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The relationship between self-control and academic achievement: A meta-analysis investigation

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ABSTRACT

Many studies report a significant relationship between self-control and academic achievement, although the strength of this relationship varies across studies. Moderator factors influencing this relationship remain unclear. Therefore, this meta-analysis aims to further explore the relationship between self-control and academic achievement and investigate potential moderating factors that may affect its strength. The study includes 70 samples from 16 primary studies published between 2005 and 2018. Data analysis was conducted using a random effects model with a significance level of $\alpha = 5\%$. In addition to the main analysis, six moderator variables were analyzed: education level, geographical region, self-control measurement tool, academic achievement measurement tool, and publication year. The results showed a moderate positive relationship between self-control and academic achievement ($r = 0.32$, $p < 0.001$). Moderator analysis indicated that all variables significantly influenced the strength of the relationship between self-control and academic performance. The positive relationship was stronger in studies with mixed participants and weakest among university students and stronger in studies conducted in the United States than in Africa and Europe. This study contributes meaningfully to the literature by clarifying moderator factors and providing insights for educators in designing targeted interventions to enhance academic performance through self-control development across diverse contexts.

INTRODUCTION

The success of an educational process is often measured by academic achievement. However, academic achievement does not stand alone; rather, it is influenced by various external and internal factors. One internal factor suspected to significantly impact academic achievement is an individual's self-control. Developmental psychology theories and previous research indicate that self-control plays a significant role in achieving personal goals, including academic success. In this context, individuals who can consciously control themselves are more likely to succeed, whether in academic achievement or character development. Therefore, it is essential to understand in more depth how self-control contributes to academic achievement and the specific factors influencing this relationship.

Self-control can be defined as an individual's ability to regulate, direct, and organize behaviors that lead to positive consequences (Marsela & Supriatna, 2019). Furthermore, self-control involves the capacity to control certain impulses that arise internally, allowing individuals to regulate

and achieve desired outcomes (Elnina, 2022). Self-control also encompasses an individual's ability to adapt to their surroundings and environmental conditions, shaping them into more disciplined individuals (Duri, 2021; Ningsih, 2018). Additionally, self-control can be interpreted as the ability to make effective decisions and take actions to achieve desired results (Intani & Ifdil, 2018). In an academic context, self-control is used to prioritize and balance time between academic and non-academic activities (Pardede & Hartono, 2022). For these reasons, understanding self-control as a mechanism that can influence success in educational settings is essential.

Previous studies emphasize the significant role of self-control in education and its close connection to academic achievement. Some studies indicate that students with strong self-control can better evaluate necessary actions to achieve their academic goals. Although most studies report a significant positive relationship between self-control and academic achievement, the strength of this relationship varies. For example, Ma and Li (2023) found a strong correlation between self-control and academic achievement, whereas other studies report a moderate correlation (Duckworth et al., 2015; Intani & Ifdil, 2018; Kuhnle et al., 2012; Wu et al., 2017). Conversely, some studies found only a weak correlation between the two variables (Bertrams & Dickhäuser, 2009; Haghi et al., 2013; Stadler et al., 2016), and other researchers reported that the relationship was not significant (Elias et al., 2005; Kuhnle et al., 2011).

These inconsistencies in research findings raise questions about how the strength of the relationship between self-control and academic achievement actually functions. Differences in these findings suggest that moderator factors may influence the relationship between self-control and academic achievement. Therefore, this study is designed to explore moderating factors that may affect the strength of the relationship between self-control and academic achievement, providing a more comprehensive view of the role of self-control in education. Specifically, this study focuses on analyzing how various moderating variables, such as education level, geographical region, self-control measurement tools, and academic achievement measurement tools, contribute to the variation in the relationship between these two main variables.

The benefits of this study include contributing to both theory and practice in education. Theoretically, this research will enrich the literature on the relationship between self-control and academic achievement, providing empirical evidence that can guide the development of more effective educational strategies. Practically, the findings may serve as a reference for educators and policymakers in designing targeted interventions to enhance academic achievement through self-control development in students. Thus, this study aims to clarify the relationship between self-control and academic achievement and to explain the factors that may strengthen or weaken this relationship

METHOD

Literature Search

We conducted a literature search for studies on self-control and academic achievement published between 2000 and 2018. The literature search was conducted using electronic databases such as Google Scholar, ProQuest, EBSCO, ERIC, Scopus, JSTOR, Web of Science, PsycINFO, and ScienceDirect. Literature searches are also carried out in reputable open access scientific journals and indexed international seminar proceedings. Keywords used to search the literature include "self-control", "self-management", "self-control and achievement", "self-control and academic achievement", " self-control and academic performance", and "self control and learning result". Furthermore, the literature that has been obtained is filtered based on the inclusion criteria set by the researcher.

