as anthropology and medicine. Earlier academic circles usually used "physique" and "health" separately. For example, in the world, physical fitness was usually translated as physical fitness and summarized as "the ability of the body to adapt to the external environment" (Guan et al.,2012). In the domestic "Ci Hai"(2009), the constitution is interpreted as "the inherent characteristics of the human body that are relatively stable in function and form based on heredity and acquisition." The more generally accepted concept of health is the World Health Organization's definition of health in 1948: "Health is not only the absence of disease and weakness but a state of physical, mental, and social integrity" (Xiao, 2006). The concept of "physical fitness" was first proposed in the "Decision on the Reform and Development of Basic Education" promulgated by the State Council in 2001, combining "physical fitness" and "health" into one word. With the promulgation of "Students' Physical Health Standards" (Trial) in 2002, "Physical Health" has become a particular vocabulary. From the point of view of the meaning of the definition, "physique" tends to describe the quality of the body, and "health" tends to describe the state of the body. Constitution is the internal basis of health, and health is the external manifestation of the constitution (He,2002).

Based on the definition of the World Health Organization, this study demonstrates the pathways of health promotion by constructing a model. In a narrow sense, the development of fundamental motor skills not only promotes the integrated performance of cardiorespiratory endurance, body composition, muscular strength, muscular endurance, flexibility and balance, and explosive power that are included in primary school students' health-related fitness, but also lays a solid foundation for their active participation in physical education and sports; the development of physical activity reflects more directly the effect of promoting health-related fitness; and the development of social-emotional skills measures the elementary school students' physical activity development, which more directly reflects the effectiveness

of promoting health-related fitness; and social-emotional development, which measures elementary school students' psychological development and social adaptability. In a broad sense, the overall development of fundamental movement skills, physical activity, and social-emotional development is consistent with the goal of health-related fitness development, and the model constructed can reflect the effectiveness of health promotion for 7- to 10-year-olds.



CHAPTER II

REVIEW OF RELATED LITERATURE

According to the purpose and work arrangement of the research, in order to ensure the smooth development of the research, the corresponding literature was searched through Google Scholar, EBSCO database, PubMed, ScienceDirect, Web of Science, Cochran Library, CNKI, and other resources, and a literature review was carried out to find out the hot spots and difficulties of the current research, which laid a good foundation for the development of this research.

The study begins with a review of research findings related to physical activity, fundamental movement skills, social-emotional development and children's health development to reveal evidence of their contribution to children's overall health development; followed by an overview of research findings on intervention methods to show the practical outcomes of Kids' Athletics in the promotion of children's health; and finally, by combining the literature on the modelling of the effectiveness of the use of sports intervention methods to promote health to form the study's modelling basis for achieving the research objectives.

2.1 Physical activity

2.1.1 The importance of physical activity promotion

World Health Organization (WHO) defines physical activity as any bodily movement produced by skeletal muscles that requires energy expenditure. This includes walking, cycling, running, swimming, dancing, and playing sports. Physical activity can be undertaken for various purposes, including recreation, fitness, transportation, and as part of one's occupation.

The movement aspect of children's and youth's lives is becoming an increasingly topical topic. The level of movement abilities and skills of students, which can be observed primarily in their movement performances in physical education classes or from the results of comprehensive tests, does not achieve the desired results. Physical activity promotes growth and development in cognitive, social, emotional, and health behaviors. PA can improve psychosocial outcomes such as self-concept and self-

efficacy, which determine a child's motivation to participate in active games and sports (Kohl HW et al., 2013).

Physical activity (PA) for the health and well-being of children and adolescents is now widely accepted by the international scientific community. Numerous countries and the WHO have published specific PA recommendations for children and adolescents (5–17 years) to improve fitness and health. Aligned with the United Nations' Sustainable Development Goals (SDGs), the WHO published the Global Action Plan on Physical Activity 2018–2030 to guide and support the implementation of national multi-sectoral PA actions and set a specific target of a 15% relative reduction in the global prevalence of physical inactivity in adults and adolescents. One of the strategic actions identified in the Global Action Plan is enhancing data systems and capabilities at national levels to support regular population surveillance of PA.

2.1.2 The Problems and significance of physical activity in children

There was consistent evidence among children that the composition of 24-hour movement behaviors, specifically more sleep, and less SB, was associated with lower adiposity (Carson V et al.,2017; Taylor RW et al.,2018). Studies suggest low compliance with all movement guidelines, ranging from 4.3 to 14.9% (Cliff DP et al.,2017; De Craemer M et al.,2018), and longitudinal associations with health and developmental outcomes are not well established.

Primary school children are advanced in age after passing through the golden age (early age), so activities are needed in accordance with their age of growth and development (Burhaein, 2017). Baharudin & Hartoto (2016) added that during childhood, children are very active in carrying out activities, one of which is sports activities. Sports activities in children are affected by mobility.

Although national and international standardized surveillance of PA among children and adolescents has increased in recent years, challenges for the global surveillance of PA and lack of generalization of PA data between and across continents persist. For example, there are methodological inconsistencies across international PA surveillance initiatives, and national PA prevalence estimates often

differ from one surveillance initiative to the next (Hallal et al., 2012; Ding, 2018; Aubert et al., 2020; Trembla,2020). Moreover, the extent of the methodological inconsistencies across international PA surveillance initiatives between and across different continents has rarely been empirically documented.

In China, two national surveys estimated that the prevalence of having at least 60 min per day of Moderate - to - Vigorous PA (MVPA) ranged from 29.9% to 34.1%. In addition, the time trend study also shows that from 2004 to 2015, the total PA of children and adolescents aged 6-17 in China showed a downward trend. The grades of the China 2022 Report Card are Overall PA (C), Organized Sport Participation (F), Active Play (C-), Active Transportation (C), Sedentary behaviors (C), Physical Fitness (INC), Family and Peers (C-), School (D), Community and Environment (D-), and Government (D). The grade of Overall Physical Activity is determined as the percentage of children and adolescents who meet the guidelines at least 60 min of MVPA per day on average in the past 7 days. 50.0% of students confirmed, and therefore, C is assigned to Overall Physical Activity. Boys (54.5%) were more active than girls (44.9%). Compared with the 2016 and 2018 report cards, the grade has been greatly improved. Nevertheless, if using the same benchmark and rationale of assessing instrument, the percentage of meeting PA guidelines in the 2022 Report Card (14%) has slightly increased compared with the 2018 Report Card (13%), which indicates the intervention strategies based on school, family or community have had a positive effect. The current results show that the proportion of high school students who meet the PA guidelines is low, and therefore more attention should be paid to them in the future.

2.1.3 Physical Activity Guidelines for Children

According to the requirements of the "Physical Activity Guidelines for Chinese Population (2021)", children accumulating 60 minutes or more of moderate-intensity to high-intensity physical activity per day can promote the growth and development of children and adolescents, improve cardiopulmonary function, strengthen bones and muscles, maintain health, enhance physical fitness, promote brain health, improve cognitive function, improve execution and processing speed, enhance memory,

improve academic performance, and relieve depression. Regular participation in outdoor activities can make the skin receive ultraviolet rays in the sun, promote vitamin D synthesis, and prevent vitamin D deficiency. Increased time spent outdoors by children and adolescents can also reduce the risk of myopia (Bureau of Disease Control, China Health and Health Commission, 2021).

Muscle strength exercises should be done at least 3 days a week. Regarding frequency and time, it is advisable to perform strength exercises for the same muscle group no more than once a day, and each time should be controlled within 1 hour (including warm-up and relaxation). Muscle strength exercises include equipment exercises and bodyweight exercises. Equipment exercises can use dumbbells, resistance bands, Swiss balls, medicine balls, etc.; bodyweight exercises can be performed up and down steps, vertical jumps, push-ups, sit-ups, pull-ups, squats, climbing, etc. Reduce static behavior, each lasting no more than 1 hour. The cumulative screen time per day is less than 2 hours.

2.1.4 The measurement of physical activity in children

The measurement method of physical activity in children and adolescents is the basis for evaluating physical activity and a prerequisite for conducting epidemiological research on physical activity among children and adolescents. Research on physical activity measurement methods for children and adolescents often takes school-age children aged 6-17 as the starting point and focus, extending to younger age groups. The physical activity of children and adolescents aged 6-17 is characterized by suddenness, high frequency, intermittent, and irregularity. It is limited by recall and cognitive abilities, making measuring their physical activity more challenging than the adult population.

Physical activity questionnaires are widely used in epidemiological surveys and physical activity interventions. In recent years, many questionnaires for measuring the physical activity of children and adolescents have emerged, with various forms, survey contents, and evaluation methods. The target group of the questionnaire survey, the level of cognition and understanding ability, the purpose and content of

the survey, the reliability and validity of the questionnaire, etc., are the influencing factors for the effective measurement of the physical activity questionnaire.

Physical activity is closely related to the physical and mental health of children and adolescents, and in the context of the urgent need to improve the physical activity level of children and adolescents in China, commissioned by the National Health Commission, starting 2016, 137 'Key Laboratory' base schools in 26 provinces, municipalities, and autonomous regions were selected nationwide to conduct physical fitness tests, physical activity questionnaires, and measurements, collected physical test and questionnaire data from 103,213 people, and after a strict reliability and validity test, it is a national industry standard and finally formed a series of physical activity evaluation tools and recommendations such as Physical Activity Intensity Comparison Chart for Children and Youths Aged 7-18 in China, Physical Activity Questionnaire, and Physical Activity Recommended Items, Intensity, and Duration, and other recommended recommendations.

2.1.5 Summarize of physical activity in children

Physical activity, encompassing movements like walking, running, and sports, plays a crucial role in children's cognitive, social, emotional, and physical health. Despite WHO recommendations for at least 60 minutes of moderate-to-vigorous PA daily for children aged 5–17, global compliance remains low, with activity levels declining in many regions, including China. PA contributes to growth, academic performance, mental health, and the prevention of issues like obesity, vitamin D deficiency, and myopia. National efforts, such as large-scale assessments in China, have led to standardized tools for evaluating and promoting PA. Incorporating regular strength exercises, minimizing sedentary behavior, and limiting screen time are essential to enhancing PA levels and overall well-being in children and adolescents.

2.2 Fundamental Movement Skill (FMS)

2.2.1 Implications for the development of fundamental movement skills in children

Children's fundamental movement skills are part of human motor development, a comprehensive process throughout life and a component of individual development, together with cognitive, emotional, sociality, and physical development, forming all-around development (Greg Payne et al., 2008). Children's fundamental movement skills are the basic movements and behaviors that can be observed, including walking, running, jumping, and throwing. In addition to improving children's physical health (Barnett et al., 2016), reducing their static behavior in front of screens (Yang et al., 2022), and preventing obesity (Meng et al., 2020), well-developed motor skills also positively influence children's perception (Guo et al., 2022), body coordination (Wang et al., 2021), physical performance (Ma & Li, 2020), and social communication ability (Dong, et al., 2021). In the human motor development model, elementary students have the most potential to improve motor skill proficiency (Gallahue & Ozmun, 2002). If children's Fundamental movement skills are underdevelopment, it might lead to deficiencies and defects in motor skills or other skills (Dong & Tao, 2004).

Young children who have mastered gross motor skills are less sedentary and more physically active in games and sports (Ulrich, 2019). They also have many more opportunities to socialize and communicate with other young children during physical play (MacDonald et al., 2013).

Fundamental movement skills play a positive role in promoting physical health. Fundamental movement skills are basic behavior patterns that can be observed in childhood. A good level of fundamental movement skills will further affect physical health. Because childhood is the golden stage for the development of fundamental movement skills, fundamental movement skills are usually put first, and physical health is more interpreted as the result or product of the development of fundamental movement skills. The better the development of fundamental movement skills, the better children's physical health can be improved (Diao, 2018).

The movement development of children aged 7-8 years old is based on the uncoordinated and clumsy phenomenon of children aged 3-6 years old and enters a stage of rapid growth at the age of 7-8 years old. Children at this stage can complete a variety of basic motor skills more efficiently and coordinately. With the increase in learning experience, the quantitative performance of children's basic motor skills, such as distance, speed, quantity, and accuracy, will continue to improve. However, they can only complete the control of objects moving in place and still cannot master the visual tracking and accuracy required—object control skills for object interception. Many studies at home and abroad have shown that developing children's basic motor skills are lagging. Most 7-8-year-old children cannot master fundamental motor skills proficiently, and the lagging development of object control skills is joint (John, 2011). The overall characteristics of the movement development of children aged 6-7 are "minimally automated basic movements and the ability to independently use their limbs." They control their growing bodies through practice.

The movement development characteristics of children aged 8-9 are "minimum automation of basic movement techniques." Movement development is in the transition period from basic movement skills to specialized movement skills. At this stage, most children have mastered several fundamental movement skills proficiently. Its combination can be used in various sports games and competitions. However, many studies at home and abroad have shown that the lagging development of children's basic motor skills is joint, and most 8.1-9-year-old children are still unable to master multiple basic motor skills (Bolger et al., 2019). If children in this age group can master a variety of basic motor skills proficiently, they will be able to better master more advanced and complex special sports skills in the future. Otherwise, children will experience motor skill disorders, and their future motor skill proficiency will be affected and restricted.

The movement development characteristic of children aged 9-10 is a "breakthrough of basic movement combination skills obstacles." Fundamental displacement, balance, and postural control skills acquired in early and middle childhood are used in modified games. Children are in the transition and application stages of developing specialized motor skills. During the transition period of specialized sports skills, children's stability, displacement, and object control skills are

further improved, combined, and differentiated, and children begin to apply various basic sports skills in sports games and competitions. During the application period of specialized sports skills, with the improvement of cognitive ability and enrichment of action experience, children can make many learning and activity participation decisions based on individual, environmental, and task factors. Children begin to decide consciously whether to participate in a particular sport. These decisions are primarily based on how the child views the task, themselves, and what factors in the environment increase or decrease the chances of having fun and experiencing success. However, due to the generally lagging development of children's basic motor skills at home and abroad, the current movement level of most 9-10-year-old children is still in the transitional stage of specialized motor skills.

2.2.2 Relationship between fundamental movement skills and health-related fitness

The research on the relationship between fundamental movement skills and physical health is already prevalent, and the early research focused on the correlation between the two, which confirmed the close relationship between fundamental movement skills and various dimensions of physical health. For example, studies have found that there is a significant correlation between mobility motor skills and operant motor skills in children's fundamental movement skills and BMI (Raudsepp et al.,1996; Okely et al.,2001), and it is believed that children with low body weight have better motor skills than children with high body weight (Zhou,2020). Other studies have found a close relationship between the proficiency of fundamental movement skills and cardiorespiratory endurance in children and adolescents (Okely et al.,2004; Hu et al.,2018). In addition, Castelli et al. (2007) comprehensively examined the relationship between basic sports skills and physical health (cardiorespiratory endurance, speed, strength, flexibility, BMI). They found that basic sports skills positively affect cardiorespiratory endurance, speed, strength, flexibility, and BMI, and this relationship becomes closer with age.

In addition to evidence from cross-sectional studies, results from some longitudinal follow-up studies also support a positive relationship between

fundamental movement skills and physical fitness. A study divided children's basic motor skill levels into low-level and high-level groups and tested their physical fitness. After investigating the physical fitness level of children after 32 months, it was found that the gap between the two did not narrow over time (Haga,2009), while significant differences appeared over time in cardiovascular endurance, 50-meter running, and balance (Hands,2008). A five-year follow-up study on whether children's motor skills can predict adolescents' physical health found that children with good object control skills completed more multi-stage physical fitness tests on average than children with poor object control skills. It is believed that the proficiency of object control observed in elementary school can predict subsequent health levels in adolescence, and it is also believed that the development of fundamental movement skills in childhood may be an essential part of interventions aimed at promoting long-term health (Barnett et al.,2008).

With the deepening of research, many empirical studies on the impact of fundamental movement skills on physical health have emerged, mainly in the form of periodic interventions using fundamental movement skills to compare the effects of improving children's physical health. More representative results include Cohen et al. (2014), who conducted a 12-month intervention study on children's fundamental movement skills and found that the cardiorespiratory endurance level of children in the intervention group was significantly higher than that in the control group. In China, 12-16 weeks of fundamental movement skills intervention studies not only found that children's cardiorespiratory endurance levels were significantly improved, but also agility, coordination, and strength were improved (Wang,2021) but the improvement of flexibility was not significant (Liu,2017). From the conclusions of many previous studies, overseas research was carried out earlier. It was meticulous and comprehensive, while research primarily focused on horizontal and longitudinal research or intervention empirical research on the correlation between the two in China. Although it has been proved that there is a significant relationship between the two, the mechanism by which fundamental movement skills affect physical health is still unclear.

Many recent studies have begun to realize that the relationship between fundamental movement skills and physical health is not single and believe that there

may be other mediating factors in the path of fundamental movement skills affecting physical health. These factors can explain the path of fundamental movement skills affecting physical health. Earlier, Stodden (2008) and colleagues proposed that "fundamental movement skills are the key underlying mechanisms driving children and adolescents' physical activity behaviors, physical fitness-related aspects, and weight status" and established a conceptual model of motor ability affecting lifelong physical activity. As the rationality of conceptual model construction has been proven, research has paid more attention to the internal mechanism between paths. Some longitudinal mediation studies of adolescents' fundamental movement skills, sensory-motor skills, physical activity, and health have concluded that the development of high sensory-motor skills through the development of object control skills is important for both boys and girls in determining adolescents' physical activity participation and health status (Barnett et al.,2008). However, the existing research is not enough to support the internal hypothesis of the path of the impact of fundamental movement skills on physical health, and further research is still needed.

Studies have only examined associations with adiposity and bone health. Across studies, null associations were reported between behaviors and indicators of adiposity, and small associations between physical activity and indicators of bone health were evident (Ip EH et al.,2016; Berglind D et al.,2018; Taylor R et al.,2018). Thus, evidence lacks the prospective associations of preschoolers' guideline compliance with later physiological, psychosocial, and educational outcomes. However, the research on fundamental movement skills in Nanning's elementary students mainly focuses on physical development. Research on motor skill development's process, characteristics, and age is missing.

2.2.3 Measurement of the development of fundamental movement skills in children

The measurement and evaluation of children's fundamental movement skills can help them understand their motor development level in time, so that effective measures can be taken to promote their further development. The tool measurement method based on movement performance is the current mainstream evaluation method

of FMS, and it has also been unanimously recognized by experts (Bardid et al.,2019). International standards for measuring and evaluating children's fundamental movement skills can be divided into outcome measurement and evaluation and process measurement and evaluation. Outcome measurement evaluation is the evaluation of fundamental movement skill test results, such as how far you can jump, how fast you can run, etc. The more commonly used tools are the "Gross Movement Coordination Scale" (Krperkoordinationstest Fur Kinder-3, KTK-3) developed by Kiphard and Schilling in 1970, focusing on the overall coordination of children aged 5 to 15 under normal development or children with movement disorders and revised twice (Kiphard et al.,2007); In 1992, Henderso and Sugden published and revised the Movement Assessment Battery for Children-2 (MABC-2) for the motor coordination ability of children aged 3 to 16 (Henderson et al.,1992); In 2007, Canada developed the Canadian Agility and Movement Ability Assessment Test (Canadian Agility and Movement Ability Assessment Test) to evaluate children's motor skills and their ability to combine simple motor skills and execute more complex motor skills to cope with changing environments. Movement Skill Assessment (CAMSA) and so on. Process measurement and evaluation evaluate the performance of basic motor skills, such as the physical performance of long jumps and running. The more commonly used tool is The Test of Gross Motor Development (TGMD), which was developed by Dr. Ulrich in 1985 to measure the development level of fundamental movement skills of children aged 3 to 12. It has been revised twice and has now been developed to the third edition (Ulrich et al.,2019). In 2010, Taiwanese scholars formulated "The Preschooler Gross Motor Quality Scale (PGMQ)" (The Preschooler Gross Motor Quality Scale, PGMQ) according to the development characteristics of Fundamental movement skills of children aged 3 to 6 in Taiwan (Sun et al.,2011), etc.

Through a comparison of the above test methods, it was found that these tools have shortcomings such as incomplete evaluation (most only test some dimensions under FMS), long process evaluation, and subjective evaluation. Based on previous literature and practical work, Chinese scholars comprehensively applied the Delphi method and testing methods to construct and verify the children's fundamental movement skill test (CFMST) for Chinese children (Li & Liu,2022).

The test indicators of CFMST correspond to two age groups, namely the 3-6 years old group and the 7-10 years old group. The test indicators are sideways sliding, running, and jumping continuously on one foot (testing movement skills); kicking a ball over obstacles and changing hands to shoot the ball on the spot (testing object control skills); walking on a balance beam and walking backward in a straight line (stability skills are tested).

In the process of constructing the test system indicators, according to the methodological procedures for the reliability and validity verification of assessment tools (Hulteen et al., 2020; Terwee et al., 2011), as well as the reliability and validity verification of motor skill assessment tools in previous studies. As a result of the research, the test-retest reliability and internal consistency reliability indicators were selected to reflect the reliability of CFMST. The construct validity and calibration validity indicators were selected to reflect the validity of CFMST. The results showed that the intraclass correlation coefficient (ICC) of each subtest in the 6-9-year-old group ranged from 0.66 to 0.94, indicating that the CFMST has good test-retest reliability. The Cronbach's alpha coefficients of the six subtests in the 6-9-year-old group were 0.62, respectively, and the internal consistency reliability of the CFMST was "acceptable." $KMO=0.71$, $P<0.001$, chi-square degrees of freedom in the 6-9-year-old group are less than 3, $RMSEA=0.3$, which has good structural validity.

During the test, the same group of subjects were tested for CFMST and TGMD-3, and correlation analysis was used to verify the concurrent validity of CFMST. The results showed that there were 48 correlation analysis results between CFMST subtest items of different ages and TGMD-3, of which 44 (95.24%) of the indicators were significantly correlated with TGMD-3 ($P<0.05$). This result shows that CFMST and TGMD-3 have good concurrent validity.

CFMST has good feasibility, reliability, and validity. It can better reflect the development of FMS in Chinese children aged 3-10 and can be used as a measurement tool to measure the development of children's FMS.

The literature on movement skill interventions has shown that interventions lasting 8-12 weeks can significantly change the development of fundamental movement skills (Amui, 2006; Conner-Kuntz & Dummer, 1996; Goodway & Branta, 2003; Hamilton et al. Sweeting & Rink, 1999). Typically, if a skill is taught in 90-120

minutes, children can learn it. Therefore, designing at least 90 minutes of instruction for each essential movement skill in elementary physical education programs is wise.

2.2.4 Summarize of fundamental movement skills in children

Fundamental movement skills (FMS) are critical for children's overall development, encompassing physical, cognitive, emotional, and social aspects, and serve as the foundation for physical activity (PA). Basic motor skills like walking, running, and throwing not only improve physical health, coordination, and social interaction but also foster active participation in games and sports, reducing sedentary behavior. Early mastery of FMS during the "golden stage" of development (ages 3-10) lays the groundwork for advanced motor skills, increased PA levels, and long-term health benefits. Studies reveal strong correlations between FMS proficiency, health-related fitness (e.g., cardiorespiratory endurance, strength, BMI), and PA behaviors, with longitudinal evidence showing that better FMS predicts higher PA engagement and improved adolescent health. Measurement tools like TGMD and CFMST reliably assess FMS and its relationship with PA. Intervention programs of 8-12 weeks, dedicating at least 90 minutes per skill, significantly enhance FMS, boosting PA participation and overall health outcomes, highlighting the interplay between motor skill development and physical activity.

2.3 Social-emotional

2.3.1 The importance of social-emotional development for children

Social-emotional competence, often referred to as "non-cognitive competence," "emotional intelligence," or "soft skills," is a personal attribute shaped by the interplay of physiological and environmental factors. This competence is defined by the coherence of one's thoughts, emotions, and behaviors (Fruyt & John, 2015). Behavioral coherence, which can develop continuously through both formal and informal learning experiences, significantly impacts an individual's life outcomes. Following the onset of industrialization and modernization, social-emotional

competence and its role in personal development have become prominent areas of research. As early as the 1920s, Thorndike, a pioneer in educational psychology, introduced the concept of social intelligence (Thorndike, 1920). In the 1970s, Stanford social psychologist Ingalls examined personality traits linked to modernization, focusing on emotional competencies (Alex & David, 1976). Around the same time, American sociologists Bowles and Gintis critiqued traditional human capital theories and proposed that social-emotional competence is a vital predictor of educational and career success. They argued that higher-order social-emotional skills are more influential than cognitive abilities in determining social mobility and stratification (Samuel & Herbert, 1976). Nobel Prize-winning economist Heckman of the University of Chicago supported this perspective by tracking U.S. GED program participants. His findings showed that, although GED holders and high school graduates had comparable cognitive abilities, GED holders—who generally had lower social-emotional competence—tended to have lower GPAs, graduation rates, and faced greater career challenges (Heckman & Rubinstein, 2001). Over the past two decades, researchers and global organizations, including UNESCO, OECD, and the World Bank, have dedicated substantial efforts to studying and promoting social-emotional competence in primary and secondary education. This research has highlighted how social-emotional skills impact academic achievement and psychological well-being across diverse student groups.

Social-emotional development encompasses a variety of positive skills and behaviors involving regulating and expressing emotions and establishing and maintaining healthy interpersonal relationships, as well as negative externalizing behaviors, such as aggression, and internalizing behaviors, such as depression and anxiety (Denham, Wyatt, Bassett, Echeverria, & Knox, 2009; M€uller & Zurbriggen, 2016; Weissberg, Durlak, Domitrovich, & Gullotta, 2015). Based on a review of over a dozen scholarly frameworks, Halle and Darling Churchill (2016) identified four critical subdomains of children’s social-emotional development: social competence, behavior problems, emotional competence, and self-regulation. Social competencies include relationship skills and children’s ability to interact positively with peers and adults; behavior problems include both externalizing behaviors, such as aggression and noncompliance, and internalizing symptoms, such as depression and anxiety;

emotional competence is described as the ability to recognize the emotions of oneself and others; and self-regulation refers to the management of one's emotions and behaviors (Halle & Darling-Churchill, 2016).

Findings from school-based research conducted over the past two decades have emphasized the importance of these social-emotional subdomains during the elementary school years (Domitrovich, Durlak, Staley, & Weissberg, 2017; Durlak, Weissberg, Dymnicki, Taylor, & Schellinger, 2011; Greenberg, 2010; Jones & Bouffard, 2012; Jones, Greenberg, & Crowley, 2015). For example, children's social competence, assessed by teachers in early elementary school, predicted critical educational and social outcomes in early adulthood, such as college completion, criminal behavior, employment, substance use, and mental health (Jones et al., 2015).

Not only is elementary children's social-emotional functioning predictive of developmental outcomes (Briggs-Gowan & Carter, 2008; Moffitt et al., 2011; Olsson, McGee, Nada-Raja, & Williams, 2013; Jones et al., 2015), but exercise and sports have been identified as important contexts for the development of children's social-emotional competencies.

Since the 21st century, China's economy has been developing at a rapid pace, and the modernization process has entered a new stage. In the face of the complex and changing modern society, the development of individual social-emotional competence is particularly important. In the field of basic education, on the one hand, the cultivation of social-emotional competence can promote the development of students' cognitive ability, improve their academic performance, as well as improve their mental health and behavioral performance, which will have a far-reaching impact on individual development. On the other hand, China's basic education has always emphasized too much on cognitive training and neglected the cultivation of students' social-emotional ability, which has led to the emergence of "bookworms" and "small-town problem solvers", and the cultivation of students' social-emotional ability is a challenge for the implementation of quality education in China, and a problem that needs to be solved in order to deepen the comprehensive education reform. Cultivating students' social-emotional competence is a challenge to the implementation of quality education in China, and a key issue that needs to be solved to deepen the education reform. Focusing on the social-emotional competence of

primary school students has become an inevitable requirement for the transformation and upgrading of basic education in China in the new era (Mao & Du, 2021).

In the field of practice, in the Social Emotional Learning (SEL) project between the United Nations Children's Education Fund (UNICEF) and the Ministry of Education of China, which began in 2011, a research team led by Mao Yaqing of Beijing Normal University has carried out a project on social-emotional learning and school management improvement in a number of provinces and municipalities across the country, focusing on curriculum development and the creation of a supportive atmosphere. In the Social Emotional Learning (SEL) program, a research team led by Mao Yaqing of Beijing Normal University carried out the Social Emotional Learning and School Management Improvement Program in several provinces and cities across China, focusing on curriculum development and supportive atmosphere creation, and constructed a whole-school model of whole-person, all-encompassing nurturing of students' social and emotional competence development. The research team headed by Yuan Zhenguo of East China Normal University launched the first round of assessment in hundreds of primary and secondary schools in Suzhou, resulting in a series of research reports.

Children aged 6-7 years still have some emotional characteristics of preschool children, such as being impulsive, emotionally unstable, emotionally exposed, etc. However, children's emotional control ability gradually increases and gradually develops in the direction of internalization and stability. In addition, since learning and interacting with classmates has become children's main activity, children's social aspects have been expanded. Some social emotions related to learning and interpersonal relationships (classmates or teachers) have become more and more dominant, such as sense of reason, sense of honor, the content of advanced emotions such as friendship, responsibility and aesthetics is becoming more and more abundant.

The age of 8-9 is an essential period for children to learn to regulate and control their own emotions and improve their ability to understand the emotions of others accurately. Although children's emotions are still relatively unstable at this stage and are easily affected by the environment, the emotional control ability of 8-9-year-old children gradually increases and shows a tendency of internalization and stability. As social interactions among 8-9-year-old children gradually expand, social emotions

between them and their teachers and classmates gradually develop, such as friendship, a sense of responsibility and honor, etc.

Noticeable gender differences begin to appear in the psychological interests and emotions of children aged 9-10. Boys are active and aggressive and prefer high-confrontation and competitive sports; girls prefer dance. This stage is an essential period for children to learn to regulate their own emotions and understand the emotions of others. Children can recognize basic emotions such as joy, anger, sorrow, and joy and gradually improve their ability to recognize complex emotions such as nervousness, shyness, and depression. Although children's emotions are still easily affected by the external environment, the overall emotional development trend gradually shifts from explicit to implicit.

2.3.2 Relationship between social-emotional and health-related fitness

Self-esteem is an important part of social emotion and is a personal judgment of value expressed in the individual's attitudes towards him (Coopersmith, 1967). Self-esteem is related to the emotional states of individuals at a high level since it means the individual's emotions about himself or herself. While individuals with high self-esteem can be said to be in a more positive mood than those with positive emotions about themselves, the same is true for individuals with low self-esteem (Baumeister & Twenge, 2003). Self-esteem positively contributes to psychological well-being and a person's behavior (Brown & Mankowski, 1993), individual compliance, and mental health (Taylor & Brown, 1988). Self-esteem has a positive effect on school-related life as well as the positive effect of individuals on their psychological and mental health. Those with high self-esteem show much more perseverance when faced with difficulties.

2.3.3 The measurement of social-emotional in children

The Student Social Emotional Competence Questionnaire compiled by the Ministry of Education-UNICEF "Social Emotional Learning (SEL)" project team is a tool commonly used to measure the social and emotional development of Chinese

primary school students (Mao et al.,2016). The questionnaire includes 6 dimensions: self-awareness, self-management, other people's cognition, other people's management, collective cognition, and collective management. Each dimension has 5 items, totaling 30 items. The questionnaire adopts a 5-point Likert scoring method, with 1 representing "completely inconsistent" and 5 representing "completely consistent". The higher the subject's score on the scale, the better the development of social-emotional abilities. The internal consistency Cronbach's alpha coefficients of each dimension of the questionnaire are 0.65, 0.75, 0.66, 0.71, 0.71, 0.69, and the reliability coefficient of the overall questionnaire is 0.91. The confirmatory factor analysis results showed that the values of each fit index were CFI=0.91, TLI=0.90, and RMSEA=0.04. Each index reached the predetermined standard, indicating that the six-factor structure of the questionnaire was supported by the data and had good performance. of construct validity.

The Student Social Emotional Competence Questionnaire has been widely used to investigate the development of social and emotional abilities of Chinese primary school students, especially in western China, ethnic areas, and rural areas (Chen & Mao,2016; Yang & Mao,2017; Yang et al.,2020). It has achieved significant results in measuring and developing children's social and emotional abilities.

2.3.4 Summarize of social-emotional in children

Social-emotional development, encompassing skills like emotional regulation, self-awareness, and interpersonal relationship management, plays a critical role in children's overall growth and is closely linked to physical activity and fundamental movement skills. Social-emotional competence significantly impacts academic success, mental health, and social mobility while influencing participation in PA and the mastery of FMS. Research shows that PA and FMS provide important contexts for developing social-emotional skills by fostering teamwork, resilience, and confidence during active play and sports. Similarly, enhanced social-emotional competence encourages greater participation in PA and improves motor skill performance. Initiatives like UNICEF's SEL program in China have emphasized curriculum development to integrate these domains, highlighting the interplay between SEL, PA, and FMS. Measurement tools, such as the Student Social Emotional Competence Questionnaire, evaluate key dimensions like self-awareness and collective management, offering reliable insights into the relationship between SEL, PA, and

FMS. Together, these competencies form a foundation for holistic child development, influencing physical health, psychological well-being, and long-term educational and social outcomes.

2.4 Kids' Athletics

2.4.1 The Origin of Kids' Athletics

Athletics, also known as track and field, encompasses various events that involve walking, running, jumping, and throwing. Various physiological, psychological, and biomechanical attributes underpin success in such events. The world's governing body of athletics, the International Association of Athletics Federation (IAAF), recognizes a few distinct disciplines to be included as events. In the last few decades, a growing trend in every sport is grassroots development. The respective governing bodies of sports are putting in an endless effort to involve as many children as possible in their grassroots development program. In the same vein, IAAF has developed a new concept of athletics that focuses on the developmental needs of children by inspiring children's sporting enthusiasm and mutual interaction. This program aims to make athletics the most popular sport in school and to educate children about sports (athletics in particular), thus promoting a balanced and healthy lifestyle. It also aims to resolve the issue of early specialization in the training programs, which temporarily boosts performance at a young age. However, it later becomes a reason for dropping out of sports.

As stated by Čillík et al. (2018), the new concept should serve to prevent premature specialization and, on the contrary, support the harmonious all-round development of children, considering their developmental needs (Čillík et al., 2018). As the IAAF (2018) adds, the program is intended not only for sports clubs but also for schools and all institutions interested in the well-being of children (IAAF, 2018). The program aims to introduce children to athletics at a grassroots level, filling the gap between young children, beginners, and experienced athletes (Čillík, 2015; IAAF, 2018). This concept brings a new, more attractive, and fun, intentional organizational form of competition in groups, where one of the most significant advantages is the opportunity to enjoy successes but also to overcome failures with a team (SAZ &

Kids' Athletics, 2015; Nemeč, 2017; Čillík et al., 2018; IAAF, 2018; Deister et al., 2020). Although the Kid's Athletics project officially focuses on three age categories: a) children aged 7 and 8, b) children aged 9 and 10, and c) children aged 11 and 12 (IAAF, 2018), its usability also extends to younger or older categories.

The methodological basis of Kids' Athletics is a practical guide from the collective of authors Gozzoli, Locatelli, Massin, and Wangemann, published in 2002. It was created not only to describe the disciplines of children's athletics but also to clarify the content and organizational goals of the program. This was created not only to describe the disciplines of kids' athletics but also to clarify the content and organizational goals of the program. The manual was further developed in 2006 by the collective of authors Gozzoli, Simohamed, and ElHebil. The mentioned authors state the main goals: involving a larger number of children at the same time, using lively forms of movement, involving even children with lower performance, changes in difficulty taking into account the age and movement abilities of the competitors, an adventurous and child-friendly program, simple and unambiguous evaluation of teams, the possibility of both boys and girls competing together in mixed teams, health support consisting in a variety of movement activities, harmonious and versatile development of the individual, social interaction based on teamwork and adventurous character. (Gozzoli, Locatelli, Massin & Wangemann, 2002; Gozzoli, Simmonhamed, Elhebil, 2006; Deister et al., 2020). The main protagonists of the project try to transfer such principles to experts through various internships and coaching or teaching seminars. The reason is the interest in implementing the ideas of the project in school physical education and sports training in sports clubs. Worldwide, there are organized trainings aimed at further education of trainers, lecturers, and teachers who want to participate in the IAAF Kid's Athletics project (IAAF, 2018).

2.4.2 The benefits of Kids' Athletics

According to more authors such as Čillík, Blanárová, Nemeč & Kozolková (2018), Katzenbogner et al. (2018), Doležalová & Lednický (2012), Čillík, Pupiš & Kremnický (2009) or Kuchen (1986) the benefit of athletics lies in the improvement

of basic locomotion, as well as the development of many movement abilities and skills (Kuchen, 1986; Čillík et al., 2009; Doležalová & Lednický, 2012; Čillík et al., 2018; Katzenbogner et al., 2018). Those that should not be neglected are students aged 6-10, whose level is often not at the required level when moving to the second grade. Katzenbogner et al. (2018) add that developing these movement abilities is the primary task of kid's athletics (Katzenbogner et al., 2018).

The methodological basis of Kids' Athletics is a practical guide from the collective of authors Gozzoli, Locatelli, Massin, and Wangemann, published in 2002. It was created not only to describe the disciplines of children's athletics but also to clarify the content and organizational goals of the program. This was created not only to describe the disciplines of kids' athletics but also to clarify the content and organizational goals of the program. The manual was further developed in 2006 by the collective of authors Gozzoli, Simohamed, and ElHebil. The mentioned authors state the main goals: involving a more significant number of children at the same time, using lively forms of movement, involving even children with lower performance, changes in difficulty taking into account the age and movement abilities of the competitors, an adventurous and child-friendly program, simple and unambiguous evaluation of teams, the possibility of both boys and girls competing together in mixed teams, health support consisting in a variety of movement activities, harmonious and versatile development of the individual, social interaction based on teamwork and adventurous character. (Gozzoli, Locatelli, Massin & Wangemann, 2002; Gozzoli, Simmonhamed, Elhebil, 2006; Deister et al., 2020). The main protagonists of the project try to transfer such principles to experts through various internships and coaching or teaching seminars. The reason is the interest in implementing the ideas of the project in school physical education and sports training in sports clubs. Worldwide, there are organized trainings aimed at further education of trainers, lecturers, and teachers who want to participate in the IAAF Kid's Athletics project (IAAF, 2018). Kids' athletic practices show a positive effect on academic achievement and self-esteem. For this reason, it is suggested that schools include Kids' Athletics programs in physical education classes (Suat Utkan Çalık et al., 2018).

