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METACOGNITIVE AWARENESS AND ACADEMIC ACHIEVEMENT: A META-ANALYSIS STUDY

ÜSTBİLİŞSEL FARKINDALIK VE AKADEMİK BAŞARI: META-ANALİZ ÇALIŞMASI

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Abstract

The notion of metacognition, characterized as reasoning about one's own mental functions or perceptions of one's own thinking patterns, has long been an important concept in the field of education. The majority of researchers and academics agree on the fact that metacognition remains an essential component in learners' progress in terms of cognitive abilities as well as academic achievement. The goal of the current meta-analysis was to examine the correlation between academic achievement and metacognitive awareness across a diverse range of research studies. To this end, the current study described a meta-analysis of 36 studies (N= 10,463), published between 2008 and 2023 April, exploring the correlation between metacognitive awareness and academic achievement. A systematic search for the related studies was conducted in electronic databases (ULAKBİM, ERIC, and GOOGLE SCHOLAR) and it included only the studies that illustrated correlation coefficients between the variables. An examination of the total effect size of metacognitive awareness on academic achievement at 95% confidence interval revealed the size of .824. This figure indicates a strong relationship between metacognitive awareness and academic achievement in accordance with the overall effect size scale, highlighting the significance of metacognitive abilities in improving students' academic achievements by indicating a robust correlation.

Keywords: Metacognition, metacognitive awareness, academic achievement, meta-analysis

Öz

Bireylerin kendi zihinsel işlevleri veya kendi düşünme kalıplarına ilişkin algıları hakkında akıl yürütmesi olarak nitelendirilen ve bireyin kendi iç-görülerini, görüşlerini, yargılarını ve davranışlarını dikkate alma kapasitesini ifade eden üstbiliş, uzun süredir eğitim alanında ilgi çeken önemli bir kavram haline gelmiştir. Araştırmacıların ve akademisyenlerin çoğunluğu üstbilişin, öğrencilerin bilişsel yetenekleri ve akademik başarıları açısından ilerlemesinde önemli bir değişken olduğu konusunda hemfikirdir. Bu araştırmanın amacı, akademik başarı ile üstbilişsel farkındalık arasındaki ilişkiyi, alanyazında bu konuda gerçekleştirilen ilgili çalışmalar yoluyla incelemektir. Bu amaçla meta-analiz çalışması gerçekleştirilmiştir. Çalışmada, üstbilişsel farkındalık ile akademik başarı arasındaki ilişkiyi araştıran, 2008 ile 2023 Nisan arasında yayınlanan 36 çalışma (N= 10.463) analiz edilmiştir. Araştırma kapsamında ilgili çalışmalara ilişkin elektronik veritabanlarında (ULAKBİM, ERIC ve GOOGLE SCHOLAR) sistematik tarama yapılmış ve üstbilişsel farkındalık ile akademik başarı arasındaki ilişkiyi araştıran ve her iki değişken arasındaki korelasyon katsayılarına odaklanan çalışmalar ele alınmıştır. Gerçekleştirilen analiz sonucunda, üstbilişsel farkındalığın akademik başarı üzerindeki toplam etki büyüklüğü %95 güven aralığında incelendiğinde .824 olarak bulunmuştur. Bu sonuç, genel etki büyüklüğü ölçeğine uygun olarak üstbilişsel farkındalık ile akademik başarı arasında güçlü bir ilişkiye işaret etmekte ve üstbilişsel farkındalığın öğrencilerin akademik başarılarını iyileştirmedeki önemini vurgulamaktadır.

Anahtar Kelimeler: Üstbiliş, üstbilişsel farkındalık, akademik başarı, meta-analiz

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Introduction

Metacognition, described by Flavell in detail, has been a significant concept in terms of education for a long time, and its scope has been broadened, defined, and dimensioned in many ways (Chekwa, McFadden, Divine, & Dorius, 2015; Durdukoca & Arıbaş, 2019; Sonowal & Kalita, 2019; Veenman, Van Hout-Wolters, & Afflerbach, 2006). It is generally defined as reasoning about one's own mental processes or perceptions about thinking patterns, and it refers to the individual's capacity to consider their own insights, views, judgments, and behaviors (Flavell, 1987; Ormrod, 2004; Song, Loyal, & Lond, 2021; Zimmermann & Moylan, 2009). Metacognition is a systematic process that regulates self-awareness and self-control of cognitive functions, through which individuals can control and take responsibility for their own learning processes as well as activities (Jaleel & Premachandran, 2016). In this sense, it is the metacognition that makes the cognitive functions, which allow individuals to promote their perception and understanding, far more effective, as metacognitive skills guide the individuals and maximize their performance in transferring knowledge to new settings (Abedini, 2021). In other words, recollection, attention, comprehension, thinking, judgment, problem solving, and making choices are all mental activities that are part of cognition (Karakelle, 2012). Furthermore, metacognition, being a higher level of thought that facilitates understanding, is about knowing why and how to find a solution to a specific task, acknowledging the knowledge an individual already possesses, and creating room for new information (Chekwa et al., 2015).