Literature Inclusion Criteria

The literature obtained through the literature search stage is then screened based on several inclusion criteria. First, studies should measure self-control and academic achievement and report the results. Studies should also report on the relationship between the two variables. Studies that only report self-control or academic achievement results will not be ecxclude. Studies that do not report the relationship between the two variables will also be excluded. Second, studies must explicitly

report the sample size used. For studies that do not report sample size will be excluded. Third, studies clearly report on the methods used to measure self-control and academic achievement. Studies that only reported or described the relationship between self-control and academic achievement but did not clearly describe how self-control and academic achievement were measured were excluded. Fourth, each study should report the Pearson correlation r clearly. Studies that only report the results of regression or multilevel model analysis will be excluded. Fifth, studies using English or Indonesian. Sixth, the grade level of participants consists of elementary school to college level. For studies that use participants at the preschool level excluded.

By applying these inclusion criteria, 16 main studies were obtained that met the criteria (see Figure 1). From the 16 main studies, 70 independent samples were obtained to be analyzed. This is because some studies report more than one relationship between self-control and academic achievement (Duckworth et al., 2012; Honken et al., 2016; Kuhnle et al., 2012; Muammar, 2015). In addition, studies that produce more than one independent sample use a variety of scales and methods to measure self-control and academic achievement (Duckworth et al., 2015; Elias et al., 2005; Wu et al., 2017). For studies that do not consistently meet the inclusion criteria will be excluded in this study.

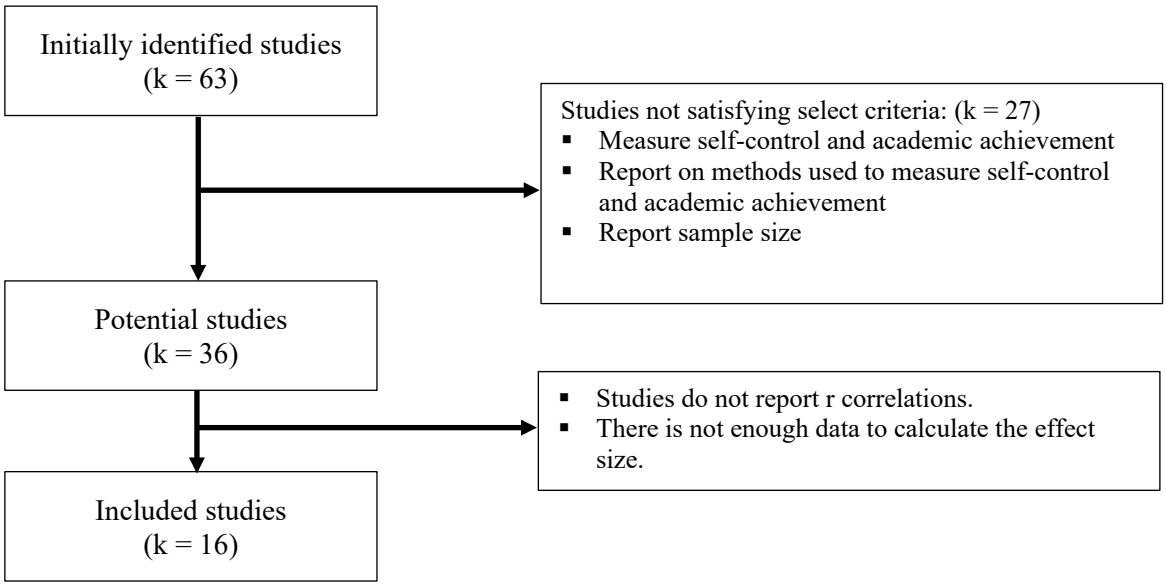

Figure 1. Flowchart of Literature Search Process

Coding

The researchers jointly screened the literature to exclude studies that did not meet the established inclusion criteria, as recommended in the meta-analysis process to ensure data validity and quality (Borenstein et al., 2021; Cooper et al., 2019). The screening process was conducted in stages by examining the abstracts and full text of articles to ensure alignment with the research objectives. Subsequently, for studies that met the inclusion criteria, each article was coded by the researchers to identify effect size variables and moderator variables present in each study.