2.4.3 Summarize of Kids' Athletics literature

Kids' Athletics, developed by the International Association of Athletics Federation (IAAF), is a grassroots program designed to introduce children aged 6-12 to athletics through engaging and developmental activities that promote physical activity, fundamental movement skills, and social-emotional development. By focusing on basic locomotion, motor skills, and physical fitness, Kids' Athletics encourages active lifestyles while preventing early specialization and fostering holistic growth. The program emphasizes teamwork, social interaction, and inclusivity, accommodating children of all abilities and promoting social-emotional skills such as collaboration, resilience, and self-esteem. Through fun, child-friendly competitions, it provides an ideal environment for developing fundamental movement skills, which enhances physical activity participation and supports long-term health. Additionally, the program's focus on social interaction nurtures social-emotional by building relationship skills, emotional regulation, and a sense of responsibility. Kids' Athletics also positively impacts academic achievement, making it a valuable addition to physical education, and its integration into schools and sports clubs globally highlights its potential to support children's holistic development.

2.5 Modeling of intervention outcomes

The full presentation of intervention results in pediatric athletics can be achieved not only by presenting the results of individual intervention tests, but also by validating the relationships between each intervention result. Structural Equation Model (SEM) is a type of modeling that establishes, estimates, and tests causal relationships, and is a statistical method for analyzing relationships between variables based on their covariance matrices. SEM belongs to the category of multivariate statistics, which integrates two methods of statistical analysis, factor analysis and path analysis, with explicit variables, latent variables, disturbance or error terms, and correlation or causation between them included in the structural equation model.

For the entire study, the process of structural equation modeling includes the following: first, determining the purpose and selection of the study; next, proposing a

research framework or model; then defining the meaning of the concepts under study, operationalizing and measuring the concepts, evaluating the reliability and validity, and then constructing the structural equation model, and interpreting and discussing the results of the model (Li,2016).

For the whole data analysis level, the full structural equation model consists of two parts: the measurement model and the structural model. Different modeling processes have been proposed by different scholars, e.g., one-step modeling, which does not distinguish between the measurement model and the structural model, but treats the whole SEM as a complete model, obtains all parameter estimates from a single estimation, and reports a model fit index to assess the model's merit. If the analysis is divided into a measurement model and a structural model in sequence, it is called two step modeling. The first step is to determine the fit of the CFA model and the second step is to add a structural model without changing the measurement model and to evaluate the fit of the structural model. This approach is now a widely recommended analytic strategy because the measurement modeling provides information on the convergent and discriminant validity of the underlying variables and the structural modeling provides evidence of predictive validity (Qiu & Lin,2019). Mulaik and Millsap (2000) proposed a four-step approach, which operates by utilizing a series of nested models and evaluating the fit of each model through a competitive model comparison strategy.

In terms of specific structural equation modeling, the basic process that scholars need to follow includes the following: the first step is to carry out model setting, i.e., there needs to be a sound theoretical basis or a basis of previous empirical results. The second step is to assess the recognizability of the model, and if the model is not recognizable, it is necessary to return to the model setup for rechecking. The third step is to perform the selection of measurement tools in order to operationalize the concepts and to collect, prepare and screen the data. In the fourth step, the model is estimated. The main assessment is to assess the model fit; if the fit is good, assuming that the model is retained, the interpretation of the parameter estimates needs to be carried out; if the fit is poor, the model needs to be reassigned where justified. In the fifth step, the model is reassigned assuming that it can be recognized. Step 6, report the results. Step 7, conduct a review of validity and reformulate the results. Step 8, apply the results. (Kline, 2016).

2.5.1. Ecological Model

The Ecological Model (EM), first proposed by Sallis et al. (2006), is primarily used to explain how health behaviors (e.g., physical activity) are influenced by a combination of multilevel factors. This theory states that physical activity is not only determined by individual factors (e.g., motivation, attitudes), but is also influenced by a combination of external factors such as society, environment, and policy. The core idea of the ecological model is that health behaviors occur because of the interaction of multiple levels of factors. It categorizes these influences into multiple levels: the individual level, the social level, the community or environmental level, the policy level, and so on. Individual-level factors include age, gender, and health status; social-level factors include family support, social norms, and cultural background; the environmental level involves the living environment, infrastructure, and accessibility of resources; and the policy level includes health policies, laws, and regulations of the national and local governments.

The ecological model has been widely used in the study of health behaviors, particularly in the areas of physical activity and health promotion. Sallis et al. showed that individual-level factors such as age, gender, and psychological traits can directly influence an individual's level of physical activity, but that the effects of these factors are often moderated and constrained by social support, environmental conditions (e.g., accessibility to parks and fitness facilities), and policies and regulations. Ecological models also emphasize the interactions between factors at various levels. For example, although individuals are strongly motivated to exercise, the occurrence of exercise behaviors may be hindered by the lack of a favorable community environment and policy support.

In specific applications, ecological modeling can help researchers and public policy makers design interventions from a more macro perspective. For example, to increase physical activity levels in youth populations, it is necessary to not only focus on individual motivation and ability, but also to support behavior change at the individual level by improving community fitness facilities, enhancing physical education in schools, and promoting health policies. Thus, the ecological model

provides a multidimensional perspective that emphasizes the synergistic role of factors at different levels in physical activity behavior.

A specific pathway for physical education class satisfaction to indirectly influence physical activity levels through sport participation and health indicators has been proposed in the context of a unique sample of adolescents. This pathway analysis is the first empirical validation of the concretization and application of established theory, especially in a South American adolescent population (Lemes et al., 2020).

2.5.2 Health-related Quality of Life (HRQOL) and Social Vulnerability Index (SVI) models

The concept of Health-Related Quality of Life (HRQOL) was first proposed by Leplège and Hunt in 1997 to assess the subjective quality of life of an individual in a healthy state. HRQOL goes beyond the traditional biomedical concept of health and integrates an individual's health status with psychological, social, and environmental factors to comprehensively assess the impact of health on quality of life. HRQOL goes beyond the traditional biomedical concept of health and combines individual health status with psychological, social and environmental factors to comprehensively assess the impact of health on quality of life. It focuses not only on an individual's physical health, but also on the dimensions of psychological well-being, social relationships, and ability to function in daily life. HRQOL has been widely used in public health research and practice, especially among people with chronic diseases, older adults, and adolescents. HRQOL is based on the theory that health is not only the absence of disease, but also the experience of holistic well-being at the physiological, psychological, and social levels. In physical activity research, HRQOL is commonly used to measure the impact of physical activity on health and quality of life.

In adolescent research, HRQOL has been used to assess the indirect effects of physical activity on cognitive performance and quality of life. scholars such as Lemes et al. (2021) explored the relationship between physical fitness and cognitive performance in adolescents and found that increased physical activity and physical

fitness not only directly improved physiological health, but also indirectly contributed to adolescents' cognitive development by enhancing the psychological and social dimensions of HRQOL. Factors such as adolescents' physical activity level, sleep quality, and body mass index (BMIz) had a significant effect on HRQOL, and the enhancement of HRQOL, in turn, enhanced the cognitive performance of individuals.

The Social Vulnerability Index (SVI) was proposed by the Chilean Government in 2009 to measure the socioeconomic vulnerability of an individual's community. The SVI integrates factors such as family income, parental education level, community infrastructure and public resources, and is an important indicator for assessing the impact of socioeconomic conditions on individual health and quality of life. The SVI is particularly suitable for studying the impact of socioeconomic inequality on health behaviors and cognitive development.

In the study of physical activity and cognitive performance, SVI is used as a key variable to explain how socioeconomic background affects adolescents' cognitive performance by affecting physical activity levels and health behaviors. The paper verified the moderating effect of SVI through structural equation modeling (SEM) and found that students from low SVI communities performed poorly in physical fitness and cognitive performance, and this gap could not be made up by physical activity levels alone (Lemes et al.,2021). By improving the supply of public resources in SVI communities and strengthening the support of schools and families, it may be effective to reduce the negative impact of this social inequality on adolescent health and cognition.

By combining HRQOL and SVI, researchers can more fully understand how social, economic, psychological, and physiological factors jointly influence adolescent health behaviors and cognitive performance. This multidimensional analysis not only reveals the direct impact of physical activity on health and quality of life, but also emphasizes the key moderating role of socioeconomic background in this process. Therefore, HRQOL and SVI provide an important theoretical basis for the design of health intervention strategies, especially in areas with significant socioeconomic inequality, by improving social support and enhancing the accessibility of health resources, the health and cognitive levels of adolescents can be effectively improved.

2.5.3 Physical Activity-Related Health Competence model

The Physical Activity-Related Health Competence (PAHCO) model aims to integrate the two key concepts of health literacy and physical literacy to explain the development of individuals' abilities in health-related physical activities (Sudeck & Pfeifer, 2016). The background of the model is the need in the health science field to better assess and improve individuals' physical activity capabilities. The PAHCO model focuses specifically on how individuals can achieve better health outcomes by controlling, regulating and managing physical activity.

The background of the PAHCO model is based on the integration of the two concepts of health literacy and physical literacy. Health literacy is defined as an individual's ability to obtain, understand, evaluate and apply health information to make decisions that are beneficial to health. Health literacy emphasizes an individual's ability to understand and apply health information. Especially in the field of public health, health literacy is widely used to measure an individual's autonomy in medical decision-making and health behavior (Nutbeam, 1998). On the other hand, physical literacy is defined as an individual's ability to maintain active physical activity throughout his or her life, with special emphasis on the core role of physical activity in improving the quality of life and health level. Physical literacy includes not only physical skills, but also an individual's attitude, confidence and understanding of physical activity (Whitehead, 2001).

The PAHCO model is widely used in health intervention and physical activity research, especially for adolescents. In the application of this model, researchers not only focus on the physical ability of individuals, but also pay special attention to how individuals can achieve the dual goals of health and mental health by controlling and regulating physical activities. Through empirical research, researchers have verified the core role of control ability in adolescent physical activities. Control ability is divided into two dimensions: control of biomedical health and control of mental health. Through detailed analysis of these two dimensions, the study found that control ability has a significant promoting effect on the quality of physical activity and health outcomes, especially among adolescents. Individuals with higher control ability show stronger physical fitness and better mental health (Haible et al., 2019).

The PAHCO model provides a comprehensive framework for health-related physical activity research, integrating the three core elements of motor ability, control ability, and self-regulation ability. Through the PAHCO model, researchers can better understand the behavioral patterns of individuals in physical activities and provide more targeted strategies for health intervention and education. Especially for adolescents, by improving their control ability and self-regulation ability, their physical fitness and overall health level can be significantly improved.

2.5.4 Summarize of the literature on model building

The use of Structural Equation Modeling (SEM) provides a robust framework for analyzing the interconnected relationships between physical activity, fundamental movement skills, social-emotional, and programs like Kids' Athletics. SEM integrates factor and path analyses, enabling researchers to validate causal pathways and examine how variables such as physical activity, fundamental movement skills, and social-emotional influence one another. The ecological model highlights multilevel factors—individual, social, environmental, and policy—that shape physical activity behaviors, creating opportunities to design interventions that address these interconnected domains. Programs like Kids' Athletics foster physical activity, enhance fundamental movement skills, and nurture social-emotional by creating inclusive, engaging environments that promote teamwork, resilience, and motor skill development. Similarly, the Health-Related Quality of Life (HRQOL) model demonstrates how PA and FMS directly and indirectly enhance cognitive, psychological, and social well-being, while the Social Vulnerability Index (SVI) underscores the role of socioeconomic factors in moderating these effects. The Physical Activity-Related Health Competence (PAHCO) model further emphasizes developing control, self-regulation, and literacy in health and physical activity to support holistic development. Together, these frameworks provide a comprehensive approach to understanding how PA, FMS, SED, and initiatives like Kids' Athletics synergistically promote children's physical, mental, and social well-being.

2.6 Research framework based on the literature review

Based on the summary of the literature study and according to the purpose of the study, the research framework developed in this study is shown in Figure 1. This study's research framework evaluates the impact of the Kids' Athletics program on children aged 7–10 across physical activity, fundamental movement skills, and social-emotional development. Using tools like the CFMST, PA questionnaires, and the Social Emotional Ability Questionnaire, the study measures these domains and employs statistical analysis to validate relationships and outcomes. The aim is to promote holistic child development by enhancing physical activity, fundamental movement skills, and social-emotional competencies, culminating in an integrated intervention impact model.

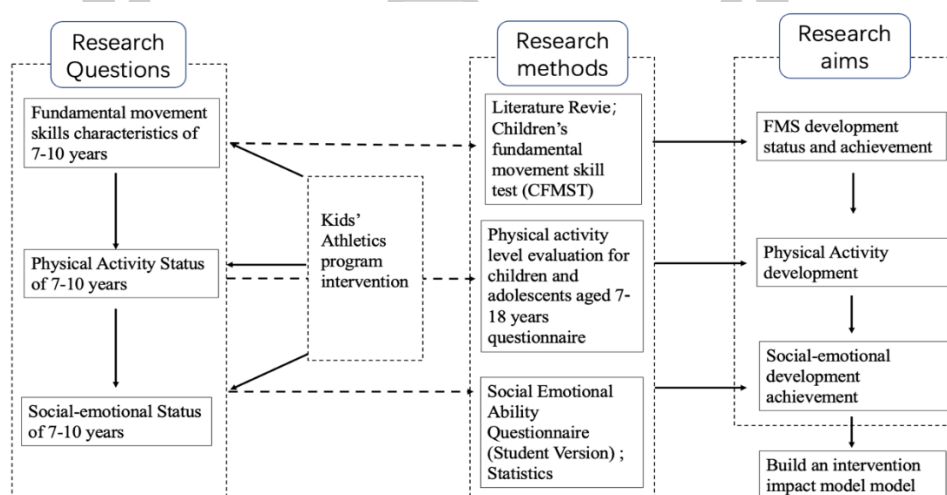


Figure 1 The Research Framework



CHAPTER III

METHODOLOGY

This chapter describes the study's overall design, including test objects, sampling, instrumentation, data collection procedure, and statistical analysis. It is divided into three phases and use Quasi-Experimental and longitudinal design with survey data collected from the samples of Kid's Athletics exercise at the city of Nanning in China.

3.1 Research Design

The research design is based on exploring the solution to the research problem. First, it starts with the fundamental movement skills, physical activities, and social-emotional of Chinese 7-10-year-old children, conducts baseline tests on their development status, and collects and analyzes the data; secondly, by using the intervention method of Kid's Athletics, the samples were grouped and compared, and the effects before and after the experiment were compared; finally, based on of differentiating age and gender, the effectiveness of the intervention method on their fundamental movement skills, physical activities, and social-emotional development was demonstrated, establish a visual model to achieve the purpose of research. A step-by-step study based on a research design.

3.2 Research Subjects

The cluster random sampling method was used to choose the subjects for the research. Inclusion criteria were: (1) Students who are in good health and do not suffer from moderate or severe cognitive impairment; (2) Have the informed consent of the principal of their primary school to participate in this study and obtain written informed consent;(3) Have the consent of their parents or guardians agree to participate in this study and obtain written informed consent.

Exclusion criteria were: (1) Suffering from moderate and severe cognitive impairment (confirmed by teachers and guardians); (2) There are significant medical

or organic diseases that affect their participation in physical exercise; (3) After testing, students who experience motor developmental delays, are unable to complete the test and may withdraw at any time.

Children aged 7-10 from eight elementary schools in Nanning participated in this study, including 172 boys and 188 girls. Due to the voluntary withdrawal of some students during the study, the final sample size was 153 boys and 152 girls.

The students were divided into two groups of every age group. The total of 7-8 years includes 50 boys and 54 girls, 8-9 years includes 47 boys and 50 girls, and 9-10 years includes 56 boys and 48 girls.

The participants were divided into experimental and control groups in which the experimental group consisted of 77 boys and 75 girls, while the control group consisted of 76 boys and 77 girls. In the control group, there were 23 boys aged 7-8 years, 24 boys aged 8-9 years, and 29 boys aged 9-10 years. There were 27 girls aged 7-8 years, 19 girls aged 8-9 years, and 31 girls aged 9-10 years. In the experimental group, there were 27 boys aged 7-8, 23 boys aged 8-9, and 27 boys aged 9-10. 27 girls aged 7-8, 31 girls aged 8-9, and 17 girls aged 9-10, shown in Table 1.

Table 1 Statistics on the number of participants (N=305)

Grade	Gender	Control group	Experimental group	Total
grade 1	boys	23	27	50
	girls	27	27	54
grade2	boys	24	23	47
	girls	19	31	50
grade 3	boys	29	27	56
	girls	31	17	48
Total		153	152	305

3.3 Research Process

From April to June 2024, 305 children aged 7-10 in Guangxi participated in this study using the cluster random sampling method. When conducting the study, the first step was to conduct a baseline test on the fundamental movement skills, physical

activity level, and social-emotional development of the respondents to understand and grasp their reality; the second step was to conduct a targeted design of interventions based on the results of the baseline test to intervene by Kid's Athletics program; and the last step was to conduct a retest of the students' fundamental movement skills, physical activities, and social-emotional development after the end of the intervention retesting, comparing the results of the pre-test and post-test, and modeling the results of the intervention to demonstrate the effects of the intervention fully.

In this study, to ensure the comparability of the experimental and control groups before the intervention, we conducted a detailed statistical analysis of the baseline data of the two samples. The results showed that the differences between the experimental and control groups in the overall development of fundamental movement skills and the scores of the dimensions of social-emotional competence were not significant. These results suggest that the experimental and control groups had a high degree of homogeneity before the intervention.

3.4 Data Collection

Literature Review: helps to understand the history, development process and influence of the characteristics of movement behaviors, physical activity, and social-emotional factors.

Test: The children's fundamental movement skill test (CFMST) was used to assess the survey subjects' fundamental movement skills development level. The tests were divided into a pre-test and a post-test, the pre-test was conducted from 2-19 April 2024 with the aim of randomizing children into experimental and control groups based on the results of the tests and to test whether the data from the pre-test could be used because of the baseline test. The post-test was conducted from 24 June to 5 July 2024, after an eight-week intervention, and data were collected to reflect the results of the intervention.

Questionnaire: Physical Activity Level Questionnaire for Children and Adolescents Aged 7-18 Years, and the Student Social Emotional Competence Questionnaire will be used. The pre-test of the Physical Activity Level Questionnaire for Children and Adolescents Aged 7-18 Years was completed on 1-5 May 2024, and

the post-test was administered on 1-3 July 2024. The pre-test of the Student Social Emotional Competence Questionnaire was completed on 22-26 April 2024 and the post-test was administered on 24-26 June 2024.

Statistics: Standard descriptive statistics were calculated for all outcome and demographic variables. The data were statistically analyzed using SPSS 26.0, and the resultant equation modeling was carried out using Amos 24.0.

3.5 Test Methods

3.5.1 Children's Fundamental Movement Skill Test (CFMST)

Use standardized testing procedures to perform CFMST operations. Mainly in the following three aspects: 1) The test equipment is standard equipment in physical education. Equipment is an indispensable part of the test. All the equipment in the CFMST has been mass-produced and popularized in physical education, which fully ensures its popularity. The balls used in the sub-test for kicking over obstacles are soft medicine balls (1 kg, 2 kg) that are commonly used in physical education. 2) Standardized requirements include the on-site test process, tester passwords, protection and assistance, and test score records. The standardized test process can ensure the stability of the test under different testers, test locations, and times and fully ensure the operability of the test. 3) A standardized site layout plan was developed to ensure the order of on-site testing to maximize space utilization.

All testers in this study have extensive experience in motor skill analysis and are physical education teachers in primary schools or master's students in exercise and sports science. At the beginning of the test, the testers completed a 5-h test on the skills used in this study. Additional training on testing methods fully ensures the smooth development of testing work.

Sideways slide running: This is one of the tested mobility skills items. The test site is a 10m long flat site with a 30 cm long marking tape on each end of the site. t site is a 10m long flat site with a 30 cm long marking tape on each end of the site. During the test, the subject stood naturally with his arms raised sideways so that his shoulders were perpendicular to the marking tape line on the floor. After hearing the

"Start" command, the subject slid from one side of the marking tape to the opposite side, reaching the point where the back foot touched. After marking the tape, turn around and return. When the subject touches the start and finish line anywhere, the tester stops the watch and records the time. Take the test 2 times and get a better score.



Figure 2 Sideways slide running test

Jumping continuously on one foot is the second test item for mobility skills. Use 10 pieces of soft square bags (10 cm × 5 cm × 5 cm) and layout double (single) foot continuous jumping mats on the flat ground (or draw 1 horizontal line every 50 cm, a total of 10 lines) for each. Place a square bag horizontally on the horizontal line and conduct the test at a venue where the starting line is set up 20 cm away from the first square bag. During the test, the subject stood behind the starting line with both (single) feet supported. After hearing the "start" command, he took off with both (single) feet and jumped once or twice with both (single) feet from the square bag. Skip 1 square bag directly above and skip 10 square bags in a row. The tester starts the timer as the subject starts. When the subject jumps over the 10th square bag and any foot lands on the ground, the tester stops the watch and records the time.



Figure 3 Jumping continuously on one foot test

Changing hands and shooting the ball on the spot: This is one of the tests of object control skills items. Use the Locomotive brand No.5 basketball produced in Shanghai, and marking tape to mark a square box with a side length of 1 m on the ground of the test site. After hearing the "Start" command during the test, the subject starts hitting the ball with his left (right) hand. After the ball bounces, he switches to the other hand to hit the ball. The bounce height of the ball is higher than the subject's knee joint, which counts as 1 time, and so on. The tester starts timing as the subject shoots the ball. After eight consecutive or intermittent shots, the test ends, and the time is recorded. Take the test 2 times and get a better score.





Figure 4 Changing hands and shooting the ball on the spot test

Kicking the ball over the obstacle: This is the second test item for control skills. The test equipment is a 2kg soft solid ball of Shuhua brand manufactured in Guangdong Province. Use a tape measure to mark 3 marking points on a straight line, with a spacing of 1.5 m between each point. Markers are placed at the middle 2 points, and markings are made with marking tape at both ends as the starting and end points, respectively. Place one marker 1 m on both sides of the central marker. The subject stood behind the starting point and placed the ball on the left (right) side of the starting point. After hearing the "start" command, the subject kicked the ball forward to bypass the middle marker and not exceed the markers on both sides. The tester starts the timer when the subject kicks the ball; when the subject kicks the ball across the end point and stops the ball, the tester stops the watch and records the time. Take the test 2 times and get a better score.

พหุ ประถมศึกษา ชีวะ



Figure 5 Kicking the ball over the obstacle test

Walking on the balance beam: This is one of the stability skills test items. Use a balance beam (300 cm×10 cm×30 cm) and a rectangular platform (20 cm) with the same height as the balance beam at each end for testing, which the Shuhua brand manufactured in Guangdong Province. The subject stood on the platform behind the starting point, facing the balance beam, raising his arms sideways. After hearing the "start" command, he alternately advanced toward the finish line with both feet. The tester gives the order in front of the subject, starts the timer at the same time as the subject starts, and follows the subject towards the end point, while paying attention to the subject's movements to prevent accidents. The watch is stopped immediately when any of the subject's toes exceeds the end point. Take the test 2 times and get a better score.

พหุ ประถมศึกษา



Figure 6 Walking on the balance beam test

Walking backward in a straight line is the second test item for stability skills. Measure a 5 m long distance on a flat site and use marking tape to make a 5 cm wide straight line to mark the starting and endpoints. The subjects stand behind the starting point with their feet crossed in front and back, with their back facing the endpoint. After hearing the "Start" command, the subject walked backward with his arms freely raised at both sides of his body. When walking backward, the crossed feet must be kept in a straight line, and the toes of each backward touch the front feet. At the heels, keep your feet in a straight line. When the toes of the subject's front feet leave entirely the endpoint, stop the watch and record the time.

The timing results are used to evaluate the test scores of the above items. At the same time, each test item can be compared individually, or the total score can be compared through statistical processing to accurately display the development status of students' fundamental movement skills.



Figure 7 Walking backward in a straight-line test

3.5.2 Physical activity level test

The Physical Activity Level Evaluation for Children and Adolescents Aged 7-18 Years was utilized to measure the physical activity level of the survey respondents. The questionnaire is a standard in the Chinese health industry and is highly authoritative in China, allowing for allowing for easy and precise results. The first part of the questionnaire measures children's physical activity behavior in the past seven days. Children aged 7-10 years old, with the help of their parents or teachers, recall the sports they have participated in, the number of times they have participated in them, and the time they have participated in them each time, which is used to calculate the total time spent on physical activity in a week, and the average time spent participating in medium- and high-intensity sports every day. 24 questions are asked. Multiple questions can be selected according to the actual situation. A total of 24 questions were asked, and multiple questions could be selected according to the actual situation. The second part of the questionnaire is the measurement of sedentary behavior, with 9 questions corresponding to the number and time of video screen behavior and the number and time of other sedentary behaviors in the past week.

3.5.3 Social-emotional development

Social-emotional development was measured using the paper-based "Social Emotional Ability Questionnaire (Student Version)".

Dimension 1: Self-awareness (questions 1-5). Able to identify and evaluate one's own emotions, interests, values and strengths; recognize the positive qualities of self-development and maintain full confidence. The higher the score, the stronger the students believe they are in identifying and evaluating their own emotions, interests, abilities, and values, and the higher their confidence in themselves.

Dimension 2: Self-management (6-10 questions). The ability to adjust self-emotions and behaviors, regulate self-stress, inspire self-will, and form and maintain good emotional experience and behavioral performance. It manifests as the self-motivation ability to adjust one's emotions to adapt to the environment, cope with stress, control impulses and persevere to overcome obstacles; the ability to establish short-term or long-term goals to achieve success; the ability to express one's emotions in an appropriate way; the ability to face setbacks and the tenacity to persevere in the face of failure. The higher the score, the stronger the students believe they are in regulating and controlling their emotions and behavior, as well as in self-motivation, persistence, resilience, etc.

Dimension 3: Cognition of others (questions 11-15). Able to identify and understand the attitudes, emotions, interests and behaviors of others; able to view issues from others' perspectives; willing to proactively communicate with others. The higher the score, the higher the level that students believe they recognize and understand others, are willing to communicate with others, and can think from others' perspective.

Dimension 4: Management of others (16-20 questions). Able to understand other people's thoughts, emotions and behaviors, respect differences, learn to be tolerant, resolve conflicts, and establish and maintain friendly interpersonal relationships. Specific manifestations include: the ability to identify, understand, respect and tolerate the thoughts, emotions and behaviors of others; the ability to resolve conflicts through communication; the ability to actively and kindly handle and maintain healthy and beneficial interpersonal relationships; the ability to follow ethical and

moral standards, the ability to reject the unethical, unsafe, and illegal behavior of others. The higher the score, the more confident the students are that they can actively and healthily handle interpersonal relationships based on understanding others.

Dimension 5: Collective cognition (questions 21-25). Have collective consciousness, identify with collective norms, understand the relationship between the collective and the individual, and form civic behaviors required by the collective and society. The higher the score, the more confident the student is in caring for the group.

Dimension 6: collective management (26-30 questions). Observe collective norms, adjust collective and individual relationships, form a sense of collective belonging, and develop good behaviors required by the collective and society. Specific manifestations include: the ability to understand collective rules, norms and values; the ability to think about problems from a collective perspective; the decision-making and leadership ability to adjust the relationship between the collective and individuals; the ability to establish pro-social tendencies and role orientation; The ability to contribute to the well-being of the school and society. The higher the score, the more satisfied the students are with their performance in coordinating individual and collective relationships.

3.6 Quality Control

Before the test, the researcher and his team of scientific researchers sought the consent of the volunteers by interviewing the volunteers and their families and signing informed consent forms. The researchers and physical education teachers are fully responsible for the quality and supervision of the basic motor skills test results. Before conducting the test, the researcher conducted operational training for the staff to familiarize them with the site, equipment, test methods, test action specifications, data entry, etc. Carefully review the inclusion and exclusion criteria for trial subjects before the trial. Arrange the test team leader to conduct inspection, guidance and supervision to ensure that the evaluation results are accurate and error-free. After the test, organize testers to conduct a summary seminar to check whether there are problems such as missing data, data entry, and data anomalies in the evaluation results.

3.7 Scale Reliability and Validity Tests

In this study, data were collected on Physical Activity Level Questionnaire for Children and Adolescents Aged 7-18 Years and the Student Social Emotional Competence Questionnaire.

The reliability of the two questionnaires was tested by Cronbach's alpha coefficient, and the validity by was tested by KMO and Bartlett's sphericity, the Cronbach's s alpha of Physical Activity Level Questionnaire for Children and Adolescents Aged 7 to 18 Years was 0.847, and the KMO was 0.8.

The Student Social Emotional Competence Questionnaire. internal consistency Cronbach's alpha coefficients of the dimensions were, in order: 0.852, 0.872, 0.786, 0.805, 0.865, 0.820, and the reliability coefficient of the overall questionnaire is 0.943. The results of the validation factor analysis show that the values of the fit indices, CFI=0.989, TLI=0.981, and SRMA=0.017, and all the indexes have reached the predetermined standards, which indicates that scale have good measurement reliability and consistency validity.

3.8 Ethical research

The Ethics Committee of Mahasarakham University approved this study, NO:184-038/2024 (Appendix B). The details of the ethical study are as follows:

(1) Provide the volunteer with an explanatory document. Volunteers may not benefit directly from this research project. However, this study's information will help increase children's awareness of the full range of physical and mental health, guide children's future exercise, and promote physical activity and self-directed exercise habits among 7- and 10-year-olds. If children decide to participate in this study, they will be asked to complete the questionnaire in 5-10 minutes with the help of their parents or teachers. The data collected in the questionnaire will be used for academic research only, and the answers will be kept entirely confidential. The information will be destroyed at the end of the study. Volunteers have the right not to answer the questions if they feel uncomfortable or uneasy about them and to withdraw from the

study at any time; non-participation or withdrawal from the research project will not affect the volunteer in any way. The information in the questionnaires will be retained and will not be made public, and the findings will be used only for this study. The information will be destroyed at the end of the study. Volunteers will not receive compensation or remuneration for this study.

(2) Volunteer's informed consent. I have read the instructions for volunteering to participate in the "Kids' Athletics Program Development and Intervention for Physical Activity, Fundamental Movement Skills, and Social-emotional of Chinese Children" research project, which includes full details of the purpose and process of the study. They were aware of the study's benefits and possible risks. The researcher will keep their information confidential and not provide private information to the public anonymously or individually. The study's results will be presented in the form of a review, which is a summary of the study's results and will be used for academic purposes only. Participation as a volunteer in this research project is voluntary. They may withdraw from this study at any time, which will have no effect and will not be for feintany of their future rights in research or work.

(3) The researchers and physical education teachers are solely responsible for the quality and supervision of the fundamental movement skills test results. Before the test, the researcher conducted operational training for the staff to familiarize them with the site, equipment, test methods, test action specifications, data entry, etc. Carefully review the inclusion and exclusion criteria for trial subjects before the trial. Arrange the test team leader to inspect, guide, and supervise to ensure the assessment results are accurate and error-free. After the test, organize a summary seminar for testers to check whether there are any problems, such as missing data, data entry, and data anomalies in the evaluation results.

3.9 The design of Kids' Athletics intervention program

Under the content framework of Kids' Athletics projects, Kids' Athletics courses were designed for the research subjects, and the intervention process was implemented in the form of game teaching. During the 8-week teaching intervention, the content covered included children's basic mobility skills, stability skills, object

manipulation skills, and team collaboration activities. Each game has a specific name so that primary school students can remember it and carry out game activities with their peers outside of class. Four interventions per week, each lasting 45 minutes. The intervention program is shown in Table 2.

Table 2 Kids' Athletics Intervention Program

weekly/ Lessons	First lesson	Second lesson	Third lesson	Fourth lesson
1	tightrope walking relay (mobility skill)	shepherd & sheep (stability skill)	fruit picking (mobility skill)	race with the ball (mobility skill)
2	tree, rock, river (mobility skill)	ladder fetch (object control skill)	play rubber band jump rope (mobility skill)	Linear throw - KYKKA (object control skill)
3	going around the pole, crossing the barrier, stepping into the relay (mobility skill)	spanning several continents (stability skill)	play hopscotch (mobility skill)	flying saucer (object control skill)
4	energy transfer (stability skill)	keep rhythm (mobility skill)	jump rope and run (mobility skill)	over the barrier throw (object control skill)
5	hold the gears (mobility skill)	Formula 1 (mobility skill)	hop, skip and jump (mobility skill)	backfire (object control skill)
6	roundabout conversion (mobility skill)	one-legged jumps, stride jumps, two-legged jumps (mobility skill)	scroll back and forth (stability skill)	kneeling relay (object control skill)
7	hold the gears (mobility skill)	jump rope in a team (mobility skill)	line up and roll over (stability skill)	hoop throw (object control skill)
8	Grade 1: energy transfer (stability skill) / Grade 2-3: kneeling relay (object control skill)	Grade 1: spanning several continents (stability skill) / Grade 2-3: single sprint run (mobility skill)	Grade 1: fruit picking (mobility skill) / Grade 2-3: accurate long jump (mobility skill)	Grade 1: over the barrier throw (object control skill) / Grade 2-3: double-handed pushover (object control skill)

The principles of repetition and intermittency were followed in the implementation of the intervention, and attention was paid to individual differences in students at different levels during the intervention process to make the intervention program as consistent in its effects as possible. The first week was designed to practice three mobility skills and one stabilization skill; the second week was designed to practice two mobility skills and two object manipulation skills; the third week consisted of two mobility skills plus one object manipulation skill and one stabilization skill; and the fourth week consisted of two mobility skills plus one object manipulation skill and one stabilization skill, and, through repetition, the consolidate the effects of the first phase of fundamental movement skills development.

The fifth week consisted of 3 mobility skills and 1 object manipulation skill; the sixth and seventh weeks consisted of 2 mobility skills plus 1 object manipulation skill plus 1 stability skill; the eighth week consisted of 2 stability skills plus 1 mobility skill and 1 object manipulation skill for first graders, 2 stability skills plus 1 object manipulation skill for second and third graders, and 2 stability skills plus 1 object manipulation skill for second and third graders. exercises plus 2 object manipulation skills. The repetitions of the exercises in Phase II were deeper and differentiated for the grade-level characteristics of the students. They were more focused on the development of fundamental movement skills.

WORLD ATHLETICS LEVEL 2

TREE, ROCK, RIVER

1 Run around the tree
2 Clear the rock
3 Clear the river
4 Become the next obstacle

SAFETY

- Check ground is safe
- 'Rock' looks in tightly, including head, or in a log
- 'Tree' and 'river' stand still
- Practise clearing individual obstacles first

EQUIPMENT

- Optional: markers and hurdles as obstacles, instead of people; e.g. poles, crates, ropes

HOW TO PLAY

- Spread your team out in a line – about 3m apart
- First player is the runner
- Second player is the tree – stand straight
- Third player is the rock – kneel and tuck-in tightly or lie flat as a log
- Fourth player is the river – stand sideways with legs and/or arms apart
- Run around, over or under the obstacles without hitting any!
- Join the line as the tree and tuck-in tightly or lie flat as a log
- Next player runs and becomes the rock, and so on

PERSONAL CHALLENGE

To begin, practise running around or over each obstacle on its own. Can you combine them to run the full course fluently?

FUNDAMENTAL SKILLS

- Agility
- Balance
- Rhythm
- Spatial awareness

TIPS

- Look where you are going
- Run tall with your head up

LIFE SKILLS & VALUES

Self-control
Why was it important for you to have self-control when running or using an obstacle? What emotions did you need to manage as you were taking part?

Respect
How did you show respect for your teammates? How did being respectful help you to trust each other and do your best?

ADAPTABLE ATHLETICS: INCLUDE, ENGAGE, SUPPORT AND CHALLENGE

SPACE

- Spread obstacles over a shorter or longer distance
- Alter the height and width of the rock and river
- Create a circular course instead of a linear one

TASK

- Team members are the same obstacle, e.g. all trees, for each round
- Runners return to their place then swap places with a teammate
- Trees hold a different shape as a static balance

EQUIPMENT

- Use objects instead of people as obstacles
- Change what natural obstacles are represented, e.g. sit on multiple trees in a 'forest', slip over 'logs' on the ground

PEOPLE

- Work in pairs to practise clearing obstacles
- Group by ability so teams tackle the task to suit their readiness
- Increase the number of people who are obstacles

WORLD ATHLETICS LEVEL 2

SHEPHERD & SHEEP

1 Agree how to communicate
2 Choose a shepherd
3 Send out the sheep
4 Guide the sheep into the pen

SAFETY

- Check the area is free from hazards – underfoot and overhead
- Have a safe zone – stop 'sheep' from leaving the safe zone

EQUIPMENT

- Blindfolds – 1 per 'sheep'
- Markers to create a sheep pen, e.g. cones, a rope
- Optional: whistle

HOW TO PLAY

- Set up a safe zone with a sheep pen in the middle, big enough for all players
- As a team, agree how to communicate commands
- Choose one player to be the shepherd – only this person gives the commands
- Blindfold the other players – the sheep – who follow the commands in silence
- Spread the sheep around the safe zone
- Guide the sheep into the sheep pen using the commands

PERSONAL CHALLENGE

Can you follow the commands confidently and exactly? Can you be more accurate by being aware and concentrating?

REGIONAL GAME

SHEPHERD & SHEEP

This is a problem-solving activity created in North America. Do you have a similar game in your country?

FUNDAMENTAL SKILLS

- Balance
- Body awareness
- Reaction and reactive movements
- Spatial awareness

TIPS

- Listen carefully
- Pay attention to your body and all of your senses

LIFE SKILLS & VALUES

Problem-solving
Why was it important to be creative when discussing how to communicate as a team? How did you overcome any unexpected challenges?

Determination
What gave you the courage to take part as a sheep? What did you do to show that you were trying your best, even if it was challenging?