Sperling, Richmond, Ramsay, and Klapp (2012) argue that the concept of metacognition has been viewed both as a distinct autonomous entity and as something positioned within self-regulation. Although acknowledging the insufficiency in the absence of fundamental abilities, Zimmerman (2002) asserts that metacognitive awareness could somehow promote self-control and therefore enhances levels of self-regulation. The roots of the research on metacognition seem to have arisen from Flavell's (1979) model that places emphasis on "metacognitive knowledge, metacognitive experiences, goals (or tasks), and actions (or strategies)" (pp. 906).

According to Flavell (1979), metacognitive knowledge embraces mainly views or understandings in terms of what we know about our own mental abilities. Metacognitive knowledge is generally divided into three types: "declarative knowledge, procedural knowledge, and conditional (strategic) knowledge" (Schraw & Moshman, 1995). Metacognitive knowledge includes the basics of doing something, such as the abilities, approaches, and resources needed to complete the given task, as well as utilizing a particular and suitable strategy when needed (Bogdanović, Obadović, Cvjetićanin, Segedinac, & Budić, 2017). More explicitly, individuals' understanding of cognition as a whole pertains to their perception of how they learn and what they know about the processes and strategies that work best for them (Schraw & Moshman, 1995). Flavell (1979) gives an example of a child's internalized idea that, compared to many of his or her peers, he or she is more proficient at arithmetic than spelling.

Metacognitive experiences refer to mindful mental or sentimental experiences, personal feelings, views, and psychological reactions given to specific stimuli or occasions. In a word, metacognitive experiences include using metacognitive knowledge to develop instant assessments and interpretations of particular mental occurrences and operations (Spada, Proctor, Caselli, & Strodl, 2013; Blummer & Kenton, 2014). An example of this might be the rapid realization that you do not understand what someone else just stated (Flavell, 1979).

According to Flavell (1979), "goals (or tasks)" refer to the objectives of a cognitive enterprise, while actions (or strategies) refer to the cognitions or other behaviors employed to achieve them". In other words, the aims of a metacognitive activity are metacognitive goals. However, it should be noted that metacognitive goals could be different from cognitive goals.

Reading and comprehending a part of a book could be a cognitive goal, while monitoring that process to assess its effectiveness could be a metacognitive goal (Brown, 1984).

Further descriptions have brought about diverse and broad theoretical definitions of metacognition. According to Schraw and Dennison (1994), the term can be divided into two components: knowledge about cognition and regulation of cognition. In this framework, metacognitive awareness is defined as the ability to contemplate, comprehend, and control one's own learning. Ormrod (2004) describes the concept as individuals' knowledge through which they organize their mental processes, and they use the processes while learning, understanding, remembering, and applying the knowledge in new settings. Lately, the term metacognition has been expanded to include mental processes, planning, being aware of and knowing one's own knowledge, cognition, affective factors, purposely observing and monitoring the processes, self-regulation, effective resource management, and utilizing the knowledge efficiently rather than in a mere and restricted framework of "thinking about thinking" as previously assumed (Ashfaq, Arif, Basit, & Qureshi, 2022; Papaleontiou-Louca, 2003).

Considering the theoretical framework thus far, it would not be surprising for researchers, scholars, and educators to intuitively hold the view that metacognition is a crucial ability and skill for learners and an indispensable component of learning. Many years of prior research studies have been conducted to present its role and its associations with various factors. Metacognitive skills revealed a positive relationship with problem-solving success (Ahdhianto, Marsigit, Haryanto, & Santi, 2020; Annevirta & Vauras, 2006; Güner & Erbay, 2021); motivation (Bourdeaud'hui, Aesaert, & Braak, 2021; Acosta-Gonzaga & Ramirez-Arellano, 2021); self-regulation (Çetin, 2017), reading comprehension performance (Muhid, Amalia, Hilaliyah, Budiana, & Wajdi, 2020; Nejad & Mahmoodi-Shahrebabaki, 2015) and ultimately academic performance (Abdelrahman, 2020; Mevarech & Amrany, 2008; Abedini, 2021; Bryce, Whitebread, & Szűcs, 2015; Ekici, Ulutaş, & Atasoy, 2019; Narang & Sarita, 2013; Özturan-Sağırlı, Baş, & Bekdemir, 2020; Teng & Yue, 2023; Young & Fry, 2012).

It can be concluded that the majority of researchers and academics agree on the fact that metacognition remains an essential component in learners' progress in terms of problem solving, learning, motivation, achievement, etc. This insight is supported by a myriad of studies, and the role of metacognition has been highlighted as a critical determinant in both learners' progress and academic achievement. As Abedini points out, being a critical skill, metacognition enables learners to become autonomous thinkers, having command and mastery over their cognitive operations. Through metacognition, learners may take charge and responsibility for what and how they study and learn, which encourages the growth of autonomous learning. It has also been highlighted that learners exhibiting high levels of metacognitive abilities are likely to set specific learning goals, identify the subject matter, design a timetable in parallel with the subject matter, and choose the most convenient cognitive and metacognitive approaches. It also provides opportunities for learners to experience real-life learning situations, and it helps them monitor their growth and development as well as assess their learning and comprehension (Ashfaq et al., 2022).