This coding was based on variables previously established within the research framework. According to Kiriakou et al. (2014), a systematic coding process helps reduce researcher bias in determining study characteristics and increases the accuracy of the analysis. In meta-analysis, coding is conducted to document key characteristics, such as sample effects and relevant variables, to ensure that the resulting data can be analyzed in aggregate (Borenstein et al., 2021). The same process is used to identify potential moderators to understand how these variables may affect the relationship between the primary variables in the study.

Based on the coding results, six categories of moderator variables were obtained: grade level, geographic region, measure of self-control, measure of achievement, sample size, and date of

publication. Each category of each moderator variable was coded according to prior research standards and recorded in Table 1, following the methods suggested by (Littell et al., 2008). By grouping these moderator categories, the study aims to provide a deeper understanding of specific conditions that may influence the strength of the relationship between the primary variables.

Table 1. Coded Study Features

No.	Moderator Variable	Identified Categories
1	Grade level	Middle School
		High School
		College
		Other
2	Geographic Region	Asia-Africa
		Europe
		USA
3	Measure of Self-Control	BSCS (Brief Self-Control Scale)
		ISC (Impulsivity Scale for Children)
		Other (e.g. Social Scale Rating System, Subjective Academic Achievement, etc.
4	Measure of Achievement	GPA (Grade Point Average)
		Other
	Sample Size	<=100 (Sample less than 100)
		101-300 (Sample consists of 101-300)
		301-500 (Sample consists of 301-500)
		>500 (Sample over 500)
5	Date of Publication	Continuous: 2003-2018

Data Analysis

Effect size calculations

For correlation studies, the Pearson correlation coefficient (r) is the effect size index of a study (Borenstein et al., 2021; Khan et al., 2019; Retnawati et al., 2018). If individual studies show statistically significant results, the resulting effect size is assumed using a p-value of 0.05. To ensure stabilization of the sample distribution, r needs to be transformed to Fisher's z transformation (Borenstein et al., 2021; Cooper et al., 2019). The formula used to transform r to z can be seen in Formula 1.

$$z = 0.5 \times ln\left(\frac{r+1}{r-1}\right) \quad (1)$$

Once the mean effect size and confidence interval are obtained, they are transformed to r. To calculate the mean effect, researchers used a random effect model. Random effect model selection is because researchers assume that effect sizes of different studies may come from different populations and that different populations have their own sampling distribution (Borenstein et al., 2021). According to Cooper (2015), the diversity of experimental settings of each study (e.g. grade level, country or region, gender) will be more suitable if the analysis is carried out using a random effect model. In addition, data analysis in this meta-analysis study uses the help of JASP free software.

Moderator Analyses

To determine the variation among research results in different studies, a heterogeneity test (Q test) was performed. If the Q statistic is significant, it can be concluded that each study is not from the common population. In other words, statistically Q significantly shows that the mean effect size of each component of the moderator variable is significantly different, so analysis of the potential moderator variable is to be performed. In this study five moderator variables (grade level, region, measure of self-control, measure of academic achievement, and sample size) were analyzed using

ANOVA-like models. For ANOVA-like models, we reported within-group effect means (weighted r), 95% confidence intervals (CI), as well as within-group variability (Q w) and between-group heterogeneity (Qb). The statistic Qb significantly shows that the mean effect size between the components of the moderator variable is significantly different.

For the publication year moderator variable, it was analyzed using Pearson's correlation test. This analysis was conducted to investigate the relationship between publication year and effect size. In this analysis we report correlation coefficients r and 95% confidence intervals. A significant r coefficient indicates that there is a significant relationship between the year of publication and effect size. All moderator variable analysis is also performed using the help of JASP software.

Evaluation of Publication Bias

This meta-analysis study used three approaches to explore publication bias, namely funnel plot, Egger's test, and fail-safe N, and. Funnel plots are used to clearly present all effect sizes, where if the pattern formed is symmetrical, indicating that there is no publication bias (Card, 2012). Egger's test is a linear regression method used to test the symmetry of funnel plots (Egger et al., 1997). Fail-safe N is used to estimate the number of studies with unpublished results needed, so that the average effect size becomes statistically insignificant (Rosenthal, 1979).

