

Effects of After-School Programs on Student Cognitive and Non-Cognitive Abilities: A Meta-Analysis Based on 37 Experimental and Quasi-Experimental Studies

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Abstract: *The after-school program is a crucial initiative for implementing the Double Reduction policy; however, prior research has not provided conclusive evidence on whether extended school hours contribute to students' cognitive and non-cognitive development or on which types of after-school services are more beneficial for student development. This study analyzed 37 after-school programs from 18 publications using meta-analytic techniques, and the results indicated that participation in after-school programs had positive effects on student cognitive and non-cognitive development despite the small effect size ($d = 0.327$, $p = 0.000$). The decomposition of the effects of after-school programs revealed that they had modestly positive effects on academic achievement ($d = 0.369$) and social-emotional competence ($d = 0.220$). In addition, the analysis of moderating variables revealed that socioeconomic status, educational phase, number of after-school service days per week, sample size, and testing instrument all influenced the after-school program effects. This study concludes, based on the results of the meta-analysis, that there should be a balanced consideration of the development of student cognitive and non-cognitive abilities in planning after-school service, a substantial variety of activities in after-school programs, a flexible adoption of diverse after-school programs, and a reasonable participation frequency in after-school service.*

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AS a crucial measure in the implementation of the Double Reduction policy, after-school programs play a pivotal role in achieving the desired outcomes. They include a variety of after-school educational activities organized by the school, such as assignments, reading, cultural and sports activities, recreational games, extended training, and club activities, with the goal of promoting the physical and mental health development of students (Zhang et al., 2021). After-school programs extend students' time in education. Policymakers intend to use them to promote educational equity and reduce the burden of caregiving on families, thereby maximizing schools' role as primary educators in fostering students' cognitive and non-cognitive abilities (Gao et al., 2022; Yang, 2021; Zhang et al., 2021). However, there is no academic consensus on whether extended school hours can improve these skills. Some studies have found that a student's cognitive development is not enhanced by remaining in school longer (Fang et al., 2018). In addition, despite the fact that the majority of schools offered after-school services to students, practices varied from school to school, and the effects of these programs varied greatly due to factors such as program type, intensity, and quality. In addition to the duration of service, the question of which types of after-school programs are most beneficial to student development must be addressed.

Currently, the existing body of research pertaining to after-school services in China is deemed inadequate. The majority of the extant literature comprises theoretical analyses and experiential overviews, lacking robust and scientifically rigorous empirical investigations. Consequently, China currently faces a dearth of scientific evidence pertaining to crucial inquiries, such as the potential benefits of after-school programs on student development and the identification of more effective types of after-school programs for fostering student development. To address these concerns, the current study utilized a meta-analysis approach to examine the influence of after-school programs on student development. Furthermore, the study aimed to analyze the effects of different types of programs by drawing upon existing literature on this topic. The ultimate objective was to offer recommendations for enhancing after-school services in China.

Literature Review

Against the backdrop of the implementation of the Double Reduction Policy, after-school programs are playing an increasingly significant role in the cognitive and non-cognitive development of students, as most institutions now offer such services. It is necessary to investigate how to develop these skills in students through extended school hours and better-planned extracurricular activities.

The effects of after-school programs on students' cognitive and non-cognitive skills have been examined in the past, and the results have been mixed. Some of them discovered that after-school programs could aid in the growth of students. The Expanded Learning Programs in California and the 21st Century Community Learning Centers are just two examples of after-school programs that have been evaluated and found to significantly improve students' academic performance and social-emotional skills. Yang (2021) reviewed evidence-based studies on after-school programs in the United States and came to this conclusion. In South Korea, a comparison of after-school programs offered by schools and off-campus tutoring organizations indicates that both can increase students' academic performance, with the former outperforming the latter (Ha & Park, 2017).

Other studies, however, have indicated that after-school programs do not aid in improving students' academic and social-emotional abilities. For instance, some studies compared math test results between students who participated in after-school programs and those who did not, and they discovered that these programs have little to no impact on students' academic achievements (Hobbs, 2012). According to other research using multilevel growth modeling, students' self-efficacy is often constant and is not influenced by their level of involvement in after-school programs (Niehaus et al., 2012). The fact that after-school programs lengthen children's academic time is another crucial aspect of these programs. However, some research revealed that longer tutoring sessions lead to higher losses in academic accomplishment (Fang et al., 2018) and that on-campus after-school tutoring has a significant negative influence on student academic performance (Li & Pan, 2020; Wang et al., 2014).

Therefore, the cognitive and non-cognitive effects of after-school programs on students are complex issues that are largely the result of a multitude of factors.