ADAPTABLE ATHLETICS: INCLUDE, ENGAGE, SUPPORT AND CHALLENGE

SPACE

- Increase or decrease the size of the safe zone
- Alter the position of the sheep pen within the zone
- Spread the sheep around the space or start them from the same point

TASK

- Allow players to see if they prefer or if they have a hearing impairment
- Use verbal, non-verbal or tactile commands
- Follow a fixed rope while blindfolded instead of shepherd and sheep

EQUIPMENT

- Close eyes instead of using blindfolds
- Use different types of non-verbal commands, e.g. whistle, drum, clap hands
- Navigate obstacles within the safe zone – between, around, over, under

PEOPLE

- Pair a shepherd and a sheep
- Have a 'strong' sheep dog to provide support to individual sheep
- Sheep tie hands so they move as one group

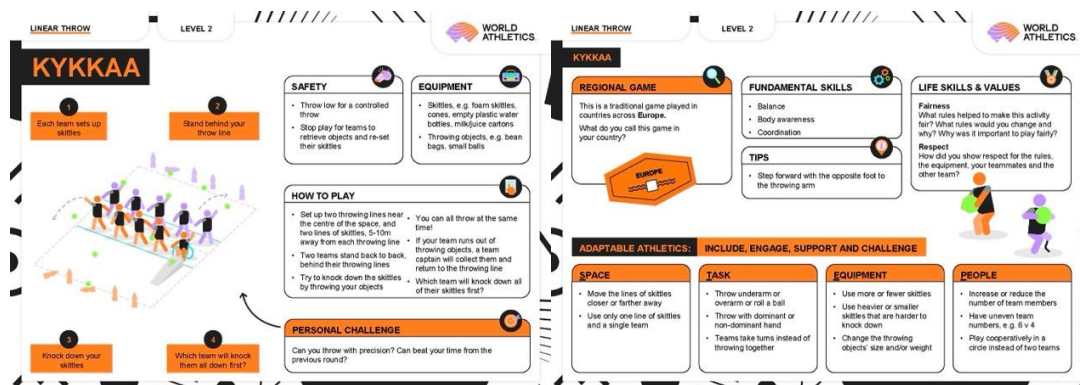


Figure 8 Kids' Athletics teaching card

The IOC assesses key aspects such as appropriateness of intervention objectives, content design, implementation, assessment tools, experimental design, and active participation of children. It ensures that activities are engaging and age-appropriate, targeting children's physical, emotional, and social development. Activities should be varied and progressively challenging, with clear instructions and flexibility to accommodate different skill levels. Intervention programs must be scientifically based, include appropriate duration and frequency of sessions, and be facilitated by trained instructors with parent or teacher involvement for support. Assessment tools should be reliable, using explicit, age-appropriate criteria to assess changes in motor skills and social-emotional outcomes, and applied consistently across experimental and control groups. Experimental designs must control for bias through randomized assignment, adequate sample size, and consistent implementation. Finally, children's active participation is critical, providing opportunities for choice, peer interaction, and feedback to ensure that the intervention meets their needs and increases their motivation. The intervention design has been validated by experts as meeting the requirements of the IOC and will serve as a good guide for the experimental intervention.

CHAPTER IV

RESULTS

The overall aim of this study was to apply the Kids' Athletic intervention to the fundamental motor skills, physical activity development, and social-emotional development of Chinese children aged 7-10 years old, and this chapter is divided into three distinct phases. The first phase studies the status of fundamental motor skills, physical activity, and social-emotional development in 7–10-year-old children. The second phase is a motor intervention tool that demonstrates the effectiveness of the intervention program in promoting students' fundamental movement skills, physical activity, and social-emotional development. The third stage is to construct an effective intervention model for fundamental movement, physical activity, and social-emotional development of Chinese children aged 7-10 years based on the intervention effects and to explore the relationship characteristics between the variables.

4.1 Phase 1: A baseline study of the development of physical activity, fundamental movement skills, and social-emotional development in Chinese children aged 7-10 years old

Data from the baseline test were also used as pre-test data in this study. The baseline test was conducted with participants ungrouped and assessed the initial status of all participants. After the baseline test was completed, based on these data, participants were randomly assigned to experimental and control groups, and the data from the baseline test were subsequently analyzed using the data from the baseline test as pre-test data. The baseline test used the same measurements and criteria as the pre-test, so the baseline data not only provided a uniform starting point for grouping, but also served as the pre-test data reflecting the participants' state before the intervention, ensuring logical consistency of the data before and after grouping. With this design, the interface between the baseline test and the pre-test is realized without the need to repeat the measurements, thus ensuring a scientific and concise experimental design.

4.1.1 Development of physical activity in children prior to intervention

4.1.1.1 Overall physical activity development of children aged 7-10 years prior to the intervention

Table 3 Overall student participation in physical activity(N=305)

Medium to high-intensity activities	numbers	rate (%)	ave./w time(min)
Playing football	93	30.49	99.05
Playing basketball	132	43.28	141.85
Playing volleyball	28	9.18	77.57
Playing table tennis	50	16.39	132.64
Playing badminton	131	42.95	104.88
Doing radio gymnastic	261	85.57	14.82
Playing aerobics	24	7.87	69.96
Dancing	81	26.56	113.58
Doing martial arts	48	15.74	96.10
Practicing Tai Chi/Yoga	14	4.59	2.86
Gymnastics (pull-ups, sit-ups)	117	38.36	28.17
High Jumping/Long Jumping	106	34.75	40.54
Throwing	27	8.85	60.22
Rope skipping/jumping	186	60.98	66.60
Playing shuttlecock	44	14.43	99.93
Playing games outdoors	213	69.84	108.63
Exercise with fitness equipment	107	35.08	27.44
House working	203	66.56	58.40
Swimming	106	34.75	135.57
Skating	22	7.21	94.50
Walking	217	71.15	21.70
Bicycling	156	51.15	17.33
Running	200	65.57	47.95
Stair climbing	208	68.20	34.04

The top five activities in terms of students' participation rates were: Doing radio gymnastics (85.57%), Walking (71.15%), Playing games outdoors (69.84%), Stair climbing (68.20%), and Running (65.57%). These results indicate that relatively simple and easy-to-participate activities such as radio gymnastics and Walking had higher participation rates, probably because these activities do not require specific equipment or venues and are more accessible for students to participate in. Similarly, activities such as playing games outdoors and stunt climbing were highly prevalent, suggesting that they are more common in students' daily activities. Furthermore, Running, a widely accepted sport, also had a high participation rate.

Overall, there are significant differences in the participation of children aged 7-10 years in physical activity. Radio gymnastics was the program with the highest participation rate of 85.57%, indicating that most students participated daily. However, due to its nature, the average length of participation was only 2.12 minutes per day. Both basketball and badminton had a participation rate of over 40%, 43.28%, and 42.95%, respectively, and a longer duration of participation per day, indicating their wide popularity among students. The participation rates for Playing football were 30.49% and for table tennis 16.39%. Although the participation rates of these two items were slightly lower, the participants spent more time every day, especially table tennis, which was close to 19 minutes per day. Overall, group-type sports such as radio gymnastics, basketball, and badminton were widely participated in, while some more specialized sports or had specific venue requirements, such as volleyball and table tennis, were participated in by fewer students. However, these students invested more time in them.



4.1.1.2 Overall sedentary behavior of students prior to intervention

Table 4 Students' sedentary behavior before intervention(N=305)

sedentary behavior	numbers	rate (%)	ave./w time(min)
Attend offline classes	88	28.85	318.52
Writing paper-based assignments	287	94.10	297.49
Sitting and chatting	113	37.05	238.36
Read paper-based books	284	93.11	200.12
Using a computer	297	97.38	167.71
Using cell phones and tablets	300	98.36	158.16
Watching TV	274	89.84	140.36
Watching a movie at the cinema	131	42.95	100.89
Taking the bus to school every day	28	9.18	56.07
Weekly screen time	305		1103.85
Average screen time per day	305		64.6

From the data analysis, almost all the students used electronic devices frequently and spent more than 5 hours per week on electronic devices. The weekly time spent on sedentary behaviors (including all sedentary activities) was 1103.85 minutes, or nearly 18 hours, meaning that each student spent more than half a day per week on sedentary behaviors, significantly reducing their time for physical activity. Students had high participation rates in sedentary behaviors and spent long hours per week on these behaviors, especially in electronic devices and written assignments. These behaviors can negatively impact students' physical health and overall lifestyle.

4.1.1.3 Summarize the state of physical activity

Overall, students' performance in physical activity and sedentary behavior is worrisome. In terms of physical activity, while easy-to-participate programs such as Doing radio gymnastics and running had high participation rates (85.57% and 71.75%), participation in medium- and high-intensity programs was low, despite their long weekly hours of participation, showing a gap between participation surface and

exercise benefits. Students' choice of sports was relatively homogeneous and lacked variety and skill, which affected overall physical development. Regarding sedentary behavior, students' screen time and cultural cramming classes were longer, with some students spending up to 6 hours or more of screen time per week, and the total hours of sedentary behavior even exceeded 20 hours. This elevated percentage of sedentary behavior may compress students' physical activity time, further limiting their athletic opportunities and health development. Combined with these data, interventions should reduce the time spent in sedentary behavior, especially screen time, increase the variety and intensity of physical activity, and encourage students to participate in a wide range of high-performance sports programs to improve overall physical fitness and health.

4.1.2 Development of fundamental movement skills in children prior to intervention

4.1.2.1 General description of the baseline test of children's fundamental movement skills

Table 5 Overall of fundamental skills pre-test (N=305)

Test content	Control group(n=153) M±SD	Experimental group(n=152) M±SD	t-test	p-value
Sideways slide running	8.12±1.24	8.18±1.21	-0.43	0.668
Jumping continuously on one foot	4.47±0.77	4.5±0.80	-0.34	0.737
Changing hands and shooting the ball on the spot	4.10±1.01	4.10±0.93	-0.02	0.986
Kicking the ball over the obstacle	8.22±2.46	8.19±2.84	0.11	0.916
Walking on the balance beam	4.14±2.32	4.07±2.20	0.28	0.783
Walking backward in a straight-line	14.35±5.54	14.22±5.41	0.21	0.836

Prior to the intervention, the results of the fundamental movement skills test of the students in the control and experimental groups were tallied, and the results showed that there was no significant difference in the performance of the students in the two groups in any of the items ($P > 0.05$). It shows that the two groups of students are homogeneous regarding fundamental movement skills performance, indicating a reasonable basis for a comparative study between the two groups.

4.1.2.2 Analysis pre-test of differences between genders

Table 6 Differences between genders in the pre-test(N=305)

Test content	gender	Control group(n=153) M±SD	Experimental group(n=152) M±SD	t-test	p-value
Sideways slide	girls	8.15±1.23	8.26±1.32	0.51	0.609
running	boys	8.21±1.20	7.99±1.14	1.20	0.231
Jumping	girls	4.53±0.77	4.55±0.76	0.11	0.912
continuously on one foot	boys	4.46±0.83	4.39±0.78	0.58	0.561
Changing hands	girls	4.02±0.83	3.98±0.83	0.30	0.767
and shooting the ball on the spot	boys	4.18±1.02	4.22±1.16	0.22	0.823
Kicking the ball	girls	8.34±2.79	8.47±2.14	0.31	0.759
over the obstacle	boys	8.03±2.90	7.97±2.73	0.15	0.883
Walking on the	girls	4.20±2.28	4.31±2.64	0.28	0.777
balance beam	boys	3.95±2.13	3.97±1.94	0.07	0.943
Walking	girls	14.58±6.03	15.25±5.73	0.70	0.484
backward in a straight-line	boys	13.87±4.74	13.44±5.23	0.53	0.596

The statistical results of the performance of boys and girls in the experimental and control groups in all test items showed that neither boys nor girls showed statistically significant differences in the results of the fundamental movement skills test ($p > 0.05$).

4.1.2.3 Analysis of pre-test results for students in different grades

Table 7 Different in grades of pre-test(N=305)

Test content	Grade	Gender	Control group(n=153) M±SD	Experimental group(n=152) M±SD	t-test	p-value
Sideways slide running	grade 1	boys	8.22±1.39	8.74±1.38	-1.31	0.196
		girls	8.60±1.80	7.95±1.68	1.36	0.181
	grade2	boys	8.18±1.04	8.43±1.15	-0.78	0.441
		girls	8.32±0.77	8.16±0.83	0.69	0.495
	grade 3	boys	7.64±0.93	7.51±0.57	0.65	0.520
		girls	7.93±1.03	8.45±0.98	-1.76	0.088
Jumping continuously on one foot	grade 1	boys	4.48±0.84	4.69±1.13	-0.72	0.474
		girls	4.57±0.73	4.57±0.87	0.01	0.991
	grade2	boys	4.28±0.65	4.38±0.55	-0.60	0.548
		girls	4.10±0.63	4.22±0.61	-0.69	0.495
	grade 3	boys	4.40±0.85	4.31±0.64	0.45	0.652
		girls	4.80±0.76	5.04±0.59	-1.22	0.229
Changing hands and shooting the ball on the spot	grade 1	boys	4.11±0.52	4.53±1.21	-1.63	0.113
		girls	4.39±0.85	4.39±0.93	0.01	0.989
	grade2	boys	3.49±0.92	3.43±0.55	0.26	0.799
		girls	3.38±0.52	3.76±0.63	-2.30	0.026*
	grade 3	boys	4.91±1.31	4.47±0.81	1.53	0.132
		girls	4.00±0.76	3.92±0.82	0.31	0.757
Kicking the ball over the obstacle	grade 1	boys	8.27±2.61	9.26±3.58	-1.13	0.262
		girls	8.21±2.47	7.80±2.93	0.54	0.588
	grade2	boys	7.29±2.76	6.58±1.67	1.08	0.287
		girls	7.93±1.41	7.84±2.35	0.17	0.868
	grade 3	boys	8.29±2.80	8.05±2.45	0.34	0.732
		girls	9.02±2.13	10.12±2.72	-1.43	0.164
Walking on the balance beam	grade 1	boys	4.80±2.32	5.38±2.68	-0.82	0.419
		girls	5.96±3.78	4.96±2.86	1.10	0.278
	grade2	boys	4.18±1.96	3.41±0.93	1.73	0.093

	girls	3.64±1.19	3.88±2.14	-0.50	0.617
	grade 3 boys	3.15±1.19	2.98±1.42	0.47	0.639
	girls	3.29±0.75	3.58±0.77	-1.26	0.217
Walking	grade 1 boys	13.25±7.39	14.04±7.22	-0.38	0.706
backward in	girls	15.68±8.81	14.37±8.77	0.55	0.585
a straight-	grade2 boys	13.18±3.29	13.68±2.77	-0.56	0.576
line	girls	13.77±2.22	14.35±4.28	-0.63	0.531
	grade 3 boys	13.81±4.59	13.87±2.64	-0.06	0.955
	girls	15.77±3.33	15.33±2.81	0.49	0.627

Note: *p<0.05, **p<0.01, ***p<0.001

Analyzing the results of the boys' and girls' fundamental motor skills pre-tests by grade grouping, it can be seen that there were no significant differences between the two groups of students in the fundamental skills tests for all grades, except for the second-grade girls who showed a potential difference in Changing hands and shooting the ball on the spot, so it can be assumed that the experimental group and the control group before intervention did not. Therefore, it can be assumed that the experimental group and the control group did not show significant differences before the intervention.

4.1.2.4 Summarize baseline testing of children's fundamental movement skills

In the baseline test results, there was no significant difference in the overall fundamental movement skills performance between the experimental and control groups, reflecting the failure of the current teaching and activity model to enhance children's movement skills adequately. This suggests that existing physical activities lack relevance and interest and do not stimulate students' potential, especially in the early grades, where developing these skills is still relatively early. By implementing interventions, pupils' movement skill development can be promoted at critical stages, particularly in individual groups such as Year 2 girls, where some skill items show potential gaps, prompting interventions to help close the gaps and improve overall performance. In addition, fun physical activities can enhance children's interest in

sports and promote physical health and psychological development. Therefore, based on pre-intervention test results, early intervention is necessary and relevant to help promote children's overall motor development.

4.1.3 Development of social-emotional in children prior to intervention

4.1.3.1 General Description of the Baseline Test of social-emotional

Table 8 Overall of social-emotional pre-test (N=305)

dimension	Control group(n=153) M±SD	Experimental group(n=152) M±SD	t-test	p-value
Self-awareness dimension total score	17.18±2.08	17.08±2.30	-0.39	0.698
Total score of self-management dimension	16.74±2.54	16.78±2.47	0.15	0.877
Total score of others' perception dimension	17.20±2.14	17.20±2.57	-0.02	0.985
Total score of others' management dimension	17.18±2.12	17.13±2.78	-0.18	0.856
Total score of collective cognition dimension	15.75±2.56	15.36±2.70	-1.32	0.189
Total score of collective management dimension	17.03±2.81	16.81±3.08	-0.64	0.521
Total score of social-emotional competencies	100.74±6.56	100.59±7.74	-0.18	0.859

Statistics on the social-emotional development of the students in the control and experimental groups were carried out, and the results showed no significant difference in the performance of the two groups of students in any of the items ($p>0.05$). This indicates that the two groups of students were homogeneous in terms of the status of social-emotional development before the intervention, which lays a solid foundation for subsequent comparative studies of the development of the two groups of students.

4.1.3.2 Analysis pre-test of differences between genders

Table 9 Differences between genders in pre-test of social-emotional (N=305)

dimension	gender	Control group(n=153) M±SD	Experimental group(n=152) M±SD	t-test	p-value
Total score of others' management dimension	girls	16.93±3.12	17.00±2.69	0.14	0.888
	boys	16.69±3.06	17.05±2.95	0.75	0.454
Total score of others' perception dimension	girls	15.27±2.83	15.94±2.62	1.51	0.133
	boys	15.44±2.57	15.57±2.51	0.30	0.762
Total score of self-management dimension	girls	16.81±2.44	16.90±2.46	0.21	0.835
	boys	16.75±2.51	16.58±2.63	0.42	0.676
Self-awareness dimension total score	girls	16.64±2.37	17.29±1.86	1.87	0.063
	boys	17.51±2.16	17.07±2.28	1.23	0.222
Total score of collective management dimension	girls	16.59±2.71	16.91±2.21	0.80	0.422
	boys	17.66±2.76	17.46±2.01	0.52	0.606
Total score of collective cognition dimension	girls	16.64±2.74	17.73±2.05	2.01	0.046*
	boys	17.74±2.28	16.97±2.22	2.11	0.037*
Total score of social-emotional competencies	girls	100.71±6.06	101.78±7.28	0.99	0.326
	boys	100.77±7.05	99.37±8.04	-1.14	0.258

Note: *p<0.05, **p<0.01, ***p<0.001

Analyzing the social-emotional development of the students in the control and experimental groups from the perspective of gender, there was no significant difference between boys and girls in terms of scores on the self-perception dimension, scores on the self-management dimension, scores on the others' perception dimension,

scores on the others' management dimension, and scores on the collective management dimension. A significant difference was observed in the collective cognition dimension between the experimental and control groups for both boys and girls ($p=0.046, 0.037 < 0.05$).

4.1.3.3 Analysis of pre-test results for students in different grades

Table 10 Different in grades of pre-test of social-emotional (N=305)

Dimension	Grade	Gender	Control group(n=153) M±SD	Experimental group(n=152) M±SD	t-test	p-value
Self-awareness dimension total score	Grade 1	boys	15.96±2.42	17.19±2.43	-1.78	0.081
		girls	17.33±1.57	16.26±2.57	1.86	0.070
	Grade 2	boys	17.08±1.91	17.57±1.90	-0.87	0.391
		girls	16.89±2.13	16.74±2.42	0.23	0.817
	Grade 3	boys	17.76±2.10	17.81±2.15	-0.10	0.922
		girls	17.45±1.96	17.35±2.03	0.16	0.872
Total score of self-management dimension	Grade 1	boys	16.04±2.57	16.48±2.38	-0.62	0.537
		girls	16.11±2.82	17.19±2.56	-1.47	0.149
	Grade 2	boys	16.88±2.72	16.39±2.35	0.65	0.517
		girls	17.37±2.36	16.65±2.27	1.07	0.293
	Grade 3	boys	16.90±2.66	17.22±2.74	-0.45	0.654
		girls	17.13±2.05	16.76±2.70	0.48	0.632
Total score of others' perception dimension	Grade 1	boys	15.26±2.80	15.41±2.58	-0.19	0.849
		girls	16.37±2.69	14.56±2.45	2.59	0.013
	Grade 2	boys	15.75±2.33	15.09±2.57	0.93	0.360
		girls	14.89±2.56	16.00±2.80	-1.43	0.161
	Grade 3	boys	15.66±2.47	16.00±2.62	-0.51	0.615
		girls	15.87±2.64	15.29±3.12	0.65	0.523
Total score of others' management dimension	Grade 1	boys	17.87±2.90	16.11±3.03	2.09	0.042*
		girls	16.22±3.11	16.89±3.41	-0.75	0.456
	Grade 2	boys	17.04±3.14	16.52±3.25	0.56	0.580
		girls	17.42±2.39	16.45±2.58	1.35	0.184
	Grade 3	boys	16.76±2.96	17.37±2.86	-0.79	0.435
		girls	17.00±2.67	18.12±2.85	-1.33	0.193
Total score of	Grade 1	boys	16.48±2.73	17.96±2.61	-1.96	0.057

collective	girls	17.04±2.47	16.22±2.83	1.13	0.265	
cognition dimension	Grade 2	boys	16.75±2.05	17.83±1.87	-1.88	0.067
		girls	17.37±1.74	16.81±2.57	0.92	0.362
	Grade 3	boys	17.41±1.84	17.59±2.32	-0.32	0.752
		girls	17.48±2.26	17.59±2.29	-0.15	0.881
	Grade 1	boys	16.83±1.97	16.70±2.80	0.18	0.857
		girls	16.78±2.45	15.70±3.28	1.36	0.179
Total score of collective management dimension	Grade 2	boys	17.63±2.12	17.48±2.71	0.21	0.838
		girls	17.16±2.19	16.84±2.34	0.49	0.629
	Grade 3	boys	17.72±1.91	18.85±2.40	-1.94	0.058
		girls	16.97±2.12	17.41±1.87	-0.75	0.459
	Grade 1	boys	99.30±6.32	100.22±8.44	0.44	0.663
		girls	96.78±8.68	98.85±8.71	-8.88	0.385
Total score of social- emotional competencies	Grade 2	boys	101.04±6.14	100.57±5.31	-0.29	0.777
		girls	101.95±5.64	100.26±7.44	-0.91	0.369
	Grade 3	boys	101.55±5.79	104.37±7.01	1.63	0.109
		girls	101.71±6.01	101.88±7.32	0.08	0.934

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The results showed that only first-grade boys showed a difference in the other management dimensions ($p=0.0416 < 0.05$) and did not show a difference in the other dimensions. Second and third-grade boys and girls did not show significant differences between the control and experimental groups. This indicates that the difference in overall socio-emotional development between the control and experimental students in the pre-test was minimal.

4.1.3.4 Summarize of the state of social-emotional

Although the current analysis shows no significant differences between genders on the dimensions of social-emotional development, the need for intervention remains significant. First, overall improvement in social-emotional skills is critical to each student's academic, mental health, and social interactions, and current averages show room for improvement. Second, there may be large differences between individuals, especially some students who may be relatively weak on specific dimensions, and intervention can help these students achieve balanced development. In addition,

although group differences were not significant, slightly lower scores on specific dimensions such as others' perception and others' management may reflect a lag in developing of some of the competencies and require further attention. Finally, the development of social-emotional competence is not limited to current performance but plays an essential role in students' long-term growth and interdisciplinary impact. Thus, systematic follow-up interventions are valuable in promoting students' holistic development, reducing individual differences, and supporting them in their future learning and lives.

Data from the baseline test were also used as pre-test data in this study. The baseline test was conducted with participants ungrouped and assessed the initial status of all participants. After the baseline test was completed, based on these data, participants were randomly assigned to experimental and control groups, and the data from the baseline test were subsequently analyzed using the data from the baseline test as pre-test data.

The baseline test used the same measurements and criteria as the pre-test, so the baseline data not only provided a uniform starting point for grouping, but also served as the pre-test data reflecting the participants' state before the intervention, ensuring logical consistency of the data before and after grouping. With this design, the interface between the baseline test and the pre-test is realized without the need to repeat the measurements, thus ensuring a scientific and concise experimental design.

The homogeneity of the baseline data provided a solid foundation for the study, enabling us to attribute the subsequent observed between-group differences primarily to the experimental intervention rather than to differences in the initial levels of the two sample groups. Meanwhile, the few significant difference indicators were adjusted by statistical methods to further enhance the explanatory power of the results and the credibility of the conclusions. This result also indicates that the sample selection and grouping methods of this study are reasonable and effective, ensuring the scientific and rigorous nature of the quasi-experimental design. Overall, the baseline analysis laid a good foundation for the subsequent comparison of intervention effects.

4.2 Phase 2: Impact of the intervention program on children's development

4.2.2 post-intervention effects on the development of physical activity

4.2.2.1 Overall hours per week of participation in moderate to high-intensity physical activity in the control and experimental groups

Table 11 Overall hours per week of participation in two groups

Medium to high-intensity activities	Hours per week for control group(minutes)	Hours per week for experimental group(minutes)
Playing games outdoors	174.58	267.54
Dancing	231.91	244.65
Walking	152.39	243.74
Skating	199.99	224.98
Playing basketball	173.39	199.01
Doing martial arts	356.23	187.53
Swimming	177.59	185.43
Playing badminton	153.86	161.14
Playing football	129.36	124.39
Playing table tennis	175	122.64
Rope skipping/jumping	80.29	83.09
Exercise with fitness equipment	51.38	81.41
Playing volleyball	92.89	73.36
Running	57.89	65.1
Doing radio gymnastic	60.62	60.76
High Jumping/Long Jumping	17.92	58.45
Gymnastics (pull-ups, sit-ups)	47.53	48.51
House working	40.6	47.18
Bicycling	76.02	44.94
Stair climbing	41.09	44.24
Playing shuttlecock	49.98	17.5

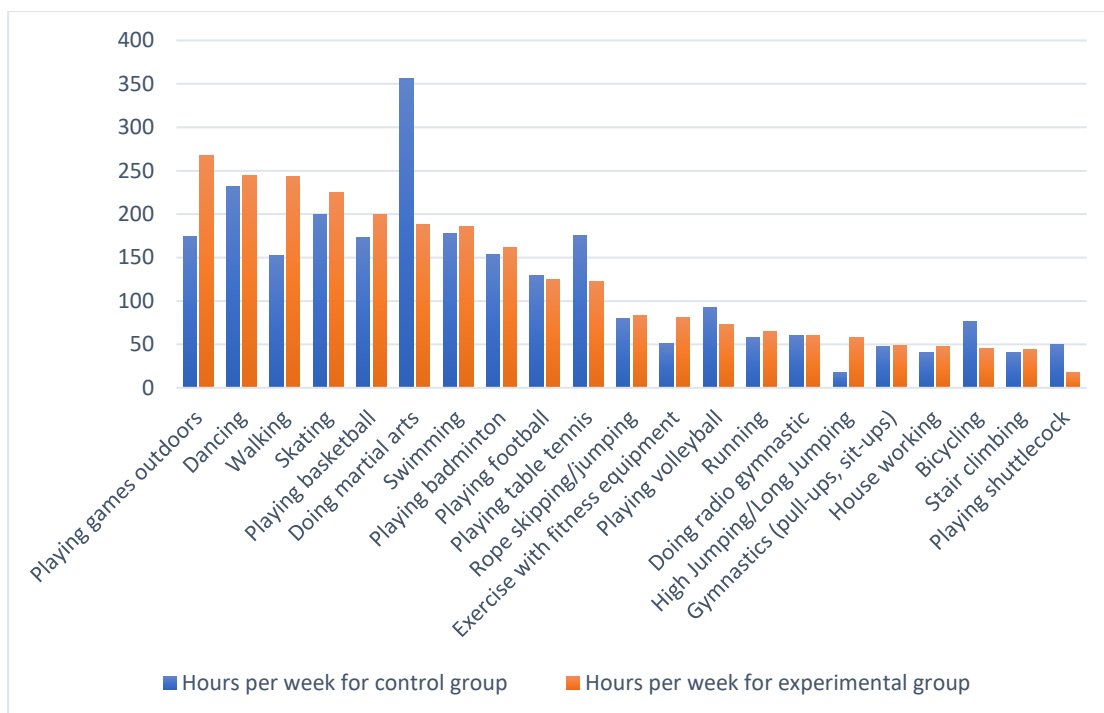


Figure 9 Statistics on the average of hours per week in two groups

The results showed different characteristics in terms of the program and duration of participation in moderate to high intensity for students in both the control and experimental groups. There were 15 programs in which the experimental group's average weekly duration of participation exceeded that of the control group, namely Playing games outdoors, Dancing, Walking, Skating, Playing basketball, Swimming, Playing badminton, Rope skipping/ jumping, Exercise with fitness equipment, Running, Doing radio gymnastic, High Jumping/Long, Jumping, Gymnastics (pull-ups, sit-ups), House working, and Stair climbing, with the most significant difference being Playing games outdoors at 92.96 minutes and the most minor difference being Doing radio gymnastic at 0.14 minutes.

For the remaining six participation programs, the control group students' average weekly participation time they exceeded that of the experimental group. The programs were Doing martial arts, playing football, table tennis, playing volleyball, Bicycling, and Playing shuttlecock, of which the most considerable difference was Playing games outdoors, with 92.96 minutes; the most negligible difference was Doing radio gymnastics, with 0.14 minutes. The most significant difference was in Doing martial

arts, with a difference of 168.7 minutes, and the smallest difference was in Playing football, with a difference of 4.97 minutes.

4.2.2.2 Participation in moderate to high intensity physical activity in the control group

Table 12 Statistics of the control group's participation in medium- and high-intensity exercise programs (N=153)

Medium to high-intensity activities	numbers	rate (%)	rate ranking	ave/w time(min)	time ranking
Rope skipping/jumping	114	74.51	1	80.29	12
Playing games outdoors	113	73.86	2	174.58	6
House working	100	65.36	3	40.6	20
Doing radio gymnastics	99	64.71	4	60.62	14
Swimming	58	37.91	5	177.59	4
Playing basketball	55	35.95	6	173.39	7
Running	50	32.68	7	57.89	15
Playing badminton	44	28.76	8	153.86	8
Stair climbing	41	26.80	9	41.09	19
Dancing	36	23.53	10	231.91	2
Gymnastics (pull-ups, sit-ups)	27	17.65	11	47.53	18
Playing table tennis	24	15.69	12	175	5
Exercise with fitness equipment	22	14.38	13	51.38	16
Walking	19	12.42	14	152.39	9
Playing football	16	10.46	15	129.36	10
High Jumping/Long Jumping	10	6.54	16	17.92	21
Bicycling	10	6.54	17	76.02	13
Doing martial arts	8	5.23	18	356.23	1
Playing volleyball	7	4.58	19	92.89	11
Skating	3	1.96	20	199.99	3
Throwing	2	1.31	21	17.5	22
Playing shuttlecock	1	0.65	22	49.98	17

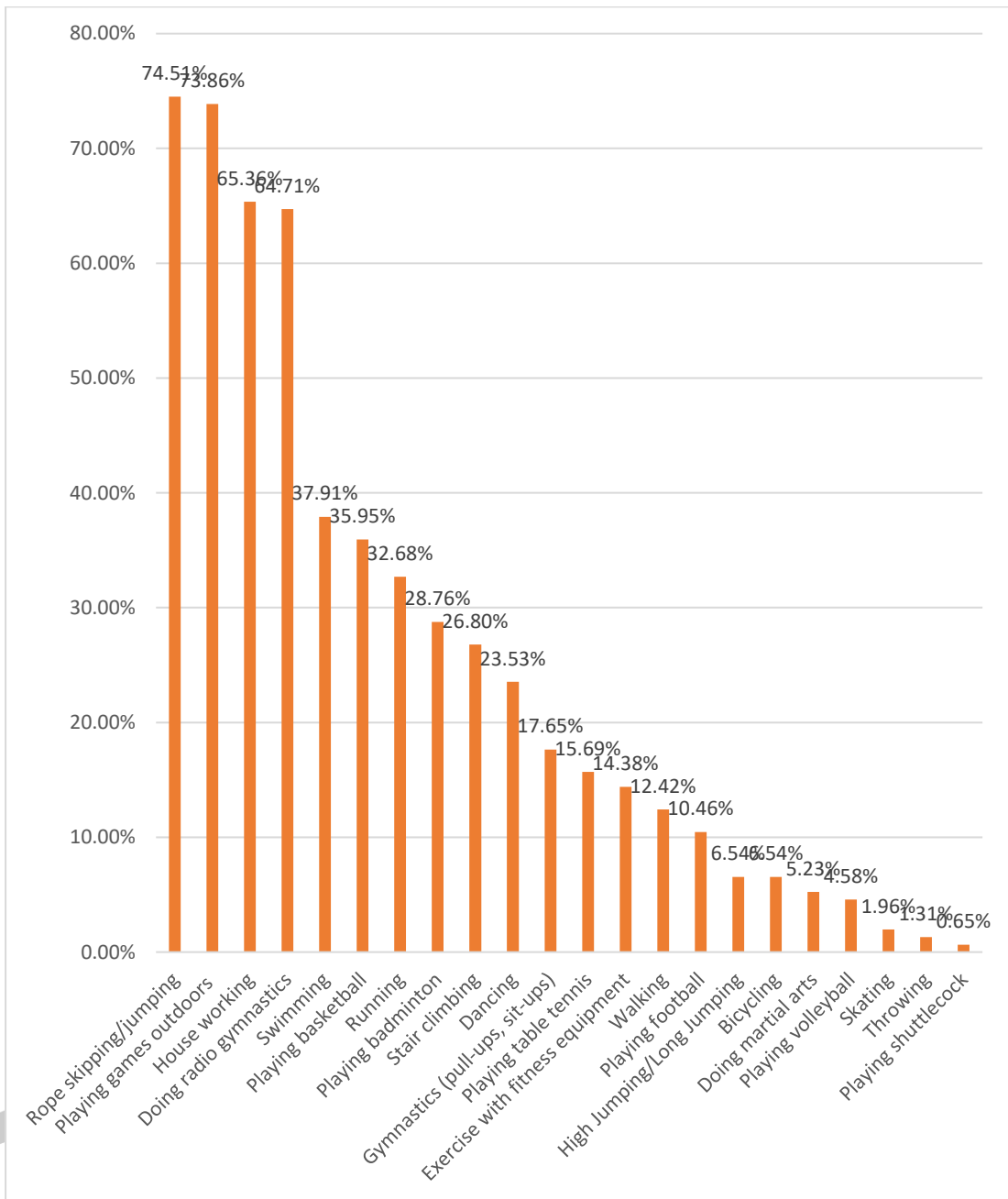
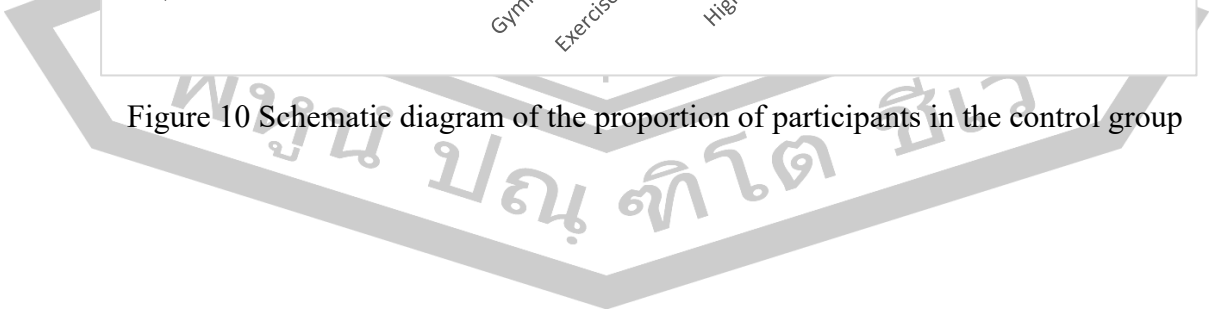


Figure 10 Schematic diagram of the proportion of participants in the control group



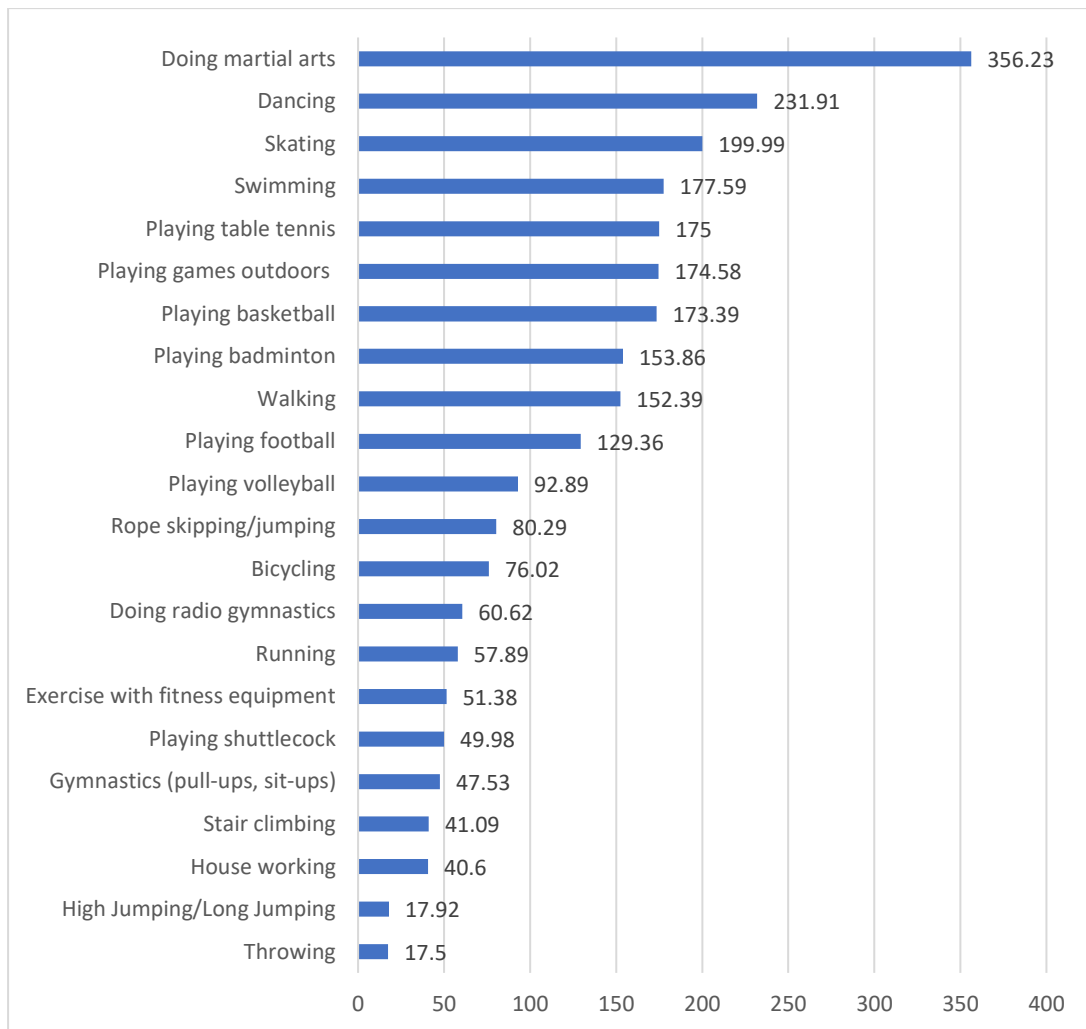


Figure 11 Control group average weekly length of participation in activities sorted (minutes)

The results show that the control group that participated in the most moderate to high-intensity physical activity was Rope skipping/jumping with a rate of 74.51%. The other activities with a more than 70% participation rate were playing games outdoors, housework, and radio gymnastics, with a participation rate of more than 60%, 65.36%, and 64.71%, respectively. Programs with participation rates over 30% were Swimming, playing basketball, Running, High Jumping/Long Jumping, Bicycling, doing martial arts, playing volleyball, Skating, Throwing, and other activities with participation rates over 70% were Playing games outdoors, House working, and Doing radio gymnastics, all with participation rates over 60% at 65.36%

and 64.71% respectively. Throwing and Playing Shuttlecock are the seven programs with participation rates below 10% (shown in Figure 10).