RESULTS AND DISCUSSION

Results

Overview of Primary Studies

After filtering the literature based on inclusion criteria set by researchers, 70 independent samples were obtained from 16 main studies (articles and theses). Table 1 presents a summary of studies included in the meta-analysis consisting of study name and year publication, effect size (r), sample size (N), participants, and grade level. Table 2 reports country, measure of self-control, and measure of academic achievement.

Table 2. Descriptive Statistics of Included Studies

Moderator Variable	Identified Categories	Counts (%)
Grade level	Middle School	19(27.14)
	High School	5(7.14)
	College	15(21.43)
	Other	31(44.29)
Geographic Region	Asia-Africa	27(38.57)
	Europe	7(10)
	USA	36(51.43)
Measure of Self-Control	BSCS	24(34.29)
	ISC	28(40)
	Other	18(25.71)
Measure of Achievement	GPA	32(45.71)
	Other	38(54.29)
Sample Size	<=100	4(5.71)
	101-300	23(32.86)
	301-500	9(12.86)
	>500	34(48.57)
Date of Publication	Continuous: 2003-2018	70(100)

Table 3 presents descriptions of moderator variables. For the grade level moderator variable, the proportion of participants for the "other" (mix participant) category was the largest (44.29%) compared to the middle school, high school, and college student categories. While the grade level for the high school category has the least proportion (7.14%). Judging from the geographic region, in this study it was found that the largest participants came from the United States of America with

a percentage reaching 51.43%, while participants from Europe the smallest percentage (10%). Of the 70 independent samples analyzed, 40% used the Impulsivity Scale for Children for measure of self-control, 34.29% used the Brief Self-Control Scale, and the rest used other instruments. For academic achievement, 54.29% was measured using other instruments or techniques, while the remaining 45.71% was measured using the Grade Point Average. Judging from the sample size, 48.57% of studies had a sample of more than 500, while for studies whose sample was less than 100 the percentage was only 5.71%.

Overall Analysis

The main findings resulting from the meta-analysis are presented in Table 3. The overall mean effect size of the 70 samples was 0.32 ($p < .001$), with a 95% confidence interval that ranged from 0.27 to 0.37. These results suggest that the relationship between self-control and academic achievement is significant. According to Cohen (1988; 1992) the effect size values of 0.80, 0.50, and 0.20 respectively represent that there is a relationship between variables with large, medium, and small categories. Thus, it can be concluded that there is a positive relationship (although somehow weak) between self-control and academic achievement. The results of statistical analysis Q (see Table 4) also show that the effect sizes of 70 independent samples are heterogeneous ($Q = 1288.6$, $df = 69$, $p < .001$). This indicates that the variance between effect sizes used in this study is different. Thus, an analysis of potential moderator variables was carried out to reveal the contribution of each moderator variable to the difference in variance between effect sizes.

Table 3. Relationship Between Self-Control and Academic Achievement: Overall Results and Moderator Analyses

Variable	*k*	Weighted *r*	95% CI	*Q*	*Df*	*Qw*	*Qb*
Overall	70	0.32*	[0.27, 0.37]	1288.6*	69		
Grade level					3	935.1	353.5*
Middle School	19	0.30*	[0.26, 0.34]	30.96	18		
High School	5	0.17	[-0.15, 0.50]	154.29	4		
College	15	0.15*	[0.06, 0.24]	98.45	14		
Other	31	0.44*	[0.36, 0.51]	651.40	30		
Region					2	1115.64	172.96*
Asia-Africa	27	0.25*	[0.18, 0.31]	158.89	26		
Europe	7	0.23**	[0.02, 0.43]	187.15	6		
USA	36	0.39*	[0.32, 0.46]	769.60	35		
Measure of self-control					2	1187.17	101.43*
BSCS	24	0.27*	[0.16, 0.38]	677.91	23		
ISC	28	0.39*	[0.33, 0.46]	395.50	27		
Other	18	0.28*	[0.19, 0.36]	113.76	17		
Measure of academic achievement					1	738.96	549.64*
GPA	32	0.45*	[0.39, 0.51]	340.80	31		
Other	38	0.22*	[0.16, 0.28]	398.16	37		
Sample Size					3	905.32	383.28*
<=100	4	0.41**	[0.13, 0.69]	11.37	3		
101-300	23	0.25*	[0.19, 0.30]	81.92	22		
301-500	9	0.09	[-0.05, 0.22]	144.13	8		
>500	34	0.43*	[0.36, 0.49]	667.90	33		
Date of publication[1]							
Correlation ES and year.	70	0.32**	[0.09, 0.51]				

Note. * $p < .001$; **$p < .05$; k = the number of study; CI = Confidence interval; Qw = Q within; Qb = Q between.