Evidently, the effects of after-school programs are largely determined by the personal characteristics of students, including their socioeconomic status (SES) and educational levels. As per a number of studies, the majority of schools offer these programs for free or at a nominal cost; therefore, they can help to close the academic achievement disparity between students from diverse socioeconomic backgrounds (Zhang et al., 2021). According to other studies (Bohnert & Ward, 2013), after-school programs have no significant impact on the social-emotional development of students from low socioeconomic backgrounds. In addition to the socioeconomic status of the family, the educational phase is a significant factor influencing the heterogeneous effects of after-school programs. Zhang et al. (2021) discovered that the influence of after-school programs on students varies by educational phase and family context. A previous meta-analysis of after-school programs that used educational phase as the moderating variable concluded that after-school

programs have significant effects on both elementary and secondary school students, albeit with much smaller effect sizes for elementary school students than secondary school students (Crawford, 2011).

The elements influencing the development of students' cognitive and non-cognitive skills in after-school programs have also been specifically examined, and it has been discovered that student personal qualities do have a substantial impact on students' growth of their cognitive and non-cognitive skills. According to a study, family background elements, including father's occupation and economic position, have a significant impact on how students' cognitive and non-cognitive skills develop (Yang, 2020). Students from privileged socioeconomic origins tended to rate their social-emotional competence higher than those from disadvantaged socioeconomic backgrounds, according to a comparative study based on the results of an OECD survey (Xu & Yang, 2021). Students in various educational phases exhibit variety in the development of their cognitive and non-cognitive skills. While kids' social-emotional skills may not always be as developed as their cognitive skills as they age, the latter tend to be. The OECD survey found that elementary school students were more socially and emotionally capable than their secondary school counterparts (Xu & Yang, 2021). It might be argued that after-school programs have different effects on students' cognitive and non-cognitive abilities because these effects are influenced by the students' individual traits.

Further studies have provided evidence indicating that the nature, level, and standard of after-school programs exert an impact on the cognitive and non-cognitive development of students. Different types of programs have diverse effects on the development of students. After-school programs designed to enhance student academic performance have been found to have a noteworthy influence on their cognitive development (Gardner, 2014). Conversely, programs that target the improvement of personal and social skills have been shown to have a favorable effect on student social-emotional development, leading to a substantial rise in self-confidence, self-esteem, and self-efficacy among adolescents (Durlak et al., 2010). Simultaneously, the impact of after-school services on student development is contingent upon the intensity of these programs, which is primarily characterized by the frequency of sessions offered per week and the subsequent level of student engagement. The existing literature on the relationship between participation rates in after-school programs and student academic and social-emotional outcomes is limited, with only a few studies examining this association. However, these studies suggest the presence of a positive relationship (Roth et al., 2010). The study conducted by Mahoney et al. (2007) indicated that variations at the program level in after-school service participation have implications for the development of students' social skills.

Moreover, factors such as the type of literature, sample size, and testing tool are associated with the heterogeneous effects of after-school programs and warrant in-depth analysis (Zhang et al., 2015).

In short, student personal characteristics such as family socioeconomic status and educational period, as well as other factors such as the type and intensity of after-school programs, can influence the programs' effects on the cognitive and non-cognitive development of students. Existing research on after-school programs in China, however, focuses primarily on research on policy implementation and international experience. These studies are primarily theoretical discussions and experience summaries, and they lack scientific, rigorous evidence. CMA3.0 was used to conduct a meta-analysis of experimental and quasi-experimental studies on the relationship between after-school programs and student cognitive and non-cognitive development, with the aim of identifying the general patterns of the impact of after-school service on student development. In addition, it investigated the factors that may account for differences in the cognitive and non-cognitive developmental effects of after-school programs on students.

Research Process

Literature Retrieval

Meta-analysis is a research approach that involves the application of consistent inclusion criteria to identify and evaluate literature in a specific field, with a particular focus on experimental research. Through a secondary analysis of the literature, the effect size of each study meeting the inclusion criteria is calculated. By considering sample sizes and employing the weighted average method, a comprehensive conclusion is derived. Furthermore, researchers employ statistical methods to investigate the underlying factors contributing to heterogeneity (Zeng & Yao, 2020). When comparing meta-analysis to traditional literature reviews and literature research, it becomes evident that meta-analysis offers notable benefits in terms of mitigating selection biases and achieving reliable, replicable, and verifiable outcomes. The current study involved a comprehensive literature search conducted in various databases, including CNKI, Web of Science, Elsevier SDOL, EBSCOhost, Springerlink, and Google Scholar. The search applied specific keywords such as “after-school program,” “after-school service,” “student outcomes,” “student performance,” “academic achievement,” “non-cognitive,” “social-emotional,” “self-control,” “emotional control,” “social skill,” “self-efficacy,” “experimental,” and “quasi-experimental.” In order to ascertain the contemporaneity and pertinence of scholarly works, the present study has delimited the publication timeframe to encompass the years 2000–

2021. This temporal boundary has been established with the aim of investigating the overarching trends characterizing the evolution of after-school programs during the 21st century. Furthermore, a diverse range of literary sources was incorporated into the present investigation, encompassing journal articles, dissertations, and research reports. Consequently, a total of 3,397 pertinent studies were identified, of which 18 satisfied the established criteria for inclusion. From this subset, a total of 37 effect sizes were extracted. The process of collecting literature was conducted independently by the research team members without engaging in any discussions. Additionally, the search results were evaluated to ensure their consistency. To achieve a comprehensive compilation of literature, the team members additionally employed the snowballing technique to carry out a secondary literature search until consistent search outcomes were attained.

