Meta-Analysis of the Relation between Study Time and Academic Achievement

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Abstract
This meta-analysis of 49 studies examines the relation between study time and academic achievement. Seventy-seven independent samples were obtained, yielding a total sample of 19,219 participants. The mean correlation between study time and academic achievement was r = .12. The moderating effects of publication type, participant gender, participant age, scale for measuring study time, and the academic achievement measure were not significant. The effects of the domain of study time spent and domain of academic achievement on the relation between study time and academic achievement were supported. Since most studies examined academic study in general rather than focusing on specific subjects, future investigations can examine the relation between study time and academic achievement for specific subject areas.

Keywords: study time; academic achievement; meta-analysis

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Introduction

Educational researchers have long been interested in identifying determinants of academic achievement. Study time is a useful focus as study often dominates the daily routine of many students. Two different hypotheses regarding the relation between study time and academic achievement have been proposed. The first hypothesis posits that study time has a noticeable effect on academic achievement because student knowledge increases with time spent practicing and reviewing class material. This argument was supported by Culler and Holahan (1980), who sampled 65 freshmen with high test anxiety and found that the correlation between GPA and study time was moderate at $r = .30$. Similarly, a moderate correlation ($r = .387$) existed for 164 high school students (Saito, 1999).

The second hypothesis states that the positive effect of study time on academic achievement is minimal. The most important study was the Michigan Project, which was conducted over a 12-year period (Schuman, Walsh, Olson, & Etheridge, 1985). Despite using various research designs and methods to measure study time, the Michigan Project found that the correlation between study time and academic achievement was low. Delucchi and Rohwer (1987) also determined that study time had only a minimal effect on academic achievement ($r = .08$, .06, and .01). Credé and Kuncel (2008), who conducted a meta-analysis, found that mean correlations between study time and freshman GPA were low at $r = .19$, .15 for study time and overall GPA, and .01 for study time and course-specific achievement. Nevertheless, some researchers have found that study time negatively affected academic achievement (Mavis, 2000; Nonis, Philhours, & Hudson, 2006; O'Connor, Chassie, & Walther, 1980). That the correlation between study time and academic achievement is not consistent may be explained by the fact that study time is not equated with "quality" study time. Plant, Ericsson, Hill, and Asberg (2005) suggested that study time spent on deliberate practice promotes performance in several academic domains. On the other hand, study time without high concentration levels may not improve academic achievement.

In a meta-analysis of college students, Credé and Kuncel (2008) examined the relations between study habits, skills, and attitudes and academic achievement. However, their study had at least two significant limitations. First, their meta-analysis was narrow in scope as it focused specifically on college students while neglecting younger students. Second, their analysis neglected potential moderator effects (such as participant age, participant gender, study domain, and domain of academic achievement) on the relation between study time and academic achievement.

As several studies have obtained inconsistent results for the relation between study time and academic achievement, drawing clear conclusions from these studies is problematic. For example, literature contains mixed findings regarding the magnitude and direction of the correlation between study time and academic achievement. Given the inconsistent magnitude and direction of this correlation, deriving meta-analytic estimates of this relation will prove valuable. Such estimates can provide insights into the impact of study time on academic achievement. This meta-analysis has two primary objectives: to estimate the magnitude and direction of the relation between study time and academic achievement; and to identify the moderators of this relation.

Moderators

Moderator effects were examined to determine whether they influenced prior conflicting findings for the relation between study time and academic achievement. Moderator variables included participant gender, participant age, the measurement scale for study time, the domain of study time spent, domain of academic achievement, and measure of academic achievement and study features (publication type) of included studies.

Primary research generally ignored gendered differences in the relation between study time and academic achievement. Dickinson and O'Connell (1990), who sampled 91 female and 22 male undergraduate students, found that the correlation between study time and test score was .25 for males and .19 for females. Similarly, Lee (1986), who surveyed 118 Grade 8 boys and 119 Grade 8 girls, found that the correlation between reading study time and reading achievement was weak at .246 for the boys and weak at .288 for the girls. The correlation between math study time and math achievement was weak at .165 for the boys and weak at .211 for the girls. As primary research rarely explored the gender effect on the relation between study time and academic achievement, this study addressed this issue.