Furthermore, just because students in the control group had a high participation rate, it did not mean that the average number of hours of participation per week became higher. The program with an average weekly participation time of more than 300 minutes was Doing martial arts, with 356.23 minutes, which ranked first in terms of participation time; the other programs with an average weekly participation time of more than 100 minutes, in descending order of time, were: Dancing, Skating, Swimming, Playing table tennis. There is no linear correlation between the average weekly length of participation and the participation rate (shown in Figure 11).

4.2.2.3 Participation in moderate to high-intensity physical activity in the experimental group

Table 13 Statistics of the experimental group's participation in medium- and high-intensity exercise programs (N=152)

Medium to high-intensity activities	numbers	rate (%)	rate ranking	ave/w time(min)	time ranking
Rope skipping/jumping	97	63.82	1	83.09	12
Playing games outdoors	76	50.00	2	267.54	1
House working	70	46.05	3	47.18	19
Doing radio gymnastics	62	40.79	4	60.76	16
Playing badminton	57	37.50	5	161.14	8
Playing basketball	52	34.21	6	199.01	5
Swimming	47	30.92	7	185.43	7
Stair climbing	43	28.29	8	44.24	21
Running	41	26.97	9	65.1	15
Dancing	39	25.66	10	244.65	2
Exercise with fitness equipment	18	11.84	11	81.41	13
Playing table tennis	15	9.87	12	122.64	11
Playing football	15	9.87	13	124.39	10
Gymnastics (pull-ups, sit-ups)	14	9.21	14	48.51	18

High Jumping/Long Jumping	12	7.89	15	58.45	17
Walking	8	5.26	16	243.74	3
Bicycling	8	5.26	17	44.94	20
Playing volleyball	6	3.95	18	73.36	14
Skating	6	3.95	19	224.98	4
Doing martial arts	4	2.63	20	187.53	6
Playing shuttlecock	2	1.32	21	17.5	22
Playing aerobics	1	0.66	22	150.01	9

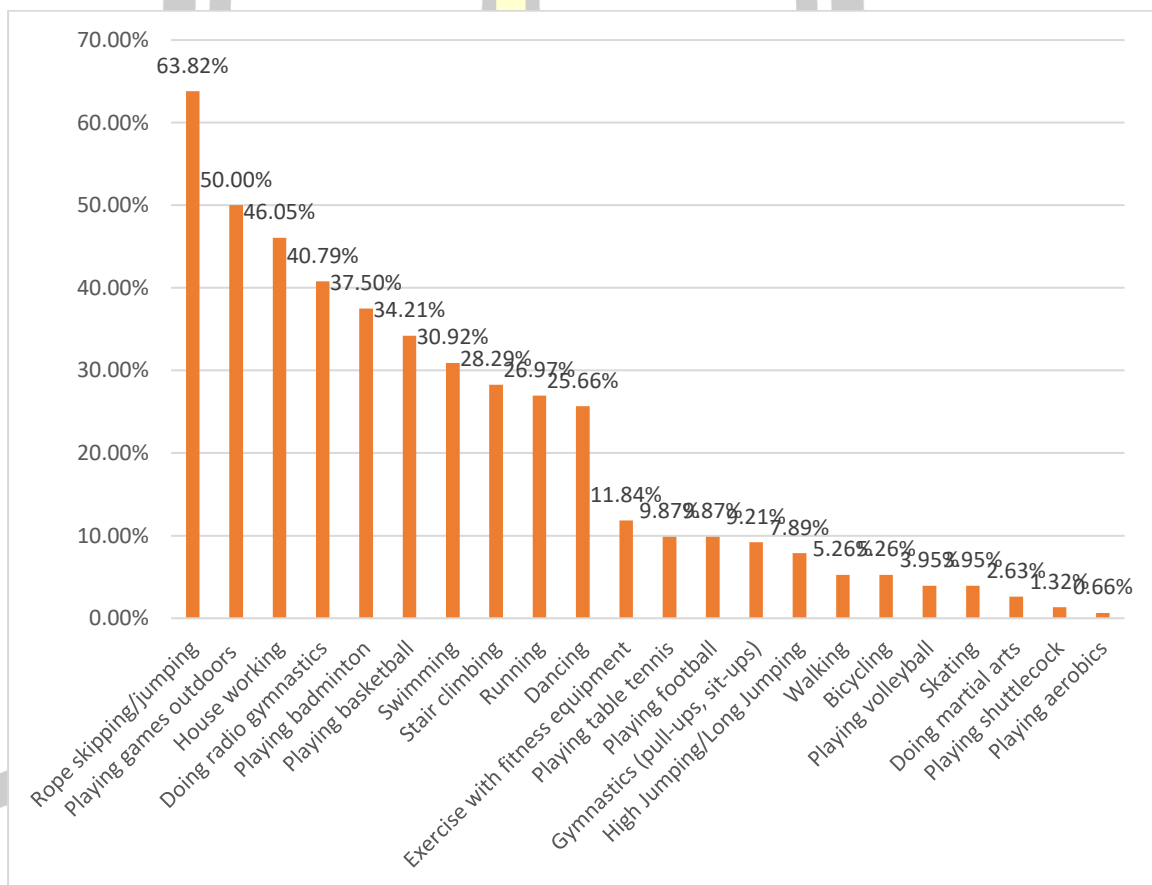


Figure 12 Schematic diagram of the proportion of participants in the experimental group

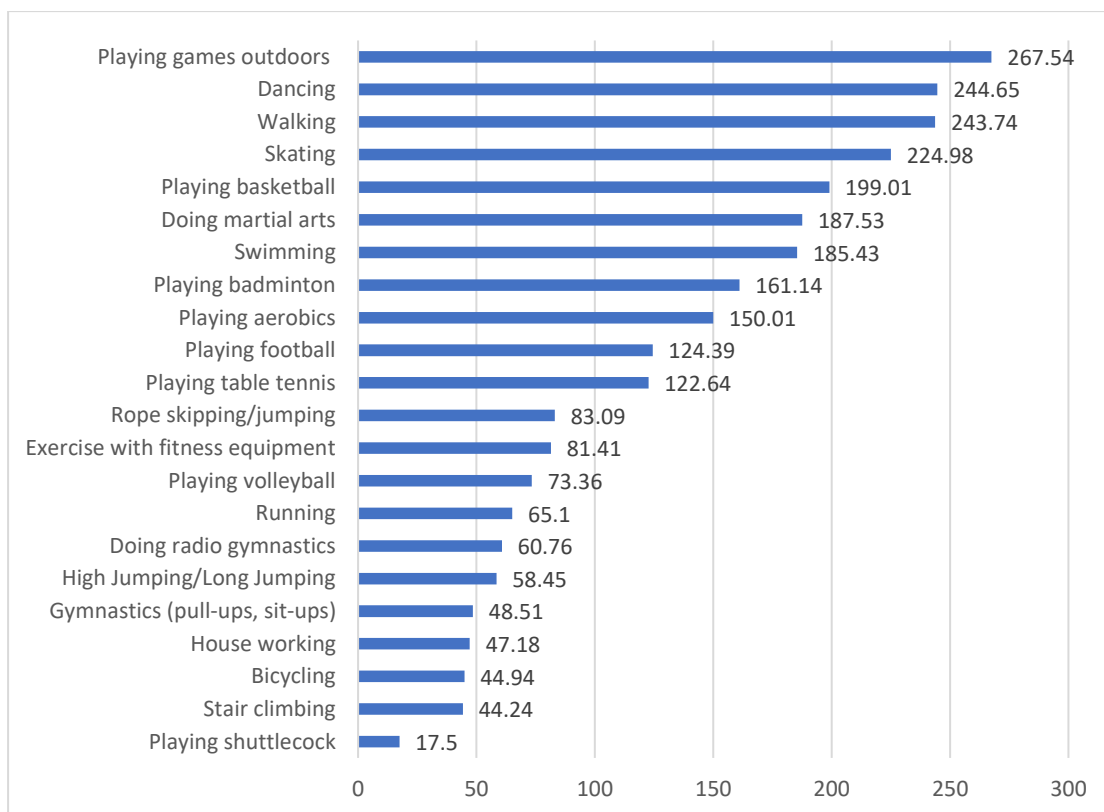


Figure 13 Experimental group average weekly length of participation in activities sorted (minutes)

The program with the highest participation rate of students in the experimental group in the past week was Rope skipping/jumping, with a more than 60% participation rate. This was followed by playing games outdoors (chasing, playing), housework, and radio gymnastics, with a rate of over 40%. Playing badminton, playing basketball, playing badminton, playing basketball, and swimming all had participation rates of over 30% (shown in Figure 12).

Students in the experimental group participated in four programs that averaged more than 200 minutes per week of moderate-intensity activities, in descending order of length: Playing games outdoors, Dancing, Walking, and Skating, while students in the experimental group participated in four programs that averaged more than 100 minutes per week of moderate-intensity activities, namely Playing basketball, Doing martial arts, Swimming, Playing badminton, Playing aerobics, Playing football, Playing table tennis. A comparison of the top ten programs in the experimental group in terms of student participation rate and the top ten programs in terms of average

weekly participation duration revealed that five programs were the top ten programs in terms of participation rate and the top ten programs in terms of average weekly hours of participation in the experimental group were Playing games outdoors, Dancing, Playing basketball, Swimming, and Playing badminton (shown in Figure 13).

4.2.2.4 Differences in statistical results between the control and experimental groups

Table 14 Physical activity difference test statistical result

Content	Control group(n=153) M±SD	Experimental group(n=152) M±SD	t-test	p-value
total weekly time	696.10±36.32	811.19±37.24	-2.2	0.028*
average time per day	99.44±5.19	115.88±5.32	-2.2	0.028*

Note: *p<0.05, **p<0.01, ***p<0.001

The test results demonstrated that the p-value between the control and experimental groups was less than 0.05 for both the total weekly time spent in physical activity and the average daily time of physical activity. This statistically significant difference indicates that the two groups varied notably in their physical activity levels. The disparity in total weekly physical activity time may be attributed to differences in how physical activity was scheduled or the level of participation between the groups, likely stemming from the fact that the experimental group underwent a specific intervention. This intervention appears to have had a measurable impact on the experimental group's total weekly physical activity time, distinguishing them from the control group.

4.2.2.5 Post-test sedentary behavior results

Table 15 Statistics of the control group's sedentary behavior

sedentary behavior	numbers	rate (%)	rate ranking	ave. time(min)	time ranking
Writing paper-based assignments	125	81.67	1	63	1
Read paper-based books	116	75.82	2	34.18	2
Attend offline classes	49	32.03	6	31.11	3
Watching TV	102	66.67	3	23.95	4
Watching a movie at the cinema	29	18.95	7	21.29	5
Using cell phones and tablets	84	54.9	4	21.14	6
Sitting and chatting	63	41.18	5	20.49	7
Using a computer	32	20.92	7	8.76	8
Taking the bus to school every day	8	5.23	9	1.14	9
Weekly screen time	153			266	
Average screen time per day	153			37.94	

From the static behavioral activities of the students in the control group, Writing paper-based assignments and Reading paper-based books are the most performed activities by the students daily, with a rate of more than 80% and 70%, respectively, occupying most of the students' daily lifetime. From the results of all the static time statistics, students in the control group spent 249.86 minutes per week Watching TV, watching a movie at the cinema, using cell phones and tablets, and using a computer, with an average of 35.69 minutes per day. The average daily time spent on sedentary behaviors by 7-10-year-olds, from longest to shortest, was Writing paper-based assignments, reading paper-based books, attending offline classes, Watching TV, watching a movie at the cinema, using a computer and using a computer with a total of 266 minutes, and an average daily time spent on video screens of 37.94 minutes. Movie at the cinema, using cell phones and tablets, Sitting and chatting, using a computer, Taking the bus to school every day.

Table 16 Statistics of the experimental group's sedentary behavior

sedentary behavior	numbers	rate (%)	rate ranking	ave. time (min)	time ranking
Writing paper-based assignments	118	77.63	2	53	1
Watching TV	107	70.39	3	27.1	2
Read paper-based books	120	78.95	1	27.04	3
Using cell phones and tablets	91	59.87	4	24.97	4
Attend offline classes	42	27.63	6	23.75	5
Watching a movie at the cinema	19	12.5	8	14.87	6
Using a computer	40	26.32	7	10.82	7
Sitting and chatting	50	32.89	5	9.41	8
Taking bus to school every day	4	2.63	9	0.36	9
Weekly screen time	152			263	
Average screen time per day	152			37.60	

The statistical results of the sedentary behaviors of the students in the experimental group showed that the rates of Writing paper-based assignments, Watching TV, and Reading paper-based books were more than 70% but less than 80%. The total weekly screen time of the students in the experimental group, including Watching TV, watching a movie at the cinema, using cell phones and tablets, and using a computer, was 263 minutes, and the average screen time per day amounted to 37.60 minutes, which was different from that of the control group. The average daily static behaviors of students in the 7-10 years experimental group, from longest to shortest, were Writing paper-based assignments, Watching TV, reading paper-based books, using cell phones and tablets, attending offline classes, watching a movie at the cinema, using a computer, Sitting and chatting, Taking the bus to school every day. The highest mean time was 53 minutes, relative to 63 minutes in the experimental group. The average time students spend on Writing paper-based assignments has decreased.

Table 17 Statistical table for the test of differences in sedentary behavior

Hours of content per week	Control	Experimental	t-test	p-value
	group(n=153)	group(n=152)		
	M±SD	M±SD		
Watching TV	95.23±8.58	115.65±10.71	-1.43	0.137
Watching a movie at the cinema	24.03±4.27	16.51±3.86	1.31	0.192
Using a computer	32.61±10.13	36.12±7.64	-0.28	0.783
Using cell phones and tablets	97.99±11.01	114.84±11.07	-1.08	0.281
Writing paper-based assignments	277.65±25.66	223.16±22.88	1.58	0.114
Read paper-based books	191.80±21.08	152.43±11.44	1.64	0.102
Taking the bus to school every day	3.82±1.49	1.22±0.62	1.62	0.107
Sitting and chatting	119.54±32.24	56.88±9.52	1.86	0.064
Attend offline classes	103.46±15.65	80.26±13.08	1.14	0.256
Total weekly sedentary behavior	946.14±66.06	797.07±36.44	1.97	0.049*

After analyzing the participation in all static activities, although the control group and the experimental group did not show a significant difference in terms of the participation time demonstrated for each behavior individually, a significant difference between the experimental group and the control group appeared in the comparison of the total weekly time spent in sedentary behaviors and the average time spent in static behaviors per day ($p=0.049$), which is very close to the critical value of 0.05, suggesting that, after the intervention, the In general, the reduction of static behavior time in the experimental group is more apparent. The intervention can affect the regulation of students' sedentary behavior.

4.2.2.6 Summary of the children's physical activity development

Table 18 Pre-test and post-test difference statistics of PA

Test content	Pre-test(N=305) M±SD	Post- test(N=305) M±SD	t-test	p
physical activity time	571.52±587.32	753.46±457.08	-4.26	0.000***
sedentary behavior time	1103.85±615.73	871.85±663.04	20.96	0.000***

Note: *p<0.05, **p<0.01, ***p<0.001

The significant impact of the intervention on the students' physical activity development can be observed by analyzing the pre-test and post-test data on sedentary behavior and physical activity. Regarding sedentary behavior, students' weekly static behavior time averaged 1103.85 minutes at the pre-test and significantly decreased to 871.85 minutes after the intervention, a reduction of 232 minutes, or approximately 4 hours. T-tests showed that this reduction was highly statistically significant (t-value = 20.96, p-value close to 0), suggesting that students reduced sedentary behaviors after the intervention, such as watching TV, sitting, gossiping, etc. This reduction reflects a gradual shift from a static, inactive lifestyle as students began to engage in more dynamic activities and gradually moved away from sedentary habits. Although the standard deviation of sedentary behavior increased after the intervention, indicating that inter-individual differences still existed, the overall trend was positive, and students' health behaviors improved significantly.

Meanwhile, the changes in physical activity were equally impressive. Students' participation in moderate to vigorous physical activity was 571.52 minutes per week on the pre-test and increased to 753.46 minutes post-intervention, 181.94 minutes, or nearly 3 hours. T-test results (t-value = -4.26, p-value = 0.000027) indicate a statistically significant difference for this increase. This suggests that the intervention successfully incentivized students to engage in more moderate to vigorous physical activity. Meanwhile, the standard deviation of physical activity decreased from 587.32 minutes to 457.08 minutes, indicating that after the intervention, the length of students' participation in physical activity became more consistent, and individual differences decreased. This phenomenon implies that the intervention not only improved the overall level of students' participation in physical activity but also, to a

certain extent, consolidated and promoted the habit of physical activity among the student population.

Combining the dual changes of decreased sedentary behavior and increased physical activity, the intervention optimizes students' lifestyles holistically. The changes are not just significant regarding data but more practical. As sedentary behavior decreased, students had more time and energy to devote to physical activity and developed healthier habits. This bi-directional moderation suggests that the intervention was effective at the individual level and had a broader impact at the group level. The increase in physical activity and decrease in sedentary behavior suggests that the intervention not only enhances students' health but may also positively impact their academics, mental health, and social interactions.

4.2.3 post-intervention effects on the development of fundamental movement skills

4.2.3.1 General description of the post-test

Table 19 Overall of fundamental skills post-test (N=305)

Test content	Control group(n=153) M±SD	Experimental group(n=152) M±SD	t-test	p-value
Sideways slide running	7.59±1.58	7.20±1.57	2.13	0.034*
Jumping continuously on one foot	4.23±0.89	3.93±0.82	3.03	0.003*
Changing hands and shooting the ball on the spot	4.05±0.86	3.81±0.83	2.50	0.013*
Kicking the ball over the obstacle	7.60±2.72	6.92±2.16	2.45	0.015*
Walking on the balance beam	3.93±2.02	3.58±1.29	1.78	0.076
Walking backward in a straight-line	13.34±5.80	11.63±4.00	3.00	0.003**

Note: *p<0.05, **p<0.01, ***p<0.001

After testing the differences between the experimental and control groups in various movement skill tests, the results showed that the experimental group showed better performance in most of the events, indicating that the experimental intervention had a significant positive effect.

In the Sideways slide running test, the average time of the experimental group was 7.20 seconds and that of the control group was 7.59 seconds, with a t-value of 2.13 and a p-value of 0.034 ($p < 0.05$). This indicates that the experimental group performed significantly better than the control group, suggesting that the experimental intervention effectively improved students' speed and agility.

In the Jumping continuously on one foot test, the mean time of the experimental group was 3.93 seconds and that of the control group was 4.23 seconds, with a t-value of 3.03 and a p-value of 0.003 ($p < 0.05$). The Jumping continuously on one foot test requires high lower limb strength and coordination, and the experimental group performed better than the control group, showing that the intervention significantly enhanced students' lower limb strength and body coordination.

The results of the Changing hands and shooting the ball on the spot test showed a significant difference with a mean time of 3.81 seconds for the experimental group and 4.05 seconds for the control group, with a t-value of 2.50 and a p-value of 0.013 ($p < 0.05$). This reflects that the experimental group was superior to the control group in terms of hand-eye coordination and reaction speed, suggesting that the intervention had a positive effect on the students' motor coordination.

In the Kicking the ball over the obstacle test, the mean time for the experimental group was 6.92 seconds and 7.60 seconds for the control group, with a t-value of 2.45 and a p-value of 0.015 ($p < 0.05$), showing a significant difference. Kicking the ball over the obstacle requires good foot control and body coordination, and the better performance of the experimental group suggests that the intervention was effective in enhancing these abilities.

The Walking on the balance beam test showed a mean time of 3.58 seconds for the experimental group and 3.93 seconds for the control group, with a t-value of 1.78 and a p-value of 0.076 ($p > 0.05$), which is not a significant difference. Although the experimental group's time was slightly shorter, it was not enough to prove that the intervention significantly affected this item.

In the Walking backward in a straight-line test, the mean time was 9.31 seconds for the experimental group and 10.39 seconds for the control group, with a t-value of 3.00 and a p-value of 0.003 ($p < 0.05$). The program assessed students' balance and physical coordination. The experimental group performed significantly better than the control group, indicating that the intervention effectively improved these aspects of motor ability.

The experimental group outperformed the control group in most of the fundamental movement skill tests, especially in speed, strength, coordination, and control. Except for Walking on the balance beam, all the other events showed significant differences, which indicated that the experimental intervention had a significant positive effect on the students' overall motor skills.

4.2.3.2 Analysis post-test of differences between genders

Table 20 Differences between genders in post-test of FMS (N=305)

Test content	gender	Control group(n=153) M±SD	Experimental group(n=152) M±SD	t-test	p-value
Sideways slide	boys	7.52±1.67	7.14±1.61	-1.42	0.156
running	girls	7.65±1.49	7.26±1.54	-1.57	0.118
Jumping	boys	4.13±0.92	3.89±0.82	-1.68	0.095
continuously on one foot	girls	4.32±0.85	3.97±0.82	-2.61	0.009**
Changing hands	boys	4.01±0.81	3.80±0.87	-1.52	0.130
and shooting the ball on the spot	girls	4.10±0.91	3.82±0.81	-1.99	0.049*
Kicking the ball	boys	7.32±2.82	7.05±2.21	-0.65	0.515
over the obstacle	girls	7.89±2.61	6.78±2.12	-2.88	0.005**
Walking on the	boys	3.55±1.36	3.69±1.49	0.60	0.551
balance beam	girls	4.30±2.46	3.48±1.04	-2.71	0.008**
Walking	boys	13.42±6.36	11.67±3.86	-2.05	0.042*
backward in a straight-line	girls	13.25±5.22	11.58±4.17	-2.19	0.031*

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The results showed that the girls in the experimental group performed significantly better than the control group in several events, indicating that the experimental intervention positively impacted the girls' fundamental movement skills. In the Sideways slide running test, the mean time of the girls in the experimental group was 7.26 seconds, slightly shorter than the control group's 7.65 seconds. However, the difference was not significant ($t=-1.57$, $p=0.118$). However, in the four events of Jumping continuously on one foot, changing hands and shooting the ball on the spot, Kicking the ball over the obstacle, and Walking on the balance beam, the mean time of the girls in the experimental group was significantly shorter than that of the control group. They performed better, and all the differences reached statistical significance. For example, in Jumping continuously on one foot, the average time of the girls in the experimental group was 3.97 seconds, and the average time of the girls in the control group was 4.32 seconds ($t=-2.61$, $p=0.009$); in the Changing hands and shoot the ball on the spot, the average time of the girls in the experimental group was 3.82 seconds, and the average time of the girls in the control group was 4.10 seconds ($t=-1.99$, $p=0.049$). In the Kicking the ball over the obstacle course, the average time of the girls in the experimental group was 6.78 seconds compared to 7.89 seconds for the control group ($t=-2.88$, $p=0.005$). On the Walking on the balance beam event, the mean time for girls in the experimental group was 3.48 seconds compared to 4.30 seconds for the control group ($t=-2.71$, $p=0.008$). These results indicate that the experimental intervention significantly improved girls' performance in these motor skill events.

In contrast, the boys' data did not show the same significant results. Although the average times of the boys in the experimental group were lower than those of the control group in all events, none of these differences reached statistical significance (p -values greater than 0.05). For example, in the Sideways slide running and jumping continuously on one-foot tests, the mean times for boys in the experimental group were 7.14 and 3.89 seconds, respectively, compared to 7.52 and 4.13 seconds for the control group, and the differences did not reach significance (slide run $t=-1.42$, $p=0.156$; one-legged hop $t=-1.68$, $p=0.095$). This study suggests that the experimental intervention significantly affected girls' fundamental movement skill improvement, while the effect on boys was more limited.

4.2.3.3 Analysis of post-test results for students in different grades

Table 21 Different in grades of post-test for FMS (N=305)

Test content	Grade	Gender	Control group(n=153) M±SD	Experimental group(n=152) M±SD	t-test	p-value
Sideways slide running	grade 1	boys	7.28±1.51	6.93±1.88	-0.71	0.480
		girls	7.82±1.80	6.96±1.66	-1.83	0.073
	grade2	boys	7.96±1.96	7.51±1.67	-0.85	0.402
		girls	7.83±1.32	7.43±1.53	-0.99	0.329
	grade 3	boys	7.36±1.51	7.04±1.23	-0.86	0.396
		girls	7.39±1.28	7.45±1.36	0.14	0.890
Jumping continuously on one foot	grade 1	boys	4.16±1.06	3.94±0.93	-0.80	0.429
		girls	4.66±1.09	3.94±0.83	-2.72	0.009**
	grade2	boys	4.32±0.89	4.01±0.88	-1.22	0.229
		girls	4.15±0.64	3.82±0.71	-1.69	0.099
	grade 3	boys	3.94±0.82	3.75±0.65	-0.98	0.332
		girls	4.13±0.63	4.28±0.93	0.59	0.558
Changing hands and shooting the ball on the spot	grade 1	boys	4.00±0.86	3.96±0.92	-0.16	0.877
		girls	4.41±0.94	3.82±0.81	-2.46	0.017*
	grade2	boys	4.06±0.76	3.49±0.76	-2.55	0.014*
		girls	4.01±1.27	3.74±0.81	-0.84	0.410
	grade 3	boys	3.97±0.83	3.90±0.86	-0.30	0.765
		girls	3.88±0.48	3.97±0.81	0.42	0.681
Kicking the ball over the obstacle	grade 1	boys	6.66±2.44	7.10±2.21	0.67	0.506
		girls	7.19±2.50	6.16±1.84	-1.73	0.090
	grade2	boys	7.89±3.71	6.98±2.12	-1.03	0.308
		girls	8.75±2.41	6.75±1.64	-3.20	0.003**
	grade 3	boys	7.37±2.15	7.05±2.36	-0.52	0.606
		girls	7.96±2.71	7.83±2.90	-0.15	0.879
Walking on the balance beam	grade 1	boys	3.50±1.00	4.60±1.91	2.62	0.012*
		girls	4.46±2.57	3.47±1.02	-1.86	0.071
	grade2	boys	4.20±1.73	3.57±1.00	-1.54	0.131
		girls	5.62±3.46	3.55±1.20	-2.51	0.020*

Walking backward in a straight- line	grade 3	boys	3.05±1.03	2.87±0.66	-0.79	0.436
		girls	3.37±0.67	3.36±0.77	-0.03	0.977
	grade 1	boys	10.14±4.02	10.46±4.22	0.27	0.787
		girls	12.87±6.07	9.99±3.98	-2.06	0.045*
	grade 2	boys	16.83±8.64	12.54±3.68	-2.23	0.033**
		girls	15.24±6.49	12.73±4.30	-1.50	0.146
	grade 3	boys	13.20±3.95	12.15±3.44	-1.07	0.291
		girls	12.37±2.90	12.02±3.61	-0.35	0.729

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

For the Grade 1 boys, the experimental group performed slightly better with slightly shorter mean times than the control group in the Sideways slide running, Jumping continuously on one foot. However, none of the differences were significant ($p > 0.05$), suggesting that the experimental intervention did not significantly affect them in these events. In the Kicking the Ball over the obstacle course event, the experimental group's meantime was slightly longer than the control group, indicating that the experimental intervention did not significantly improve ($p > 0.05$). In the Walking on the balance beam test, the mean time of the experimental group was significantly higher than that of the control group, with a t-value of 2.62 ($p = 0.01$), indicating that the experimental group performed worse.

For the Grade 1 girls, the experimental group showed better motor skill levels with shorter mean times than the control group in the test of Sideways slide running, jumping continuously on one foot, changing hands and shooting the ball on the spot, Kicking the ball over the obstacle course and Walking on the balance beam. The differences in the four events of Jumping continuously on one foot, changing hands and shooting the ball on the spot, kicking the ball over the obstacle, and Walking on the balance beam reached the level of statistical significance ($p < 0.05$), indicating that the experimental intervention had a significant positive impact on the girls' movement performance in these events. The Sideways slide running did not reach the level of significance ($p = 0.12$). However, the girls in the experimental group still had a shorter average time and performed slightly better than the control group.

For Grades 2 and 3, the overall trend was similar to that of Grade 1. Girls in the experimental group had shorter mean times than the control group in most of the

events. In particular, the experimental group performed significantly better than the control group in Jumping continuously on one foot, Kicking the ball over the obstacle, and Walking on the balance beam ($p < 0.05$), showing the positive effect of the experimental intervention on these events. In contrast, the boys' results showed that although the experimental group performed slightly better than the control group in some of the items, these differences did not reach the level of significance ($p > 0.05$).

4.2.3.4 Other results of the analysis of variance

Table 22 Results of the analysis of variance (N=305)

Test content	Mann-Whitney U statistic	Mann-Whitney U p-value	Kruskal-Wallis H-statistic	Kruskal-Wallis p-value	ANOVA F-statistic	ANOVA p-value
Sideways slide running	17461.5	0.000	114.28	0.000	55.20	0.000
Jumping continuously on one foot	16145.5	0.000	99.36	0.000	25.25	0.000
Changing hands and shooting the ball on the spot	14190.0	0.001	79.03	0.039	12.19	0.001
Kicking the ball over the obstacle	15337.0	0.000	62.08	0.000	23.80	0.000
Walking on the balance beam walking backward in a straight-line	12722.0	0.156	71.14	0.000	8.92	0.003
	15706.0	0.000	56.28	0.000	23.58	0.000

In order to show the differences between the two groups in specific statistical indicators, the test data were further analyzed to show that the Mann-Whitney U test was applied to compare the median differences between the two groups of data, except for the median difference in the time of Walking on the balance beam, which was not significant ($p=0.1556$), the experimental group and the control group in the time of all other items of the median showed a significant difference.

The Kruskal-Wallis test is a nonparametric statistical method for comparing the median difference between two or more independent groups. The results of the Kruskal-Wallis test indicated that the experimental intervention significantly improved movement skill improvement across all grades on all test items. This further validates the generalized effectiveness of the experimental intervention across a wide age range of students.

The results of ANOVA clearly showed that the experimental intervention significantly enhanced all motor skills, especially in speed, coordination, balance, and the ability to perform complex tasks; the experimental group was significantly better than the control group. The magnitude of the F-value reflected the strength of the effect of the intervention, with higher F-values for the Sideways slide running and jumping continuously on one-foot change events indicating the most significant enhancement of these skills, and a slightly smaller F-value for the Walking on the balance beam, but still showed the effectiveness of the intervention. The significance of the p-values further validated the intervention's critical role in enhancing these skills. The results of all these tests consistently showed that the experimental group significantly outperformed the control group in all aspects of fundamental movement skills, demonstrating the positive impact of the experimental intervention on students' movement skill development.

Overall, the results of the various tests consistently indicated that the experimental intervention significantly enhanced the students' performance in all motor skills. The grade level factor had a significant effect on the performance of most of the skills, suggesting that there were differences in the adaptation and effectiveness of the intervention at different grade levels. The gender factor had a nonsignificant effect in all items, indicating that the intervention was equally effective

for boys and girls. These results validate the broad applicability and effectiveness of the experimental intervention.

4.2.3.5 Summary of the children's fundamental movement skills development

Table 23 Pre-test and post-test difference statistics of FMS

Test content	Pre-test(N=305) M±SD	Post-test(N=305) M±SD	t-test	p-value
Sideways slide running	8.15±1.22	7.39±1.58	6.72	0.000***
Jumping continuously on one foot	4.48±0.79	4.08±0.87	6.02	0.000***
Changing hands and shooting the ball on the spot	4.10±0.97	3.93±0.85	2.37	0.018*
Kicking the ball over the obstacle	8.20±2.65	7.26±2.48	4.53	0.000***
Walking on the balance beam	4.11±2.26	3.76±1.70	2.18	0.030*
walking backward in a straight-line	14.29±5.47	12.49±5.05	4.29	0.000***

Note: *p<0.05, **p<0.01, ***p<0.001

The results of the comparison of pre-test and post-test data on fundamental movement skills showed that the intervention improvement the movement abilities of children aged 7-10 years.

Significant changes were seen in all measured skill metrics. Specifically, the pre-test mean of 8.15 seconds for the Sideways slide running was significantly reduced to 7.40 seconds for the post-test mean, with a t-test showing a p-value much less than 0.01, suggesting a significant improvement in participant performance on this skill. Similarly, the pre-test means of 4.48 seconds and post-test mean of 4.08 seconds for the Jumping continuously on one foot showed significant improvement ($p < 0.01$). These results suggest that participants' speed and stability in these sports were enhanced after intervention. The mean values for Changing hands and shooting the ball on the spot also showed some improvement; However, the differences were relatively small, with a t-value of 2.37 and a p-value of 0.018. They still reached a

level of statistical significance, indicating an improvement in control and coordination.

In the more challenging events, such as Kicking the ball over the obstacle test, the pre-test and post-test means were 8.20 seconds and 7.26 seconds, respectively, and this difference passed a highly significant t-test ($p < 0.01$), indicating that the participants showed significant improvement in flexibility, coordination, and reaction time. Performance on Walking on the balance beam was also improved, with pre-test means of 4.11 seconds and post-test means of 3.76 seconds, with a p-value of 0.03, showing improvements in balance and core strength, essential for developing general physical fitness.

Taken together, the posttest means for all programs were lower than the pretests and all showed significant differences, reflecting significant progress in these fundamental movement skills in 7–10-year-olds. This improvement may be closely related to the intervention. Comparisons of means and standard deviations also showed more focused performance and smaller standard deviations in the posttest data, which may imply that participants acquired more consistent and effective skills after the intervention. In addition, the results of the significance tests further indicated that these improvements were statistically significant and reflected the effectiveness of the intervention.

4.2.4 post-intervention effects on the development of social-emotional

4.2.4.1 General description of the post-test

Table 24 Overall of social-emotional post-test (N=305)

dimension	Control group(n=153) M±SD	Experimental group(n=152) M±SD	t-test	p-value
Self-awareness dimension total score	19.10±4.22	21.38±3.70	5.03	0.000***
Total score of self-management dimension	19.46±4.63	20.87±3.81	2.91	0.004**

Total score of others' perception dimension	18.41±4.07	18.82±4.11	0.88	0.381
Total score of others' management dimension	18.73±4.23	20.24±3.83	3.25	0.001***
The total score of collective cognition dimension	19.31±4.79	21.31±3.68	4.10	0.000***
The total score of collective management dimension	18.90±4.36	20.31±3.68	3.05	0.003**
Total score of social-emotional competencies	113.91±23.68	122.93±19.55	3.63	0.000***

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Differences in scores between the experimental group and the control group on six dimensions of social-emotional development were used to assess the effectiveness of the experimental intervention. The results showed that the mean scores of the experimental group were significantly higher than those of the control group on the “self-awareness dimension” ($p < 0.001$), indicating that the experimental intervention significantly improved the participants' self-awareness. The mean score of the “self-management dimension” was also higher than that of the control group ($p < 0.01$), indicating that the experimental intervention also significantly improved the participants' self-management. For the “others' perception dimension score,” although the mean score of the experimental group was slightly higher than that of the control group, the difference was not significant ($p > 0.05$), which implies that the experimental intervention has a limited effect on improving others' cognitive ability and that a more extended intervention period or other methods may be needed. The experimental group scored significantly ($p < 0.01$) higher than the control group on the dimension of managing others, indicating that the experimental intervention positively improved the participant's ability to manage others. The experimental group scored significantly higher ($p < 0.001$) than the control group on the “Collective Cognition Dimension Score,” which further indicates that the intervention contributed to the improvement of collective cognitive abilities. Finally, the experimental group

also scored significantly higher ($p < 0.001$) than the control group on the “Collective Management Dimension Score,” suggesting that the experimental intervention made significant progress in collective management. Similarly, there was a significant and significant difference between the experimental and control groups on the total score of social-emotional competencies.

Overall, the experimental intervention demonstrated significant effects in enhancing the participants' five dimensions of self-awareness, self-management, management of others, collective perception, and collective management, with self-perception and collective management being particularly significant.

Table 25 Analysis of specific scores on the dimension of others' perceptions (N=305)

Specific scores on the dimension of others' perceptions	Control group(n=153) M±SD	Experimental group(n=152) M±SD	t-test	p-value
I can read other people's thoughts from their actions	3.46±1.15	3.55±1.08	-0.64	0.521
When a classmate is unhappy, I can understand the reason	3.59±1.05	3.56±1.13	0.233	0.816
I can understand the choices others make	3.59±1.17	3.74±1.13	-1.18	0.239
I understand when my classmates refuse to lend me things	3.83±1.15	4.00±1.13	-1.31	0.193
I can accept students with different characteristics	3.94±1.04	3.97±1.13	-0.26	0.794

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In terms of the specific components included in measuring scores on the dimension of other people's perceptions, children aged 7-10 years did not show significant differences in their observation of other people's behavior, insight into other people's inner worlds, understanding of other people's choices, role-swapping in interpersonal interactions, or acceptance of characters' personalities. This is in line

with the age characteristics of children, who at a lower age are not able to reach the stage of maturity in their psychological development, so their understanding of others is not as good as that of adults, especially in the process of psychological role swapping, and they more often still look at the problem from the perspective of their own roles, which makes the difference between the results of the control group and the experimental group in terms of the dimensions of other people's perceptions not significant.