Literature Inclusion Criteria

To establish a literature pool that satisfies the needs of the research subject and supports further research, meta-analysis requires consistent inclusion criteria. These criteria must be used to acquire and screen publications linked to a specific issue. In this study, it was essential to first define after-school programs and the research issue in order to gather relevant literature. Pre-class, lunchtime, and summer programs are not included in after-school programs, which are defined as services offered or coordinated by schools and received by kids after school hours. This study's focus is on how participation in after-school activities affects students at basic education levels' development of both cognitive and non-cognitive skills. As a result, the intervention is whether or not to enroll in both academic and extracurricular after-school activities. Students in elementary, middle, and high schools are the study's participants. Academic performance is used to gauge a student's cognitive ability, while the OECD's social-emotional skill framework, which takes into account sociability, emotional regulation, self-control, and other social-emotional domains, is used to gauge a student's non-cognitive ability (Chernyshenko et al., 2018).

Based on the definition of after-school programs, the study theme, the subjects, the features of the literature, and the statistical requirements of meta-analysis, the following criteria for literature inclusion were established:

- i. The study's intervention must be participants' decisions on whether or not to take part in academic and extracurricular after-school programs offered or planned by their schools, excluding extracurricular off-campus activities like private tutoring, enrichment classes, and training. Students in elementary, middle, and high schools should serve as research participants.

- ii. The goals of the research should be in line with how students' cognitive and non-cognitive capabilities, including their academic performance and social-emotional skills, are developing.
- iii. The included studies must have been released between 2000 and 2021 in either Chinese or English, with no restrictions on the publications' genres, in order to be current and relevant.
- iv. With the use of experimental groups and control groups, the study design must be experimental or quasi-experimental. While control groups may be placed in different scenarios, experimental groups must be placed in a scenario of the after-school program.
- v. To prevent biases brought on by exceptionally small sample sizes or a wide disparity in sample sizes between the experimental and control groups, the sample sizes of the two groups should be comparable.
- vi. To determine effect sizes, the study should provide details like the mean, standard deviation, sample size, t-value, and p-value.
- vii. The experimental and control groups' pretest results should not significantly differ, and the pretest effect size d should not be greater than 0.5 (Cheung & Slavin, 2016).

The experimental intervention time, sample size, and testing method should all be included as screening criteria in a meta-analysis when experimental studies serve as the main source of data for analysis (Cheung & Slavin, 2016). These factors were not included in the inclusion criteria for the current investigation, despite the fact that other heterogeneity analyses would have looked at them.

Literature Coding

As mentioned previously, a meta-analysis is an analysis based on the integration of a large corpus of literature, with the possibility of heterogeneity between studies. For subsequent analysis, the included studies must be coded (as shown in **Table 1**), and the specific codes are described below.

- i. Types of literature: Journals are coded as journals, and other types are coded as others.
- ii. Types of after-school programs: Academic programs are coded as academic; art and sports programs are coded as art and sports; programs focusing on interactions with nature, such as Equine Facilitated Learning¹, are coded as close to nature; programs covering multiple aspects, such as academic activities and recreational activities (e.g., 21st Century Community Learning Centers²), are coded as mixed; and those that do not report the type are coded as unreported.
- iii. Testing tools: Standardized tests (including standardized tests and assessment scales) are coded as standardized, and unreported tests are coded as unreported.

- iv. Family economic status: Low family economic status is coded as low, middle classes are coded as middle, a mixture of different family backgrounds is coded as mixed, and the unreported are coded as unreported.
- v. Length of after-school programs: programs not shorter than 12 weeks or one school year are coded as > 12, those lasting 6–12 weeks or half a school year are coded as 6–12, those shorter than 6 weeks are coded as < 6, and the unreported are coded as unreported.
- vi. Frequency of participation (per week): One time and 2–5 times are coded as 1 and 2–5, respectively, and the unreported are coded as unreported.
- vii. Educational phases: Elementary schools (K–5) are coded as elementary, junior secondary schools (K6–8) are coded as middle, senior secondary schools (K9–12) are coded as high, and a mixture of different educational stages is coded as mixed.
- viii. Sample sizes: Studies with sample sizes smaller than 100, between 100 and 250, and larger than 250 are coded as < 100, 100–250, and > 250, respectively, for both experimental and control groups.
- ix. Types of outcomes: Outputs related to academic performance are coded as academic performance (including math, reading, language arts, etc.); outputs related to social-emotional skills are coded as social-emotional; and outputs related to artistic performance are coded as artistic performance.