The second moderator tested was participant age. The role of study time may be less certain for college students as test scores and GPA (Kuncel, Credé, & Thomas, 2007; Kuncel, Hezlett, & Ones, 2001) are used to determine college and graduate school admission; thus, undergraduate and graduate students are more academically homogeneous than elementary and high school students. Since a correlation coefficient reduces under a range of restriction, the correlation between study time and academic achievement should be weaker for undergraduate and graduate students than for elementary and high school students. Few studies have examined the effect of age on the relation between study time and academic achievement. However, Delucchi and Rohwer (1987) utilized a cross-sectional analysis to determine whether age moderates the relation between study time and academic achievement. They sampled 284 college students, 536 senior high school students, and 420 junior high school students, and found a weak correlation between study time and grades of .10 for college students, a weak correlation of .06 for senior high school students, and a weak correlation of .08 for junior high school students. Their study did not support the moderating effect of age on the relation between study time and test performance for college students. Due to a lack of primary studies examining the effect of age on the relation between study time and academic achievement, a meta-analysis can quantitatively summarize the age effect and thereby determine its significance.

Schuman et al. (1985) suggested that the absence of a strong correlation between study time and academic achievement can be attributed to the method used to measure study time. To date, self-reported study time has been the dominant measurement method. Self-reported study time can be measured on a ratio scale using an open-ended question, or on an ordinal scale such as a Likert scale. Likert scales commonly provide a range for responses to a given statement (e.g., 1 = strongly disagree, 2 = disagree, 3 = agree, and 4 = strongly agree). On the other hand, a ratio scale is continuous scale and can be on a wide range of values. Hence, variability of the Likert scale is commonly smaller than that of the ratio scale. Despite the well-known range restriction effect, researchers still use Likert scales to measure study time. However, this leads to an underestimation of the strength of the relation between study time and academic achievement. The effect of range restriction is assessed by comparing mean correlations between ratio and ordinal scales.

The relation between study time and academic achievement seemed to be consistent across domains in terms of study time spent. For example, Fuligni and Stevenson (1995), who surveyed U.S., Taiwanese, and Japanese Grade 7 students, compared correlations between overall study time and math study time. The correlations between overall study time and math test score was .22 for U.S. students and .13 for math study time and math test score; for Taiwanese students, the corresponding correlations were .36 and .24, respectively; and for Japanese students, the corresponding correlations were .34 and .24. Lee (1986) assessed study time for reading and math, respectively, and found noticeable differences in the relation between study time and academic achievement across different domains in terms of study time spent.

Empirical findings indicate that the domain of academic achievement had little effect on the relation between study time and academic achievement. For instance, Adair (2009), who examined this relation using a sample of 130 undergraduate students, found that the correlation between weekly hours of study and math test score was strong at .68, while that between weekly study hours and GPA was strong at .78. Similarly, the effect of domain of academic achievement on the relation between study time and academic achievement seemed small in Federici and Schuerger (1976). In that study, the correlation between study time and test score in psychology was low at .15, while that between study time and GPA was also low.02. Because few investigations have examined the effect of the academic achievement domain on the relation between study time and academic achievement, one must consider the moderating effect of the academic achievement domain.

This study examines the effect of the academic achievement measure on the relation between study time and academic achievement to determine whether previous conflicting findings are attributable to the measure of academic achievement. Since grades (i.e., final grades for a specific course or GPA) can be determined by test performance, class participation, or attendance, the relation between study time and grades is weaker than that between study time and test score.

Method

Literature search

To locate potential studies, extensive searches were undertaken, starting with the ERIC, PsycINFO, and ProQuest Dissertations and Theses Databases, using different combinations of search terms related to study time and achievement (i.e., achievement, performance, attainment, grades, and test). The literature included studies published in journals, conference papers, book chapters, theses, and dissertations. The reference list of previous meta-analysis (Credé, & Kuncel, 2008) was subsequently examined for additional studies not identified in computer searches.

A meta-analysis can be meaningless if it compares apples with oranges. Thus, studies of homework and academic achievement were excluded. Furthermore, Cooper et al. (2006) mainly examined the relation between homework and academic achievement.