4.2.4.2 Analysis post-test of differences between genders

Table 26 Differences between genders in the post-test of SE (N=305)

dimension	gender	Control group(n=153) M±SD	Experimental group(n=152) M±SD	t-test	p-value
Self-awareness dimension total score	boys	18.72±4.07	20.94±4.16	3.33	0.001***
	girls	19.47±4.36	21.84±3.12	3.87	0.000***
Total score of self-management dimension	boys	18.93±4.63	20.16±3.92	1.76	0.081
	girls	19.97±4.61	21.60±3.56	2.44	0.016*
Total score of others' perception dimension	boys	17.86±3.94	18.42±3.93	0.88	0.380
	girls	18.96±4.15	19.24±4.27	0.41	0.684
Total score of others' management dimension	boys	18.03±4.17	19.42±3.90	2.13	0.035*
	girls	19.43±4.21	21.08±3.60	2.60	0.010*
Total score of collective cognition dimension	boys	18.84±4.95	20.73±3.92	2.61	0.010*
	girls	19.77±4.62	21.91±3.33	3.29	0.001***
Total score of collective management dimension	boys	18.50±4.58	19.77±3.80	1.86	0.065
	girls	19.30±4.12	20.87±3.50	2.53	0.012*
Total score of social-emotional competencies	boys	110.88±23.50	119.42±20.80	-2.38	0.019*
	girls	116.90±23.63	126.53±17.60	-2.85	0.005**

Note: *p<0.05, **p<0.01, ***p<0.001

According to the statistical results, there was a significant difference between the performance of students of the same gender in the control and experimental groups on the same dimension. On the self-perception dimension, for both boys' and girls' students, the mean scores of the experimental group were significantly higher than those of the control group (boys: $p = 0.0011$; girls: $p = 0.0002$), which indicates that the experimental intervention significantly enhanced the students' self-perception. Similarly, for the self-management dimension, the scores of the female students in the experimental group were significantly higher than those of the female students in the control group ($p = 0.016$). In contrast, the difference did not reach the significance level in the male group. However, they also showed higher scores ($p = 0.0806$), which showed that the intervention significantly enhanced the female students' self-management skills. For the others' cognition dimension, the experimental and control groups did not show significant differences between boys and girls ($p = 0.3797$; girls: $p = 0.6835$), suggesting that the intervention had a limited effect in enhancing others' cognitive abilities. On the management of others dimension, all students in the experimental group scored significantly higher than the control group (boys: $p = 0.0350$; girls: $p = 0.0102$), suggesting that the intervention positively impacted the student's ability to manage others. On the collective cognition dimension, boys and girls in the experimental group scored significantly higher than the control group (boys: $p = 0.0101$; girls: $p = 0.0013$), suggesting that the experimental intervention effectively enhanced students' collective cognitive abilities. Finally, on the collective management dimension and total score of social-emotional competencies, boys and girls in the experimental group also scored significantly higher than the control group, indicating that the intervention played a similarly positive role in promoting students' collective management skills. Overall, these results indicate that the experimental intervention positively affected students in most social-emotional development dimensions, particularly in self-perception, others' management, collective perception, and collective management dimensions. Although the effects were less pronounced on the dimensions of others' perceptions, overall, the intervention provided strong support for students' multidimensional development.

4.2.4.3 Analysis of post-test results for students in different grades

Table 27 Different in grades of post-test for SE (N=305)

Dimension	Grade	Gender	Control group(n=153) M±SD	Experimental group(n=152) M±SD	t-test	p-value
Self-awareness dimension total score	Grade 1	boys	21.17±2.53	20.15±4.54	-1.00	0.321
		girls	19.78±3.97	21.19±2.95	1.48	0.146
	Grade 2	boys	16.29±4.84	22.17±3.55	4.76	0.000***
		girls	18.47±5.50	22.23±3.24	2.70	0.012*
	Grade 3	boys	18.79±3.17	20.67±4.14	1.89	0.065
		girls	19.81±3.93	22.18±3.15	2.28	0.028*
Total score of self-management dimension	Grade 1	boys	21.09±3.41	20.74±3.63	-0.35	0.730
		girls	19.48±4.71	21.59±3.53	1.86	0.069
	Grade 2	boys	16.54±4.91	19.61±3.46	2.48	0.017*
		girls	20.05±5.28	21.19±4.17	0.80	0.429
	Grade 3	boys	19.21±4.44	20.04±4.59	0.69	0.495
		girls	20.35±4.18	22.35±2.18	2.18	0.035*
Total score of others' perception dimension	Grade 1	boys	19.13±2.99	18.74±3.81	-0.40	0.687
		girls	18.70±3.74	19.48±3.65	0.77	0.443
	Grade 2	boys	16.75±4.33	18.13±3.67	1.18	0.244
		girls	17.68±5.00	18.19±4.81	0.35	0.725
	Grade 3	boys	17.76±4.09	18.33±4.37	0.51	0.614
		girls	19.97±3.79	20.76±3.80	0.70	0.492
Total score of others' management dimension	Grade 1	boys	19.61±4.02	19.67±3.90	0.05	0.960
		girls	19.59±4.24	21.37±3.32	1.71	0.093
	Grade 2	boys	16.50±4.20	19.09±3.68	2.25	0.030*
		girls	18.53±5.58	20.97±3.32	1.73	0.096
	Grade 3	boys	18.03±3.92	19.44±4.19	1.30	0.200
		girls	19.84±3.13	20.82±4.59	0.79	0.437
The total score of the collective cognition dimension	Grade 1	boys	21.04±3.82	21.04±3.68	-0.01	0.996
		girls	19.78±4.67	21.74±3.62	1.73	0.091
	Grade 2	boys	16.42±5.59	21.26±3.57	3.55	0.001***
		girls	18.95±5.86	21.90±2.96	2.04	0.052
	Grade 3	boys	19.10±4.40	19.96±4.43	0.73	0.470
		girls	20.26±3.71	22.18±3.64	1.73	0.092*

The total score of the collective management dimension	Grade 1	boys	20.39±4.09	20.26±3.77	-0.12	0.907
		girls	18.93±4.47	20.37±4.22	1.22	0.228
	Grade 2	boys	16.75±4.86	19.96±3.13	2.70	0.01**
		girls	18.74±4.99	21.19±2.89	1.96	0.062
	Grade 3	boys	18.45±4.25	19.11±4.35	0.58	0.567
		girls	19.97±3.16	21.06±3.36	1.10	0.280
Total score of social-emotional competencies	Grade 1	boys	122.43±18.02	120.59±21.16	0.33	0.741
		girls	116.26±23.06	125.74±18.02	-1.68	0.099
	Grade 2	boys	99.25±26.18	120.22±17.41	-3.25	0.002**
		girls	112.42±30.42	125.68±16.98	-1.74	0.094
	Grade 3	boys	111.34±20.85	117.56±23.57	-1.05	0.300
		girls	120.19±19.32	129.35±18.77	-1.59	0.120

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

A comparison of the performance of the experimental and control groups on the self-perception dimensions in different grades and genders showed that the experimental intervention had different levels of impact on the students' self-perception skills. First, in Grade 1, for both boys and girls, the difference in scores between the experimental and control groups did not reach the level of significance ($p = 0.3207$ for boys and $p = 0.1460$ for girls), which suggests that the experimental intervention did not have a significant effect on the enhancement of self-perceived competence of Grade 1 students. Possible reasons for this include insufficient time for the intervention, limited receptivity of younger students, or the content of the intervention not fully matching the cognitive level of the students in that grade. In contrast, in the second grade, boys scored significantly higher in the experimental group than in the control group ($p = 0.000023$), indicating that the experimental intervention had a more pronounced effect on promoting self-perceived competence among second-grade boys. This result may indicate that second-grade boys were more receptive to and applied the intervention components in the experiment or that their cognitive development at their age level fit right into the experimentally designed intervention strategies. On the other hand, the results of the third-grade analyses showed that girls scored significantly higher on self-concept in the experimental group than in the control group ($p = 0.0281$). In contrast, the difference in boys' scores was close to significant ($p = 0.0645$). This implies that the experimental intervention

significantly improved self-perception in third-grade girls. At the same time, it may have affected boys as well, so further validation is needed. The significant results for third-grade girls may be related to their social-emotional development stage and the experimental content's high fit. In contrast, the near-significant results for boys may have required a more extended intervention or more precise content adjustments to reach significance. Overall, the experimental intervention produced different results across grade levels and genders, with significant positive effects, especially among second-grade boys and third-grade girls.

4.2.4.4 Summary of the children's social-emotional development

Table 28 Pre-test and post-test difference statistics

dimension	Pre-test M±SD	Post-test M±SD	t-test	p-value
Self-awareness dimension total score	17.13±2.19	20.24±4.12	-11.63	0.000***
Total score of self- management dimension	16.76±2.50	20.16±4.29	-11.95	0.000***
Total score of others' perception dimension	17.2±2.36	20.30±4.38	-10.90	0.000***
Total score of others' management dimension	17.16±2.47	19.60±4.09	-8.94	0.000***
The total score of the collective cognition dimension	15.55±2.63	18.62±4.09	-11.00	0.000***
The total score of the collective management dimension	16.92±2.95	19.48±4.10	-8.87	0.000***
Total score of social- emotional competencies	100.72±6.93	118.4±22.15	-13.30	0.000***

Note: *p<0.05, **p<0.01, ***p<0.001

Based on the results of the difference test between the pre-test and post-test data, there are significant differences across all dimensions of social-emotional development before and after the intervention. Specifically, in the dimensions of self-awareness, self-management, others' perception, others' management, collective awareness, collective management, and the total score, the post-test scores are significantly higher than the pre-test scores, indicating a notable improvement in these abilities among participants following the intervention.

Firstly, in the dimension of self-awareness, the pre-test mean score is 17.13 with a standard deviation of 2.19, while the post-test mean score is 20.24 with a standard deviation of 4.12. The t-test result shows a t-value of -11.63 and a p-value far below 0.05 ($p < 0.001$), indicating a significant increase in self-awareness ability after the intervention. Similarly, for self-management, the pre-test mean is 16.76 with a standard deviation of 2.50, and the post-test mean is 20.16 with a standard deviation of 4.29. The t-value is -11.95, and the p-value is also far below 0.05 ($p < 0.001$), further confirming the substantial impact of the intervention on self-management.

In the dimensions of social awareness and relationship management, there is also a notable change. For social awareness, the pre-test mean score is 15.55 with a standard deviation of 2.63, while the post-test mean is 18.62 with a standard deviation of 4.09; the t-value is -11.00, and the p-value is less than 0.001, indicating a significant improvement in social awareness among participants after the intervention. Regarding relationship management, the pre-test mean is 16.92 with a standard deviation of 2.95, and the post-test mean is 19.48 with a standard deviation of 4.10. The t-value is -8.87, and the p-value is similarly significant ($p < 0.001$). These results demonstrate that the intervention has not only improved participants' social awareness but also enhanced their ability to manage others' behavior and emotions.

For the dimensions of collective awareness and collective management, the results show a similar trend. The pre-test mean for collective awareness is 17.20 with a standard deviation of 2.36, and the post-test mean is 20.30 with a standard deviation of 4.38. The t-value is -10.90, and the p-value is less than 0.001, suggesting a significant increase in collective awareness ability. The changes in collective management scores also show a significant improvement, with a pre-test mean and standard deviation of 16.92 and 2.95, respectively, and a post-test mean and standard

deviation of 19.48 and 4.10. The t-value is -8.87, and the p-value is similarly significant. This indicates that the intervention has effectively enhanced participants' ability to manage and regulate behaviors within a group context.

In summary, these results indicate that the intervention has a significant impact on improving participants' social-emotional abilities. The scores in all dimensions have significantly increased, especially in self-awareness, self-management, social awareness, relationship management, collective awareness, and collective management. The significant improvement in post-test scores demonstrates the effectiveness of the intervention in promoting social-emotional development. These findings provide empirical support for using similar methods in future educational and psychological interventions and suggest that systematic interventions can substantially improve social-emotional skills.

4.3 Phase 3: Construct models of intervention

4.3.1 Research-based hypothesis of intervention effect model

When constructing a model of fundamental movement skills, social-emotional development, and physical activity development based on the results of Kids' Athletics intervention, the ecological model, health-related quality of life (HRQOL) and social vulnerability index (SVI) theories, and the physical activity-related health competence model (PAHCO) can be combined. The ecological model provides a multi-level analytical framework that emphasizes how multiple factors such as individuals, society, environment, and policy jointly affect children's motor skills and social-emotional development. Through this model, intervention can be carried out from the individual level (such as children's psychological characteristics), the social level (such as parental and teacher support), the environmental level (such as the accessibility of sports facilities), and the policy level (such as the setting of school physical education courses). The HRQOL theory helps to evaluate how the intervention improves the quality of life of children by improving their physical, psychological, and social health, while the SVI theory can identify the impact of different socioeconomic backgrounds on the intervention effect, ensuring that children

in low socioeconomic groups also benefit. The PAHCO model provides systematic guidance from three aspects: control ability, motor ability, and self-regulation ability, ensuring the long-term effect of the intervention by improving children's motor skills, self-management, and exercise habits. Combined with these theoretical foundations, the model can comprehensively promote children's physical, psychological, and social-emotional development.

The intervention effect modelling hypotheses aim to explain how the intervention affects children's fundamental movement skills, social-emotional development and levels of physical activity, and to provide a theoretical rationale for each pathway. The conceptual model for this study is shown in Figure 14.

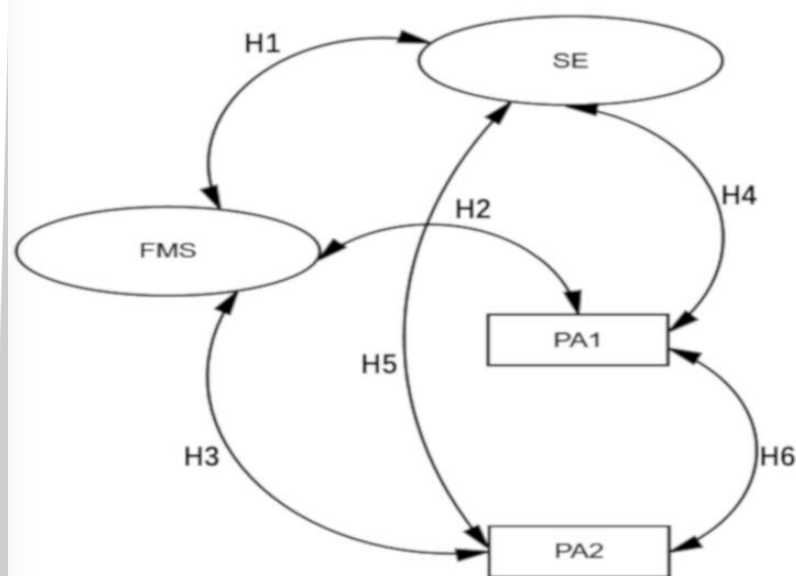


Figure 14 Conceptual model of intervention effectiveness

4.3.2 Development of intervention modelling assumptions

In this research model, the development of fundamental movement skills, social-emotional, and physical activity are the core dependent variables of the study and will be influenced by other potential variables of the model. Thus, the following hypotheses are proposed:

H1: Improving fundamental movement skills can promote the social-emotional development of children aged 7-10 years.

H2: The improvement of fundamental movement skills plays a positive role in promoting medium to high intensity physical activities in children aged 7-10 years.

H3: The development of fundamental movement skills can reduce sedentary behavior within a week in children aged 7-10 years.

H4: The social-emotional development of children aged 7-10 years has a positive impact on their participation in moderate-to-high-intensity physical activities during the week.

H5: The social-emotional development of children aged 7-10 years can reduce the time they spend in sedentary behaviors throughout the week.

H6: Following the intervention, the relationship between weekly moderate to high intensity physical activity and sedentary behaviors was weakly correlated in children aged 7-10 years.

4.3.3 Steps in constructing the model

4.3.3.1 CFA model construction

An SEM model must be statistically and methodologically identifiable for the estimation procedures and statistical processes to work smoothly. In the case of CFA models, a properly recognized model must meet the following requirements: standardized variance as the common unit of the latent variable. A factor loading of 1 is assigned to one of the measured variables affected by the latent variable, allowing the variance of the latent variable to be estimated freely (Qiu & Lin, 2019).

To provide an adequate presentation of the relationships between fundamental movement skills, physical activity, and social-emotional development in children aged 7-10 years after conducting the Kids' Athletics intervention, structural equation modeling was conducted to model the overall post-intervention performance.

In the model construction, three latent variables were defined: the exogenous latent variable, FMS, and two endogenous latent variables, SE and PA. FMS was measured as observables in Sideways slide running (FMS1), Jumping continuously on

one foot (FMS2), Changing hands and shooting the ball on the spot (FMS3), Kicking the ball over the obstacle (FMS4), Walking on the balance beam (FMS5), and walking backward in a straight line (FMS6), each variable has a corresponding measurement error (e11 to e16).

The observable variable measurements for SE were the Self-perception dimension (SE1), the self-management dimension (SE2), the others' perception dimension (SE3), the others' management dimension (SE4), the collective perception dimension (SE5), and the collective management dimension (SE6). Each variable also has a corresponding measurement error (e1 to e6).

PA consists of physical activity (IPA1) and sedentary behavior (IPA2) as observed variables, the measurement errors for each variable are e17 and e18. The measurement model is shown in Figure 15.

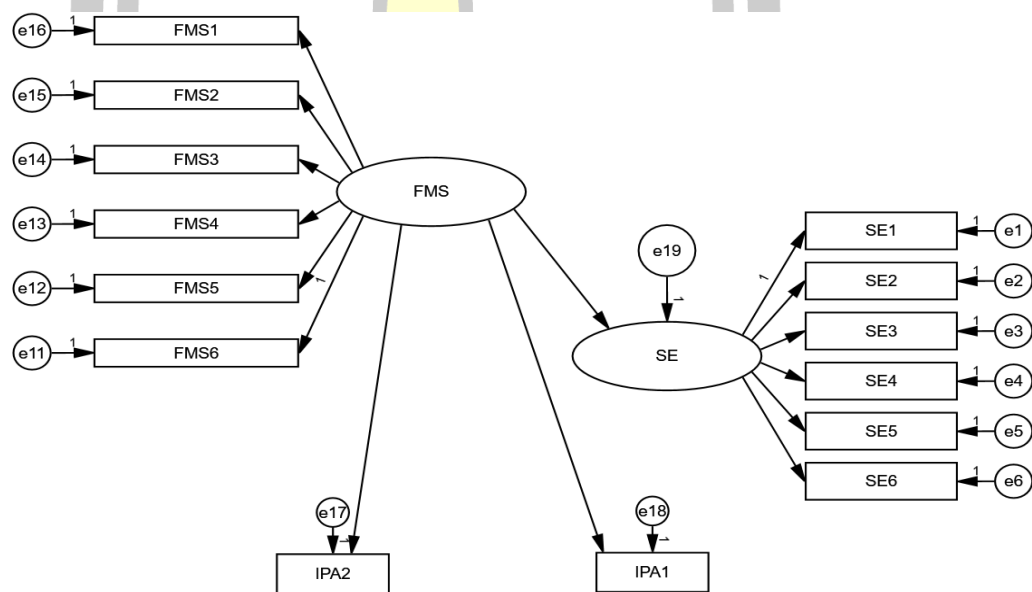


Figure 15 Measurement model

4.3.2 Result of the CFA model

Structural equation modeling (SEM) was used to reveal the causal relationship between FMS and SE and PA, and the correlation between SE and PA (Figure 16).

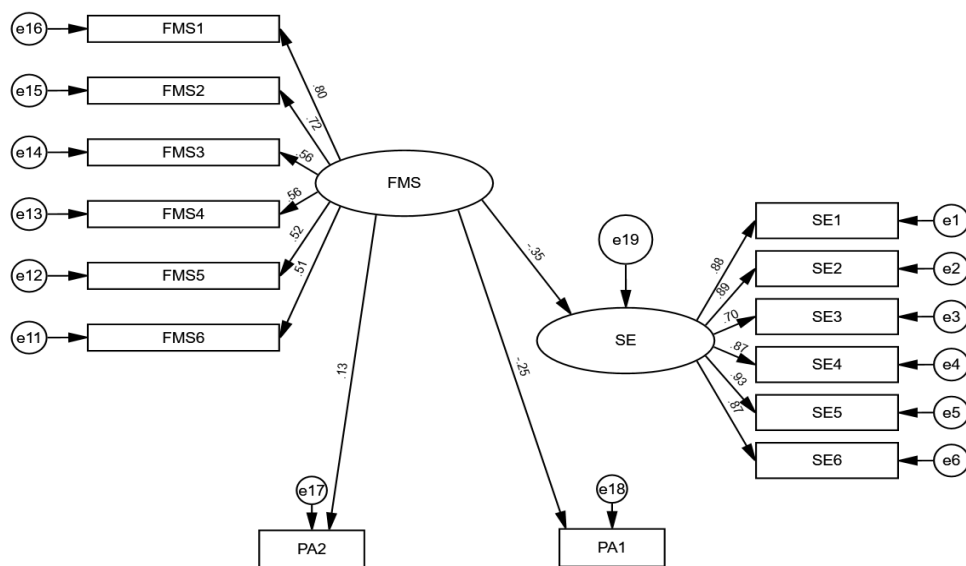


Figure 16 Structural the CFA modeling

The results of the structural equation model (SEM) in this study provide a comprehensive understanding of how fundamental motor skills (FMS) influence social-emotional development (SE) and participation intensity (IPA) among children. The model shows a strong positive relationship between FMS and SE, with a standardized path coefficient of 0.55, indicating that children with higher levels of motor skills tend to exhibit better social-emotional outcomes. This positive association suggests that the development of motor skills is not only essential for physical fitness but also plays a crucial role in enhancing various dimensions of social-emotional competence, such as self-awareness, self-management, social awareness, relationship management, collective awareness, and collective management. The high factor loadings for each SE indicator (ranging from 0.70 to 0.88) confirm the robustness and reliability of the measurement model, underscoring the importance of motor skill development in fostering holistic child development.

Conversely, the relationship between FMS and IPA reveals a more nuanced dynamic. The path coefficient from FMS to IPA1 is 0.13, indicating a weak positive effect, while the coefficient from FMS to IPA2 is -0.35, demonstrating a moderate negative effect. These contrasting results suggest that as children's fundamental motor skills improve, there may be a slight increase in certain types of participation intensity (likely structured or organized activities), but a decrease in others (possibly more

passive or less structured forms of activity). This finding points to a potential substitution effect, where children with better motor skills might prefer more challenging or skill-intensive activities, reducing their engagement in less demanding ones. Understanding these complex relationships can help educators and policymakers design more targeted physical and social-emotional development programs that cater to the diverse needs of children with varying motor skill levels.

The model's overall fit indices, such as $\chi^2/df = 2.435$, NFI = 0.921, CFI = 0.952, TLI = 0.942, RMSEA = 0.069, demonstrate that the model is well-fitted to the data, confirming its validity in explaining the relationships between the constructs. These indicators suggest that the model provides a statistically robust framework for understanding the interplay between motor skills, social-emotional development, and activity participation among children. This study highlights the critical role of FMS in promoting SE, suggesting that fostering motor skills through targeted interventions can significantly improve children's social-emotional competencies.

4.3.3 Tests for common method bias

Common method bias is the extent to which observed correlation coefficients deviate from the true correlation coefficients, which in most cases manifests itself as an inflation or overestimation of observed correlation coefficients and can sometimes give rise to false-positive results leading to erroneous inference of causality (Zhu & Li, 2019). In the same measurement, all items may have measured the method factor in addition to the trait factor. The variance of items mainly contains the variance of trait factors, method factors. The test for common method bias is an important way to ensure that the model has explanatory power. Statistical control of common method bias is the reduction of the effect of methodological variation on intra- or inter-test study results by statistical means. For the control of common methodological bias, the first step should be to consider the method of procedural control, through which the source of methodological bias should be eliminated as much as possible.

If procedural control cannot be implemented or common methodological bias cannot be eliminated completely because of the constraints of the conditions, then statistical methods should be considered at the data analysis stage to test and control

the effect of common methodological bias. In practice, the Harman one-factor test, the CFA labelled variable method, the ULMC method, and the DMLMF method are commonly used to carry out the test (Bagozzi, 1991; Podsakoff, 2003; Podsakoff 2012).

In this study, the Harman one-factor test was used to make judgements about the fit of the CFA model. The CFA method suggests that if the fit index of the one-factor CFA model does not meet the criterion of goodness of fit, or if the one-factor CFA model is the one with the worst fitted data among the competing models, it indicates that the CMB is not serious (Naresh et al., 2006; Tang & Wen, 2020).

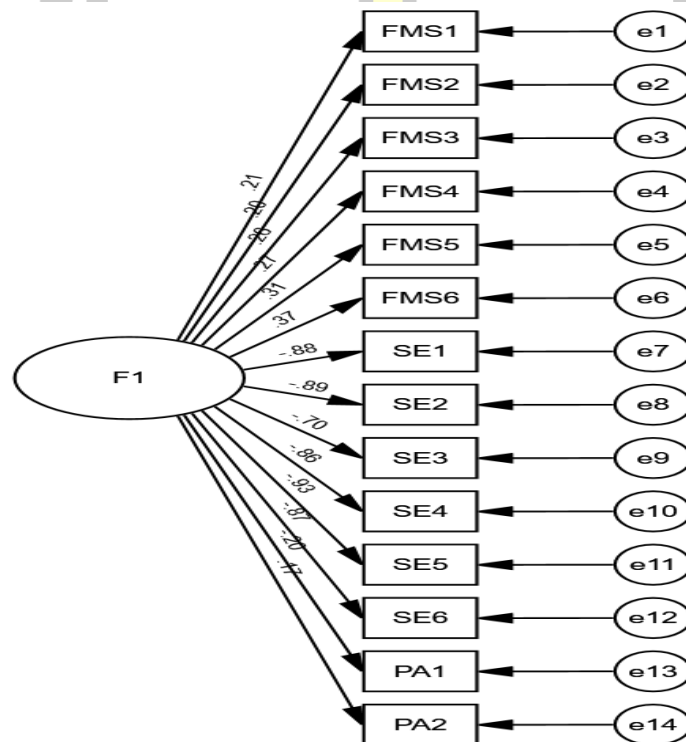


Figure 17 Harman one-factor test

Harman's one-way test showed a poor fit for the CFA model with $\chi^2/df = 6.731$, NFI = 0.779, CFI = 0.804, TLI = 0.786, RMSEA = 0.137, and SRMR = 0.127. The common method bias of the CFA model was therefore considered to be not serious.

4.3.4 Reliability and validity tests of the model

In this study's model, the CFMST test results had Cronbach's $\alpha = 0.618$, $\chi^2/df = 3.394$, NFI = 0.934, TLI = 0.920, CFI = 0.952, RMSEA = 0.089, and SRMR = 0.048, which showed good construct validity.

The overall Cronbach's $\alpha = 0.943$, CFI = 0.989, TLI = 0.981, and SRMA = 0.017 for the social-emotional developmental outcomes in the model indicate good measurement reliability and consistent validity.

Among the physical activity level evaluation questionnaires, Cronbach's $\alpha = 0.85$ for the moderate to high intensity physical activity level questionnaire section, indicating high internal consistency for this dimension, and Cronbach's $\alpha = 0.72$ for the sedentary behavior section, indicating fair consistency. The structural validity of the questionnaire was verified through principal component analysis. The three main factors (variables related to moderate- and high-intensity physical activity, variables related to screen time, and variables related to other sedentary behaviors) were able to effectively differentiate between the different dimensions of physical activity and sedentary behaviors, and the items were reasonably attributed, explaining 63.7% of the total variance, indicating that the questionnaire had good structural validity. The validity of the questionnaire was further supported by the fact that most of the variables had high loadings on the corresponding factors, especially the variables of physical activity and sedentary behaviors had high correlations with their expected factors.

HTMT is the ratio of inter-trait correlations (between-trait) to intra-trait correlations (within-trait). It is the ratio of the means of the correlations of indicators between different constructs relative to the means of the correlations of indicators between the same constructs. HTMT takes values less than 0.85 and is considered to have discriminant validity (Henseler et al., 2014). The HTMT value of the model was 0.404, indicating good discriminant validity of the model.

4.3.5 Matrix of correlation coefficients for each measured variable

Table 29 Matrix of correlation coefficients

Table29 Matrix of correlation coefficients

variable	FMS1	FMS2	FMS3	FMS4	FMS5	FMS6	SE1	SE2	SE3	SE4	SE5	SE6	PA1	PA2
FMS1	1													
FMS2	.593**	1												
FMS3	.496**	.436**	1											
FMS4	.463**	.368**	.207**	1										
FMS5	.367**	.393**	.354**	.268**	1									
FMS6	.412**	.352**	.157**	.380**	.249**	1								
SE1	-0.083	-0.11	-.168**	-.258**	-.278**	-.318**	1							
SE2	-.199**	-.183**	-.252**	-.224**	-.277**	-.294**	.808**	1						
SE3	-0.082	-0.047	-.150**	-.169**	-.178**	-.280**	.611**	.631**	1					
SE4	-.122*	-.156**	-.218**	-.185**	-.215**	-.273**	.747**	.779**	.663**	1				
SE5	-.194**	-.155**	-.235**	-.242**	-.282**	-.330**	.831**	.823**	.630**	.797**	1			
SE6	-.172**	-.182**	-.222**	-.215**	-.245**	-.360**	.737**	.764**	.604**	.763**	.831**	1		
PA1	-.201**	-.182**	-0.062	-.164**	-.160**	-.125*	.122*	.204**	.139*	.171**	.172**	.200**	1	
PA2	0.058	0.074	0.029	.189**	0.037	.145*	-.160**	-.145*	-.151**	-.128*	-.150**	-.145*	0.018	1

In this matrix of correlation coefficients, the correlation between fundamental movement skills (FMS) variables was strong, for example, the correlation coefficient between FMS1 and FMS2 was 0.593, and the correlation coefficient between FMS5 and FMS3 was 0.354, both reaching the level of significance ($p < 0.01$), which suggests that these skills are mutually reinforcing. The correlation between the FMS variables and the social-emotional (SE) variables was mostly negative the correlation coefficients between FMS4 and SE1 were -0.258 and between FMS5 and SE2 were -0.277 ($p < 0.01$), suggesting an inverse correlation between a decrease in FMS time and an increase in SE scores. For physical activity (PA), the correlation coefficients of PA1 with SE4, SE5, and SE6 were 0.204, 0.171, and 0.172, respectively, which were positive and significant ($p < 0.05$), suggesting that moderate participation in physical activity is positively associated with some dimensions of social-emotional development. PA2, on the other hand, was negatively correlated with SE6 (-0.145, $p < 0.05$), suggesting that there is an association between PA2 and SE enhancement, further validating the positive relationship between PA and SE.

4.3.6 Analysis for intervention SEM

In this study, the model fitness index is proposed with reference to the test criteria given by scholars in the model Goodness-of-fit Indices (Wu,2013). The fit indices can be used to measure the degree of mutual fit between the hypothetical path analysis model diagram and the sample data obtained from the research, and a model diagram that can satisfy the fit evaluation criteria only shows that it is more in line with the measurement of the actual data, and does not indicate that the path analysis model diagram is good or bad.

Commonly used parameters for evaluating model fitness include:

(1) The smaller the chi-square value (χ^2) (expectation of P-value is not significant) indicates that the model is more fit, but due to the fact that the chi-square value is very sensitive to the size of the data samples, most of the scholars recommend that it be used only as a reference for the evaluation of the model fit, when the number of the samples is greater than 250, and the number of the observed variables is more

than 30, the chi-square value of the expectation of χ^2 needs to be significant (Hajr et al., 2010);

(2) The smaller the ratio of the chi-square degrees of freedom (χ^2/df), the better the model fit, if the χ^2/df value between 1-3 indicates that the model fit is good;

(3) RMSEA is the asymptotic mean square of the residuals and the square root of the residuals, when the RMSEA is between 0.05-0.08, it indicates that the model has a mediocre fit, and when <0.05 , it indicates that the model fitness is very good (good fit);

(4) GFI is a good-of-fit index, the general criterion for $GFI > 0.9$, indicating that the model path diagram and data fitness is good;

(5) In the value-added fitness indicators, commonly used in the NFI (normed fit index), CFI (comparative fit index), IFI (incremental fit index), when the three indices are > 0.9 , it indicates that the model fit is good, and when > 0.95 , it indicates that the model fit is quite perfect (Hu & Bentler, 1999);

(6) The parsimonious fit index has parsimonious fit index PGFI, PNFI (parsimony-adjusted NFI), and PCFI (parsimony-adjusted CFI), and when all three are above 0.5, it indicates that the hypothesized model is acceptable.

The results of the structural model fitness index analysis showed the following: model chi-square value $\chi^2=174.302, df=73, p=0.000$ (much less than 0.05, highly significant); RMSEA=0.068 (less than 0.8); $\chi^2/df=2.388$ (less than 3); GFI=0.927 (greater than 0.9); NFI=0.926 (greater than 0.9); IFI=0.955 (greater than 0.95); CFI=0.955 (greater than 0.95); PNFI (0.742), PCFI (0.766), PGFI (0.644) are all greater than 0.5. The results of the analyses show that the structural model of intervention effect has a good fit, that is, the theoretically hypothesized path relationship is more in line with the actual measured data, and the structural model construction and assumptions are more satisfactory (shown in Table 30).

Table 30 Structural model fit parameter results

statistical	Absolute Fitness Index			Value Added Fitness Index			Simplicity Fitness Index		
	χ^2/df	RMSEA	GFI	NFI	IFI	CFI	PNFI	PCFI	PGFI
Adaptation Standards Parameters of the model	<3	<0.08	>0.9	>0.9	>0.9	>0.9	>0.5	>0.5	>0.5
	2.388	0.068	0.927	0.926	0.955	0.955	0.742	0.766	0.644

4.3.7 Analysis for hypothesis testing of each structural path

Table 31 Hypothesis testing for each structural path

Hypothesis	Path	Standardized Estimate	Estimate	S.E.	C.R.	P
H1	FMS↔SE	-0.33	-3.104	0.713	-4.315	***
H2	FMS↔PA1	-0.24	-287.627	81.864	-3.513	***
H3	FMS↔PA2	0.12	203.574	110.554	1.841	0.066
H4	SE↔PA1	0.19	321.168	99.089	3.241	**
H5	SE↔PA2	-0.17	-397.684	142.882	-2.783	*
H6	PA1↔PA2	0.02	5376.426	17327.635	0.310	0.756

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In terms of path coefficients, FMS was significantly negatively correlated with SE ($r = -0.33$, $p < 0.001$); FMS was significantly negatively correlated with PA1 ($r = -0.24$, $p < 0.001$); SE was significantly positively correlated with PA1 ($r = 0.19$, $p = 0.001$), SE was significantly negatively correlated with PA2 ($r = -0.167$, $p = 0.005$). FMS was insignificantly correlated with PA2 ($r = 0.120$, $p = 0.066$), and PA1 was insignificantly correlated with PA2 ($r = 0.018$, $p = 0.756$).

Combining the content of the model hypotheses and the results of the structural model analysis, the hypotheses of the relationship between the model variables were further tested to see if they were valid, and the results of the test of the research hypotheses are shown in Table 31. The results of the test showed that the test of difference for all hypotheses presented a difference in results, except for the test of difference for H3 and H6 which were not significant. The improvement of fundamental movement skills in 7–10-year-old children after the intervention had a significant social emotional developmental promotion, as well as the time they spent

participating in moderate to high intensity physical activities; positive social-emotional development was able to increase the time spent participating in moderate to high intensity physical activities in 7–10-year-old children, as well as reduce the time spent in sedentary behaviors. In contrast, the effect of the improvement of fundamental movement skills on the reduction of children's time for sedentary behavior was not significant enough, and the effect between the increase in the time of participation in medium- and high-intensity physical activity and the reduction of the time for sedentary behavior during the development of the level of physical activity in children aged 7-10 years was not significant.

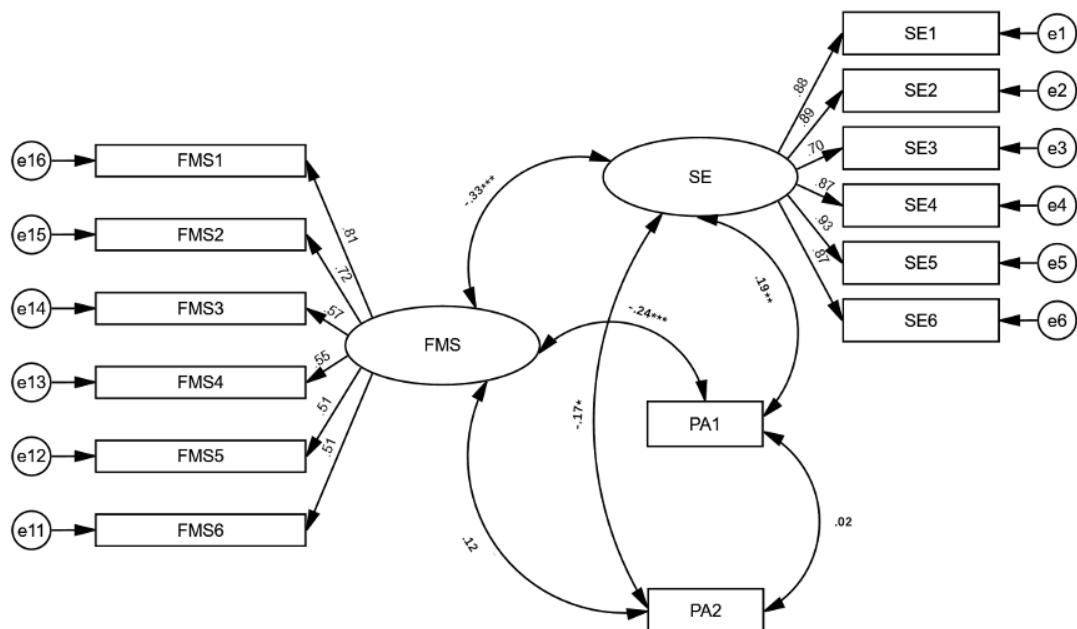


Figure 18 Result of intervention structural equation modeling

The results showed that most of the model fitting indices reached a good level (Figure 18). The findings emphasize the importance of considering different types of activity participation and how they are affected by motor skill development. The bidirectional impact of FMS on PA1 and PA2 suggests that children's participation in activities is not uniform but varies according to their motor ability and the nature of the activity. This realization is critical to assessing the effectiveness of interventions, showing that the re-intervention process should not only encourage students to be physically active, but also promote social-emotional growth.