Considering how metacognition and academic performance are related to each other would have major implications for approaches to teaching, curriculum development, and pedagogical practices. In this way, researchers can find appropriate methods that would improve learning outcomes by looking into the connection between metacognitive awareness and academic performance. In addition, by gaining an understanding of how metacognitive abilities affect academic performance, customized interventions could be developed to enhance students' learning opportunities and accomplishments. It, thus, may lead to improved problem

solving skills, deeper learning and efficient studying. It is also thought that this would aid in enhancing educational opportunities, enhancing the performance of learners, and assisting in the creation of successful instructional methods and interventions. The findings of a meta-analysis on the link between metacognitive awareness and academic achievement could also provide a guide to the development of teaching practices and a thorough synthesis of the body of literature. Even though several studies have examined the association between metacognition and academic achievement, the literature presents diverse methodological approaches and results that vary. By meticulously and thoroughly analyzing multiple studies of research, combining data from various populations, samples, and backgrounds, and offering a more precise estimation of the total impact size, a meta-analysis could help fill in these information gaps. A meta-analysis can provide valuable insights and shed light on the nature and degree of the link between metacognition and academic success by synthesizing longitudinal as well as experimental studies that could explore the influence of metacognitive involvement on academic achievements. Furthermore, performing a meta-analysis improves the generalizability of results and statistical power, as limited samples in individual research studies might make it difficult to find subtle but significant effects. Thus, a meta-analysis could boost the statistical power to identify those effects by combining data from many studies and offering a more accurate estimate of the total impact size. In light of these insights, the purpose of the current study has been identified as follows: What is the effect level of metacognitive awareness on academic achievement?

Method

A meta-analytic technique that highlights outcomes from several studies rather than results from a single research study was applied in this study. A meta-analysis is a statistical method that employs particular metrics, such as the effect size, to reflect the significance of variable correlations in the studies included in the study. The method highlights outcomes from several studies rather than results from a single study (Shelby & Vaske, 2008; Shorten & Shorten, 2013).

Data Collection

Research Plan

A thorough and meticulous systematic search for the related studies was conducted in electronic databases (ULAKBİM, ERIC, and GOOGLE SCHOLAR). The keywords "metacognition" OR "metacognitive awareness" OR "metacognitive thinking" AND "academic achievement" OR "academic success" OR "academic performance" OR "GPA (Grade Point Average)" were searched at the initial stage of the study's criteria. In view of the practical constraints and availability of sufficient studies, the search was limited to articles published in these databases in English between 2008 and April 2023.

Study Selection and Exclusion Criteria

A total of 932 studies were accessed in the initial search results. However, during the process of a thorough and scrupulous study selection for a full-text review, possible relevant papers were chosen, and after the full-text evaluation, 36 papers were considered eligible for inclusion in the meta-analysis. In the review process, the studies were required to have the following inclusion criteria: (1) the research written in English; (2) the research carried out in quantitative method; (3) the research providing the correlation coefficients between metacognitive awareness and academic achievement; (4) research addressing the study question directly and offering insightful data for the meta-analysis; (5) research corresponding to the topic of the meta-analysis and published within the specified dates; (6) research published in a peer-reviewed journal with adequate detail of the method and data; (7) research with open-

access options and databases available. Figure 1 demonstrates the literature review and study selection process.

