

Relationship between Self-efficacy and Academic Achievement in Online Learning : Meta-analysis

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|| ABSTRACT ||

This meta-analysis examined academic self-efficacy in learning and its relationship to academic achievement. After an overview of the theoretical framework and current research, the results of selected studies are integrated in this paper. A PRISMA-guided systematic review was conducted in 2024 to examine the empirical evidence on the relationship between self-efficacy and academic achievement, investigate the underlying mechanisms, and assess the quality of the current evidence. Online databases were used to search for peer-reviewed articles that studied the relationship between self-efficacy and academic achievement in online courses. The results were organized into a narrative content synthesis and a meta-analysis. Twelve articles met the inclusion criteria. The overall quality of the study was quite good, with a pooled effect size of 0.36 [0.28; 0.44], indicating that self-efficacy has a moderate impact on student performance. Critical discussions based on the findings were conducted to understand methods for academic performance improvement, the implementation of educational activities, and their implications for future research.

Keywords: self-efficacy, achievement, meta-analysis, online learning

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I . Introduction

Self-efficacy refers to an individual's belief perception of the ability required to achieve set goals and considered to be the basis of human motivation and behavior (Bandura, 1997). Self-efficacy includes specific self-efficacy and general self-efficacy. Specific self-efficacy theory believes that the skills required for human action vary widely in different situations and tasks. Self-efficacy is an individual's self-belief in his or her ability to complete specific tasks (Bandura, 1997). Compared with specific self-efficacy, some studies believe that humans have a general self-efficacy when dealing with different environmental challenges or facing new things (Azizli et al. , 2015). This general self-efficacy Sense of efficacy is an overall belief gained through various past experiences of success and failure. It is a stable perception of personal ability that does not follow situations and tasks.

Academic achievement is regarded as a standard for measuring students' knowledge level and adaptability to school. It is an effective indicator for quantitatively evaluating the effectiveness of national education. It has become a core term of concern for students, parents, schools and society. Good academic achievement is not only conducive to the realization of a virtuous cycle in the development process of individuals, but also an important factor in eliminating the intergenerational transmission of poverty (Wang & Zhao, 2022). It can be seen that analyzing the influencing factors of academic achievement is of great significance.

In the studies of the relationship between self-efficacy and academic achievement, it was found that the impact of the two factors is not completely consistent. For example, most of other studies have shown that self-efficacy has positively affected on academic achievement (Lee & Kim, 2014 ; Kim & Lee, 2022). However still a research prove that it hurts academic achievement (Kim, 2023). Therefore, this study adopts the meta-analysis method to try to answer the following three questions: 1. What is the overall average effect size of self-efficacy on academic achievement? 2. What is the relationship between the effect size of self-efficacy and achievement with the moderating variables?

II. literature review

College students' self-efficacy is their subjective judgment on whether they can complete a certain task. Academic achievement covers many aspects of comprehensive quality for contemporary college students. A large number of studies have shown that college students' self-efficacy is closely related to academic achievement. Students with high self-efficacy spend more time studying than students with low self-efficacy and are confident in their learning. Bandura (1997) showed a positive correlation between students' academic self-efficacy and academic performance. Komarraju and Nadler (2013), Maria de Fátima Goulão (2014) research shows that academic self-efficacy is significantly positively related to academic achievement. Students with high academic self-efficacy enjoy learning more and have higher academic achievement (Komarraju & Nadler, 2013).

In addition, there are some mediating factors and moderating factors between self-efficacy and academic achievement. Among the specific mediating paths tested, they are also divided into internal factors and external factors, which partially mediate the relationship between ASE and academic achievement. External factors are mainly the teacher-student relationship (Liu et al., 2021). Internal factors such as learners' learning motivation (Li et al., 2022), positive academic emotions (Gao et al., 2023) play a mediating role between self-efficacy and academic achievement. This shows that students face a more effective learning environment and the relationship between teachers and students is more harmonious. Students who receive support from their teachers are more likely to succeed academically. In addition, the higher the students' ASE level, the more likely they are to have higher learning motivation and devote energy to learning tasks. At the same time, they also have more positive learning emotions and stronger self-regulation abilities, which may lead to higher levels of academic achievement. This is a logical conclusion and is supported by the results of previous studies.