4.3.8 The control group model result

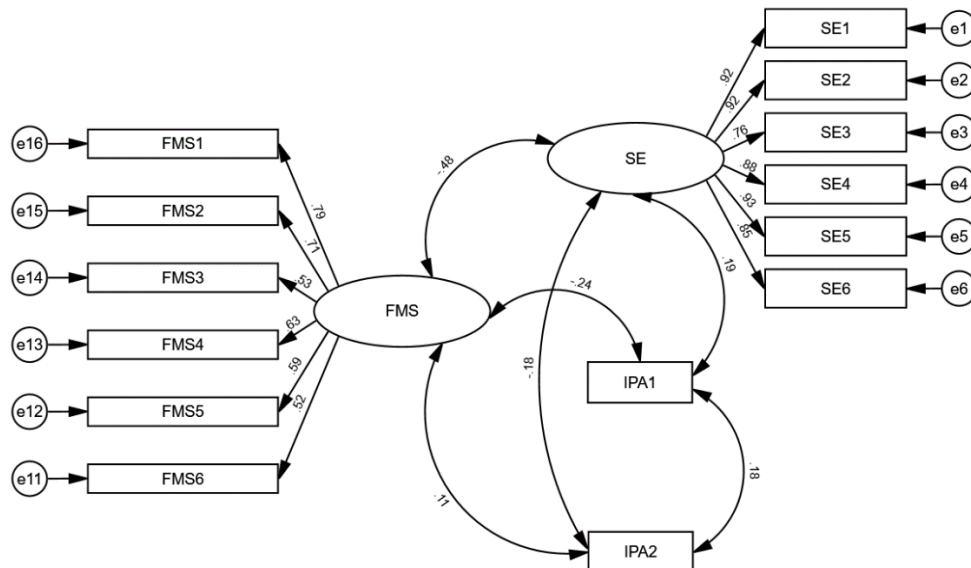


Figure 19 Structural equation modeling for control group results

This control group model demonstrated the relationship between FMS, SE, and IPA, and the stability of the model was verified by several fitting indicators. The $\chi^2/df = 1.694$, CFI = 0.959, TLI = 0.949, RMSEA = 0.068, NFI = 0.908, GFI = 0.899, and AGFI = 0.855, which all showed good model fit and stability. The path coefficient of the FMS on the SE was -0.48, which indicated that essential motor skill enhancement was positively correlated with social-emotional development is positively correlated; the path coefficient of FMS on IPA2 is 0.11, showing that basic motor skills affect sedentary behavior; and the path coefficient of SE on IPA2 is -0.18, indicating that social-emotional development is negatively correlated with sedentary behavior. Although the GFI and AGFI are slightly lower than ideal, the overall fit is still good. The coefficients of the paths are reasonable and consistent with the theoretical expectations, and no abnormal paths appear, so the model can be considered to have good explanatory power and stability.

4.3.9 The experimental group model result

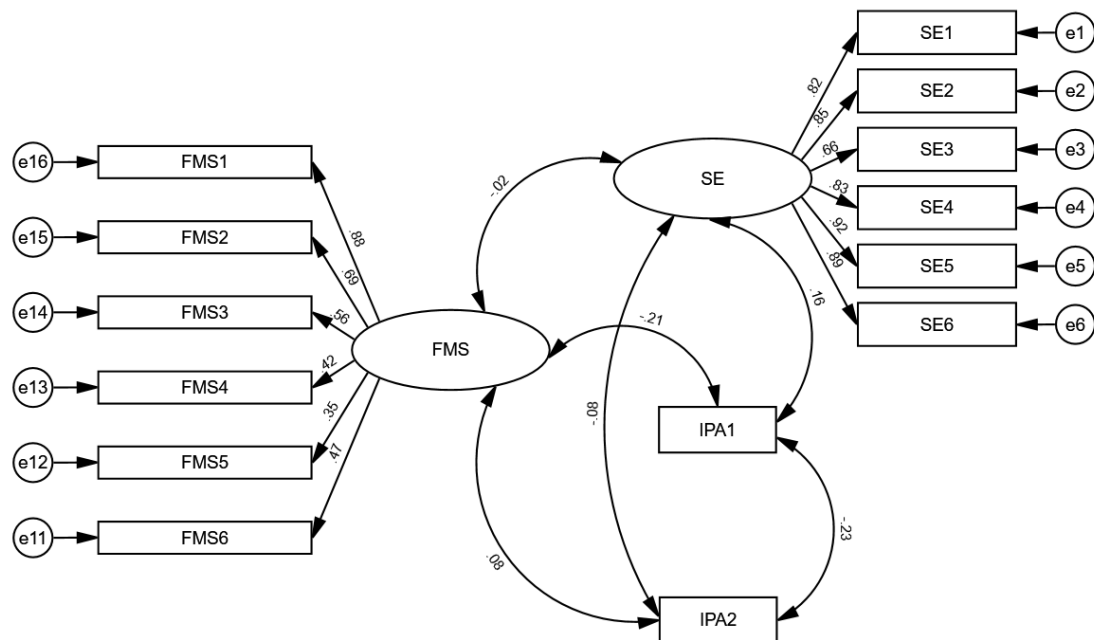


Figure 20 Structural equation modeling for experimental group results

The fitting results of the model in the experimental group were generally good, reflecting the rationality of the model structure and the consistency of the data. The $\chi^2/df = 1.664$, CFI = 0.948, TLI = 0.936, GFI = 0.907, and RMSEA = 0.066, indicated that the model had a good fit, low error, and stable structure. Regarding the path coefficients, the direct effect of FMS on SE was weak (-0.02), indicating that basic motor skills (FMS) had a limited effect on social-emotional development (SE); the positive effect of FMS on IPA2 was weak (0.08), indicating that the effect of FMS on IPA2 was insignificant. The negative effect of SE on IPA2 (-0.08), although it existed, had a small effect, suggesting that social-emotional is not a significant factor in the change of IPA2. Although some path coefficients are close to zero, which may suggest an unstable role, the overall model's fit indicators are within a reasonable range, showing that the model has some explanatory power and stability. These results provide a basis for subsequent, more in-depth intervention and regulation mechanisms studies.

CHAPTER V

DISCUSSIONS AND CONCLUSIONS

5.1 Discussions

5.1.1 Pre-intervention fundamental movement skills, physical activity, and social-emotional development of 7–10-year-olds

5.1.1.1 Reflections on results of baseline tests of fundamental movement skills

The results show that children's fundamental movement skills development showed regularity and variability. Based on the descriptive statistical analysis results, we found that the average performance time for each fundamental movement skill varied widely. For example, the average time for Sideways slide running was 8.15 seconds, reflecting the children's overall ability in terms of coordination and speed. The average time for Jumping continuously on a one-foot test was 4.48 seconds, a skill that tested children's abilities in balance, coordination, and lower-body strength. The average time for Changing hands and shooting the ball on the spot test was 4.10 seconds, indicating children's performance in hand-eye coordination, rhythmic control, and reaction time. The mean time for Kicking the ball over the obstacle was 8.20 seconds, showing their strength, precision, and coordination development. The average time for Walking on the balance beam was 4.11 seconds, a skill that tested children's core stability and balance. The average time for Walking backward in a straight line was 14.29 seconds, showing how children are challenged with coordination and body control of complex movements.

Regarding standard deviation, performance times for all skills showed some fluctuation, suggesting individual differences in the level of development of children's fundamental movement skills within the same age group. Some children may perform better in specific skills, while others may need more practice and instruction. Movement skills of higher complexity, like Kicking the ball over the obstacle and walking backward in a straight line, had more significant standard deviations, suggesting that developmental differences in these skills were more pronounced among children.

Although the variance test between the control and experimental groups showed that the skills failed to reach a significant difference ($p > 0.05$), overall, the children's level of movement skill development had a wide range of variability. This reflects the diversity in children's physical activity participation and the uniqueness of individual growth. Further research could focus on intervention strategies in different contexts to enhance the development of specific skills.

5.1.1.2 Discussion of physical activity of children aged 7-10 years prior to the intervention

A survey of students' physical activity before the intervention revealed significant differences between their participation in physical activity and sedentary behavior and their potential health effects. First, playing basketball and badminton were the most popular physical activities, with participation rates of 43.28% and 42.95%, respectively, and high average daily duration of participation of 20.26 minutes and 14.98 minutes, respectively. Playing football had a participation rate of 30.49% and an average length of participation of 10.60 minutes per day. Playing volleyball had a participation rate of only 9.18% but a participation length of 11.08 minutes per day, showing that a few students invested more time in the sport. Overall, there were large individual differences in physical activity participation, with some students spending significantly more time in the activity than the average, while others were less involved. On the other hand, students' hours of sedentary behavior were higher overall. The data showed that the average weekly duration of sedentary behavior was 1103.85 minutes (about 18.4 hours). In addition, the average weekly video screen time was 452.21 minutes (approximately 7.5 hours). These data suggest that many students are overly engaged in sedentary behavior after school hours and significantly prolonged screen use, which may harm their health. Studies have shown that excessive sedentary behavior is strongly associated with obesity, metabolic syndrome, and mental health problems. Therefore, reducing sedentary behavior and increasing physical activity should be important intervention goals for schools and families.

Schools can increase student participation by promoting more popular physical activity programs while adding low participation but healthful activities. For students with prolonged periods of sedentary behavior, especially individuals with excessive screen time, schools and parents should take steps to help students develop healthier habits through education and supervision. Targeted exercise interventions to interrupt periods of sedentary behavior can help students become less sedentary and screen dependent. In addition, exercise health education programs can help students and parents better understand the health implications of sedentary behaviors so that they can consciously control their sedentary behavior time. The study reveals an imbalance in physical activity and sedentary behavior, suggesting that increasing physical activity and decreasing sedentary behavior is critical to students' overall health. Schools, families, and society should work together to create a healthier lifestyle through multiple interventions to promote their overall physical and mental development.

5.1.1.3 Discussion of social-emotion status of children aged 7-10 years prior to the intervention

Analysis of the data from the pre-test of social-emotional development of children aged 7-10 shows that students performed well overall in the dimensions, with scores clustered between 15-18, reflecting a robust social-emotional foundation. In the six dimensions of self-awareness, self-management, others' awareness, others' management, collective awareness, and collective management, the average scores were high, and the standard deviations were minor, indicating that most students possessed a certain degree of social-emotional competence. However, individual differences still existed, and some students were weak in the dimensions of self-management and management of others, with scores as low as 10, suggesting that these students may have some difficulties in emotion regulation and social interaction. The variance test showed that the differences in scores between boys and girls on social-emotional development dimensions were insignificant, suggesting that gender has less influence on social-emotional development in the current educational environment. This may be attributed to the emphasis placed on social-emotional

development in the educational process by schools and families and the relatively balanced gender education policy.

Although the overall performance was good and the gender differences were not significant, the significant inter-individual differences suggest that there is still a need for intervention. First, intervention can help students who are lagging in specific dimensions, helping them to improve their abilities in self-management, emotion regulation, and group cooperation. Second, intervention is not just about improving deficits. It can also help all students build on what they already must further enhance their social-emotional competence, especially in their future learning, life, and interpersonal relationships. In addition, social-emotional development is fundamental to students' long-term development, and early intervention and guidance can provide a stronger foundation for their future academic success and social adjustment. Educational interventions can help prevent potential emotional and social problems, enabling students to cope more comfortably with complex social situations and to have more vital teamwork and emotional management skills.

Overall, while showing higher levels of social-emotional performance among students, the pre-test data also revealed the importance of individual differences. Intervention is especially critical to ensure all students achieve optimal performance on all dimensions. Implementing the intervention can further focus on the social-emotional development of students of different ages, explore the manifestation of gender differences in different age groups, and promote the healthy social-emotional development of students through the exercise intervention program, which will also help them better adapt and grow in their future lives.

5.1.1.4 Discussion of the overall development of children aged 7-10 years prior to the intervention

Individual differences and the need for intervention were revealed by analyzing the essential social-emotional development, physical activity, and fundamental movement skills of children aged 7-10. Their overall social-emotional development was good, but individual students showed deficits in self-management, others' perceptions, and group management, revealing differences in social-emotional skills.

Physical activity analyses showed that basketball and badminton were the most popular sports, but there were large variations in overall physical activity participation; some students were significantly more engaged than average in terms of length of participation, while others were under-active. In addition, long hours of sedentary behavior, especially excessive screen use, can hurt health, increasing the risk of obesity and mental health problems. Tests of fundamental movement skills showed that there were also significant differences in student performance in events such as sideways slide running and jumping continuously on one-foot tests, with some complex skills such as kicking the ball over the obstacle and walking backward in a straight line showing large individual fluctuations. Such differences suggest that basic training of movement skills still needs to be strengthened, especially for students with weaker motor ability and lower participation in physical activities. Future sports intervention programs should begin with enhancing students' physical activity levels and reducing the time spent in sedentary behavior, combined with fundamental movement skills training, to help students develop holistically.

When designing intervention programs, the first step should be encouraging more students to participate by enriching physical activity. At the same time, screen use should be reduced by increasing participation in physical activities for students who spend more time in sedentary behavior. Sports intervention programs should improve students' health-related fitness and promote their social-emotional development through team activities and cooperative tasks so that physical activity interacts with enhancing social-emotional competence. In addition, during the intervention process, students are also helped to understand the negative impact of sedentary behavior on health and form conscious exercise habits and healthy lifestyles. Through these comprehensive interventions, students can not only improve their physical activity level and develop fundamental movement skills but also enhance their social-emotional competence to achieve the goal of holistic physical and mental development.

5.1.2 Discussion of post-intervention development effectiveness

5.1.2.1 Discussion of fundamental movement skills development

The results of this study, which comprehensively analyzed the significance of the differences between children in the experimental and control groups on several movement skills test items, showed that the experimental intervention had a significant positive effect on the children's movement skills in most of the items. Overall, children in the experimental group performed significantly better than the control group in Sideways slide running, jumping continuously on one foot, changing hands and shooting the ball on the spot, Kicking the ball over the obstacle, and walking backward in a straight line. Specifically, the results of Sideways slide running ($p=0.034$) and jumping continuously on one foot ($p=0.003$) showed that the experimental intervention significantly improved children's speed, agility, and balance. Changing hands to shoot the ball on the spot ($p=0.013$) and kicking the ball over the obstacle ($p=0.015$) reflected the intervention's effectiveness in hand-eye coordination, reaction speed, and integration of complex skills. The significant difference in walking backward in a straight line ($p=0.003$) further suggests that the intervention significantly improved children's reverse coordination and sense of spatial orientation. However, in the Walking on the balance beam test, although the experimental group's mean performance was better than the control group, the difference did not reach the level of statistical significance ($p=0.076$), suggesting that the intervention may require a longer period or more specialized training tools to show significant effects in some specific movement skills areas. This result suggests that the experimental intervention enhanced children's overall movement skills performance but may still need to be optimized or improved in some specific skill areas. Overall, the experimental intervention strategy demonstrated the potential for multidimensional enhancement of children's motor performance and was influential in promoting children's overall movement skills.

Further sub-sex analyses revealed significant differences in the effects of the experimental intervention on boys and girls in different movement skills tests. It was found that the positive effect of the experimental intervention was particularly

significant for girls, especially in the tests of one-legged hop ($p=0.009$), in situ ball tapping ($p=0.048$), Kicking the ball over the obstacle ($p=0.005$), and walking on a balance beam ($p=0.008$), in which the girls in the experimental group performed significantly better than the control group. These results suggest that the experimental intervention showed significant advantages in enhancing balance, coordination, and integration of complex skills in girls, which may be related to the fact that girls are more likely to follow instructions and focus on technical details during exercise. In addition, girls' significant improvements in these programs may also have benefited from the targeted training design of the experimental intervention, such as balance and coordination enhancement through specific physical activities and game play. In contrast, the effects of the experimental intervention on boys were relatively insignificant. Although the boys performed slightly better than the control group in Sideways slide running ($p=0.156$), Jumping continuously on one foot ($p=0.095$), and Changing hands and shooting the ball on the spot ($p=0.130$), none of these differences reached the level of statistical significance. This may be because the boys were more inclined to show speed and power in their sport, whereas the design of the experimental intervention may have been more focused on technical details and coordination enhancement. Therefore, future studies may need to tailor the training methods to enhance the intervention for boys. For example, adding more intense physical training or more challenging skill practice may help to enhance boys' athletic performance.

In the grade-specific analysis of variance, the experimental intervention showed different effects among children in different grades. For first-grade children, the experimental group performed slightly better than the control group in the slide running, one-legged hopping, and in-situ ball slapping tests. However, none of the differences reached the significance level, suggesting that the experimental intervention may need a more extended training period to show a significant effect on these fundamental movement skills. However, in Walking on the balance beam, the performance of the first-grade children showed a significant between-group difference ($p=0.012$), with the experimental group performing significantly worse than the control group, which may be attributed to the fact that the balance beam program requires a high level of body control and coordination, in which the lower-grade

children are less well grounded, making it difficult for them to make significant progress in the short term through regular training. For children in grades 2 and 3, the experimental group performed significantly better than the control group on the one-legged hop ($p < 0.05$), Kicking the ball over the obstacle ($p < 0.05$), and Walking on the balance beam ($p < 0.05$) tests, suggesting that children's movement skills and coordination are more susceptible to the positive effects of the intervention as they progress through the grades. In particular, the children in higher grades appeared to be better able to respond to the intervention on items with complex skills and high precision control requirements. This may be because as children's physical control and cognitive understanding increase with age, they are better able to understand and carry out training instructions, leading to significant progress in these skill programs. This finding suggests that future intervention strategies could be adapted to better suit the developmental needs of children at different grade levels in terms of their movement skills. For example, interventions for younger children could focus more on polishing basic skills, while more complex skills and combination exercises could be incorporated for higher grade children to improve their overall motor performance.

5.1.2.2 Effects of intervention on children's physical activity development

The analysis shows that there are some differences in the participation of students in the experimental group and the control group, but in general, the two groups' participation patterns are similar in many activities.

Firstly, the main activities in the experimental and control groups were rope skipping/jumping, playing games outdoors (chasing, playing), doing housework, and so on. These activities have a high participation rate. These activities had a high percentage of participation and were quite important in both groups. These activities may align with students' daily interests and habits and thus have a high participation rate.

Secondly, regarding the average length of participation per day, the top activities in both the experimental and control groups were Playing games outdoors (chasing, playing), Swimming, and Playing basketball. The average day length for these activities was relatively high, possibly because they required more time to complete

or were more consistent. In addition, activities such as Swimming and Playing basketball usually require specific venues and longer schedules, which explains their prominence in terms of duration.

Students in the experimental and control groups showed similar overall patterns of participation in physical activity, which may be related to common characteristics of the school and home environments. The two groups of students may have come from similar community backgrounds and were influenced by similar school schedules and parental behaviors. For example, activities such as Playing games outdoors (chasing, playing) and Rope skipping/jumping did not require specific equipment or venues, and were available to students both inside and outside of school, thus resulting in high levels of participation and low variance.

No significant differences were found between the experimental and control groups, possibly reflecting the limited effect of the physical activity intervention. On the one hand, this may be related to the intervention's delivery method. For example, the intensity, frequency, and type of intervention activities may not be sufficiently engaging or exciting to significantly change students' participation behavior. On the other hand, students' motivation and interest in physical activity may be influenced by multiple factors, including family support, peer influences, and personal interests, rather than just school interventions.

In terms of duration, although no significant differences were found, the differences in duration between activities are worth exploring further. The study shows that the relatively high duration of activities such as Playing games outdoors, Swimming, and Playing basketball may be related to the intensity and demand of these activities. For example, Swimming usually requires a long duration to achieve the desired fitness effect. At the same time, playing games outdoors can be performed over a long period and is highly adaptable. Therefore, these activities are important in students' physical activity time.

The data shows that activities with high participation (e.g., Rope skipping/jumping, playing games outdoors) do not necessarily have the highest average length of time, suggesting that students may participate in various activities but spend relatively less. This pattern may reflect students' preferences for different activities or the time-demanding nature of the activities themselves. For example,

Rope skipping/jumping is a convenient and simple activity that is easy to do during recess or at home, but a single session may be short.

The results of the test of difference indicated that the difference between the experimental and control groups also reached statistical significance. This result may indicate that the students in the experimental group, because of the intervention, caused them to be more physically active than the control group in terms of average daily physical activity time, which positively affected the students' physical activity level.

In the study of sedentary behavior, the analyses showed some differences between the control and experimental groups, especially regarding the interaction of the gender and grade factors. The overall p-value of 0.049 is close to the critical value of 0.05 at the level of significance, which means that statistically, it can be considered that there is a statistically significant difference between the two groups on some static behavioral variables, but this difference is relatively small.

Specifically, independent samples t-tests and chi-square tests were conducted on several sedentary behavioral indicators, including the number of days spent watching TV, the average length of time spent watching TV per day, the number of hours spent watching TV per week, the frequency and length of sitting and chatting, and participation in offline courses. Among these variables, only the “average length of time spent sitting and chatting per day” showed a significant difference between the experimental and control groups, with the length of time spent chatting in the experimental group being significantly less than that in the control group ($p = 0.0256$). This result may indicate that the intervention in the experimental group reduced the children's static behavior time to some extent.

On the other hand, the control group and the experimental group did not show significant differences in other sedentary behavioral indicators. For example, there were no significant differences between the two groups in the indicators of “number of days watching TV”, “average length of time watching TV per day” and “time watching TV per week”, which may reflect the children's habitual stability in these behaviors, which were not significantly affected by the short-term intervention. This may reflect the habitual stability of these behaviors, which were not significantly affected by the short-term intervention. In addition, the results of the test for

differences in these behaviors by gender and grade showed that there were no significant differences by gender by grade, nor were there significant differences in the distribution of gender itself between groups, indicating that these factors had a negligible effect on the distribution of the sample.

While the p -value of 0.049 is close to the significance level, suggesting a difference between the control and experimental groups in some of their static behaviors, this difference is not very significant or widespread. Perhaps influenced by the fact that the student's physical activity evaluation questionnaire was primarily open-ended, the results presented only yielded differences in general and did not address more extensive content differences. Therefore, a more in-depth study of influences such as family environment and social-cultural background is needed to better present the reasons for the differences.

5.1.2.3 Effects of intervention on children's social-emotional development

Overall, students in the experimental group scored significantly higher than the control group on a few social-emotional dimensions, especially on self-awareness, self-management, management of others, collective awareness, and collective management. This suggests that the experimental intervention has a positive effect in enhancing students' socio-emotional competence. The most significant differences were found in the self-perception and collective management dimensions, with students in the experimental group scoring significantly higher on these dimensions than the control group (self-perception dimension: $p = 0.0011$ for boys and $p = 0.0002$ for girls; collective management dimension: $p = 0.0101$ for boys and $p = 0.0013$ for girls). This suggests that the content of the experimental intervention achieved significant results in improving students' training in self-awareness and ability to manage collective activities. For the Others Awareness dimension, the difference between the experimental and control groups was not significant (boy $p = 0.3797$, girl $p = 0.6835$), which may reflect the fact that the enhancement of Others Awareness skills requires a more extended period of intervention or that the current intervention strategy is not practical in touching the developmental needs of the students in this area.

Further analyzing the gender differences, we found some significant differences in the impact of the experimental intervention on students of different genders. On the self-perception dimension, both males and females scored significantly higher in the experimental group than in the control group ($p = 0.0011$ for boys and $p = 0.0002$ for girls), suggesting that the intervention improved students' self-perception. However, on the self-management dimension, while females in the experimental group scored significantly higher than females in the control group ($p = 0.016$), the difference in the male group did not reach the level of significance ($p = 0.0806$), which shows that the intervention was more effective in improving self-management skills of females. The possible reason is that females are more inclined to accept and internalize externally provided interventions in their social-emotional development, especially in self-management, so the intervention can affect their performance more directly.

On the management of others dimension, the experimental intervention significantly positively affected both boys and girls, suggesting that the intervention effectively promoted students' competence in managing others. This may be related to the emphasis on cooperation and team interaction in the intervention content. On the collective awareness and collective management dimensions, both male and female students in the experimental group scored significantly higher than those in the control group (collective awareness: boy $p = 0.0101$, girl $p = 0.0013$; collective management: boy $p = 0.0101$, girl $p = 0.0013$), demonstrating the wide-ranging effects of the intervention in enhancing students' collective awareness and ability to manage collective activities. Overall, the experimental intervention positively affected both genders on several social-emotional dimensions. However, gender differences in the self-management dimension reflect that female may be more receptive to this intervention.

In terms of grade level differences, the effects of the experimental intervention were likewise significantly different between grades. On the self-concept dimension, second-grade boys scored significantly higher in the experimental group than in the control group ($p = 0.000023$), showing that the experimental intervention significantly boosted second-grade boys' self-conceptual abilities. This may be because second graders are in a critical period of cognitive and socio-emotional development, where they are relatively sensitive to cognitive enhancement and can assimilate and apply

the intervention content in the experiment more quickly. In contrast, the differences between the experimental and control groups for both male and female first graders did not reach the significance level ($p = 0.3207$ for males and $p = 0.1460$ for females), suggesting that the experimental intervention was not as effective among first graders. Possible reasons for this include the young age of the first graders, their limited receptivity, or the fact that the content of the experiment did not precisely match their developmental level.

In third grade, girls scored significantly higher on self-perception in the experimental group than in the control group ($p = 0.0281$), while the difference for boys was close to significant ($p = 0.0645$). This implies that the experimental intervention had a significant contribution to the improvement of self-perception in third grade girls, while it may have influenced boys as well, but further validation is needed. The significant results for third-grade girls may be related to their stage of social-emotional development and the high fit of the experimental content, whereas the near-significant results for boys may have required a longer intervention or more precise content adjustments to reach significance. For third graders, the experimental intervention was particularly significant in the areas of collective cognition and collective management, suggesting that students at this grade level are more likely to be positively affected by teamwork and management skills training in these areas.

Taken together, the experimental intervention had a positive effect on students' social-emotional competence, but its effects varied by gender and grade level. For second-grade boys and third-grade girls, the effects of the intervention were most significant, showing that in these groups the content of the intervention matched well with students' cognitive and emotional developmental stages. However, the effects of the intervention were relatively less pronounced for first-grade students, especially boys, and the intervention content may need to be adjusted to better fit their level of cognitive development.

In terms of gender differences, females showed more significant gains in the self-management dimension, suggesting that gender differences should be taken into account when designing future interventions, especially in adding more incentives and support to encourage male students to engage in self-management and reflection. Future research could further explore the differential needs of students across genders

and grade levels in the development of social-emotional competence in order to optimize intervention strategies to better support the holistic development of all students. With more targeted intervention designs, students' growth in all areas of self-awareness, managing others, and group collaboration could be promoted, leading to more effective social-emotional development and overall growth.

5.1.3 Discussion of Model Results

In structural equation modeling (SEM) of children's fundamental movement skills (FMS), physical activity (PA), and social-emotional development (SE) after intervention, the theoretical framework emphasizes the complex interactions among the three. Fundamental movement skills represent children's motor performance, and interventions are designed to enhance these skills, with the expectation that FMS enhancement will have a direct impact on social-emotional development through increased motor competence and self-confidence. At the same time, the development of physical activity, including moderate- to high-intensity activity participation and reduction of sedentary behaviors, was also an essential goal of the intervention. The increase in PA contributes to physical fitness and promotes socio-emotional dimensions, such as self-management and social awareness, in children. Therefore, the theoretical hypothesis is that FMS further promotes SE development by increasing PA, i.e., PA plays a mediating role between FMS and SE. Through SEM modeling, the direct and indirect effects of the intervention on FMS, PA, and SE can be simultaneously analyzed, systematically revealing the interactions among the three.

The construction of the structural equation model was based on the path relationships between the latent and observed variables of FMS, PA, and SE. The development of FMS was measured by the reduction in the time required for motor tasks. In contrast, PA was assessed by the amount of time spent engaging in moderate- to high-intensity activities and the reduction in sedentary behavior. The latent variables of SE included six dimensions of self-awareness, self-management, and social awareness. The pathway design of the model included the direct effect of FMS on PA, the direct effect of PA on SE, and the indirect effect of FMS on SE through PA, constituting a mediated effects model of $FMS \rightarrow PA \rightarrow SE$. The model's

fitness was tested by common fit indicators, such as the chi-square test and comparative fit index (CFI), to ensure the rationality of the path relationship. The model allows for an in-depth exploration of the role of interventions in the development of FMS, PA and SE in children, revealing the direct and indirect effects of interventions on these domains.

The structural equation model (SEM) developed in this study aims to explore the impact of fundamental motor skills (FMS) on social-emotional development (SE) and physical activity (PA). The model fit indices demonstrate that the overall model is well-fitted, confirming its appropriateness and validity. The chi-square to degrees of freedom ratio ($\chi^2/df = 2.435$) falls within the acceptable range (between 1 and 3), indicating an adequate model fit; the Normed Fit Index (NFI = 0.921), Comparative Fit Index (CFI = 0.952), and Tucker-Lewis Index (TLI = 0.942) all exceed 0.90, especially the CFI being close to the ideal value of 1, showing superior performance in fitting the data. Furthermore, the Root Mean Square Error of Approximation (RMSEA = 0.059) and the Standardized Root Mean Square Residual (SRMR = 0.073) are within satisfactory ranges, further supporting the model's adequacy.

From the path coefficients, FMS shows a significant positive impact on SE (path coefficient = 0.55), suggesting that the development of fundamental motor skills plays a crucial role in enhancing social-emotional development. As children develop fundamental motor skills, they may simultaneously cultivate confidence, self-control, social interaction skills, and other dimensions of social-emotional capabilities, which can further explain the significant positive relationship between FMS and SE. The high standardized loadings for each dimension of SE (ranging from 0.70 to 0.88) also indicate that the measurement indicators have strong explanatory power for the latent variable SE, further supporting the reliability of the measurement model established in this study.

On the other hand, the path coefficient of FMS to IPA1 is 0.13, showing a positive but relatively weak relationship, which means that the development of fundamental motor skills has a limited positive impact on IPA1. This result may reflect that child with higher fundamental motor skills are slightly more likely to participate in certain activities (such as organized or group activities), but the impact is not very pronounced. Conversely, the path coefficient from FMS to IPA2 is -0.35,

indicating a moderate negative relationship, suggesting that as fundamental motor skills improve, certain types of participation intensity (such as static or low-intensity activities) may decrease. This result hints at a possible substitution effect, where children with enhanced motor skills might prefer more challenging activities, thus reducing their participation in other activities.

These findings have significant educational and practical implications. First, the results highlight the importance of fundamental motor skills in children's social-emotional development, suggesting that educators should prioritize developing these skills in physical activities to foster holistic development. Second, the results reveal complex relationships between different types of participation intensity, indicating that when encouraging children to engage in diverse activities, their varying levels of fundamental motor skills should be considered to design more targeted physical and social-emotional education programs. Especially in policy and curriculum development, attention should be given to balancing and promoting participation in different types of activities to maximize overall developmental benefits.

Additionally, the model illustrates how various dimensions of social-emotional competencies (such as self-awareness, self-management, and social awareness) interact synergistically with fundamental motor skills. The enhancement of social-emotional abilities may not only stem from the confidence gained through motor skill development but also from learning cooperation, communication, and adaptability during physical activities. Therefore, combining physical education with social-emotional education can enhance motor skills and help develop well-rounded children. By applying these theoretical findings to specific educational practices, we can more effectively design activities and curricula that promote comprehensive development in children, fostering both social-emotional and physical growth.

The analysis of SEM for control group shows that there are significant interactions between fundamental motor skills, social-emotional development, and physical activity. Improved FMS positively impacts SE, while SE improvements reduce unhealthy sedentary behaviors. Although the impact of FMS on IPA2 is weak, the overall model explains the complex relationships between these variables well. The model provides a solid foundation for further analysis, while also leaving room for adjustments and optimization to improve the explanatory power and fit.

From the perspective of model stability, the fit indicators of the experimental group show that the overall structure of the model is more solid and can explain the relationship between the data better. The fit indicators such as the χ^2/df , CFI, TLI all indicate that the model has a small error between the model and the data, and possesses good stability. Meanwhile, the RMSEA is 0.066, which is not entirely ideal but still within the acceptable range, further supporting the robustness of the model.

5.2 Conclusions

(1) After the intervention, the experimental group showed significant improvements in most movement skills compared to the control group. Specifically, children in the experimental group performed significantly better in tests of Sideways slide running, jumping continuously on one foot, changing hands and shooting the ball on the spot, Kicking the ball over the obstacle, and walking backward in a straight line. These results indicate that the intervention strategy was effective in enhancing children's speed, balance, coordination, and complex motor skill integration. However, responses to the intervention varied by gender and grade level. Girls demonstrated more substantial improvements, particularly in balance and coordination tasks, while boys showed less progress, with some items not reaching statistical significance. Additionally, older children responded more significantly to the intervention, especially in tasks requiring more complex motor skills.

(2) After the intervention, children aged 7-10 years were significantly better than before the intervention in terms of overall development of physical activity. There were significant differences between the experimental and control groups, with the experimental group having significantly more total weekly physical activity time and average daily physical activity time than the control group. This suggests that the intervention successfully increased physical activity among the students, potentially promoting healthier behaviors. However, while there were general differences in sedentary behavior between the two groups of students, specific unilateral differences in sedentary behavior were not statistically significant.

(3) After the intervention, children aged 7-10 significantly improved their social-emotional development, especially in self-awareness and group management. Boys in Grade 2 and girls in Grade 3 made significant progress, suggesting that the intervention was well adapted to their stage of development. However, first graders made less progress, suggesting age-appropriate strategies were needed. Gender-specific results showed that girls benefited more in terms of self-management.

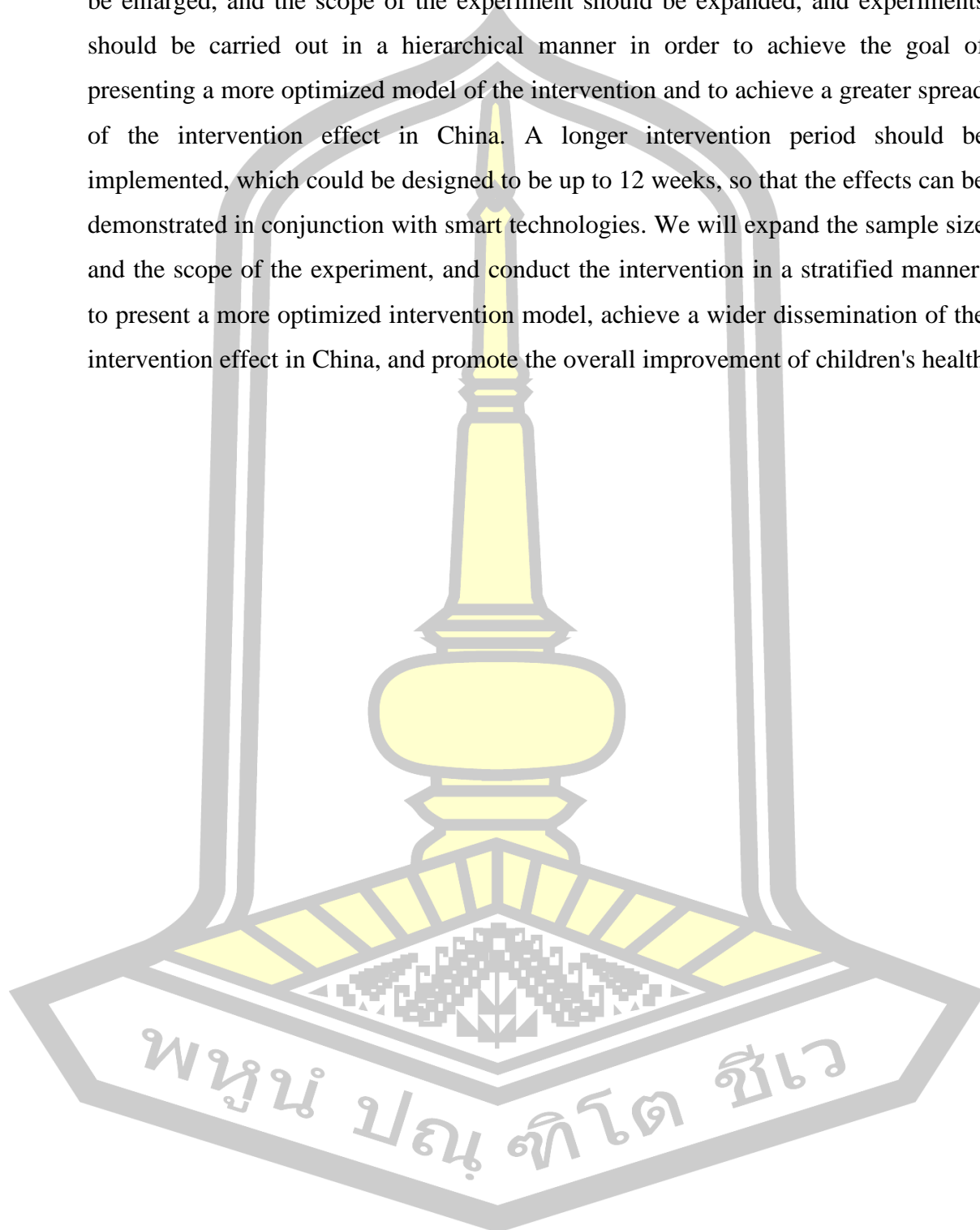
(4) The intervention effect model effectively explained the link between fundamental movement skills, social-emotional and physical activity with a good model fit. The development of fundamental movement skills significantly contributed to social-emotional development, which also significantly increased physical activity behaviors and achieved a reduction in sedentary behaviors; the increase in social-emotional competence also significantly contributed to the increase in physical activity and significantly reduced children's sedentary behaviors. And the significant relationship between increased physical activity behaviors and reduced sedentary behaviors needs to be supported by additional research findings.