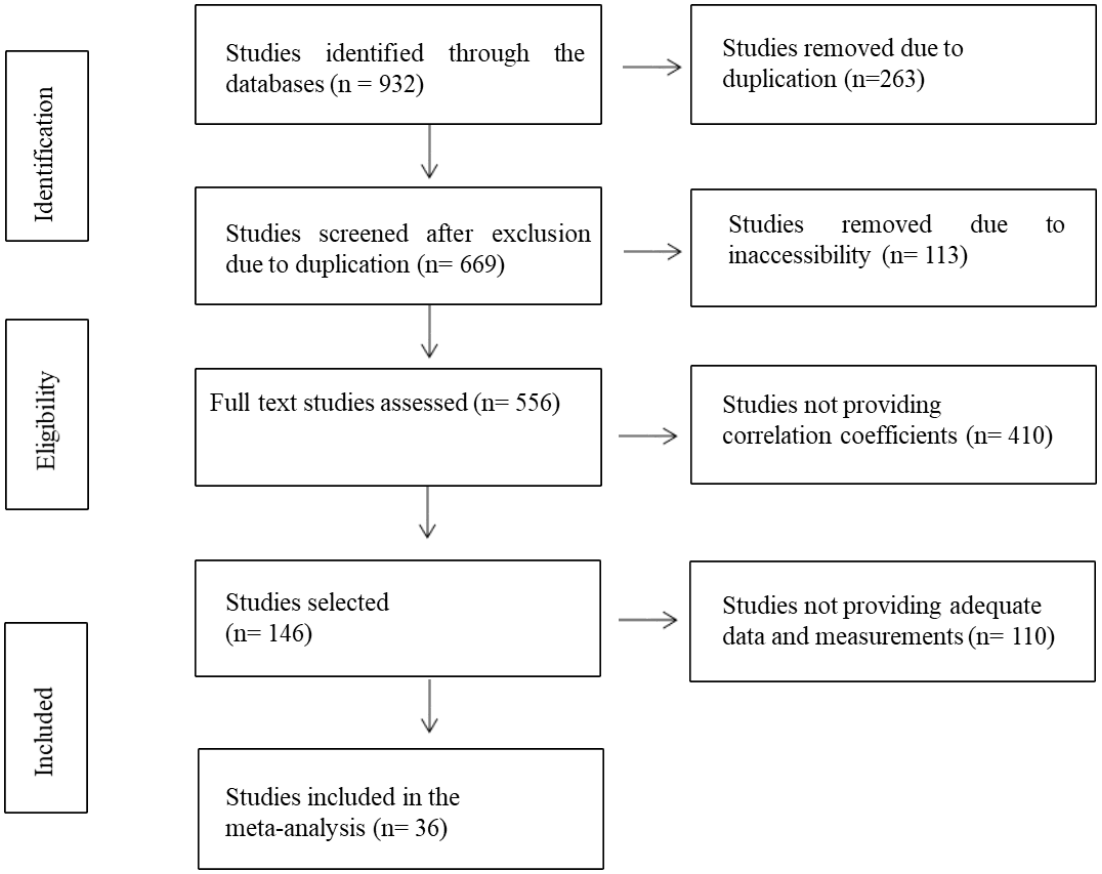


Figure 1. Flow Diagram of Selection Process

Throughout the selection process, the related literature was reviewed cautiously, and each study was analyzed in a detailed way. Initially, the titles, abstracts, and full texts of studies were examined, and the ones with inappropriate study designs, unsuitable populations, insufficient data, language limitations, and not having adequate data in terms of correlation coefficients as well as theses were excluded. At the end of the process, 896 research studies were excluded from the analysis as they did not meet the inclusion criteria. Ultimately, a total of 36 papers were included in accordance with the research question. In Table 1, the studies chosen to be convenient for the meta-analysis are listed.

Table 1. Description of studies included in the synthesis

Study	Date	r	Sample size	Tools of Creativity	Tools of Academic Achievement
Abdellah	2015	.81	75	Metacognitive Awareness Inventory (MAI)	GPA
Abedini	2021	.35	240	Metacognitive Awareness Inventory (MAI)	GPA
Adıgüzel & Orhan	2017	.079	310	Metacognition Scale	First Mid-Term Exam
Ajisuksmo & Saputri	2017	.08	103	Metacognitive Awareness Inventory (MAI)	Student Academic Achievement in Mathematics
Akbarilakeh & SharifiFard	2021	.79	255	Metacognitive Awareness Inventory (MAI)	Total Grade Point Average
Akbayır & Topçul	2021	.22	120	Metacognitive Awareness Inventory (BFE)	Students' grades in the first term mathematics exams
Akpur	2017	.43	253	Metacognitive Awareness Inventory (MAI)	GPA
Aykut et al.	2016	-.14	430	Metacognitive Awareness Inventory (BFE)	GPA
Bağçeci et al.	2011	.34	194	Metacognitive Awareness Inventory (UFE)	GPA
Bogdanovic et al.	2015	.48	746	Metacognitive Awareness Inventory (MAI)	Knowledge Test of Physics
Bozgun & Akın-Kosterelioglu	2023	.22	390	Metacognitive Awareness Inventory (MAI)	GPA
Çelik & Arslan	2022	.56	462	Mathematical Metacognition Awareness Scale	Math Class End of Year Grades
Çetin	2021	.25	86	Metacognitive Awareness Inventory (MAI)	GPA
Çevik & Abdioğlu	2018	.82	26	Metacognitive Awareness Inventory (ÜFÖ)	STEM Achievement Test
Dos	2014	.29	209	Metacognitive Awareness Inventory (MAI)	GPA
Ekici et al.	2019	.21	367	Metacognitive Awareness Inventory (MAI)	Academic Grade Averages
Fitrisia et al.	2015	.14	272	Metacognitive Awareness of Reading Strategies Inventory (MARSI)	Reading Comprehension Test
Gul & Shehzad	2012	.22	345	Metacognitive Awareness Inventory (MAI)	GPA
Iqbal et al.	2022	.25	332	Metacognitive Awareness of Reading Strategies Inventory (MARSI)	Collected academic performance (first annual professional part 1 results)