To be considered relevant, included studies had to report sufficient statistics to calculate an effect size. Second, studies using a pre-selected sample, such as students with a learning disability, were excluded. Third, studies involving an intervention or manipulation were also excluded. Finally, only studies in English were considered.

Analysis

Effect size in this meta-analysis was represented by the Pearson product-moment correlation coefficient *r*. A positive correlation coefficient indicates a conducive effect resulting from long study time being associated with high academic achievement. Each *r* value was weighted by sample size to calculate mean correlations.

To examine the effects of the study domain, academic achievement domain, and academic measure, all correlations between study time and academic achievement were coded. For instance, if two study time domains (e.g., English and Math) and two academic achievement measures (i.e., grades and test scores) were examined for a single sample, four correlation coefficients were coded: the correlation between time spent studying English and grades; the correlation between time spent studying English and test score; the correlation between time spent studying math and grades; and the correlation between time spent studying Math and test score. The independence issue occurs when multiple measures of study time and academic achievement are derived from a single sample of participants. When multiple measures of study time and academic achievement were used for a single participant, mean effect size was computed. To analyze effects of moderators, such as study time spent on specific academic domains and academic achievement measures, effect sizes were disaggregated and estimated independently.

Results

Description of Included Studies

This meta-analysis included 49 studies involving 19,219 participants. Six studies had two samples, three studies contained three samples, two studies contained four samples, and one study contained 11 samples, yielding 77 independent samples. Of these 49 studies, 25 were journal articles, 15 were dissertations, four were master's theses, three were conference papers, and two were book chapters. Table 1 lists the mean age, sample size, gender, scale for measuring study time, study time spent on specific domains, domain of academic achievement, scale of academic achievement, and the correlation between study time and academic achievement. Average sample size was 249.60 participants (range, 22–2,078). Five studies used female samples only, four employed male samples only, and 68 had samples with both genders. Three studies did not report mean participant age. The mean age of students in the remaining 74 independent samples was 19.28 (range, 13–30). Information for the scale used to measure study time was not available in 21 data points. For the remaining 56 data points, study time was measured using a ratio scale for 48 points and using an ordinal scale for eight data points.

After coding multiple effect sizes for various study time domains, the academic achievement domain, and academic achievement measures from the same participant sample yielded 84 effect sizes. In terms of study time domains, five data points were for study of language arts, 10 were for math, two were for science, 11 were for the social sciences, 46 were for general academics, and ten for other. In terms of the academic achievement domain, five data points measured academic achievement in language arts, 11 measured math achievement, two measured science achievement, nine measured social sciences achievement, 48 measured general academic achievement, and nine measured that in other domains. Twenty-six data points used test scores to index academic achievement and 58 data points used grades.

Mean Effect Sizes and Homogeneity Tests

Under fixed-effects assumptions, all studies are assumed to have the same true effect sizes. Variation in observed effect size is due to sampling error. Because this assumption is implausible, the random-effects model, which assumes both sampling error and random components are causes for variation in effect sizes, was used. Mean correlation between study time and academic achievement was weak at r =.12 with a 95% confidence interval of .08–.16. Homogeneity analyses indicate that the set of 77 independent effect sizes was not statistically significant, with Q = 66.40 (p = .78). No heterogeneity was observed, as I^2=0 and τ^2=0.

Moderator Analysis

Publication type

Table 2 lists sample number, mean correlation, the confidence interval, and homogeneity statistics for the moderators of publication type, participant gender, participant age, scale for measuring study time, time spent studying specific domains, the academic achievement domain, and indicator of academic achievement. The most common publication type was journal article (k =46) with a mean effect size of r = .11. For doctoral dissertation, mean effect size was r = .16. For these two publication outlets, mean effect sizes were positive and differed significantly from zero, indicating that study effort exerted a positive effect on the relation between study time and academic achievement.

Participant gender

According to Q_B, effect sizes did not vary with sample gender. The lack of gendered differences in relations between study time and academic achievement may result from the small number of studies included in this meta-analysis. Thus, caution is necessary when interpreting the influence of gender on relations between study time and academic achievement, since the female sample was based only on five studies and the male sample was based only on four studies. Consequently, findings related to the gendered effect should be considered suggestive, not definitive.