[1] Analyzed using Pearson's correlation.

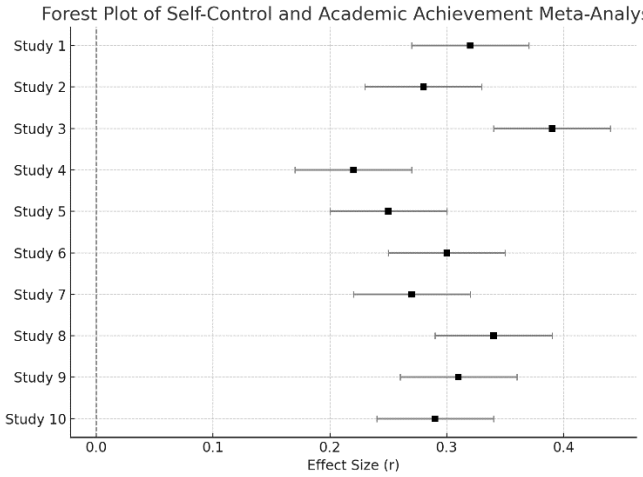

Figure 2. Forest Plot

Figure 2 shows forest plots from 70 studies analyzed using a random effect model. In forest plot effect size, each study is symbolized by square dot, while horizontal lines extending from both sides of the squared dot indicate the estimated confidence interval. By looking at forest plots, it can be seen that there are seven studies that have negative effect sizes, Elias et al. (2005) for study 2 and study 3, Kuhnle et al. (2011), and Honken et al. (2016) for study 2a, 2b, and 2c, while the rest have positive effect size. In addition, it can also be seen that most effect sizes have narrow confidence intervals (Duckworth et al, 2015; Honken et al., 2016), while some effect sizes have a slightly wide confidence interval (Muammar, 2015) .

Grade Level

In this meta-analysis, there are four grade level groups formed, namely middle school, high school, college, and other group. The results of the analysis of these moderator variables (see Table 4) show that grade level has an effect on the relationship between self-control and academic achievement ($Qb = 353.5$, $p < .001$). These results indicate that the average effect size of the four groups at the variable grade level is significantly different. From the results of the analysis, it can be seen that the relationship between self-control and academic achievement is strongest in studies using samples from other groups ($r = 0.44$, $p < .001$), followed by middle school group ($r = 0.3$, $p < .001$) and college group ($r = 0.15$, $p < .001$). The relationship between self-control and academic achievement for studies using samples from high schools was not significant ($r = 0.17$, $p = 0.29$), although the mean effect size was higher than in the college group.

Geographical Region

Geographical region moderator variables are categorized into three groups, namely Asia-Africa, Europe, and USA. The results of the analysis showed that geographical region had an effect on the relationship between self-efficacy and academic achievement ($Qb = 172.96$, $p < .001$). These results indicate that the mean effect sizes of the three geographical region groups differ significantly. The association between self-control and academic achievement from studies using samples from the USA ($r = 0.39$, $p < .001$) was stronger than studies using samples from other groups. As for studies using samples from Europe, the association between self-efficacy and academic achievement was weakest ($r = 0.23$, $p < .005$).

Measure of Self-Control

The study identified several scales used by each study to measure self-control variables. In this study, the moderator variables of self-control were categorized into three groups, namely BSCS, ISC, and other scales. The results of the moderated variable analysis showed that the strength of the relationship between self-control and academic achievement was also influenced by the type of scale used to measure self-control ($Qb = 101.43$, $p < .001$). These results indicate that the average effect

size of the three groups of self-control measurement scales is significantly different. Judging from the scale to measure self-control, the relationship between self-control and academic achievement was strongest for studies using the ISC scale (r = 0.39, p < .001) and followed by studies using other scales (r = 0.28, p < .001). Studies using the BSCS scale produced the weakest association between self-control and academic achievement (r = 0.27, p < .001).