5.3 Limitations and recommendations of the study

The limitations of this study are, firstly, because the target of the survey is students in the lower grades, the use of the questionnaire failed to better communicate with teachers and parents, especially with the parents of the students, resulting in some parents not being clear enough about the requirements for filling out the questionnaire, which affected the validity of the questionnaire to a certain extent. Secondly, the scope of the study failed to cover a wider range of regions and schools and failed to provide students of different nationalities and areas of different economic development with better physical education resources and opportunities to practice improving their overall health. Finally, in the construction of the model, the control variables and moderating variables were not adequately considered, and the stability of the model in the experimental and control groups needs to be improved.

It is recommended that in future studies, when filling out the questionnaire, the training of teachers and parents should be strengthened to ensure that teachers and parents understand the purpose of the questionnaire and the method of filling it out

through repeated re-testing of the reliability test; the sample size of the survey should be enlarged, and the scope of the experiment should be expanded, and experiments should be carried out in a hierarchical manner in order to achieve the goal of presenting a more optimized model of the intervention and to achieve a greater spread of the intervention effect in China. A longer intervention period should be implemented, which could be designed to be up to 12 weeks, so that the effects can be demonstrated in conjunction with smart technologies. We will expand the sample size and the scope of the experiment, and conduct the intervention in a stratified manner, to present a more optimized intervention model, achieve a wider dissemination of the intervention effect in China, and promote the overall improvement of children's health.



REFERENCES



REFERENCES

- Amalia, E. F., Setiawan, E., Kastrena, E., Jumareng, H., Rahadian, A., Patah, I. A., & Gani, R. A. (2021). Physical education curriculum model: Can FEM and SEM create participation in physical activity and enjoyment? *Journal sport area*, 6(3), 286-295. [https://doi.org/10.25299/sportarea.2021.vol6\(3\).6851](https://doi.org/10.25299/sportarea.2021.vol6(3).6851)
- Bardid, F., Huyben, F., Lenoir, M., Seghers, J., De Martelaer, K., Goodway, J. D., & Deconinck, F. J. A. (2016). Assessing fundamental motor skills in Belgian children aged 3-8 years highlights. *Acta paediatrica*, 105(6), e281-e290. <https://doi.org/10.1111/apa.13380>
- Bardid, F., Vannozi, G., Logan, S. W., et al. (2019). A hitchhiker's guide to assessing young people's motor competence: Deciding what method to use. *Journal of Science and Medicine in Sport*, 22(3), 311-318. <https://doi.org/10.1016/j.jsams.2018.08.007>
- Barnett, L. M., Lai, S. K., Veldman, S. L. C., Hardy, L. L., Cliff, D. P., Morgan, P. J., Zask, A., Lubans, D. R., Shultz, S. P., Ridgers, N. D., Rush, E., Brown, H. L., & Okely, A. D. (2016). Correlates of Gross Motor Competence in Children and Adolescents: A Systematic Review and meta-analysis. *Sports medicine (Auckland, N.Z.)*, 46(11), 1663-1688. <https://doi.org/10.1007/s40279-016-0495-z>
- Barnett, L. M., Stodden, D., Cohen, K. E., Smith, J. J., Lubans, D. R., Lenoir, M., Iivonen, S., Miller, A. D., Laukkanen, A., Dudley, D., Lander, N. J., Brown, H., & Morgan, P. J. (2016). Fundamental Movement Skills: An Important Focus. *Journal of Teaching in Physical Education*, 35(3), 219-225. <https://doi.org/10.1123/jtpe.2014-0209>
- Behan, S., Belton, S., Peers, C., O'Connor, N. E., & Issartel, J. (2019). Moving Well-Being: Investigating the maturation of fundamental movement Skill proficiency across sex in Irish children aged five to twelve. *Journal of sports sciences*, 37(22), 2604-2612. <https://doi.org/10.1080/02640414.2019.1651144>
- Bolger, L. A., Bolger, L.E., O'Neill, C., Coughlan, E., Lacey, S., O'Brien, W., & Burns, C. (2019). Fundamental Movement Skill Proficiency and Health Among

- A Cohort of Irish Primary School Children. *Research quarterly for exercise and sport*,90(1), 24-35. <https://doi.org/10.1080/02701367.2018.1563271>
- Brand, C., Lima, R. A., Silva, T. F., Macêdo, D. S., Mota, J., Andersen, L. B., Martins, C. M. L., & Gaya, A. R. (2020). Effect of a multicomponent intervention in components of metabolic syndrome: a study with overweight/obese low-income school-aged children. *Sport Sciences for Health*,16,137-145. <https://doi.org/10.1007/s11332-019-00590-w>
- Choi, J., Lee, M., Lee, J. K., Kang, D., & Choi, J. Y. (2017). Correlates associated with participation in physical activity among adults: A systematic review of reviews and update. *BMC Public Health*, 17(1), 1–13. <https://doi.org/10.1186/s12889-017-4255-2>
- Cohen, J. (1998). *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence Erlbaum Associates Publishers.
- De Fruyt, F., Wille, B., & John, O. P. (2015). Employ ability in the 21st century: Complex (interactive) problem solving and other essential skills. *Industrial and Organizational Psychology*, 8(2), 276–281. <https://doi.org/10.1017/iop.2015.33>
- Diao, Y. C., Dong, C. X., & Li, J. (2018). The Establishment of Norm of Gross Motor Development Test in Shanghai. *China Sports Science and Technology*,54(02), 98-104. <https://doi.org/10.16470/j.csst.201802013>
- Diao, Y. C., Dong, C. X., & Li, J. (2017). The relationship between basic motor skills and self-perception in children aged 4-9 years. *Journal of Tianjin University of Sport*,32(04), 326-331.<https://doi.org/10.13297/j.cnki.issn1005-0000.2017.04.008>
- Dong, L. S., Pu, J., Shen, B., Pang, L. Y., Song, Y., & Ying, Y. (2021). The Effect of Ten-week Exercise Intervention on Fundamental Motor Skills and Social Ability of Children with Autism Spectrum Disorders. *Chinese Journal of Sports Medicine*,40(03), 171-180. <https://doi.org/10.16038/j.1000-6710.2021.03.002>
- Dong, Q., & Tao, S. (2004). *Action and psychological development* (2nd ed.). Beijing Normal University Press.
- Duncan, M. J., Roscoe, C. M. P., Noon, M., Clark, C. C. T., O'Brien, W., & Eyre, E. L. J. (2019). Run, jump, throw and catch: How proficient are children attending English schools at the fundamental motor skills identified as key within the

- school curriculum?. *European Physical Education Review*, 26(4), 814-826.
<https://doi.org/10.1177/1356336X19888953>
- Durlak, J., Weissberg, R., Dymnicki, A., Taylor, R., & Schellinger, K. (2011). The impact of enhancing students' social and emotional learning: A meta-analysis of school-based universal interventions. *Child Development*, 82(1), 405–432.
<https://doi.org/10.1111/j.1467-8624.2010.01564.x>
- Eddy, L. H., Bingham, D. D., Crossley, K. L., et al. (2020). The validity and reliability of observational assessment tools available to measure fundamental movement skills in school-age children: A systematic review. *PloS One*, 15(8), e0237919. <https://doi.org/10.1371/journal.pone.0237919>
- Gallahue, D. L., Ozmun, J. C., & Goodway, J. D. (2006). *Understanding motor development: Infants, Children, Adolescents, Adults* (6th ed.). Jones and Bartlett Learning Press.
- Guo, J. J., Yang, J., Xing, J. M., Fan, L. N., & Wang, S. (2022). The Relationship between Basic Motor skills, Physical Activity and Physical Perception of children aged 8-9. *Journal of Sports and Science*, 43(01), 93-97.
<https://doi.org/10.13598/j.issn1004-4590.2022.01.014>
- Hardy, L. L., King, L., Farrell, L., Macniven, R., & Howlett, S. (2010). Fundamental movement skills among Australian preschool children. *Journal of Science and Medicine in Sport*, 13(5), 503-508. <https://doi.org/10.1016/j.jsams.2009.05.010>
- Haible, S., Volk, C., Demetriou, Y., Höner, O., Thiel, A., & Sudeck, G. (2020). Physical activity-related health competence, physical activity, and physical fitness: Analysis of control competence for the self-directed exercise of adolescents. *International Journal of Environmental Research and Public Health*, 17(1), Article 39. <https://doi.org/10.3390/ijerph17010039>
- Hoerber, J., de Vries, S., Krijger-Hombergen, M., et al. (2016). Validity of an athletic skills track among 6- to 12-year-old children. *Journal of Sports Sciences*, 34(21), 2095-2105. <https://doi.org/10.1080/02640414.2016.1151920>
- Kelly, L., O'Connor, S., Harrison, A. J., & Cheilleachair, N.J.N. (2018). Does fundamental movement skill proficiency vary by sex, class group or weight status? Evidence from an Irish primary school setting. *Journal of sports sciences*, 37(9), 1055-1063. <https://doi.org/10.1080/02640414.2018.1543833>

Kline Rex B. (2016) Principles and practice of structural equation modeling (Fourth Edition). The Guilford Press.

Lawson, C., Eyre, E. L. J., Tallis, J., & Duncan, M. J. (2021). Fundamental Movement Skill Proficiency Among British Primary School Children: An Analysis of Behavioral Component levels. *Perceptual and Motor Skills*,128(2), 625-648. <https://doi.org/10.1177/0031512521990330>

LeGear, M., Greyling, L., Sloan, E., Bell, R. I., Williams, B., Naylor, P., & Temple, V. A. (2012). A window of opportunity? Motor skills and perceptions of competence of children in kindergarten. *International Journal of Behavioral Nutrition and Physical Activity*,9 (1), 29. <https://doi.org/10.1186/1479-5868-9-29>

Lemes, V. B., Gaya, A. C. A., Brand, C., Dias, A. F., Cristi-Montero, C., Mota, J., & Gaya, A. R. (2020). Associations among psychological satisfaction in physical education, sports practice, and health indicators with physical activity: Direct and indirect ways in a structural equation model proposal. *International Journal of Pediatrics and Adolescent Medicine*,8(4),246-252. <https://doi.org/10.1016/j.ijpam.2020.11.004>

Lemes, V., Gaya, A. R., Sadarangani, K. P., Aguilar-Farias, N., Rodriguez-Rodriguez, F., Martins, C. M. L., Fochesatto, C., & Cristi-Montero, C. (2021). Physical Fitness Plays a Crucial Mediator Role in Relationships Among Personal, Social, and Lifestyle Factors With Adolescents' Cognitive Performance in a Structural Equation Model. The Cogni-Action Project. *Frontiers in Pediatrics*,9,1-12. <https://doi.org/10.3389/fped.2021.656916>

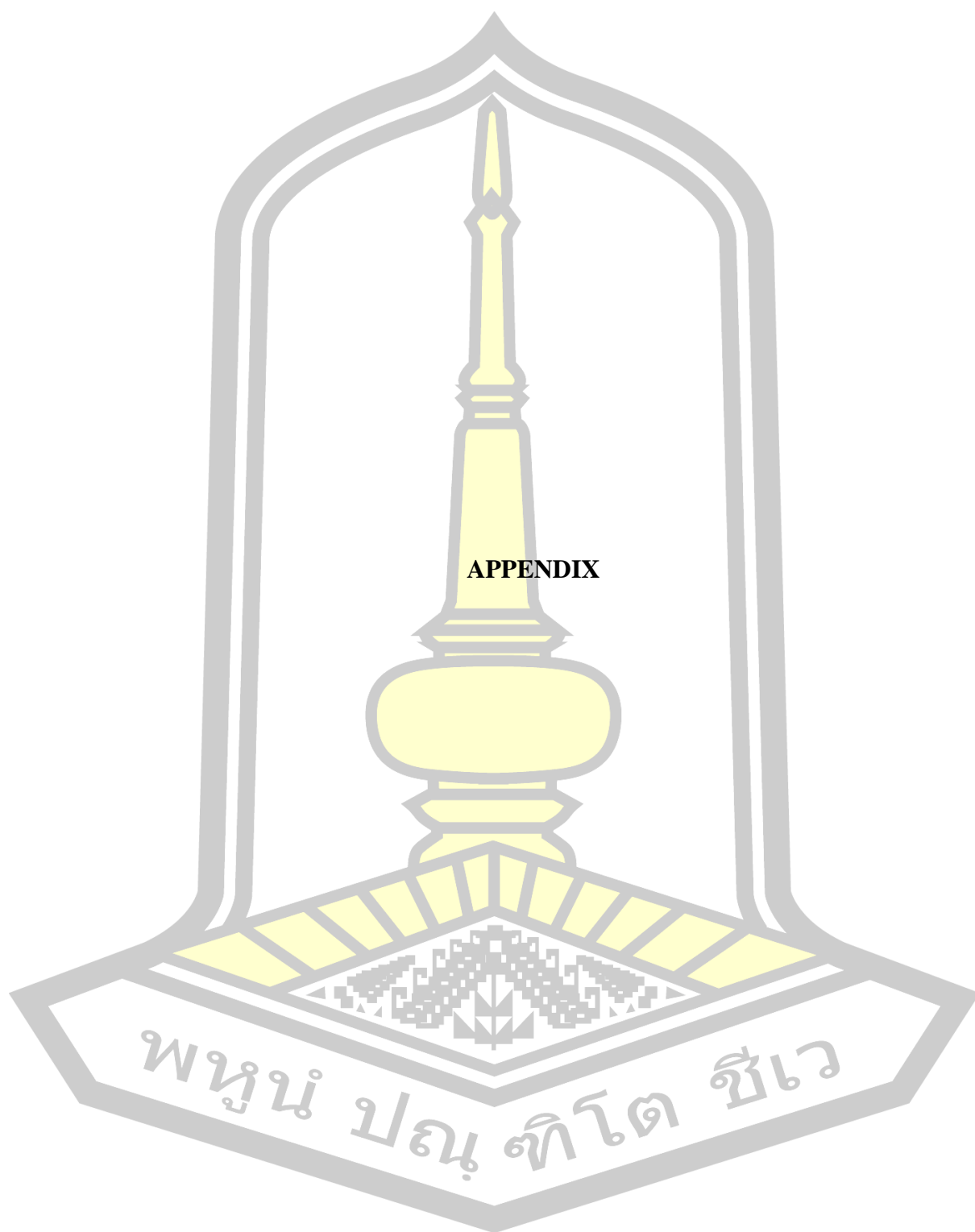
Li, J. (2009). Children gross motor development from ages 3 to 10 in Shandong. *Journal of Shandong Institute of Physical Education and Sports* ,25(04), 47-50. <https://doi.org/10.14104/j.cnki.1006-2076.2009.04.014>

Li,X. Y., Wang, X. Z., Ulrich, D. A., Xu, Q. P., He, Y. H., & Guo, Q. (2022). Reliability and Validity of TGMD-3 in Fundamental Movement Skills Test for Children Aged 3-12 in China. *Journal of Wuhan Institute of Physical Education*,56(03), 86-92. <https://doi.org/10.15930/j.cnki.wtxb.2022.03.009>

- Logan, S. W., Ross, S. M., Chee, K., et al. (2017). Fundamental motor skills: A systematic review of terminology. *Journal of Sports Sciences*, 36(2), 1-16. <https://doi.org/10.1080/02640414.2017.1340660>
- Longmuir, P. E., Boyer, C., Lloyd, M., et al. (2017). Canadian Agility and Movement Skill Assessment (CAMSA): Validity, objectivity, and reliability evidence for children 8-12 years of age. *Journal of Sport and Health Science*, 6(2), 231-240. <https://doi.org/10.1016/j.jshs.2015.11.004>
- Ma, L., & Li, H. J. (2020). Relationship of Physical Activity and Fundamental movement Ability Development in Children Aged 7-8. *Chinese Journal of School Health*, 41(03), 454-457. <https://doi.org/10.16835/j.cnki.1000-9817.2020.03.038>
- Maeng, H. J., Webster, E. K., & Ulrich, D. A. (2016). Reliability for the Test of Gross Motor Development-Third Edition (TGMD-3). *Research Quarterly for Exercise and Sport*, 87(S2), A38-A38.
- Melguizo-Ibáñez, E., Zurita-Ortega, F., Ubago-Jiménez, J. L., López-Gutiérrez, C. J., & González-Valero, G. (2023). An explanatory model of the relationships between sport motivation, anxiety and physical and social self-concept in educational sciences students. *Current Psychology*, 42:15237–15247. <https://doi.org/10.1007/s12144-022-02778-9>
- Meng, J., & Wu, X. P. (2020). Relationships between Fundamental Movement Skill and BMI of Children with Mild Intellectual Disability. *Journal of Tianjin University of Sport*, 35(02), 149-155. <https://doi.org/10.13297/j.cnki.issn1005-0000.2020.02.004>
- Modecki, K. L., Zimmer-Gembeck, M. J., & Guerra, N. (2017). Emotion regulation, coping, and decision making: Three linked skills for preventing externalizing problems in adolescence. *Child Development*, 88(2), 417–426. <https://doi.org/10.1111/cdev.12734>
- Oberle, E., Schonert-Reichl, K., Hertzman, C., & Others. (2014). Social-emotional competencies make the grade: Predicting academic success in early adolescence. *Journal of Applied Developmental Psychology*, 35(3), 138–147. <https://doi.org/10.1016/j.appdev.2014.02.004>

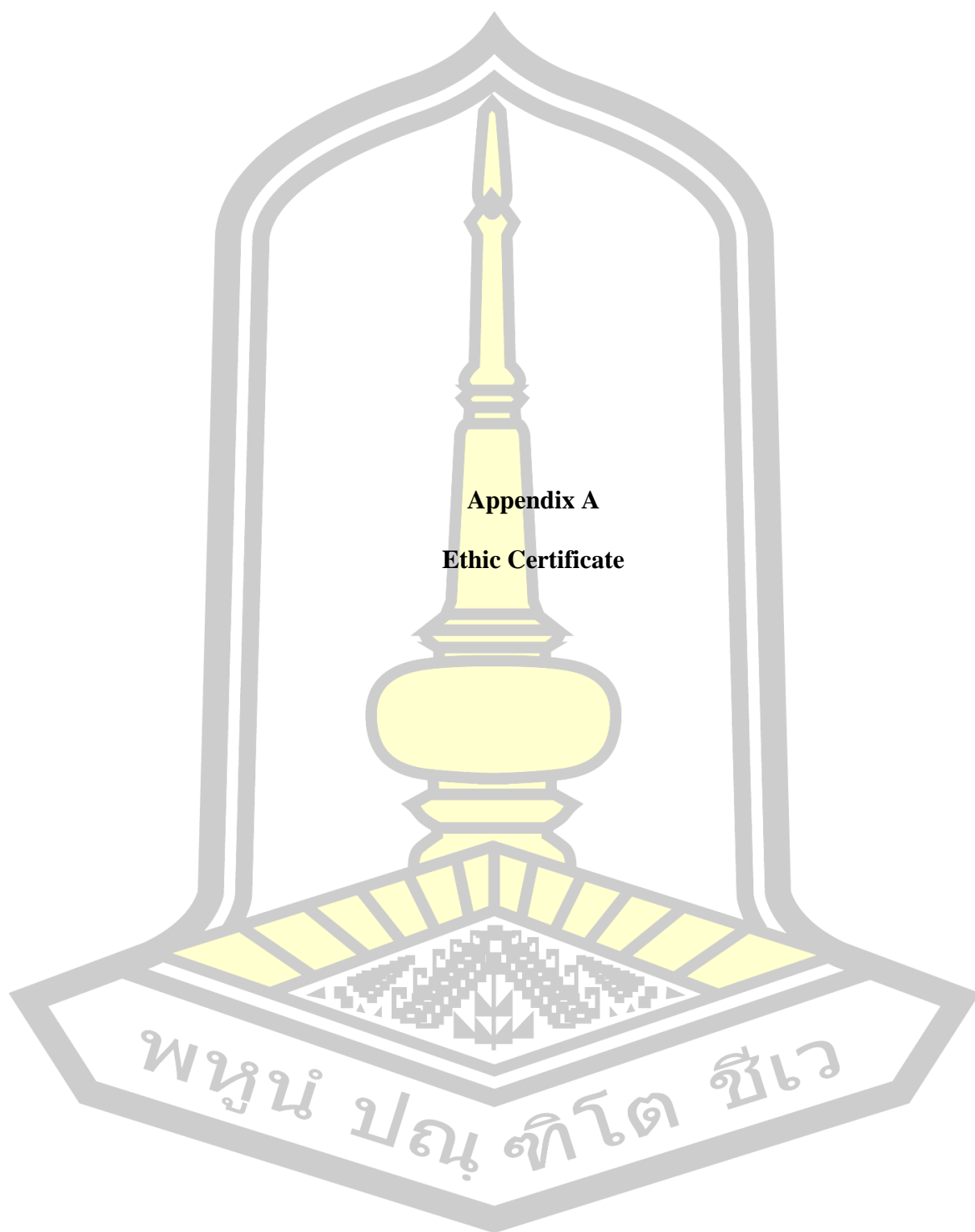
- O'Brien, W., Belton, S., & Issartel, J. (2016). Fundamental movement skill proficiency amongst adolescent youth. *Physical Education and Sport Pedagogy*, 21(6), 557–571. <https://doi.org/10.1080/17408989.2015.1017451>
- Okuyama, J., Seto, S., Fukuda, Y., Funakoshi, S., Amae, S., Onobe, J., Izumi, S., Ito, K., & Imamura, F. (2021). Mental health and physical activity among children and adolescents during the COVID-19 pandemic. *Tohoku Journal of Experimental Medicine*, 253(3), 203–215. <https://doi.org/10.1620/tjem.253.203>
- Panayiotou, M., Humphrey, N., & Wigelsworth, M. (2019). An empirical basis for linking social and emotional learning to academic performance. *Contemporary Educational Psychology*, 56, 193–204. <https://doi.org/10.1016/j.cedpsych.2019.01.009>
- Payne, V. G., Geng, P. X., & Liang, G. L. (2008). *A Survey of Human Motor Development* (1st ed.). People's Education Press.
- Pruttiakaravanich, A., & Songsiri, J. (2020). Convex formulation for regularized estimation of structural equation models. *Signal Processing*, 166, Article 107237. <https://doi.org/10.1016/j.sigpro.2019.107237>
- Robinson, L. E. (2011). The relationship between perceived physical competence and fundamental motor skills in preschool. *Child: care, health and development*, 37(4), 589-596. <https://doi.org/10.1111/j.1365-2214.2010.01187.x>
- Samuel W. Logan, Samantha M. Ross, Keanu Chee, David F. Stodden & Leah E. Robinson. (2018). Fundamental motor skills: A systematic review of terminology. *Journal of Sports Sciences*, 36(7):781-796. <https://doi.org/10.1080/02640414.2017.1340660>
- Spessato, B. C., Gabbard, C., Valentini, N., & Rudisill, M. (2013). Gender differences in Brazilian children's fundamental movement skill. *Early Child Development and Care*, 183(7), 916-923. <https://doi.org/10.1080/03004430.2012.689761>
- Taylor, R. D., Oberle, E., Durlak, J. A., & Weissberg, R. P. (2017). Promoting positive youth development through school-based social and emotional learning interventions: A meta-analysis of follow-up effects. *Child Development*, 88(4), 1156–1171. <https://doi.org/10.1111/cdev.12864>
- Trost, S. G., Owen, N., Bauman, A. E., Sallis, J. F., & Brown, W. (2002). Correlates of adults' participation in physical activity: Review and update. *Medicine &*

- Science in Sports & Exercise, 34(12), 1996–2001.
<https://doi.org/10.1097/00005768-200212000-00020>
- Van Stryp, O., Duncan, M. J., & Africa, E. (2022). Fundamental movement skills proficiency amongst neurotypical grade one children in Cape Town, South Africa. *Sport Sciences for Health*, 18(3), 933–938.
<https://doi.org/10.1007/s11332-021-00877-x>
- Wang, H., Yang, H. T., & Cheng, Y. J. (2021). Effects of Motor Skills and Family Environment on the Development of Coordination Ability in Preschool Children aged 3 to 5 Years: A One-year Follow-up Study. *China Sport Science*, 41(03), 55-62. <https://doi.org/10.16469/j.css.202103007>
- Ward, B., Thornton, A., Lay, B., et al. (2020). Can proficiency criteria be accurately identified during real-time fundamental movement skill assessment? *Research Quarterly for Exercise and Sport*, 91(1), 64-72.
<https://doi.org/10.1080/02701367.2019.1646852>
- Wu, H., Eungpinichpong, W., Ruan, H., Zhang, X. D., & Dong, X. J. (2021). Relationship Between Motor Fitness, Fundamental Movement Skills and quality of movement patterns in primary school children. *PloS one*, 16(5), e0237760-e0237760. <https://doi.org/10.1371/journal.pone.0237760>
- Wu. (2013). *Structural Equation Modeling— Tips for Practical Application*. Chongqing University Press.
- Yang, S. W., Li, Y., & Jia M. N. (2022). Relationship between screen time and gross motor development among preschool children. *Chinese Journal of School Health*, 43(01), 104-107. <https://doi.org/10.16835/j.cnki.1000-9817.2022.01.023>
- Yide, Liu., Cheng Yu., & Svenja Damberg. (2021). Exploring the drivers and consequences of the “awe” emotion in outdoor sports – a study using the latest partial least squares structural equation modeling technique and necessary condition analysis. *International Journal of Sports Marketing and Sponsorship*, 23(2), 278-294. <https://doi.org/10.1108/IJSMS-12-2020-0232>
- Yuan, X., Wang, L. Y., Wang, L. J., & Liu, H. (2019). Relationship between gross motor development and perceived motor competence in children aged 7 to 8 years old. *Chinese Journal of School Health*, 40(05), 738-741.
<https://doi.org/10.16835/j.cnki.1000-9817.2019.05.025>



APPENDIX

พหุณฺ์ ปณฺุ ทิโต ชีเว



Appendix A
Ethic Certificate



MAHASARAKHAM UNIVERSITY ETHICS COMMITTEE FOR
RESEARCH INVOLVING HUMAN SUBJECTS

Certificate of Approval

Approval number: 184-038/2024

Title : Kids' Athletics Program Development and Intervention for Physical Activity,
Fundamental Movement Skills, and Social-emotional of Chinese Children.

Principal Investigator : Mr. Chenhua Huang

Responsible Department : Faculty of Education

Research site : Nanning, Guangxi Zhuang Autonomous Region, China

Review Method : Expedited Review

Date of Manufacture : 28 March 2024

expire : 27 March 2025

This research application has been reviewed and approved by the Ethics Committee for Research Involving Human Subjects, Mahasarakham University, Thailand. Approval is dependent on local ethical approval having been received. Any subsequent changes to the consent form must be re-submitted to the Committee.

Ratree S.

(Assistant Professor Ratree Sawangjit)

Chairman

Approval is granted subject to the following conditions: (see back of this Certificate)

67/038

ECMSU01-09.03 Update 2021

Clarification documents for the volunteers' parent

Dear all Subject

Because I (Chenhua Huang, PhD candidate, Health and Sport Science. Faculty of Education, Maharakham University) conducting research on "Kids' Athletics Program Development and Intervention for Physical Activity, Fundamental Movement Skills, and Social-emotional of Chinese Children". You may not benefit directly from participating in this research project. However, the research results of this project may support your research in the field of children's sports and health promotion, and help improve your effectiveness on children's physical activity levels, fundamental movement skills, and social and emotional development.

After being recommended by your teacher and interviewed by the researcher, your child will eligible to be a volunteer for this study. If you decide to participate in this study, your child will take a fundamental movement test and you will spend 5-10 minutes filling out two questionnaires. Please return the questionnaire to the researcher after you have completed it (the questionnaire will be collected face-to-face and online). If you and your child feel uncomfortable or uncomfortable with certain questions, you have the right not to answer them. Your child will not be affected in any way by this study.

Yours basic personal information will be retained and not disclosed to the public. Yours Basic personal information will only be used for this study, and the relevant data will be destroyed after the study is completed. All participants' data will be encrypted and stored on the researcher's computer. Set the password for the folder where the data is saved, and set the computer boot password. After the end of the experiment, all the experimental data on the experimental instrument will be deleted to ensure that the experimental data will not be leaked during the collection process. The analysis and digitization of the experimental data is carried out on the researchers' computers to ensure that there is no risk of data leakage. We will only use comprehensive information and data for reporting and will not disclose personal information of volunteers. You will not be paid or charged for the study.

If you have questions about the research Please feel free to contact us at (Chenhua Huang-Health and Sport Science. Faculty of Education, Maharakham University, Phone: +8618176260316). If you were not treated as described or want to know your rights while participating in this study, You can contact at "Human Research Ethics Committee Maharakham University Division of Research and Academic Service Promotion Maharakham University "Tel. +66043754416 Internal number 1755.

Sincerely

.....
(Chenhua Huang)

Researcher



Informed consent form for research from volunteers' parent
(For volunteers under 10 years old)

I am a child's (father/mother) :Child's name:

Child's date of birth:

House number: Village No.:

Sub-district: District: province:

Convenient phone:

Read the explanation / listen to the explanation from Mr. Chenhua Huang about volunteering in the research project on "Kids' Athletics Program Development and Intervention for Physical Activity, Fundamental Movement Skills, and Social-emotional of Chinese Children", the explanatory text consists of Full details about the purpose of the research, details of the research. That I have to do and be treated, the benefits that I may gain from the research and the risks that may arise from participating in the study. Including guidelines for questions that may arise throughout. It has also received an explanation and an answer to any questions from the research project leader.

As well as the testimony from the researcher that will keep my information confidential. In addition, not anonymously or private information individually to the public. The results of the research will be presented in the form of an overview that is a summary of the research results for academic purposes only. Because your child is a minor and belongs to a vulnerable group, he is protected by the United Nations Convention on Children, and you will spend 10-15 minutes with your parents to complete each questionnaire. If you feel uncomfortable or uncomfortable with certain questions, you have the right not to answer them. Your child will not be affected in any way by this study.

"In participating as a volunteer of this research project I join voluntarily." And I can withdraw from this study at any time. If I wish which will not have any effect and will not lose any rights in study or work that I will receive in the future.

sign..... Volunteers' parent

(.....)

Date.....

sign..... witness

(.....)

Date.....

sign..... researcher

(Mr.Chenhua Huang)

Date.....



Inclusion criteria and Exclusion criteria

1. Inclusion criteria

Inclusion criteria were:

- (1) Students who are in good health and do not suffer from moderate or severe cognitive impairment;
- (2) Have the informed consent of the principal of their primary school to participate in this study and obtain written informed consent;
- (3) Have the consent of their parents or guardians agree to participate in this study and obtain written informed consent.

2. Exclusion criteria

Exclusion criteria were:

- (1) Suffering from moderate and severe cognitive impairment (confirmed by teachers and guardians);
- (2) There are major medical or organic diseases that affect their participation in physical exercise;
- (3) After testing, students who experience motor developmental delays, are unable to complete the test and may withdraw at any time.



Notes on the Fundamental Movement Skills Test

1. Quality supervision of fundamental movement skills test assessment

- (1) The researchers and physical education teachers are solely responsible for the quality and supervision of the fundamental movement skills test results.
- (2) Before conducting the test, the researcher conducted operational training for the staff to familiarize them with the site, equipment, test methods, test action specifications, data entry, etc.
- (3) Carefully review the inclusion and exclusion criteria for trial subjects before the trial.
- (4) Arrange the test team leader to inspect, guide and supervise to ensure that the assessment results are accurate and error-free.
- (5) After the test, organize a summary seminar for testers to check whether there are any problems such as missing data, data entry, and data anomalies in the evaluation results.

2. Prevention and treatment of injuries during the assessment of fundamental movement skills test

- (1) Organize warm-up activities for children before the test so that muscles, joints, brain and other organs can reach the best physical condition for taking the test.
- (2) The testers introduce the testing content, testing methods, precautions, safety protection and other knowledge, and correctly demonstrate the testing process.
- (3) Before the test, all testers will inspect the site and equipment to eliminate potential safety hazards and eliminate factors such as slippery sites and unsafe equipment.
- (4) Division of labor clearly defines the division of labor among testers, ensures professional and standardized testing process, arranges other testers to work together to maintain on-site order, protects children during the testing process, and tracks the entire process to prevent children from falling during testing.
- (5) Prepare emergency supplies in advance, including elastic bandages, ice, medicines, etc., and arrange 1-2 medical staff at the test site. Train testing personnel in advance on the treatment of sports injuries, including applying ice, bandaging, raising the injured limb, using drugs, calling first aid, etc., and do a good job in preventing injuries that may occur during basic sports fundamental movement skills tests.



Fundamental movement skills tests

1. Sideways slide run

This is one of the tests of mobility skills items. This is one of the tests of mobility skills. The test site is a 10m long flat site with a 30 cm long marking tape on each end of the site. t site is a 10m long flat site with a 30 cm long marking tape on each end of the site. During the test, the subject stood naturally with his arms raised sideways so that his shoulders were perpendicular to the marking tape line on the floor. After hearing the "Start" command, the subject slid from one side of the marking tape to the opposite side, reaching the point where the back foot touched After marking the tape, turn around and return. When the subject touches the start and finish line anywhere, the tester stops the watch and records the time. Take the test 2 times and get the better score.

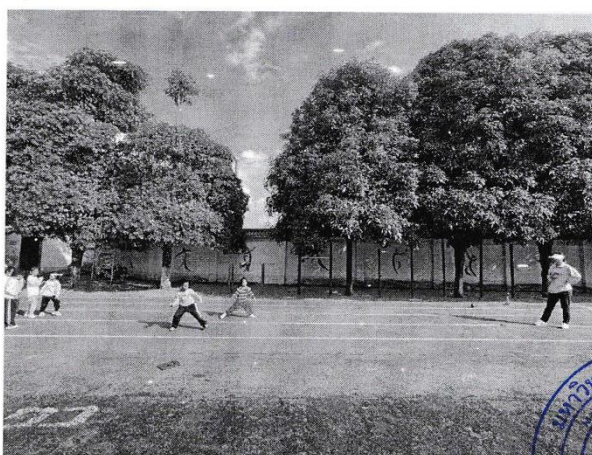


Figure 1 Sideways slide run test



2. Jump continuously on one foot

This is the second test item for mobility skills. Use 10 pieces of soft square bags (10 cm × 5 cm × 5 cm) and lay out double (single) foot continuous jumping mats on the flat ground (or draw 1 horizontal line every 50 cm, a total of 10 lines) for each Place a square bag horizontally on the horizontal line, and conduct the test at a venue where the starting line is set up 20 cm away from the first square bag. During the test, the subject stood behind the starting line with both (single) feet supported. After hearing the "start" command, he took off with both (single) feet and jumped once or twice with both (single) feet from the square bag. Skip 1 square bag directly above and skip 10 square bags in a row. The tester starts the timer as the subject starts. When the subject jumps over the 10th square bag and any foot lands on the ground, the tester stops the watch and records the time.

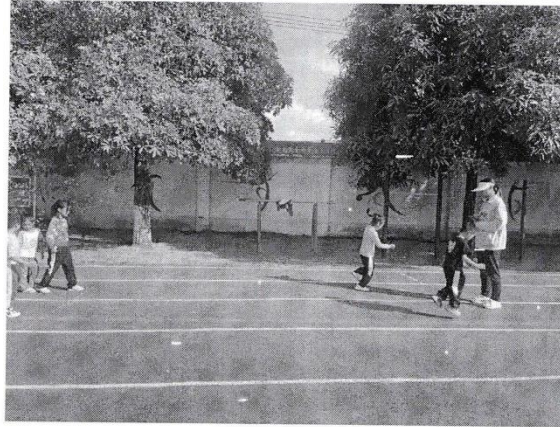


Figure 2 Jump continuously on one-foot test

3. Change hands and shoot the ball on the spot

This is one of the tests of object control skills items. Use a No. 5 basketball and use marking tape to mark a square box with a side length of 1 m on the ground of the test site. During the test, after hearing the "Start" command, the subject starts hitting the ball with his left (right) hand. After the ball bounces, he switches to the other hand to hit the ball. The bounce height of the ball is higher than the subject's knee joint, which counts as 1 time, and so on. The tester starts timing as the subject shoots the ball. After 8 consecutive or intermittent shots, the test ends and the time is recorded. Take the test 2 times and get the better score.



Figure 3 Change hands and shoot the ball on the spot test

4. Kick the ball over the obstacle

This is the second test item for control skills. The test site and equipment are soft solid balls of 2 kg; 4 markers. Use a tape measure to mark 3 marking points on a straight line, with a spacing of 1.5 m between each point. Markers are placed at the middle 2 points, and markings are made with marking tape at both ends as the starting point and end point respectively. Place one marker 1 m on both sides of the central marker. The subject stood behind the starting point and placed the ball on the left (right) side of the starting point. After hearing the "start" command, the subject kicked the ball forward to bypass the middle marker and not exceed the markers on both sides. The tester starts the timer when the subject kicks the ball; when the subject kicks the ball across the end point and stops the ball, the tester stops the watch and records the time. Take the test 2 times and get the better score.

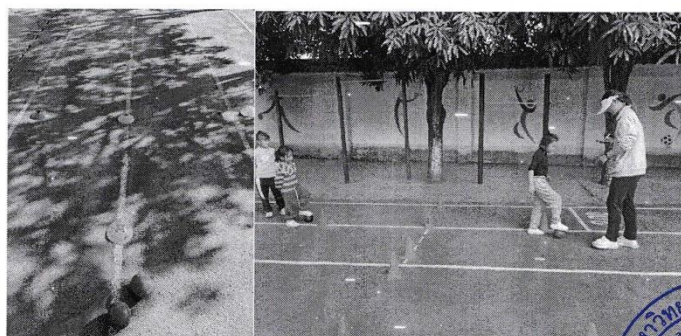


Figure 4 Kick the ball over the obstacle test

5. Walking on the balance beam

This is one of the stability skills test items. Use a balance beam (300 cm × 10 cm × 10 cm) and a rectangular platform (20 cm) with the same height as the balance beam at each end for testing. The subject stood on the platform behind the starting point, facing the balance beam, raising his arms sideways. After hearing the "start" command, he alternately advanced toward the finish line with both feet. The tester gives the order in front of the subject, starts the timer at the same time as the subject starts, and follows the subject towards the end point, while paying attention to the subject's movements to prevent accidents. When any of the subject's toes exceeds the end point, the watch is stopped immediately. Take the test 2 times and get the better score.