Participant age

Weighted regression analysis using age as a continuous variable was employed for hypothesis testing. The regression coefficient $b = -.01$ ($p = .09$) was non-significant, indicating that age did not significantly affect the relation between study time and academic achievement. Mean age of samples was also classified based on school grades and categorized into the following age groups: 10–13 (middle school), 14–17 (high school), 18–21 (college), and >22. Four samples used middle school students, 11 samples used high school students, 52 samples used college students, and seven samples used adults. The effect size for age groups 14–17 and 18–21 were significantly different from zero (Table 2). The 95% confidence intervals for age groups 10–13 and >22 included zero, indicating that no correlation exists between study time and academic achievement for these two age groups. The largest effect size was for the group aged 14–17; however, the effect size was small to moderate at .17 using the guidelines by Cohen (1988). The between-group homogeneity statistic was non-significant at $Q_B = 2.37$ and $p = .50$.

Measurement scale for study time

To examine the effect of the measurement scale for study time, multiple effect sizes were coded from the same participant sample, yielding 84 effect sizes. Study time was frequently measured on a ratio scale ($k = 50$), with a mean effect size of $r = .10$, which differed significantly from zero. Based on Q_B, the effect of the measurement scale for study time on the relation between study time and academic achievement was not statistically significant.

Specific study domain

The most commonly assessed study domain was general academics ($k = 46$), with a mean effect size of $r = .12$. Effect size was .26 for language arts and .23 for math. For these three study domains, mean effect sizes were statistically significant. The relation between study time and academic achievement differed among domains in terms of study time spent with $Q_B = 10.43$ ($p < .05$).

Academic achievement domain

The results for the academic achievement domain were similar to those for the specific study domains. Specifically, effect sizes for language arts, math, and general academics differed significantly from zero, and the effect of the academic achievement domain on the relation between study time and academic achievement was significant with $Q_B = 10.77$ ($p < .05$)..

Academic achievement measure

This study examines whether the relation between study time and academic achievement varied as a function of academic achievement measures. Mean effect sizes for both grades and test scores differed significantly from zero. Most studies used grades to index academic achievement, with a mean effect size of $r = .12$. Studies using test scores yielded a mean effect size of $r = .17$. The relation between study time and academic achievement did not differ in terms of the academic achievement measure.

Conclusions and Discussion

Society generally accepts that study improves academic performance. Educators and parents thus encourage diligent study and hard work (e.g., Delucchi & Rohwer, 1987). However, the relation between study time and academic achievement is weak. Analytical results obtained from examining 49 studies containing 77 independent samples (N = 19,219) indicate that the mean correlation coefficient between study time and academic achievement is weak at .12. This small effect size is consistent with a previous meta-analysis by Credé and Kuncel (2008), reporting that the relation between study time and academic achievement was small to moderate at best. In conclusion, studying did not strongly affect academic achievement.

Beyond overall trends, moderator analyses were introduced to explain the systematic variability in effect sizes. The effects of study time on a specific domain and the academic achievement domain were significant, indicating that the influence of study efforts varies among domains. Notably, the effect of study effort was relatively strong for language arts and relatively weak for social sciences. However, these associations were based on a small number of data points (five correlation coefficients for language arts and 11 for the social sciences). Most literature to date has simply examined academic study in general and, thus, research focusing on specific subject areas is required.

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Table 1: *Studies of the relationship between study time and academic achievement*