Research Results and Analysis

Heterogeneity Tests and Analysis Model

A meta-analysis is based on the integration of a large body of research, but there is heterogeneity among individual studies. Chen et al. (2016) cite the Q statistic, the H statistic, and the I^2 values as the primary methodologies for heterogeneity tests. Using the Q statistic and I^2 values, the present investigation analyzed the heterogeneity between studies. The Q statistic indicated that there was heterogeneity among the samples ($Q = 102.041$, $p = 0.000$), while the I^2 values indicated that there was significant heterogeneity among the studies ($I^2 = 64.720$). As the testing results indicated sample heterogeneity, the random-effects model was utilized for the analysis in this study.

Analysis of the Effects of After-School Programs on Student Development

As shown in **Table 2**, the effect size of after-school programs on student development was 0.327% ($p < 0.05$). According to Cohen (2013), the effect sizes of 0.2, 0.5, and 0.8 are minor, medium, and large, respectively. According to his criteria, after-school programs have a significant positive

Table 1. Literature Coding.									
Literature	Type of outcomes	Type of literature	Type of after-school program	Testing instruments	Family economic status	Length of after-school programs	Frequency of participation per week	Educational phases	Sample sizes
Dreyer, 2010a	Academic performance(m)	O	Ac	Std	Low	>12	2-5	Mx	<100
Dreyer, 2010b	Academic performance(r)	O	Ac	Std	Low	>12	2-5	Mx	<100
Venze, 2011a	Academic performance(la)	O	Mx	Std	Mx	>12	Ur	M	<100
Venzen, 2011b	Academic performance(m)	O	Mx	Std	Mx	>12	Ur	M	<100
Venzen, 2011c	Academic performance(la)	O	Mx	Std	Mx	>12	Ur	M	<100
Venzen, 2011d	Academic performance(m)	O	Mx	Std	Mx	>12	Ur	M	<100
Fulmer, 2014a	Academic performance(la)	O	Ac	Std	Low	>12	1	H	<100
Fulmer, 2014b	Academic performance(m)	O	Ac	Std	Low	>12	1	H	<100
Gardner, 2014	Academic performance(r)	O	Ac	Std	Low	6-12	2-5	E	<100
Ha & park, 2014	Academic performance(t)	J	Mx	Std	Ur	Ur	Ur	H	>250
Townsend & collins, 2019	Academic performance(v)	J	Ac	Std	Ur	<6	2-5	M	<100
Moldow, 2007a	Academic performance(rw)	O	Mx	Std	Low	>12	2-5	E	100-250
Moldow, 2007b	Academic performance(s)	O	Mx	Std	Low	>12	2-5	E	100-250
Moldow, 2007c	Academic performance(m)	O	Mx	Std	Low	>12	2-5	E	100-250
Moldow, 2007d	Social-emotional(sk)	O	Mx	Std	Low	>12	2-5	E	100-250
Jones, 2014a	Academic performance(m)	O	Ac	Std	Low	>12	2-5	M	<100
Jones, 2014b	Academic performance(r)	O	Ac	Std	Low	>12	2-5	M	<100
Hobbs, 2012a	Academic performance(m)	O	Mx	Std	Mx	>12	Ur	Mx	<100
Hobbs, 2012b	Academic performance(m)	O	Mx	Std	Mx	>12	Ur	E	<100
Hobbs,2012c	Academic performance(m)	O	Mx	Std	Mx	>12	Ur	M	<100

Yun, 2011a	Artistic performance	O	AS	Ur	Middle	>12	1	M	<100
Yun, 2011b	Social-emotional(se)	O	AS	Std	Middle	>12	1	M	<100
Martin, 2000a	Academic performance(r)	O	Mx	Std	Low	6-12	2-5	E	<100
Martin, 2000b	Academic performance(m)	O	Mx	Std	Low	6-12	2-5	E	<100
Martin, 2000c	Academic performance(r)	O	Mx	Std	Low	6-12	2-5	E	<100
Martin, 2000d	Academic performance(m)	O	Mx	Std	Low	6-12	2-5	E	<100
Londregan, 2011	Academic performance(m)	O	Ac	Std	Low	6-12	2-5	M	<100
Pendry et al., 2014	Social-emotional(sk)	J	CN	Std	Low	6-12	1	Mx	<100
Pendry & roeter, 2013	Social-emotional(sk)	J	CN	Std	Low	6-12	1	Mx	<100
Ariyo & adeleke, 2018	Academic performance(m)	J	Ac	Ur	Ur	Ur	Ur	H	<100
Lecroy, 2004a	Social-emotional(a)	J	Mx	Std	Mx	>12	Ur	M	<100
Lecroy, 2004b	Social-emotional(sef)	J	Mx	Std	Mx	>12	Ur	M	<100
Morrison, 2000a	Academic performance(m)	J	Mx	Ur	Low	Ur	Ur	M	100-250
Morrison, 2000b	Social-emotional(sc)	J	Mx	Std	Low	Ur	Ur	M	100-250
Morrison, 2000c	Social-emotional(c)	J	Mx	Std	Low	Ur	Ur	M	100-250
Morrison, 2000d	Social-emotional(a)	J	Mx	Std	Low	Ur	Ur	M	100-250
Biggart, 2013	Academic performance(r)	J	Mx	Std	Ur	>12	2-5	E	100-250

Note: there exist variations of the dependent variable in some experiments due to differences in disciplines and social-emotional skill categories. In such circumstances, each variation is treated as an independent effect size and differentiated by annotations. For academic achievement, m, r, la, t, v, rw, s stands for mathematics, reading, language arts, general, vocabulary, reading and writing, and speaking, respectively. For social-emotional skills, sk, se, a, sef, sc stands for social skills, self-esteem, assertiveness, self-efficacy, and self-control, respectively.