Academic self-efficacy is also related to various moderating relationships with academic achievement. in terms of external factors. Relationships appear to have a strong impact on student learning. Whether it's the parenting style of parents and their relationships with their children, or the relationships and support teachers provide their

students, all have a big impact on self-efficacy (Huang et al., 2021). The authority of parents, the harmonious coexistence and support between parents, teachers and students have a certain promotion effect on students' ASE. In addition, negative lifestyle factors, such as academic self-efficacy such as study pressure, also show a negative regulatory effect on academic achievement (Liu, 2023). From the perspective of internal factors, the learner's own learning attitude, learning motivation, achievement goal direction, learning depth and subjective well-being will also affect students' self-efficacy, which in turn affects the learner's performance.

III. Method

We used a meta-analysis approach in our study. Meta-analysis is a literature review method used to combine and reinterpret the results of similar studies conducted independently in a specific field (Guzzo et al., 1987). It involves representing the results of each study by a numerical index of effect size and statistically combining these estimates across studies. This study examines the impact of self-efficacy on academic achievement using a meta-analytic approach and comments from a holistic perspective using findings from previous independent studies. Several variables thought to influence the results of academic achievement studies were conducted. This also affects the purpose of determining the extent of their effect.

1. Search strategy

The literature search was conducted through the Korean search website (www.riss.kr) of the Korea Institute of Educational Research. The search time of the database is from the establishment of the database to November 12, 2023 (the final search date). The search string contains the following search terms: [self-efficacy AND (mechanism* OR belief* OR theory)]AND (performance* OR achievement* OR result*OR outcome*). These keywords were based on previous systematic reviews in the relevant field, an initial scoping search, and discussions by the first author and all authors after the initial search.

The results of all searches are exported to 100 Endnote X9 reference management software, and duplicate items are removed using a combination of automatic and manual deduplication.

2. Eligibility criteria

A set of inclusion and exclusion criteria were established to guide the inclusion of papers in the review and ensure that all literature relevant to the review objectives was found. The literature included in this review meets the following criteria: 1. Published in peer-reviewed journals; 2. contained original empirical data; 3. used quantitative analysis methods to measure task performance; quantitatively assesses the relationship between self-efficacy and academic achievement. The exclusion criteria stated that studies were ineligible when they: 1. did not use quantitative performance measures; 2. used papers unrelated to the research topic; 3. were review papers, reviews, or scale validation studies; 4. used a single theme design.

3. Data extraction, analysis and synthesis

All titles and abstracts retrieved from the search were initially read and checked against the eligibility list above. Data extraction for the final selected studies was performed and all studies were read twice before extracting and synthesizing findings to enhance familiarity with the data (Hunter & Schmidt, 2004; Payne et al., 2019). According to the recommendations of Popay et al. (2006), the following data fields were extracted: author; publication date; participant sample characteristics; correlation coefficient, paper type.

4. Compute the meta-analysis

The R language was used to calculate the random-effects meta-analysis. Selection size in meta-analyses is a standard measure used to determine the strength and direction of relationships in studies (Borenstein et al., 2010). The Pearson correlation coefficient (r) was determined as the effect size in this study. Because the value of the correlation

coefficient is between +1 and -1. The calculated r value is evaluated by converting the value to what appears in the z table. Given that multiple correlation values were given between calculations of the same structure in related meta-analytic studies, two different approaches were used when determining the method to be used in the meta-analysis (Borenstein et al., 2010). for this study. (i) First, if the correlations are independent, then all relevant correlations are included in the analysis and considered as independent studies, and I^2 is greater than 50%, indicating large heterogeneity, and a random effects model is used.

In each case, the interpretation also followed Cohen's rules of thumb (VanVoorhis & Morgan, 2007). To check for heterogeneity in the data, we performed a visual inspection by checking the similarity of point estimates, the overlap of confidence intervals, and the results of statistical heterogeneity tests shown at the bottom of the forest plots. If greater similarity of point estimates and greater overlap of confidence intervals are observed, this implies less heterogeneity (Doi et al., 2015). The P value determined by the chi-square test is the probability of the null hypothesis that there is no heterogeneity between studies qualitative. Furthermore, less than 50% of I^2 used fixed-effects models and more than 50% used random-effects models. For advanced analysis, the funnel plot was used to calculate publication bias. Due to the small number of original studies, no moderator analyses were calculated. The focus of this review was on the method-critical evaluation.