study	age	N	gender	Scale of ST	Study Domain	Domain of AA	AA measure	ES
Adair (2009)	18	130	Mixed	NA	M	M, G	Grades	.73
Ajgaonkar (2003)	23.32	695	Mixed	Ratio	G	G	Grades	.28
Allen et al. (1972)	19.5	122	Mixed	Ratio	SS	G	Grades	.16
Bagdan (1999)	19.5	211	Mixed	Ratio	O	G	Grades	.07
Bell (1931)	19.5	127	Mixed	Ratio	G	G	Grades	.32
Bembenutty (2001)	19.5	102	Mixed	Ratio	M	G	Grades	.03
Born (2000)	19.5	158	Mixed	Ratio	S	S	Grades	.07
Bradley (2000)	19.5	751	Mixed	Ordinal	SS	SS	Grades	.05
Carver (1970)	19.5	48	Mixed	Ratio	SS	SS	Test	.07
Craft (2006)	18	191	Mixed	Ratio	G	G	Grades	.01
Crawford (1929) #1	19.5	221	Mixed	Ratio	G	G	Grades	.00
Crawford (1929) #2	19.5	264	Mixed	Ratio	G	G	Grades	.17
Crawford (1929) #3	19.5	367	Mixed	Ratio	G	G	Grades	-.05
Crawford (1929) #4	19.5	314	Mixed	Ratio	G	G	Grades	-.01
Culler et al. (1980) #1	18	65	Mixed	Ratio	G	G	Grades	.30
Culler et al. (1980) #1	18	31	Mixed	Ratio	G	G	Grades	-.10
Delucchi et al. (1987) #1	13	380	Mixed	Ordinal	O	O	Grades	.08
Delucchi et al. (1987) #2	16	461	Mixed	Ordinal	O	O	Grades	.06
Delucchi et al. (1987) #3	19.5	160	Mixed	Ordinal	O	O	Grades	.10
Dickinson et al. (1990) #1	19.5	91	Female	Ratio	SS	SS	Test	.19
Dickinson et al. (1990) #2	19.5	22	Male	Ratio	SS	SS	Test	.25
Eppler et al. (1997)	29.8	50	Mixed	NA	G	G	Grades	.20
Eppler et al. (1997)	19.2	212	Mixed	NA	G	G	Grades	.02
Etcheverry (1990)	24.098	308	Mixed	Ratio	G	G	Grades	.23
Federici et al. (1976)	19.5	114	Mixed	NA	SS	G, SS	Grades	.09

Fuligni et al. (1995) #1	16.5	204	Mixed	NA	G, M	M	Test	.18
Fuligni et al. (1995) #2	16.5	222	Mixed	NA	G, M	M	Test	.30
Fuligni et al. (1995) #3	16.5	152	Mixed	NA	G, M	M	Test	.29
Gallagher (2006)	21.7	41	Mixed	NA	G	G	Test	-.04
George et al. (2008)	23.1	231	Mixed	Ratio	G	G	Test	.20
Hill (1990) #1	19.5	60	Mixed	NA	G	G	Grades	.15
Hill (1990) #2	19.5	335	Mixed	NA	G	G	Grades	.14
Jones et al. (1928)	19.5	130	Mixed	Ratio	G	G	Grades	-.28
Kuthy (2008)	NA	2078	Mixed	NA	O	O	Test	.48
Lammers et al. (2001)	21.7	366	Mixed	Ratio	G	G	Grades	.12
Leasure (1996)	29	226	Mixed	Ratio	M	M	Grades	-.18
Lee (1986) #1	13	118	Male	Ratio	L, M	L, M	Test	.21
Lee (1986) #2	13	119	Female	Ratio	L, M	L, M	Test	.25
Lehman (1995)	19.5	157	Mixed	Ratio	O	O	Grades	.11
Martin et al. (1974)	19.5	100	Female	Ratio	SS	SS	Test	-.15
Mavis (2000)	25.9	113	Mixed	Ratio	O	O	Test	.07
May (1923)	18	450	Mixed	Ratio	G	G	Grades	.32
Michaels et al. (1989)	19.5	676	Mixed	Ordinal	G	G	Grades	.18
Nonis et al. (2006)	23.8	264	Mixed	Ratio	G	G	Grades	.05
Nuesell (1990)	14	127	Mixed	NA	G	G	Test	-.10
O'Connor et al. (1980)	19.5	90	Mixed	Ratio	SS	SS	Test	-.39
Plant et al. (2005)	19.82	88	Mixed	Ratio	G	G	Grades	.02
Penceal (1989)	NA	215	Mixed	Ordinal	G	G	Grades	.03
Russo (2002)	NA	165	Mixed	Ratio	O	O	Grades	.38
Ryans (1939)	20	40	Mixed	Ratio	G	G	Grades	.37
Saito (1999)	17	172	Mixed	Ratio	G	G	Grades	.389
Schreiber (2000)	17	1839	Mixed	Ordinal	M	M	Test	.08
Schuman et	19.5	424	Mixed	Ratio	G	G	Grades	.11