Khodabakhshzadeh et al.	2017	.65	122	Metacognitive Awareness Inventory (MAI)	Learners' Language Scores at the End of the Term
Kirbulut & Uzuntiryaki-Kondakci	2019	.37	576	Metaconceptual Awareness and Regulation Scale (MARS)	Primary Education to Secondary Education System Exam
Kortisarom	2020	.27	29	A metacognitive Awareness Questionnaire	A listening Comprehension Test
Rahman et al.	2010	.45	900	Metacognitive Awareness Inventory (MAI)	Achievement Test
Ramadhanti & Yanda	2021	.81	63	Metacognitive Awareness Writing Questionaire (MAWQ)	Writing Explanatory Text
Robillos & Bustos	2022	.39	27	Metacognitive Awareness in Listening Questionnaire (MALQ)	Listening Comprehension Tests
Sağırlı et al.	2020	.10	764	Metacognitive Awareness Inventory (MAI)	GPA (AGNO)
Sarıçoban & Behjoo	2017	.54	82	Metacognitive Awareness Reading Strategies Inventory (MARSI)	Reading Achievement Test
Shah & Modna	2022	.46	64	Metacognitive Awareness Inventory (MAI)	Final Percentage Score in Physiology
Siddiqui et al.	2020	.10	1200	Metacognitive Awareness Inventory (MAI)	GPA
Sonowal & Kalita	2019	.22	134	Metacognitive Awareness Inventory (MAI)	Class XI Higher Secondary (First Year) Examination
Sperling et al.	2012	.25	97	Metacognitive Awareness Inventory (MAI)	GPA
Toraman et al.	2020	.78	412	The Metacognitive Awareness Inventory for Children (MAI-C)	Maths Course Achievement
Ullah et al.	2020	.37	101	Metacognitive Awareness Reading Strategies Inventory (MARSI)	University Professional Examination
Ward & Butler	2019	.22	97	Metacognitive Awareness Inventory (MAI)	CGPA
Xu & Huang	2018	.11	402	Listening Metacognitive Awareness Questionnaire (MALQ)	CET-4 Listening Test
Young & Fry	2008	.23	178	Metacognitive Awareness Inventory (MAI)	GPA

Data Analysis

In the current study, the Comprehensive Meta-Analysis (CMA 2.2) software package was utilized to quantify and conduct the required statistical analysis of the individual and overall effect sizes of metacognitive awareness on academic achievement. The overall effect size scale is a standard measure that assesses the amount of a meta-analysis's effect. It allows the

researchers to evaluate the magnitude and pattern of the association between the variables across different studies. The following scale was applied to determine the overall effect size: -0.15 - 0.15 negligible; 0.15 - 0.40 small; 0.40 - 0.75 medium; 0.75 - 1.10 large; 1.10 - 1.45 very large; 1.45 excellent (Dinçer, 2014; Sullivan & Feinn, 2012).

In an attempt to identify the overall effect size, the heterogeneity test is to be performed in order to figure out whether to apply the fixed effects model or the random effects model. In other words, in a meta-analysis, a heterogeneity test is required to measure the diversity in the impact sizes of various studies, guide the selection of models, have accurate interpretation, uncover the outliers, and ultimately offer a more precise and comprehensive view of the overall findings (Dinçer, 2014; Huedo-Medina, Sánchez-Meca, Marín-Martínez, & Botella, 2006). The heterogeneity test results are shown in Table 2.

Table 2. The findings of the heterogeneity test

			95% CI							
Model	N	Estim.	Low.L.	Up. L	Z-val.	P-val.	Q-val.	df (Q)	p-val.	l-squared
Fixed	36	0,595	0,554	0,637	28,152	0,000	660,090	35	0,000	94,698
Random	36	0,824	0,634	1,014	8,504	0,000				

Table 2 displays the results of the heterogeneity test. As depicted, it can be concluded that the studies in the meta-analysis can be considered heterogeneous because the p-value is 0.000. Additionally, as the Q value in the x2 significance table for 35 (df) is less than 660,090 ($p<0,005$), the result supports the conclusion that the appropriate approach is to use the random effects model. The random effects model here suggests that there is variability both within and between studies, making it appropriate for circumstances where studies are predicted to have varied real impact sizes due to genuine differences. In this way, a more detailed assessment of the overall effect and insights into study variability are far more possible.

Following the heterogeneity test, the funnel plot was also analyzed in order to visually evaluate the presence of publication bias. The link between the effect sizes of different studies and their accuracy is graphically shown in a funnel plot. The studies included in the meta-analysis are supposed to be dispersed symmetrically around the estimated overall effect size in the plot, resembling an inverted funnel. In other words, if there is no publication bias, the plot will show an approximately symmetrical distribution of studies around the overall effect size. In Figure 3, funnel plot of the analysis is presented.