E: Elementary School; M: Middle School; H: High School; Std: Standardized; J: Journals; O: Others; Ac: Academic; Mx: Mixed; AS: Art & Sports; CN: Close to Nature; Ur: Unreported;

Table 2. Effect Sizes Of Student Development							
		K	Q	ES	95%CI	p	
Type of outcomes	Academic performance	27	3.907 (p = 0.142)	0.369	0.247	0.491	0.000
	Social-emotional skills	9		0.223	0.132	0.314	0.000
	Artistic performance	1		0.429	-0.059	0.917	0.085
Student cognitive and non-cognitive abilities		37	102.041 (p = 0.000)	0.327	0.238	0.416	0.000

effect on the cognitive and non-cognitive abilities of students, albeit with a modest effect size ($d = 0.327$).

As was already said, a student’s academic success and social-emotional skills primarily reflect both their cognitive and non-cognitive talents. Because it possesses characteristics of both academic performance and social-emotional skills, student artistic performance was discussed independently. To investigate the specific impacts of after-school programs on these skills, a thorough analysis of the output types of student’s cognitive and non-cognitive abilities was done. **Table 2**’s findings demonstrate the after-school programs’ considerably beneficial effects on a variety of outcomes, including academic performance ($d = 0.369$, $p = 0.000$), social-emotional skills ($d = 0.223$, $p = 0.000$), and artistic performance ($d = 0.429$, $p = 0.085$). The small sample sizes of this study, particularly for social-emotional skills and artistic performance, may explain the modest effect sizes of all three output types. Additionally, the findings indicate that after-school programs are substantially more effective at fostering students’ cognitive development than at enhancing their social-emotional competencies. This finding may be related to the types of after-school programs that were covered in the literature. The authors discovered that earlier research had placed a stronger emphasis on academically oriented after-school activities and had given more consideration to student academic performance improvement than to the growth of their social-emotional skills.

Analysis of Moderating Variables

As indicated previously, there was significant heterogeneity among the samples included in this study ($Q = 102.041$, $p = 0.000$, $I^2 = 64.720$), which may be a result of differences in the type of after-school programs and student family socioeconomic status. To determine the reasons for the heterogeneous effects of after-school programs, which were examined at both the individual and program levels, analyses of moderating variables were required.

Table 3. Heterogeneity at the Individual Level.

		K	Q	ES	95%CI	p	
Family SES	Low	22	7.034 (p = 0.071)	0.228	0.166	0.289	0.000
	Middle	2		0.244	-0.115	0.604	0.183
	Mixed	9		0.463	0.261	0.664	0.000
	Unreported	4		0.680	0.117	1.243	0.018
Educational phases	Elementary	13	13.067 (p = 0.004)	0.147	0.068	0.226	0.000
	Middle	4		0.376	0.264	0.488	0.000
	High	15		0.733	-0.038	1.505	0.063
	Mixed	5		0.299	0.129	0.468	0.001

Table 4. Heterogeneity at the Program Level.

		K	Q	ES	95%CI	p	
Types of after-school program	Academic	10	2.662 (p = 0.447)	0.499	0.177	0.820	0.002
	Art and sports	2		0.244	-0.115	0.604	0.183
	Close to nature	2		0.393	0.095	0.691	0.010
	Mixed	23		0.259	0.181	0.336	0.000
Lengths of after-school program	< 6	1	2.411 (p = 0.491)	0.212	-0.436	0.861	0.521
	6-12	8		0.276	0.125	0.427	0.0
	> 12	22		0.279	0.184	0.373	0.000
	Unreported	6		0.520	0.221	0.818	0.001
Frequency of participation per week	1	6	10.410 (p = 0.005)	0.303	0.119	0.488	0.001
	2-5	16		0.179	0.106	0.251	0.000
	Unreported	15		0.487	0.308	0.667	0.000

Table 5. Heterogeneity of Characteristics of the Literature and Studies.