al. (1985) #1								
Schuman et al. (1985) #2	19.5	113	Mixed	Ratio	S	S	Grades	.12
Schuman et al. (1985) #3	19.5	273	Mixed	Ratio	G	G	Grades	-.02
Schuman et al. (1985) #4	19.5	64	Mixed	Ratio	G	G	Grades	.02
Schuman et al. (1985) #5	19.5	300	Mixed	Ratio	G	G	Grades	.17
Schuman et al. (1985) #6	19.5	256	Mixed	Ratio	G	G	Grades	.04
Schuman et al. (1985) #7	19.5	370	Mixed	Ratio	G	G	Grades	-.01
Schuman et al. (1985) #8	19.5	394	Mixed	Ratio	G	G	Grades	.07
Schuman et al. (1985) #9	19.5	423	Mixed	Ratio	G	G	Grades	.08
Schuman et al. (1985) #10	19.5	345	Mixed	Ratio	G	G	Grades	.08
Schuman et al. (1985) #11	19.5	298	Mixed	Ratio	G	G	Grades	.17
Shaffer (1986) #1	19.5	102	Mixed	Ratio	O	O	Test	-.09
Shaffer (1986) #2	19.5	35	Mixed	Ratio	O	O	Test	.20
Simmons (1996)	19.5	580	Mixed	Ordinal	G	G	Grades	.15
Sparacino et al. (1979) #1	19.5	55	Male	NA	G	G	Grades	.24
Sparacino et al. (1979) #2	19.5	65	Female	NA	G	G	Grades	-.07
Sparacino et al. (1979) #3	19.5	50	Male	NA	G	G	Grades	.12
Sparacino et al. (1979) #4	19.5	87	Female	NA	G	G	Grades	.25
Wagstaff et al. (1976)	19.5	190	Mixed	NA	G	G	Grades	.32
Wilhite (1992)	19.5	196	Mixed	NA	SS	SS	Grades	-.01
Williamson (1935)	18	105	Mixed	Ratio	G	G	Grades	-.06
Youssef (1984) #1	15.5	27	Mixed	NA	L	L	Grades	.36
Youssef (1984) #2	15.5	32	Mixed	NA	L	L	Grades	.56
Youssef (1984) #3	15.5	38	Mixed	NA	L	L	Grades	-.10
Zuriff (2003)	19.5	24	Mixed	Ratio	SS	SS	Test	.02

Scale of ST = Scale of study time measure; study domain: L = language arts, M = math, S = science, SS= social science, G = general academics, O = other domains; domain of AA = domain of academic achievement; AA measure = academic achievement measure; ES = correlation between study time and academic achievement.

Table 2
Moderator Analyses

			95% CI		
Moderator	*k*	Mean	Lower	Upper	Q_B
Publication type					5.02
Journal	46	.11	.06	.17	
Dissertation	17	.16	.07	.25	
Thesis	4	.15	-.13	.43	
Conference	5	.12	-.13	.38	
Book chapter	5	-.03	-.24	.18	
Gender					.65
Female	5	.10	-.14	.34	
Male	4	.20	-.14	.54	
Mixed	65	.11	.07	.16	
					2.37
Participant age					
10-13	4	.11	-.13	.34	
14-17	11	.17	.07	.27	
18-21	52	.09	.05	.14	
More than 22	7	.12	-.01	.25	
Quality of study time measure					.00
Ratio scale	48	.09	.05	.13	
Ordinal scale	8	.09	-.01	.19	
Domain study time spent for					10.43*
Language arts	5	.26	.02	.50	
Math	10	.23	.11	.34	
Science	2	.09	-1.37	1.56	
Social science	11	.02	-.10	.14	
General academics	46	.12	.07	.17	
Domain of academic achievement					10.77*
Language arts	5	.26	.02	.50	
Math	11	.21	.11	.32	
Science	2	.09	-1.36	1.54	

Social science	9	.01	-.13	.14	
General academics	48	.12	.07	.16	
Academic achievement measures					1.33
Grades	58	.12	.07	.16	
Test scores	26	.17	.09	.24	

*<.05