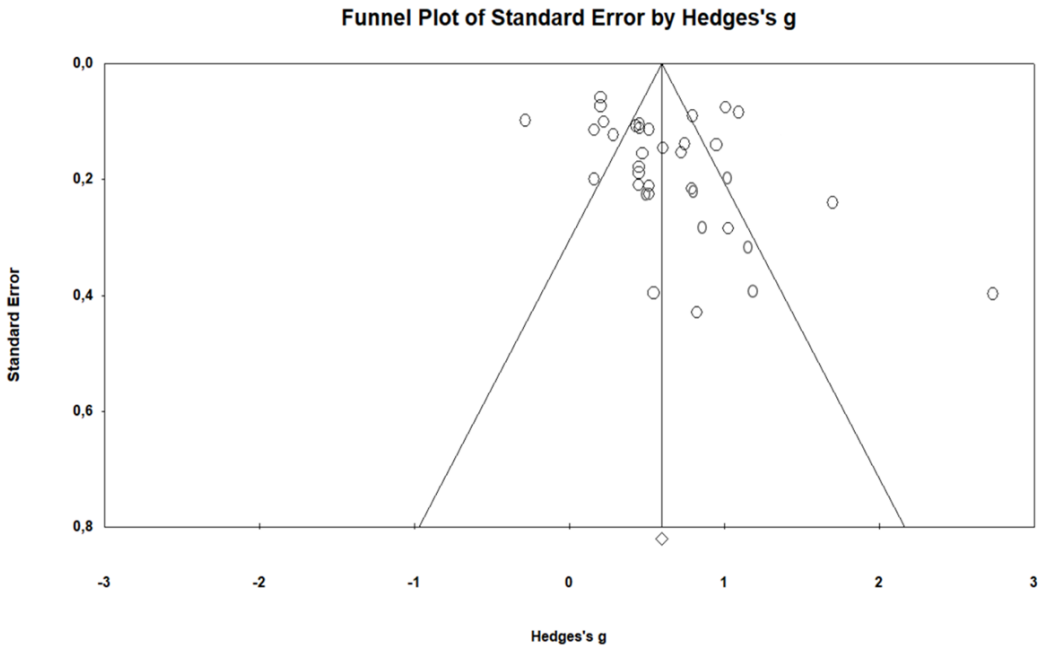


Figure 2. The Funnel Plot of the Studies

Figure 3 displays the funnel plot of the studies included in the analysis. Examining the figure, it can be concluded that the studies mostly located around the axis connotes the minimality of publication bias. It should be noted that the asymmetry in the funnel plot may be a sign of publication bias or other variables affecting how impact sizes are distributed. When the dots representing the studies are generally evenly distributed around the overall effect size estimate, the funnel plot is said to have a symmetrical distribution. In such circumstances, the graph shows that studies with both lower and greater effect sizes are quite evenly distributed on both sides of the middle line (Kossmeier, Tran, & Voracek, 2019; Stern & Harbord, 2004). Subsequently, Rosenthal's Safe N method, a technique for figuring out how publication bias could affect outcomes, was applied in order to anticipate the number of unpublished studies with non-significant results that are required to nullify the reported overall effect size. Table 4 presents the results of the analysis.

Table 4. Rosenthal's Safe N Analysis

Z-value for observed studies	16.60
p-value for observed studies	0.00
Alpha	0.05
Tails	2.00
Z for alpha	1.95
Number of observed studies	36.00
Numb. of missing studies to bring p-value to > alpha	8213

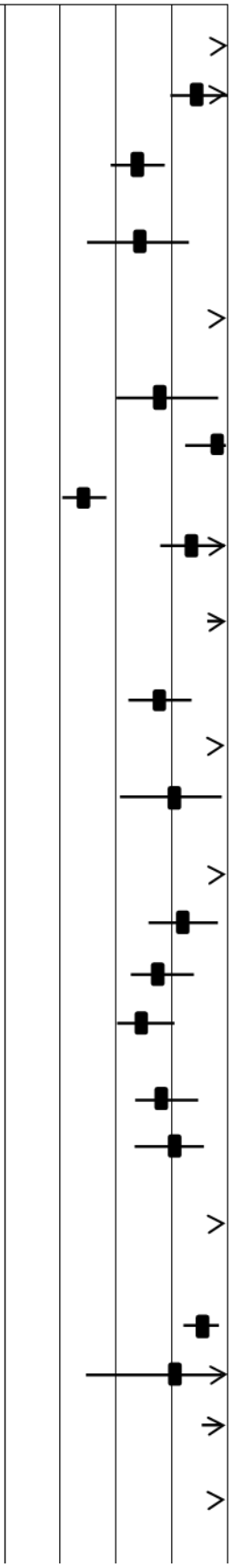
In an effort to determine how many unpublished studies with null or non-significant findings could be absent from the analysis, Rosenthal's Safe N method was applied. Table 4 indicates that as the alpha value (0.05) is higher than the p value (0.00), the overall effect size is likely to be robust against publication bias. In addition, the figure 8213 referring to the number of missing studies suggests the idea of estimating the number of additional studies that would have to be included in the analysis to make the total p-value higher than alpha.

Overall, the results of the analysis suggest that the probable effects of publication bias on the findings are of minimal significance. In other words, the reported impact size is less likely to be a consequence of publication bias, as it would take a significant number of missing studies to change the result.

Findings

As a part of the inclusion criteria, the research studies that provide the correlation coefficients between metacognitive awareness and academic achievement were reviewed, and the values of correlation were identified. Figure 2 depicts the individual effect sizes of each research study as well as the overall effect sizes of the studies involved in the meta-analysis.