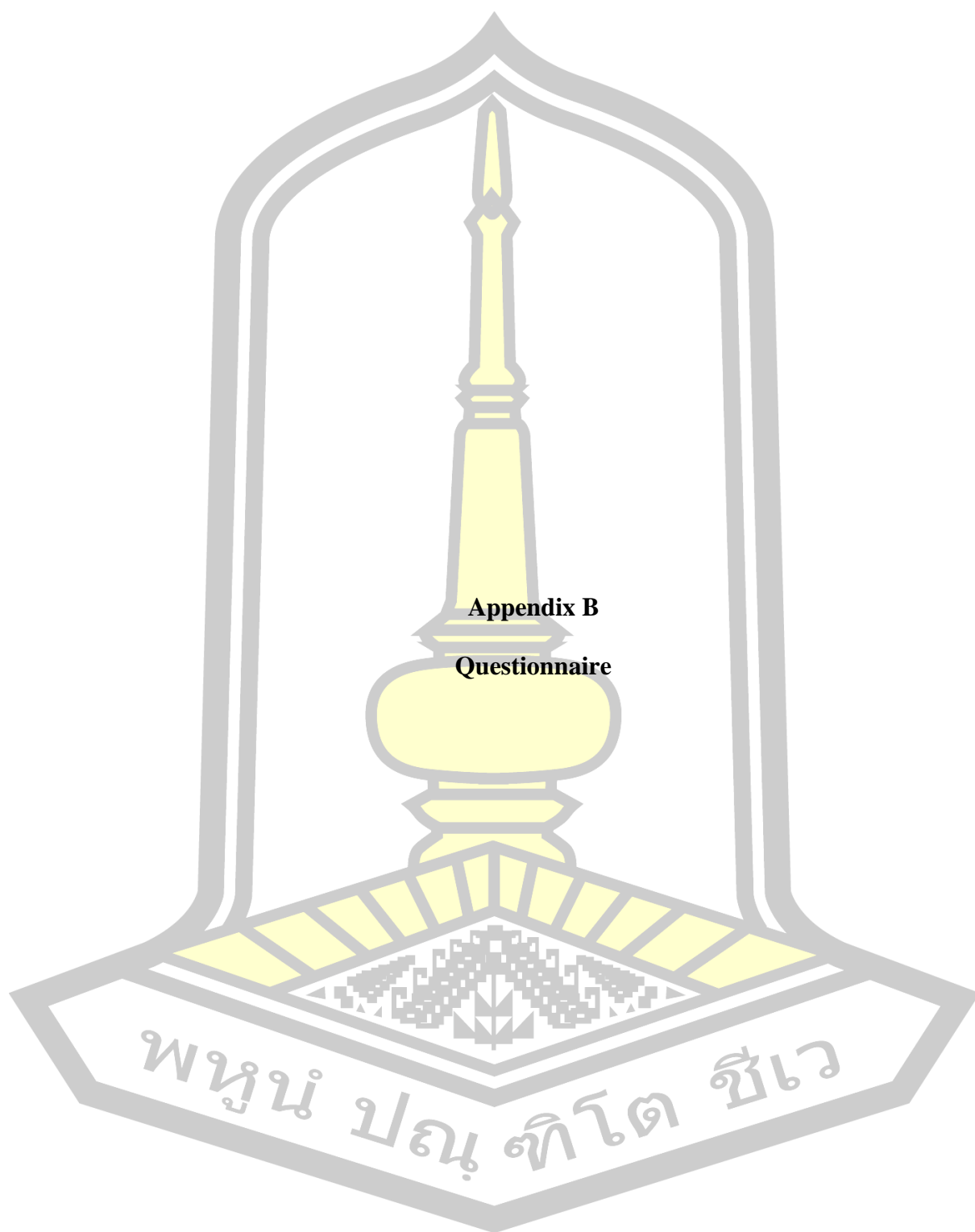
Figure 5 Walking on the balance beam test

6. Walk backwards in a straight line

This is the second test item for stability skills. Measure a 5 m long distance on a flat site, and use marking tape to make a 5 cm wide straight line to mark the starting point and end point. The subject stands behind the starting point with their feet crossed in front and back, with their back facing the end point. After hearing the "Start" command, the subject walked backwards with his arms freely raised at both sides of the body. When walking backwards, the crossed feet must be kept in a straight line, and the toes of each backwards touch the front feet. At the heels, keep your feet in a straight line. When the toes of the subject's front feet completely leave the end point, stop the watch and record the time.



Figure 6 Walk backwards in a straight-line test



Appendix B
Questionnaire

ICS 13.100
CCS C 56

WS

Health Industry Standard of the People's Republic of China

WS/T 10008—2023

Evaluation of physical activity levels in children and adolescents aged 7 to 18 years

Physical activity level evaluation for children and adolescents aged 7y18 years

Published on 2023-12-15

2024-05-01 implementation



Physical activity level questionnaire for children and adolescents aged 7-18 years
(normative)

Instructions for completing the questionnaire: This questionnaire asks about the program, frequency, duration and subjective feeling of intensity of the physical activities you have participated in the past 1 week, both in and out of school (including physical education classes). Please recall as accurately as possible the activities you performed, fill in the number of times you participated and the average duration of each activity, and put a tick on the self-perception of your choice, or leave it blank if you did not participate in the activity. Self-perception is defined by the condition of breathing: ① relaxed: normal breathing; ② a little tired: breathing faster; ③ very tired: shortness of breath. 1-3 grade students are assisted by their teachers or parents in filling out the form.

encodings	Which of the following activities have you participated in the past week.	Total number of times attended, if not attended, do not fill in.	Average length of time per activity. (minutes rounded to the nearest whole number)	self-perception
1	Playing football	___times	___minutes	① relaxed ② a little tired ③ very tired
2	Playing basketball	___times	___minutes	① relaxed ② a little tired ③ very tired
3	Playing volleyball	___times	___minutes	① relaxed ② a little tired ③ very tired
4	Playing table tennis	___times	___minutes	① relaxed ② a little tired ③ very tired
5	Playing badminton	___times	___minutes	① relaxed ② a little tired ③ very tired
6	Doing radio gymnastics	___times	___minutes	① relaxed ② a little tired ③ very tired
7	Playing aerobics	___times	___minutes	① relaxed ② a little tired ③ very tired
8	Dancing	___times	___minutes	① relaxed ② a little tired ③ very tired
9	Doing martial arts	___times	___minutes	① relaxed ② a little tired ③ very tired
10	Playing Tai Chi/Yoga	___times	___minutes	① relaxed ② a little tired ③ very tired
11	Gymnastics (pull-ups, sit-ups)	___times	___minutes	① relaxed ② a little tired ③ very tired

12	High Jumping/Long Jumping	___times	___minutes	① relaxed ② a little tired ③ very tired
13	Throwing	___times	___minutes	① relaxed ② a little tired ③ very tired
14	Rope skipping/jumping	___times	___minutes	① relaxed ② a little tired ③ very tired
15	Playing shuttlecock	___times	___minutes	① relaxed ② a little tired ③ very tired
16	Playing games outdoors	___times	___minutes	① relaxed ② a little tired ③ very tired
17	Exercise with fitness equipment	___times	___minutes	① relaxed ② a little tired ③ very tired
18	House working	___times	___minutes	① relaxed ② a little tired ③ very tired
19	Swimming	___times	___minutes	① relaxed ② a little tired ③ very tired
20	Skating	___times	___minutes	① relaxed ② a little tired ③ very tired
21	Walking	Total ___minutes		① relaxed ② a little tired ③ very tired
22	Bicycling	Total ___minutes		① relaxed ② a little tired ③ very tired
23	Running	Total ___minutes		① relaxed ② a little tired ③ very tired
24	Stair climbing	Total ___minutes		① relaxed ② a little tired ③ very tired

Questionnaire on Sedentary Behavior in Children and Adolescents 7 to 18 Years of Age(normative)

Instructions for filling out the form: This questionnaire asks about the sedentary behavior and related situations that you have participated in the past 1 week. Please recall as accurately as possible the activities that you have conducted and fill in the number of days (times) you have participated and the time you have spent on the activities, or do not fill in the form if you have not participated in the activity. Among them, the use of TV, computer or mobile phone/tablet for offline classroom teaching and online video teaching arranged by the education department is not counted as video screen time. students in grades 1 to 3 will be assisted by their teachers or parents to fill in the questionnaire.

encodings	Which of the following activities have you participated in the past week.	Total number of times attended, if not attended, do not fill in.	Average length of activity (times) per day. (Hours and minutes are rounded)
1	Watching TV	_____ days	___Hours___ Minutes
2	Watching a movie at the cinema	_____ days	___Hours___ Minutes
3	Using a computer	_____ days	___Hours___ Minutes
4	Using cell phones and tablets	_____ days	___Hours___ Minutes
5	Writing paper-based assignments	_____ days	___Hours___ Minutes
6	Read paper-based books	_____ days	___Hours___ Minutes
7	Taking the bus to school every day	_____ days	___Hours___ Minutes
8	Sitting and chatting	_____ days	___Hours___ Minutes
9	Attend offline classes	_____ days	___Hours___ Minutes

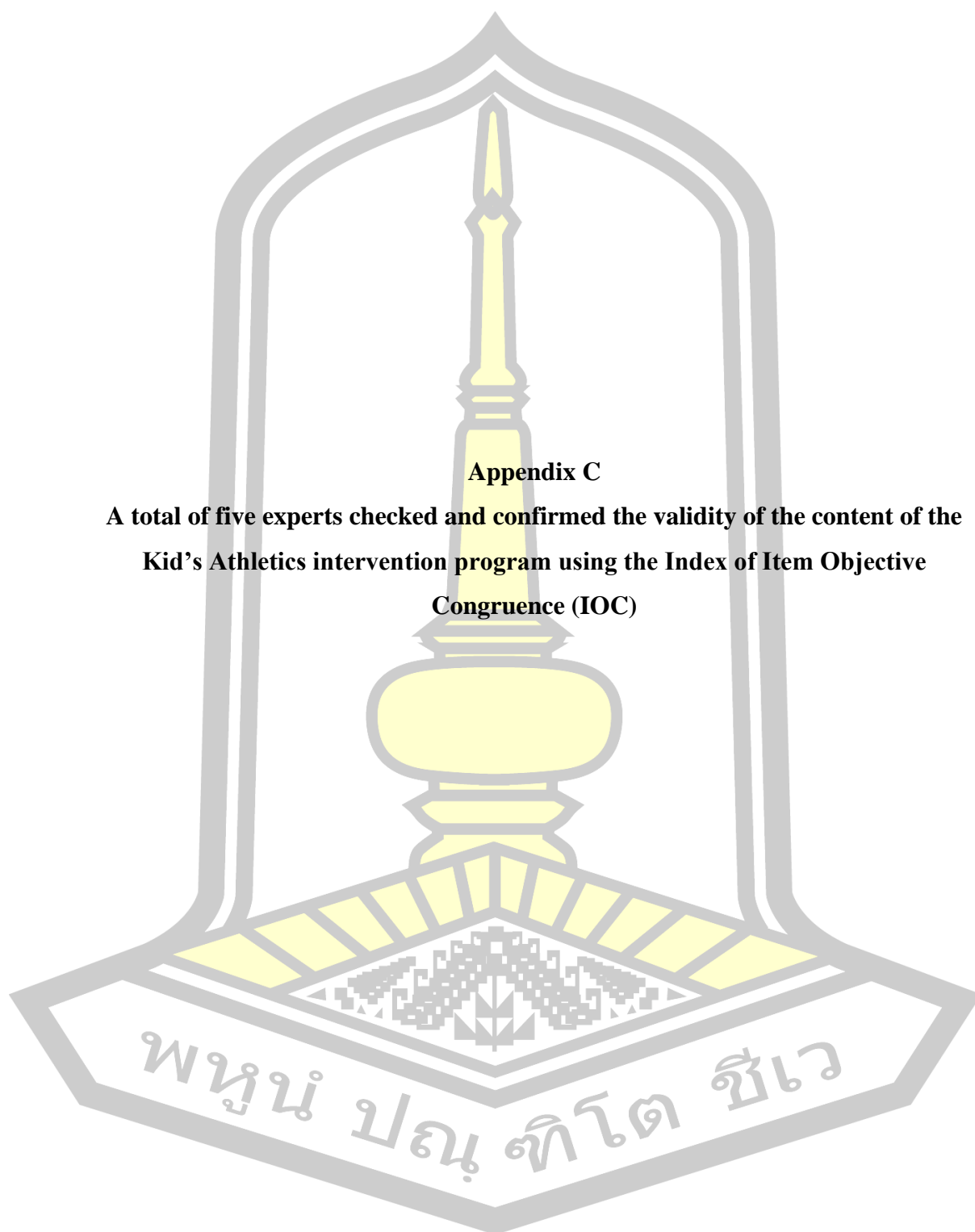
Social-emotional development was measured using the Social Emotional Ability Questionnaire (Student Version)

Please tick the most appropriate option based on your actual situation.					
Describe	Disagree	Don't quite agree	General	Compare agree	Agree
1. I know what I do well.	1	2	3	4	5
2. I know when I get angry.	1	2	3	4	5
3. When I answer questions, I hope other students will listen	1	2	3	4	5
4. I hope to be respected by others.	1	2	3	4	5
5. I like to get compliments from my classmates.	1	2	3	4	5
6. What others can do, I can do if I work hard.	1	2	3	4	5
7. I believe I can achieve my goals.	1	2	3	4	5
8. I will find experience from successful things.	1	2	3	4	5
9. I will cheer myself up when I encounter difficulties.	1	2	3	4	5
10. I believe that if you plan something, you should stick to it.	1	2	3	4	5
11. I can read other people's thoughts from their actions.	1	2	3	4	5
12. When a classmate is unhappy, I can understand the reason.	1	2	3	4	5
13. I can understand the choices others make.	1	2	3	4	5
14. I understand when my classmates refuse to lend me things.	1	2	3	4	5
15. I can accept students with different characteristics.	1	2	3	4	5
16. I will take the initiative to say hello to others.	1	2	3	4	5
17. I get along well with my classmates.	1	2	3	4	5
18. After a fight with my classmate, I am willing to talk to him first.	1	2	3	4	5

19. I can communicate with classmates to eliminate misunderstandings with friends.	1	2	3	4	5
20. I can forgive my classmates for their mistakes.	1	2	3	4	5
21. I am very happy to be a member of the class.	1	2	3	4	5
22. I think class matters are also my personal matters.	1	2	3	4	5
23. I will pick up the confetti when I see them on campus.	1	2	3	4	5
24. I will help an old man who falls down.	1	2	3	4	5
25. I complete the tasks assigned to me seriously.	1	2	3	4	5
26. I will actively discuss with my peers during group activities.	1	2	3	4	5
27. I won't do anything bad to the class.	1	2	3	4	5
28. I take the lead in doing good deeds to others.	1	2	3	4	5
29. My opinions can be accepted by everyone during group activities.	1	2	3	4	5
30. I am willing to participate in community or village service activities.	1	2	3	4	5

***This scale comes from the China Natural Science Foundation's "Research on Comprehensive Reform of School Management for the Development of Chinese Students' Social Emotional Competencies" project (71774017). The project leader is Professor Mao Yaqing of Beijing Normal University. The user, doctoral student Huang Chenhua, has signed a confidentiality agreement with the person in charge.**

พหุบัณฑิต ชีวะ



Appendix C

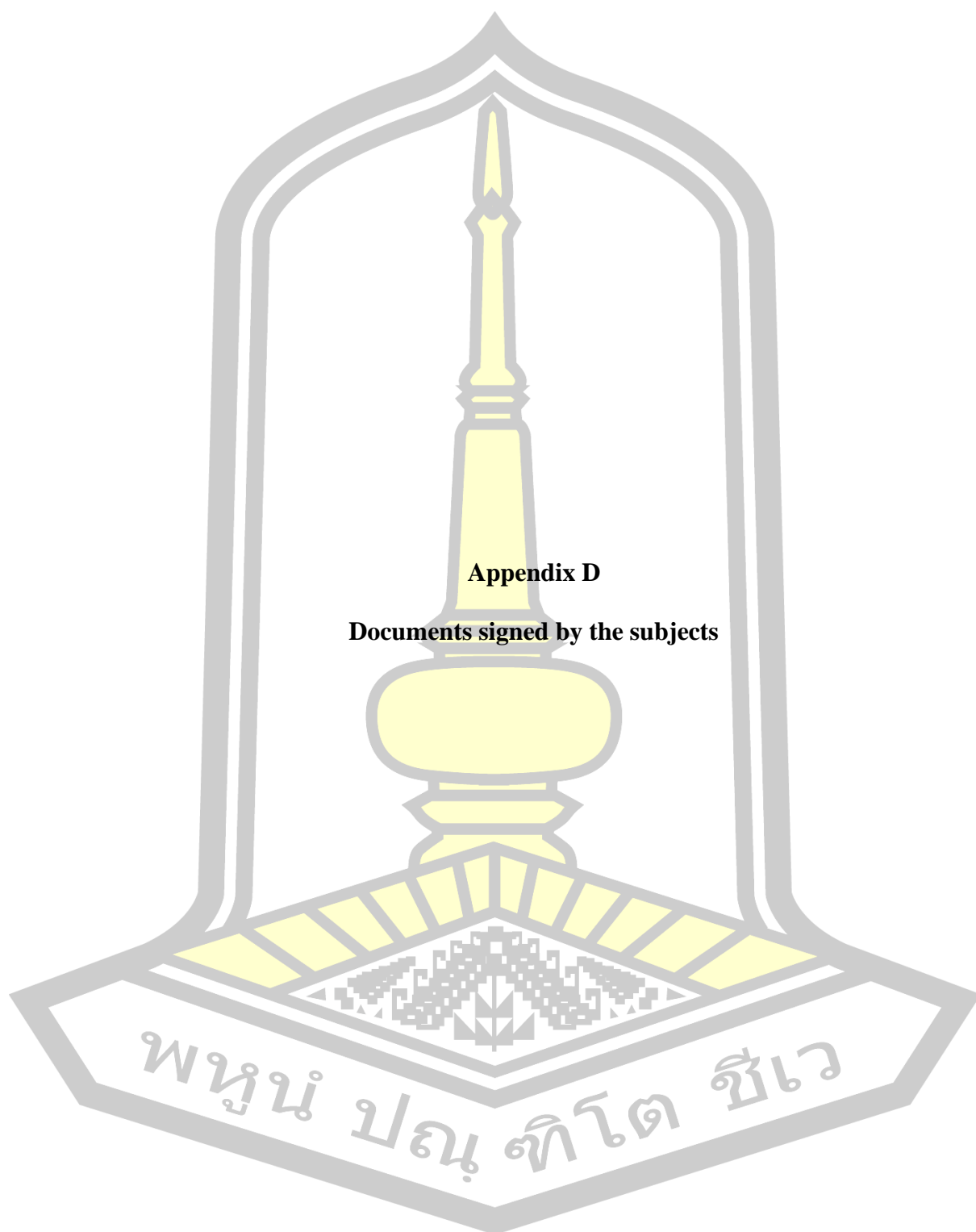
**A total of five experts checked and confirmed the validity of the content of the
Kid's Athletics intervention program using the Index of Item Objective
Congruence (IOC)**

IOC Scoring Summary Table

Dimension	Content	Expert A	Expert B	Expert C	Expert D	Expert E	Result
Appropriateness of Intervention Objectives	Fun and Appeal	1	1	1	1	1	1
	Age-Appropriate Goals	1	1	1	1	1	1
	Alignment with Physical Development	1	1	1	1	1	1
	Balance between Physical and Mental Development	1	1	1	0	1	0.8
	Cultural and Contextual Relevance	1	0	1	1	1	0.8
Rationality of Content Design	Variety of Skills Trained	1	1	1	1	1	1
	Progressive Difficulty	1	1	1	1	1	1
	Clear Instructions and Rules	1	1	1	1	1	1
	Adaptability of Activities	1	1	1	1	1	1
	Encouraging Creativity and Imagination	1	1	1	1	1	1
Scientific Implementation Plan	Duration of Sessions	1	1	1	1	1	1
	Frequency of Intervention	1	1	1	1	1	1
	Ratio of Guidance to Play	1	1	1	1	1	1
	Qualified Instructors	1	1	1	1	1	1
	Parental or Teacher Involvement	1	1	1	1	0	0.8
Validity of Evaluation Tools	Clarity of Measurement Criteria	1	1	1	1	1	1
	Age-Appropriate Assessment Methods	1	1	1	1	1	1

	Pre- and Post- Intervention Comparisons	1	1	1	1	1	1
	Quantitative and Qualitative Measures	1	1	1	1	1	1
	Consistency Across Groups	1	1	1	1	1	1
Rationality of Experimental Design	Appropriate Sample Size	1	1	1	1	1	1
	Randomized Assignment	1	1	1	1	1	1
	Control of Confounding Variables	1	0	1	1	1	0.8
	Blinding of Assessors	1	1	1	1	1	1
	Fidelity of Intervention Implementation	1	1	1	1	1	1
Children's Active Participation	Self-Selection Opportunities	1	1	1	1	1	1
	Engagement and Enjoyment Monitoring	1	1	1	1	1	1
	Opportunities for Peer Interaction	1	1	1	1	1	1
	Child-Led Play Elements	1	1	1	1	1	1
	Feedback from Children	1	1	1	1	1	1





Appendix D

Documents signed by the subjects

ECMSU01-07.10 English 2023

**Informed consent form for research from volunteers' parent
(For volunteers under 10 years old)**

I am a child's (father/mother) : Li Yao Child's name: Ruishan Hu
 Child's date of birth: 18.03.2015
 House number: 2801 Village No.: 111, Mingxiu road
 Sub-district: Xixiangtang District: Nanning province: Guangxi
 Convenient phone: 188.77116.778

Read the explanation / listen to the explanation from Mr. Chenhua Huang about volunteering in the research project on "Kids' Athletics Program Development and Intervention for Physical Activity, Fundamental Movement Skills, and Social-emotional of Chinese Children", the explanatory text consists of Full details about the purpose of the research, details of the research. That I have to do and be treated, the benefits that I may gain from the research and the risks that may arise from participating in the study. Including guidelines for questions that may arise throughout. It has also received an explanation and an answer to any questions from the research project leader.

As well as the testimony from the researcher that will keep my information confidential. In addition, not anonymously or private information individually to the public. The results of the research will be presented in the form of an overview that is a summary of the research results for academic purposes only. Because your child is a minor and belongs to a vulnerable group, he is protected by the United Nations Convention on Children, and you will spend 10-15 minutes with your parents to complete each questionnaire. If you feel uncomfortable or uncomfortable with certain questions, you have the right not to answer them. Your child will not be affected in any way by this study.

"In participating as a volunteer of this research project I join voluntarily." And I can withdraw from this study at any time. If I wish which will not have any effect and will not lose any rights in study or work that I will receive in the future.

sign Li Yao Volunteers' parent

(.....)

Date 16.04.2024

sign Ruishan Hu witness

(.....)

Date 16.04.2024

sign Chenhua Huang researcher

(Mr.Chenhua Huang)

Date 16.04.2024



ECMSU01-07.10 English 2023

**Informed consent form for research from volunteers' parent
(For volunteers under 10 years old)**

I am a child's (father/mother) Jiaying He Child's name: Jingyu Liao
 Child's date of birth: 11.01.2015
 House number: 402 Village No.: 2, Yangzhe road
 Sub-district: Xixiangtang District: Nanning province: Guangxi
 Convenient phone: 18074809982

Read the explanation / listen to the explanation from Mr. Chenhua Huang about volunteering in the research project on "Kids' Athletics Program Development and Intervention for Physical Activity, Fundamental Movement Skills, and Social-emotional of Chinese Children", the explanatory text consists of Full details about the purpose of the research, details of the research. That I have to do and be treated, the benefits that I may gain from the research and the risks that may arise from participating in the study. Including guidelines for questions that may arise throughout. It has also received an explanation and an answer to any questions from the research project leader.

As well as the testimony from the researcher that will keep my information confidential. In addition, not anonymously or private information individually to the public. The results of the research will be presented in the form of an overview that is a summary of the research results for academic purposes only. Because your child is a minor and belongs to a vulnerable group, he is protected by the United Nations Convention on Children, and you will spend 10-15 minutes with your parents to complete each questionnaire. If you feel uncomfortable or uncomfortable with certain questions, you have the right not to answer them. Your child will not be affected in any way by this study.

"In participating as a volunteer of this research project I join voluntarily." And I can withdraw from this study at any time. If I wish which will not have any effect and will not lose any rights in study of work that I will receive in the future.

sign Jiaying He Volunteers' parent

(.....)

Date 16.04.2024

sign Jingyu Liao witness

(.....)

Date 16.04.2024

sign Chenhua Huang researcher

(Mr.Chenhua Huang)

Date 16.04.2024



ECMSU01-07.10 English 2023

**Informed consent form for research from volunteers' parent
(For volunteers under 10 years old)**

I am a child's (father/mother) : Li Tang Child's name: Jinhao Zhang
 Child's date of birth: 14.03.2016
 House number: 1501 Village No.: 111, Mingxiu road
 Sub-district: Xixiangtang District: Nanning province: Guangxi
 Convenient phone: 13878101333

Read the explanation / listen to the explanation from Mr. Chenhua Huang about volunteering in the research project on "Kids' Athletics Program Development and Intervention for Physical Activity, Fundamental Movement Skills, and Social-emotional of Chinese Children", the explanatory text consists of Full details about the purpose of the research, details of the research. That I have to do and be treated, the benefits that I may gain from the research and the risks that may arise from participating in the study. Including guidelines for questions that may arise throughout. It has also received an explanation and an answer to any questions from the research project leader.

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"In participating as a volunteer of this research project I join voluntarily." And I can withdraw from this study at any time. If I wish which will not have any effect and will not lose any rights in study or work that I will receive in the future.

sign Li Tang Volunteers' parent

(.....)
Date 05.04.2024

sign Jinhao Zhang witness

(.....)
Date 05.04.2024

sign Chenhua Huang researcher

(Mr.Chenhua Huang)
Date 05.04.2024



ECMSU01-07.10 English 2023

**Informed consent form for research from volunteers' parent
(For volunteers under 10 years old)**

I am a child's (father/mother) : Xiaoting Zhou Child's name: Huaxian Chen
 Child's date of birth: 30.06.2016
 House number: 203 Village No.: 38 Hengyang road
 Sub-district: Xixiangtang District: Nanning province: Guangxi
 Convenient phone: 18777136252

Read the explanation / listen to the explanation from Mr. Chenhua Huang about volunteering in the research project on "Kids' Athletics Program Development and Intervention for Physical Activity, Fundamental Movement Skills, and Social-emotional of Chinese Children", the explanatory text consists of Full details about the purpose of the research, details of the research. That I have to do and be treated, the benefits that I may gain from the research and the risks that may arise from participating in the study. Including guidelines for questions that may arise throughout. It has also received an explanation and an answer to any questions from the research project leader.

As well as the testimony from the researcher that will keep my information confidential. In addition, not anonymously or private information individually to the public. The results of the research will be presented in the form of an overview that is a summary of the research results for academic purposes only. Because your child is a minor and belongs to a vulnerable group, he is protected by the United Nations Convention on Children, and you will spend 10-15 minutes with your parents to complete each questionnaire. If you feel uncomfortable or uncomfortable with certain questions, you have the right not to answer them. Your child will not be affected in any way by this study.

"In participating as a volunteer of this research project I join voluntarily." And I can withdraw from this study at any time. If I wish which will not have any effect and will not lose any rights in study or work that I will receive in the future.

sign Xiaoting Zhou Volunteers' parent

(.....)

Date 05.04.2024

sign Huaxian Chen witness

(.....)

Date 05.04.2024

sign Chenhua Huang researcher

(Mr.Chenhua Huang)

Date 05.04.2024



Informed consent form for research from volunteers' parent
(For volunteers under 10 years old)

I am a child's (father/mother) : Lin Qin Child's name: Xiaoyi Hu
Child's date of birth: 14.08.2016
House number: 502 Village No.: 40, Hengyang road
Sub-district: Xixiangtang District: Nanning province: Guangxi
Convenient phone: 13978804309

Read the explanation / listen to the explanation from Mr. Chenhua Huang about volunteering in the research project on "Kids' Athletics Program Development and Intervention for Physical Activity, Fundamental Movement Skills, and Social-emotional of Chinese Children", the explanatory text consists of Full details about the purpose of the research, details of the research. That I have to do and be treated, the benefits that I may gain from the research and the risks that may arise from participating in the study. Including guidelines for questions that may arise throughout. It has also received an explanation and an answer to any questions from the research project leader.

As well as the testimony from the researcher that will keep my information confidential. In addition, not anonymously or private information individually to the public. The results of the research will be presented in the form of an overview that is a summary of the research results for academic purposes only. Because your child is a minor and belongs to a vulnerable group, he is protected by the United Nations Convention on Children, and you will spend 10-15 minutes with your parents to complete each questionnaire. If you feel uncomfortable or uncomfortable with certain questions, you have the right not to answer them. Your child will not be affected in any way by this study.

"In participating as a volunteer of this research project I join voluntarily." And I can withdraw from this study at any time. If I wish which will not have any effect and will not lose any rights in study of work that I will receive in the future.

sign Lin Qin Volunteers' parent
(.....)
Date 13.04.2024
sign Xiaoyi Hu witness
(.....)
Date 13.04.2024
sign Chenhua Huang researcher
(Mr.Chenhua Huang)
Date 13.04.2024



ECMSU01-07.10 English 2023

**Informed consent form for research from volunteers' parent
(For volunteers under 10 years old)**

I am a child's (father/mother): Xueling Zeng Child's name: Liangyu Pang
 Child's date of birth: 19.08.2015
 House number: 2202 Village No.: 111, Mingxiu road
 Sub-district: Xixiangtang District: Nanning province: Guangxi
 Convenient phone: 13978697320

Read the explanation / listen to the explanation from Mr. Chenhua Huang about volunteering in the research project on "Kids' Athletics Program Development and Intervention for Physical Activity, Fundamental Movement Skills, and Social-emotional of Chinese Children", the explanatory text consists of Full details about the purpose of the research, details of the research. That I have to do and be treated, the benefits that I may gain from the research and the risks that may arise from participating in the study. Including guidelines for questions that may arise throughout. It has also received an explanation and an answer to any questions from the research project leader.

As well as the testimony from the researcher that will keep my information confidential. In addition, not anonymously or private information individually to the public. The results of the research will be presented in the form of an overview that is a summary of the research results for academic purposes only. Because your child is a minor and belongs to a vulnerable group, he is protected by the United Nations Convention on Children, and you will spend 10-15 minutes with your parents to complete each questionnaire. If you feel uncomfortable or uncomfortable with certain questions, you have the right not to answer them. Your child will not be affected in any way by this study.

"In participating as a volunteer of this research project I join voluntarily." And I can withdraw from this study at any time. If I wish which will not have any effect and will not lose any rights in study or work that I will receive in the future.

sign Xueling Zeng Volunteers' parent
 (.....)
 Date 13.04.2024
 sign Liangyu Pang witness
 (.....)
 Date 13.04.2024
 sign Chenhua Huang researcher
 (Mr.Chenhua Huang)
 Date 13.04.2024



Informed consent form for research from volunteers' parent
(For volunteers under 10 years old)

I am a child's (father/mother) : Jie Liu Child's name: Shichen Zhou
Child's date of birth: 05.06.2017
House number: 301 Village No.: 111, Mingxiu road
Sub-district: Xixiangtang District: Nanning province: Guangxi
Convenient phone: 15181410360

Read the explanation / listen to the explanation from Mr. Chenhua Huang about volunteering in the research project on "Kids' Athletics Program Development and Intervention for Physical Activity, Fundamental Movement Skills, and Social-emotional of Chinese Children", the explanatory text consists of Full details about the purpose of the research, details of the research. That I have to do and be treated, the benefits that I may gain from the research and the risks that may arise from participating in the study. Including guidelines for questions that may arise throughout. It has also received an explanation and an answer to any questions from the research project leader.

As well as the testimony from the researcher that will keep my information confidential. In addition, not anonymously or private information individually to the public. The results of the research will be presented in the form of an overview that is a summary of the research results for academic purposes only. Because your child is a minor and belongs to a vulnerable group, he is protected by the United Nations Convention on Children, and you will spend 10-15 minutes with your parents to complete each questionnaire. If you feel uncomfortable or uncomfortable with certain questions, you have the right not to answer them. Your child will not be affected in any way by this study.

"In participating as a volunteer of this research project I join voluntarily." And I can withdraw from this study at any time. If I wish which will not have any effect and will not lose any rights in study or work that I will receive in the future.

sign Jie Liu Volunteers' parent
(.....)
Date 13.04.2024

sign Shichen Zhou witness
(.....)
Date 13.04.2024

sign Chenhua Huang researcher
(Mr.Chenhua Huang)
Date 13.04.2024



ECMSU01-07.10 English 2023

**Informed consent form for research from volunteers' parent
(For volunteers under 10 years old)**

I am a child's (father/mother) : Jing Wei Child's name: Jingtong Rui
 Child's date of birth: 23.04.2016
 House number: 206 Village No.: 27 Hengyang road
 Sub-district: Xixiangtang District: Nanning province: Guangxi
 Convenient phone: 18578907300

Read the explanation / listen to the explanation from Mr. Chenhua Huang about volunteering in the research project on "Kids' Athletics Program Development and Intervention for Physical Activity, Fundamental Movement Skills, and Social-emotional of Chinese Children", the explanatory text consists of Full details about the purpose of the research, details of the research. That I have to do and be treated, the benefits that I may gain from the research and the risks that may arise from participating in the study. Including guidelines for questions that may arise throughout. It has also received an explanation and an answer to any questions from the research project leader.

As well as the testimony from the researcher that will keep my information confidential. In addition, not anonymously or private information individually to the public. The results of the research will be presented in the form of an overview that is a summary of the research results for academic purposes only. Because your child is a minor and belongs to a vulnerable group, he is protected by the United Nations Convention on Children, and you will spend 10-15 minutes with your parents to complete each questionnaire. If you feel uncomfortable or uncomfortable with certain questions, you have the right not to answer them. Your child will not be affected in any way by this study.

"In participating as a volunteer of this research project I join voluntarily." And I can withdraw from this study at any time. If I wish which will not have any effect and will not lose any rights in study of work that I will receive in the future.

sign Jing Wei Volunteers' parent
 (.....)
 Date 13.04.2024
 sign Jingtong Rui witness
 (.....)
 Date 13.04.2024
 sign Chenhua Huang researcher
 (Mr.Chenhua Huang)
 Date 13.04.2024



ECMSU01-07.10 English 2023

Informed consent form for research from volunteers' parent
(For volunteers under 10 years old)

I am a child's (father/mother) : Hengyue Zhu Child's name: Yuexi Zhu
 Child's date of birth: 20.02.2017
 House number: 601 Village No.: 38. Hengyang road.
 Sub-district: Xixiangtang District: Nanning province: Guangxi
 Convenient phone: 13907860099

Read the explanation / listen to the explanation from Mr. Chenhua Huang about volunteering in the research project on "Kids' Athletics Program Development and Intervention for Physical Activity, Fundamental Movement Skills, and Social-emotional of Chinese Children", the explanatory text consists of Full details about the purpose of the research, details of the research. That I have to do and be treated, the benefits that I may gain from the research and the risks that may arise from participating in the study. Including guidelines for questions that may arise throughout. It has also received an explanation and an answer to any questions from the research project leader.

As well as the testimony from the researcher that will keep my information confidential. In addition, not anonymously or private information individually to the public. The results of the research will be presented in the form of an overview that is a summary of the research results for academic purposes only. Because your child is a minor and belongs to a vulnerable group, he is protected by the United Nations Convention on Children, and you will spend 10-15 minutes with your parents to complete each questionnaire. If you feel uncomfortable or uncomfortable with certain questions, you have the right not to answer them. Your child will not be affected in any way by this study.

"In participating as a volunteer of this research project I join voluntarily." And I can withdraw from this study at any time. If I wish which will not have any effect and will not lose any rights in study or work that I will receive in the future.

sign Hengyue Zhu Volunteers' parent

(.....)
Date 12.04.2024

sign Yuexi Zhu witness

(.....)
Date 12.04.2024

sign Chenhua Huang researcher

(Mr.Chenhua Huang)

Date 12.04.2024



Informed consent form for research from volunteers' parent
(For volunteers under 10 years old)

I am a child's (father/mother) : Xiaoyun Zhu Child's name: Jinxuan Zhou
Child's date of birth: 27.07.2016
House number: 305 Village No.: 38, Hengyang road
Sub-district: Xixiantang District: Nanning province: Guangxi
Convenient phone: 18776041618

Read the explanation / listen to the explanation from Mr. Chenhua Huang about volunteering in the research project on "Kids' Athletics Program Development and Intervention for Physical Activity, Fundamental Movement Skills, and Social-emotional of Chinese Children", the explanatory text consists of Full details about the purpose of the research, details of the research. That I have to do and be treated, the benefits that I may gain from the research and the risks that may arise from participating in the study. Including guidelines for questions that may arise throughout. It has also received an explanation and an answer to any questions from the research project leader.

As well as the testimony from the researcher that will keep my information confidential. In addition, not anonymously or private information individually to the public. The results of the research will be presented in the form of an overview that is a summary of the research results for academic purposes only. Because your child is a minor and belongs to a vulnerable group, he is protected by the United Nations Convention on Children, and you will spend 10-15 minutes with your parents to complete each questionnaire. If you feel uncomfortable or uncomfortable with certain questions, you have the right not to answer them. Your child will not be affected in any way by this study.

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sign Xiaoyun Zhu Volunteers' parent
(.....)
Date 12.04.2024

sign Jinxuan Zhou witness
(.....)
Date 12.04.2024

sign Chenhua Huang researcher
(Mr.Chenhua Huang)
Date 12.04.2024



BIOGRAPHY

NAME	Mr.Chenhua Huang
DATE OF BIRTH	15 July 1985
PLACE OF BIRTH	China
ADDRESS	No.89 Longteng Road, Nanning, Guangxi, China
POSITION	Associate
PLACE OF WORK	Institute of exercise and health, Guangxi College for Preschool Education
EDUCATION	2003 to 2007 Studied in the Physical Education Department of Guangxi Teachers Education University, earn a bachelor's degree 2007 to 2010 Studied at the Physical Education College of Guangxi Teachers Education University, earn a master's degree 2021 to 2024 Doctor of Philosophy Program in Exercise and Sport Science, Mahasarakham University
Research output	Children's exercise health and promotion

พหุบัณฑิต ชีวะ