Measure of Academic Achievement

In addition to investigating the effect of scales used to measure self-control, the study also investigated the effect of scales used to measure academic achievement. Academic achievement variables are categorized into two groups, namely GPA and other measurements. The results of the analysis indicated that the type of academic achievement measure also had a significant effect on the strength of the relationship between self-control and academic achievement (*Qb* = 549.64, p < .001). From these results, it is clear that the average effect size between studies using GPA and other measurements is significantly different. For studies using GPA to measure academic achievement resulted in stronger self-control and academic achievement associations (r = 0.45, p < .001) compared to studies using other measurements (r = 0.22, p < .001).

Sample Size

The moderator sample size variable in this study was categorized into four groups, namely studies with samples less than 100, 101-200, 301-500, and more than 500. The results of the analysis showed that sample size influenced the relationship between self-control and academic achievement (*Qb* = 383, p < .001). This indicates that the mean effect size for each sample size group differs significantly. The relationship between self-control and academic achievement occurred for studies using samples more than 500 (r = 0.43, p < .001). For studies using a sample less than 100 produced a strong association (r = 0.41, p < .005). However, for studies using samples of 301 to 500, the association between self-control and academic achievement was not significant (r = 0.09, p = 0.21), while for studies with samples of 101 to 300 produced a significant, although tentied, weak link (r = 0.25, p < .001).

Publication Years

This study involved studies published in the last 14 years (2005-2018). To evaluate the effect of publication years variables on the relationship between self-control and academic achievement, Pearson's correlation between publication years and all study effect sizes was conducted. The results showed that there was a significant correlation (although it tended to be weak) between publication years and effect size (r = 0.32, p < .05). The publication years variable is only able to have an influence of about 10% (R2 = 0.10) on the effect size, while the rest is influenced by other variables. Graphically the relationship between the two variables can be seen in Figure 3.

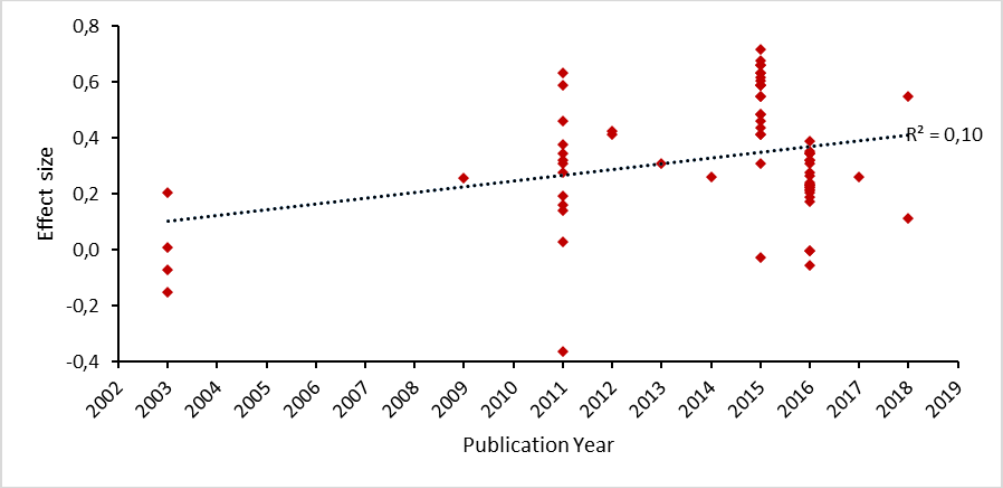

Figure 3. Relationship Between Effect Size and Publication Year

Assessment of Publication Bias

The funnel plots resulting from this meta-analysis study show that all plot effect sizes form a symmetrical pattern (Figure 4). This indicates that there is no problem with publication bias in the data used in this study. From the results of Egger's test obtained z = ¬-0.823, p = 0.41, where the results confirm that the funnel plot formed is symmetric. For fail-safe N testing, according to Retnawati et al. (2018) when the value of fail-safe N is larger than 5K + 10 (K represents the number of individual studies), it can be concluded that there is no publication bias. In this study K = 70, so 5(70) + 10 = 360. The fail-safe N value obtained in this study is 7110, with a target significance of 0.05 and p < 0.001. These results indicate that there was no publication bias in this meta-analysis study. Based on all the test results, it can be concluded that there is no publication bias in this study.