Study Name	Hedges' g	Stan. Error	Var.	Lower Limit	Upper Limit	Z	P
Abdellah, 2015	2.734	0.398	0.158	1.954	3.514	6.813	0.000
Abedini, 2021	0.745	0.138	0.019	0.474	1.016	5.388	0.000
Adıgüzel and Orhan, 2017	0.158	0.114	0.013	-0.066	0.382	1.384	0.166
Ajisuksmo and Saputri, 2017	0.159	0.199	0.040	-0.231	0.550	0.800	0.424
Akbarilakeh and SharifiFard, 2021	2.569	0.205	0.042	2.168	2.971	12.54	0.000
Akbayır and Topçul, 2021	0.448	0.188	0.035	0.079	0.817	2.380	0.017
Akpur, 2017	0.950	0.140	0.020	0.676	1.223	6.799	0.000
Aykut et al., 2016	-0.282	0.098	0.010	-0.474	-0.091	-2.893	0.004
Bağçeci et al., 2011	0.720	0.153	0.023	0.420	1.021	4.699	0.000
Bogdanovic et al., 2015	1.093	0.084	0.007	0.929	1.257	13.084	0.000
Bozgun and Akın-Kostereliogl u, 2023	0.450	0.104	0.011	0.246	0.654	4.328	0.000
Çelik & Arslan, 2022	1.350	0.112	0.013	1.129	1.570	11.998	0.000
Çetin, 2021	0.512	0.225	0.050	0.071	0.952	2.278	0.023
Çevik & Abdioğlu, 2018	2.775	0.706	0.498	1.392	4.158	3.933	0.000
Dos, 2014	0.604	0.145	0.021	0.320	0.888	4.162	0.000
Ekici et al., 2019	0.429	0.107	0.011	0.219	0.638	4.007	0.000
Fitrisia et al., 2015	0.282	0.123	0.015	0.041	0.523	2.296	0.022
Gul and Shehzad, 2012	0.450	0.111	0.012	0.233	0.667	4.069	0.000
Iqbal et al., 2022	0.515	0.114	0.013	0.293	0.738	4.535	0.000
Khodabakhshzadeh et al., 2017	1.700	0.240	0.057	1.230	2.170	7.091	0.000
Kirbulut and Uzuntiryaki-Kondakci, 2019	0.795	0.090	0.008	0.619	0.972	8.857	0.000
Kortisarom, 2020	0.545	0.396	0.157	-0.231	1.321	1.377	0.169
Rahman et al., 2010	1.007	0.075	0.006	0.861	1.153	13.477	0.000
Ramadhanti and Yanda, 2021	2.728	0.435	0.189	1.876	3.581	6.274	0.000