		K	Q	ES	95%CI	p	
Types of literature	Journals	12	1.439 (p = 0.230)	0.402	0.222	0.581	0.000
	Others	25		0.278	0.186	0.370	0.000
Sample sizes	< 100	27	7.797 (p = 0.020)	0.419	0.280	0.558	0.000
	100-250	9		0.187	0.102	0.272	0.000
	> 250	1		0.253	0.122	0.385	0.000
Testing tools	Standardized	33	3.561 (p = 0.059)	0.251	0.187	0.316	0.000
	Unreported	4		0.805	0.234	1.376	0.006

Individual-level heterogeneity resulted from the SES of the student family and their educational stages. **Table 3** presents the outcomes. Although the effect size is modest ($d = 0.228$, $p = 0.000$), after-school activities significantly benefit individuals from poor socioeconomic backgrounds in terms of family SES ($Q = 7.034$, $p = 0.071$). This shows that although the compensating objective of after-school activities has been achieved, there is still potential for improvement. There is statistically substantial evidence that after-school activities have an impact on students in basic education in terms of educational phases ($Q = 13.067$, $p = 0.004$). The largest effect size ($d = 0.733$) comes at the senior secondary phase, followed by the junior secondary phase ($d = 0.376$), indicating that after-school programs have a bigger impact on secondary school children than on elementary school kids ($d = 0.147$).

Table 4 displays the results of heterogeneity at the program level, which is caused by changes in after-school program type, duration of intervention, and frequency of participation. The development of students' cognitive and non-cognitive skills was significantly aided by programs like Equine Facilitated Learning, which allow students to interact with nature ($d = 0.393$), and academic programs produced the strongest effect of all after-school programs ($Q = 2.662$, $p = 0.447$). Additionally, blended programs with both educational and recreational components, like the 21st Century Community Learning Centers, had statistically significant positive effects on the participants ($d = 0.259$). Programs lasting 6–12 weeks or more than 12 weeks had significant impacts, though with minor effect sizes (0.279 and 0.276, respectively), whereas programs shorter than 6 weeks had worse results ($d = 0.212$, $p = 0.521$). This is according to the length of the intervention ($Q = 2.411$, $p = 0.491$). “One day per week” has a bigger influence ($d = 0.303$), which is still a tiny but statistically significant effect size, on the frequency of involvement in after-school service ($Q = 10.410$, $p = 0.005$).

Furthermore, characteristics of literature and studies may also be significant heterogeneity factors. Considering this, the current study examined the moderating effects of literature type, sample size, and testing instruments. **Table 5** provides the results. Even though the sample size in journal articles is much smaller than that in other types of literature ($Q = 1.439$, $p = 0.230$), its effect size ($d = 0.402$, $p = 0.000$) is substantially greater than that of other types ($d = 0.278$, $p = 0.000$), both of which are statistically significant. The effect size of small sample sizes (with less than 100 subjects) is the greatest ($d = 0.419$), followed by that of large sample sizes (over 250 subjects) ($d = 0.253$). In terms of testing instruments ($Q = 3.561$, $p = 0.059$), the effect size derived by evaluating students via standardized tests is relatively larger ($d = 0.251$) and statistically significant, but still falls within the category of small effect sizes.

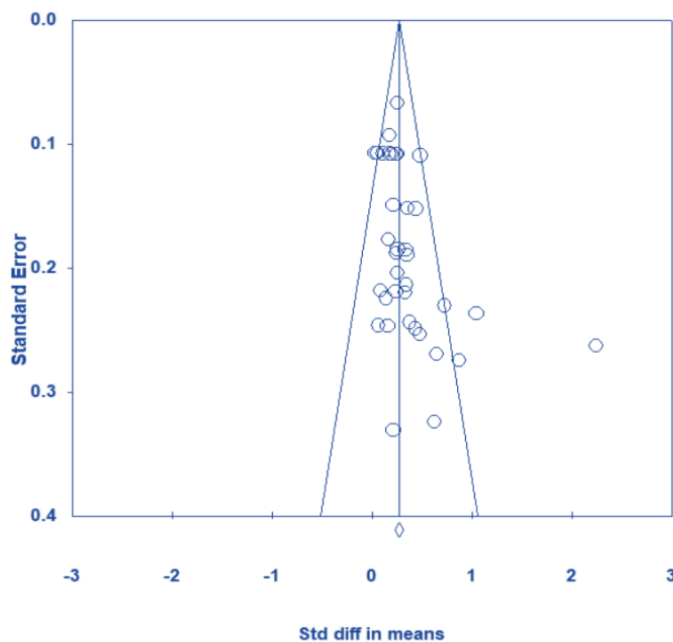


Figure 1. Funnel Plot.

The aforementioned analyses demonstrate that only the SES of the student family, educational phases, frequency of after-school program participation, sample size, and testing tool have a significant impact on the heterogeneity of experiments, whereas other factors like the type of after-school programs and the duration of the intervention were not the causes of the heterogeneity in this study. The reason could be that the current study, which mostly focused on on-campus after-school services, had a limited scope compared to other studies. The fact that there were so few sources of heterogeneity in this study may possibly be due to the fact that several of the studies that were included in the meta-analysis did not explicitly state whether the control groups were free from the intervention of after-school programs.