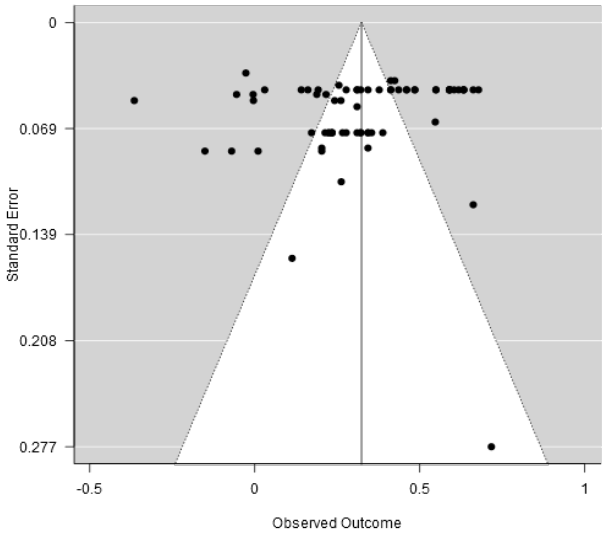

Figure 4. Funnel Plot From 70 Individual Studies

Discussion

The significant correlation between self-control and academic achievement indicates that self-control is a crucial factor influencing educational outcomes. Based on the results of this study, it was found that self-control relates not only to overall academic achievement but also to course grades and performance on standardized achievement tests. This finding aligns with the theory that self-control enables individuals to regulate behavior and focus on long-term goals (Cohen, 2013), thereby enhancing academic performance.

High academic achievement depends not only on effective teaching methods but also on students' psychological factors, particularly self-control and self-adjustment. Previous studies, such as those by Duckworth et al. (2012) and Judistira and Wijaya (2017), have shown that students who can regulate cognitive, motivational, and behavioral aspects of their academic functioning are more effective learners. This self-regulation encompasses the ability to manage internal impulses and maintain focus on goals, which is essential in facing academic challenges.

The analysis results show that children's self-control plays a role in shaping abilities that support academic achievement (Ma & Li, 2023; Michaelides & Durkee, 2021; Nota et al., 2004). This finding is further supported by an analysis of moderated mediating effects based on structural equation models, which revealed that emotional conflicts between teachers and students amplify the negative impact of low student self-control on academic achievement through mastery goals. Conversely, emotional support from teachers did not significantly moderate this relationship, as reported by Li et al. (2022) and Whelan et al. (2022). This suggests that diminished self-control may hinder academic performance.

Based on the definitions and previous studies, it can be concluded that self-control is an individual's ability to control, regulate, and direct behavior and impulses toward positive consequences. Additionally, self-control can be seen as behavioral regulation through careful consideration before acting or managing impulsive reactions that could hinder academic success. In

other words, self-control encompasses a person's capacity to organize, direct, guide, and structure behavior, emotions, and impulses, as well as the ability to resist or modify undesirable behavioral tendencies to achieve positive outcomes and avoid excessive reactions.

Implications and Limitations of the Study

These findings hold important implications for education and psychological interventions. First, interventions aimed at enhancing students' self-control could have a direct impact on their academic achievement. Training programs that focus on developing self-control skills could better equip students to face academic challenges and achieve optimal outcomes. Additionally, these results highlight the role of educators and parents in supporting the development of students' self-control, which has a positive impact on academic achievement.

However, this study has limitations that should be acknowledged. First, variability in results across studies suggests the presence of additional factors influencing the relationship between self-control and academic achievement that were not fully identified in this study. Furthermore, this research is limited by the sample and measurement methods used in the studies analyzed. The use of a random-effects model in this meta-analysis allows for variation across sample populations, but the findings may not be entirely generalizable to other contexts. Future research should consider additional factors, such as cultural differences and more specific educational contexts. In conclusion, this study underscores the importance of self-control in education and encourages targeted interventions to support students in achieving optimal academic outcomes.

CONCLUSION

The analysis of 70 samples revealed a moderate positive relationship between self-control and academic achievement ($r = 0.32$, $p < 0.001$). Key findings indicate that self-control plays a crucial role in supporting students' academic success. Moderator analysis showed that factors such as education level, geographical region, self-control measurement tools, and achievement metrics significantly influence this relationship's strength. Specifically, the association was stronger in studies with mixed participant groups and weakest among college students. It was also stronger in studies involving U.S. students, using the ISC scale for self-control, and GPA for academic achievement. These findings suggest that educational interventions aimed at enhancing self-control, especially at the elementary and secondary levels, could improve students' ability to handle academic challenges. Future studies should explore additional factors, such as cultural differences and family environment, that might moderate this relationship. Developing more sensitive and contextually appropriate measures of self-control could also improve the accuracy of future research in this area.

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