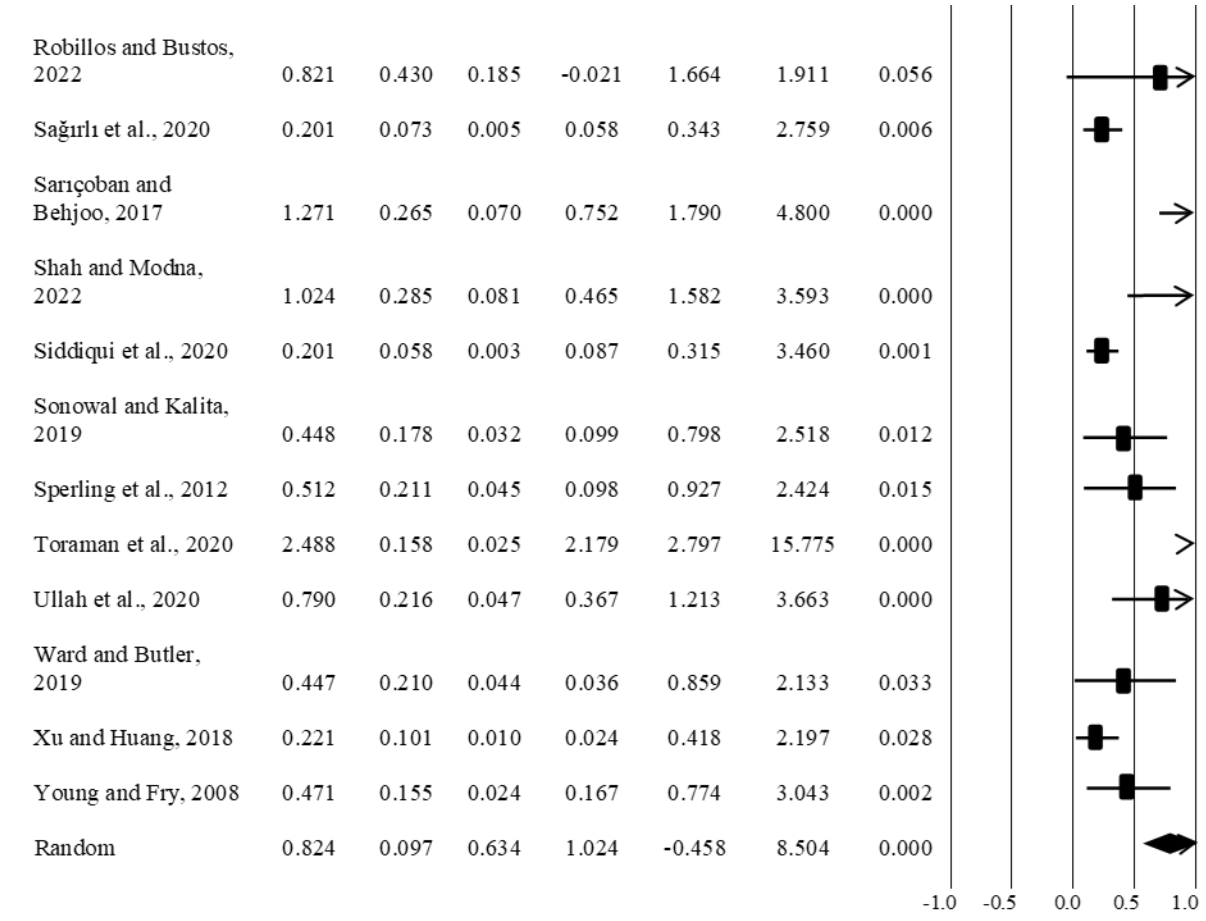


Figure 3. The effect size values of the studies

The effect size values of the studies are presented in Figure 2. Within the limits of the 95% confidence interval, the figure demonstrates the Hedges' g, standard error, variance, lower and upper limits, z, as well as p values of each study. It is observed that the Hedges'g value ranges from -0.282 to 2.775. According to the data, the only study conducted by Aykut et al. (2016) has a negative effect among others. Most importantly, the statistical measure that allows researchers to comprehend and interpret the range of an impact over several research studies is the total effect size value. In the current analysis, the total effect size of 0.824 indicates a large and strong effect in accordance with the overall effect size scale.

Discussion

The goal of the current meta-analysis was to examine the correlation between academic achievement and metacognitive awareness across a diverse range of research studies. The synthesis of findings from these studies revealed a total effect size of 0.824, demonstrating a strong and large positive relationship between the variables. This effect size highlights the significance of metacognitive abilities in improving students' academic achievements by indicating a robust correlation.

The overall effect size of 0.824, underscoring a strong and meaningful tie between academic achievement and metacognitive awareness, also aligns with the conceptual theories asserting that learners who are more conscious of their own metacognition are better able to use efficient learning strategies, keep track of and take control of their own learning development, and choose appropriate learning strategies (Abedini, 2021; Ashfaq et al., 2022; Livingston, 2003; Siqueira et al., 2020; Song et al., 2021). These skills likely pave the way for far better academic achievement across a range of courses and educational levels.

The view that metacognitive awareness acts as an important variable for academic ability is further supported by the constancy of the positive association across many situations and demographics. In line with the findings of the current study, a number of other studies also highlight the positive and meaningful relationship between the variables. To illustrate, Ward and Butler (2019), in their study with college students, found a significant and positive link between metacognitive awareness and the participants' academic achievement, indicating that, compared to ones with lower levels of metacognitive awareness, those with greater levels are likely to be academically more successful. Likewise, another study conducted by Young and Fry (2012) with graduate and undergraduate students yielded similar results, highlighting a significant positive association between the variables.

Another important point to be emphasized in terms of the result is that conclusively, the aforementioned close association is not restricted to particular contexts or populations, although the methodologies, research designs, cultural backgrounds, assessment criteria, measurements, participant characteristics, and ages, as well as moderators, vary, and the assumption that there is a strong and positive relationship still holds. In other words, the robustness of the observed effect size is noteworthy, especially considering the wide range of studies included in this meta-analysis. The consistency of the positive relationship across different contexts and populations further supports the argument that metacognitive awareness serves as an important factor for academic achievement.

It is also worth noting that although the link between metacognitive awareness and academic achievement does exist, this relationship could be influenced by a variety of factors, including individual differences, learning contexts, and subject matter complexity. To put it differently, it should be noted that the association might be subject to several moderators such as cognitive skills and development, cultural differences and issues, individual objectives, lived experiences, different educational interventions, assessment tools, and success criteria, all of which might either enhance or mitigate the relationship.

The findings of this meta-analysis also have practical implications for policymakers as well as practitioners in education. By acknowledging the major role of metacognitive awareness in academic achievement, stakeholders in education can develop specialized interventions that will help learners promote their metacognitive abilities. In order to improve and promote positive learning outcomes, attempts such as intentional and planned instruction on metacognitive strategies, goal-setting, monitoring one's own learning progress, adapting appropriate approaches, methodical thinking, self-regulatory as well as self-assessment procedures, and so on could potentially be included in educational frameworks.

Much as the positive and strong correlation between the mentioned variables has been widely revealed, it is important to take into account certain constraints and limitations that might influence the reliability and generalization of the results. For one thing, the root causes that mediate or modify the association mostly remain unknown. To offer a more complex and detailed view, future studies should go deeper into identifying these aspects. In addition, the inclusion of heterogeneous studies, variations in assessment tools, and differences in learning settings may all lead to some degree of variation in the total effect size. Therefore, studies addressing the particular relationship between the variables in a different way should be considered for future studies. Moreover, certain measures might fail to encompass all distinctive components of metacognition, which would result in an inadequate assessment of the multifaceted construct of metacognition.

Finally, this meta-analysis, drawing attention to the potential importance of metacognitive awareness in educational contexts, provides convincing evidence for an important and notable positive link between metacognitive awareness and academic

achievement. The overall effect size of 0.824 emphasizes the need for enhancing metacognitive abilities in order to foster learners' academic performance. While the findings have significant implications in terms of teaching and learning, additional research is needed to address the multidimensional nature of metacognition as well as examine the processes that might have an effect on the association. Ultimately, focusing on the development of metacognitive awareness seems to be an opportunity that could improve the achievement of learners and learning outcomes.

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