Robustness Testing

Publication Bias

Publication bias jeopardizes the validity of quantitative evidence from meta-analyses because the studies included in the meta-analysis are the result of publishers' selection, and this selective bias typically produces positive results. It is therefore necessary to evaluate the scientific validity of the meta-

analysis results. The present study utilized commonly used funnel diagrams and Egger's Regression coefficient to assess publication bias. This study's funnel plot is depicted in **Figure 1**, which is roughly symmetrical. The effect sizes of the included samples are primarily concentrated in the effective region of the funnel plot's middle and upper portions. Egger's Regression coefficient indicates a significant result of the Egger test ($B0 = 1.75488$, $t = 2.7674$, $p1 = 0.00448$ and $p2 = 0.00897$), indicating publication bias in this study. The Trim and Fill method was used to correct the effect size of this investigation, which was 0.203.

Sensitivity Analysis

Commonly, the Fail-Safe N is used to evaluate the dependability and robustness of the results. A larger fail-safe N indicates that the meta-analysis results are less sensitive to the excluded studies, indicating greater robustness (Zeng & Yao, 2020). According to Rosenthal (1979), the conclusions of a meta-analysis should be viewed with caution if the fail-safe N is less than $5K+10$ (K is the number of studies included). In the present study, the fail-safe N was 1,285 ($\alpha = 0.05$, $p < 0.0000$), indicating that 1,285 additional studies would be required to render the results non-significant or to refute the conclusions. Consequently, the findings of this investigation were relatively reliable.

Discussion and Conclusions

Discussion

In the context of the implementation of the Double Reduction policy, after-school programs are significant initiatives in reducing the burden on students and enhancing their learning efficacy. There is an urgent need for evidence-based answers to queries such as "whether and how after-school programs can promote the development of students' cognitive and non-cognitive abilities." This study analyzed 37 after-school program interventions from 18 studies using meta-analytic techniques to investigate the effects of after-school programs on students' cognitive and non-cognitive development and their general patterns. The objective was to provide scientific evidence to support the improvement of related work.

After-school programs can considerably foster students' cognitive and non-cognitive growth, according to the current study ($d = 0.327$, $p = 0.000$), with an influence on academic achievement that is bigger than that on social-emotional abilities ($d = 0.223$). This finding is in keeping with the findings of other studies of after-school programs carried out in various

countries, as well as the conclusion reached by Durlak et al. (2010) that after-school services have a good impact on student academic achievement and social skills. Despite the constant favorable influence, this study's effect size was different from the conclusions of these academics. Although the effect size of after-school activities was just 0.17, Durlak and coworkers discovered that they significantly improved student academic performance. This can be connected to the different ways that after-school program interventions are defined. Researchers from other nations have defined after-school programs as ones offered by communities, schools, and mixed environments involving schools, covering pre-class and lunchtime scenarios as well as summer vacations. In the current study, after-school programs are defined as services provided or organized by schools during after-school hours. Even though summer camps were not included in Durlak and coworkers' definition of after-school programs, their research may have included treatments that took place before classes, during lunch, and on other occasions. They added that some activities organized by communities as well as those by schools were included in the activities they analyzed. As a result, in terms of research scope, their study differs greatly from the one under consideration.

Zief et al. (2006), in contrast to the findings of the present study, reported that after-school activities had little to no impact on participants' social-emotional abilities and had a minimal and insignificant impact on their academic performance ($d = 0.083$, $p = 0.16$). This might be brought on by differences in how after-school programs are defined as interventions. The coupling of youth entertainment and/or development activities with academic support services was stressed by Zief and colleagues as one of the inclusion criteria for after-school program research. According to them, after-school activities can run in a variety of locations, including schools, communities, and places of worship. The definition of output results may also play a role in the discrepancy in findings. While the current study is based on the OECD framework of social-emotional skills, which includes sociability, emotional control, self-efficacy, self-regulation, and more, Zief et al.'s definition of social-emotional skills focuses more on aspects like college aspirations, perseverance, social integration, etc.

This study found that additional after-school service hours positively affect the cognitive and non-cognitive development of students, whereas Fang et al. (2018) and Li and Pan (2020), whose studies focused on after-school programs in China, reached the opposite conclusion. The inconsistency may result from differences in after-school service components between China and other countries. In some foreign countries, after-school services consist of a variety of components rather than being dominated by demanding extra tutoring. According to Dreyer's (2010) description of the after-school program's schedule, the program in question did not begin with purely academic activities but rather with a half-hour refreshment break;

subsequent learning activities were interspersed with other enrichment activities. Such examples are useful for refining after-school programs in China. The results of the present study indicate that academic learning in after-school programs may enhance student academic performance if it is not overly burdensome. However, more rigorous empirical evidence is necessary to corroborate whether academic learning in after-school programs in China, where students generally face enormous academic pressure, can help improve student academic performance in the same way as foreign researchers have discovered.

The present study has its limitations due to the information provided in the literature. It was challenging to determine whether the control groups in some of the included studies actually did not participate in after-school programs as defined in the current study because it was unclear from some of the studies whether the control groups were truly free from the interventions of after-school programs. As a result, the results of the meta-analysis may be adversely affected if these studies are unable to provide clean, uncontaminated control data. Few Chinese experimental or quasi-experimental studies on the outcomes of after-school programs match the requirements for inclusion. As a result, the current study was unable to incorporate any material that had been published in China, which may have somewhat diminished the value of the study for how after-school programs are implemented in China. These issues probably played a role in why this study failed to pass the publication bias test. We undertook the literature review procedure several times in an effort to incorporate more qualified papers in order to overcome this problem, but we were unable to completely eradicate publication bias. To finally fix the overall effect size, we have to use the Trim and Fill approach. Though no systematic biases were found in the final meta-analysis results, more studies with trustworthy research findings are required to get more substantial and all-encompassing evidence. Basically, this study examined the effects of after-school programs on the growth of students' cognitive and non-cognitive abilities as well as the impact of various program types in an effort to provide implications for the successful implementation of the Double Reduction policy and the optimization of the quality of after-school programs. It was based on findings from previous empirical research.

Conclusions and Suggestions

The present study analyzed 37 after-school program interventions from 18 studies using meta-analytic techniques to investigate the effects of participation in after-school programs on students' cognitive and non-cognitive abilities. In addition, because of the heterogeneity of the studies, their causes were examined at the individual and program levels. Even though the overall effect size is modest ($d = 0.327$, $p = 0.000$), the findings indicate that (i) af-

ter-school programs can considerably enhance student development. (ii) After-school programs have positive effects on student academic performance ($d = 0.369$) and social-emotional skills ($d = 0.223$), with modest effect sizes on both aspects but a larger effect on academic performance. (iii) The socio-economic status of the student's family, the educational phase, the frequency of participation, the sample size, and the testing instrument are the primary sources of heterogeneity, while other factors have no significant associations with the heterogeneity.

Further investigation revealed a link between the various after-school services' effects on students' development and the different kinds of after-school programs mentioned in the literature. Academic after-school programs greatly outnumbered other types of activities in the studies that were considered. For instance, assessing the impact of the 21st Century Community Learning Center programs on student academic attainment was a major part of the study.

The identification of overarching patterns pertaining to the impact of after-school programs on student development can facilitate the advancement of after-school services in China. Based on the preceding analysis, the authors propose enhancements to after-school programs in China in the following areas:

First, balance cognitive ability- and non-cognitive ability-focused after-school programs. The findings of the meta-analysis indicate that after-school programs yield notable and favorable impacts on the enhancement of both cognitive and non-cognitive abilities among students. Hence, it is imperative to prioritize the enhancement of both academic achievement and social-emotional competencies when implementing after-school programs. The primary objective is to foster comprehensive student development rather than transform the programs into a mere extension of the traditional classroom setting.

Second, introduce diverse after-school programs. The findings of the meta-analysis indicate that various types of programs, including academic programs, art and sports programs, programs emphasizing interactions with nature, and mixed programs, have a positive impact on the cognitive and non-cognitive abilities of students. Moreover, the effect sizes of academic programs, programs focusing on interactions with nature, and mixed programs are larger. Currently, the prevailing emphasis of after-school programs in China lies in academic tutoring, while arts and sports activities, which foster social-emotional skills to a greater extent, receive comparatively less attention. Hence, it is recommended that future after-school programs focus on enhancing their curriculum rather than imposing excessive tutoring or course instruction, which may place additional demands on students. The arduous and monotonous nature of learning hampers the effectiveness of studying, and establishing a harmonious equilibrium between

academic endeavours and leisure activities is more favorable for the holistic growth of students.

Third, control the intensity of after-school service. The findings of the meta-analysis indicate that engaging in after-school programs on a weekly basis yields the most optimal outcomes for both cognitive and non-cognitive development among students. In China, a significant proportion of educational institutions offer after-school services on weekdays, thereby facilitating parental retrieval of their children following their work commitments. According to Fang et al. (2018), further research has indicated that extended school hours may have a negative impact on the development of specific essential skills among students. Furthermore, the implementation of a uniform after-school service model undermines the individualized developmental requirements of students and imposes an excessive workload on teachers. Hence, it is advisable for educational institutions to exercise reasonable regulation over student school hours and offer increased flexibility in terms of the frequency of after-school services to enhance their overall efficacy.

Note

1. *Equine Facilitated Learning is an 11-week after-school program that consists of 90-minute sessions of individual and group activities. Its goal is to help kids become more socially adept and well-behaved through activities that make use of horses' instinctive behaviors and their connections with people.*
2. *The 21st Century Community Learning Centers, which opened schools to the community in an effort to improve the academic abilities of public-school kids from lower socioeconomic backgrounds, were approved by the US Congress in 1994. In 1998, the program started concentrating on offering educational and leisure activities in public schools before school, after school, on weekends, and during summer vacations. Therefore, only those projects from the program that specifically incorporate after-school activities in schools were included in this study.*

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