IV. Results

In order to calculate the impact of self-efficacy on academic performance through meta-analysis, this study used 15 relevant papers retrieved in 2023 as the research object, used the Korean Institute of Educational Research Information search website (www.riss.kr) to collect data, and searched for “Self-efficacy”, “grades” and “achievement”, 3787 academic papers and 2334 papers were initially retrieved. Among them, a total of 879 studies were screened out after excluding repeated searches, as well as whether there were papers published in academic journals and papers with known

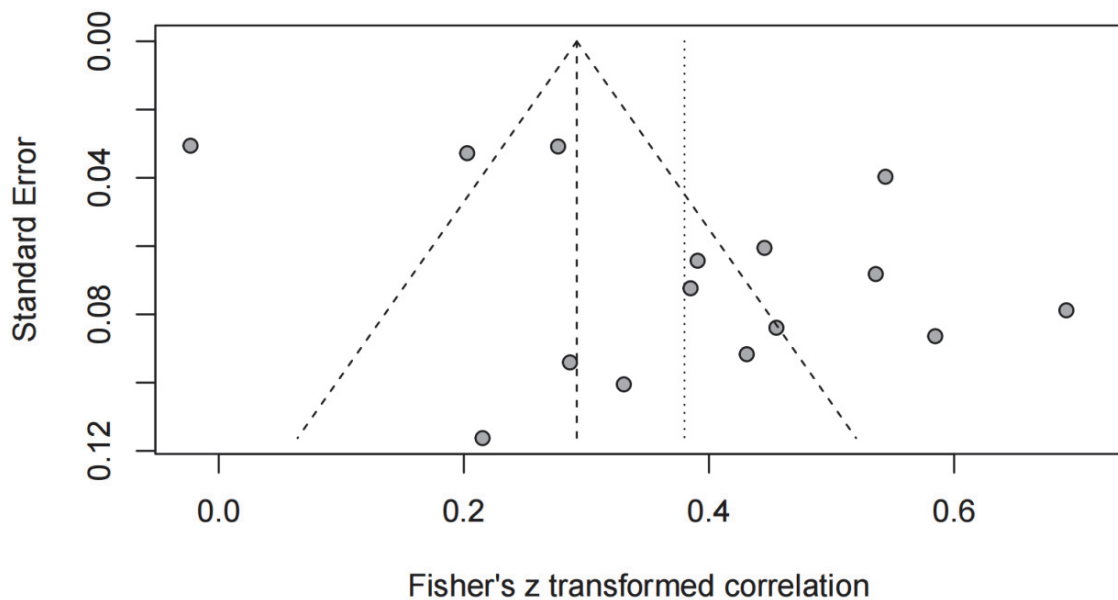
relevance. In the next step, a total of 177 studies were screened out by confirming the topic and research content and eliminating duplication. Afterwards, inclusion in the study was decided by checking whether they were consistent with the research subjects. For example, when the title mentions traffic or academic achievements, exclude research that is not relevant to the follow-up and reduce the number of papers in the process. Next, in order to derive effect sizes for comparisons between studies, studies that can clearly present correlation or regression analysis. Therefore, a total of 15 studies were included in this study. As shown in <Table 1> below:

<Table 1> Study characteristics

Researcher	Publication year	Publication Type	Samples(n)	r
Kyunghee Lee,	2014	Journal	934	0.2
Kim Won-jong,	2022	Journal	116	0.279
Seo Hyeong-eun,	2022	Journal	122	0.406
Gilchorong	2021	Journal	145	0.426
Kim Won-jong,	2023	Journal	137	0.526
Hyosook Kang	2013	Thesis	638	0.496
Kim Hyo-jeong	2023	Thesis	1072	-0.023
Si Ji-hyeon	2022	Journal	102	0.319
Cho Myung-sook,	2022	Journal	245	0.372
Soyoung Baek	2022	Journal	194	0.367
Han Jeong-seon,	2018	Journal	218	0.490
Insook Lee	2003	Journal	77	0.212
Kim Eui-cheol,	2013	Journal	1057	0.270
Seongah Lee	2021	Thesis	164	0.599
Jiang Yihang	2021	Thesis	276	0.418

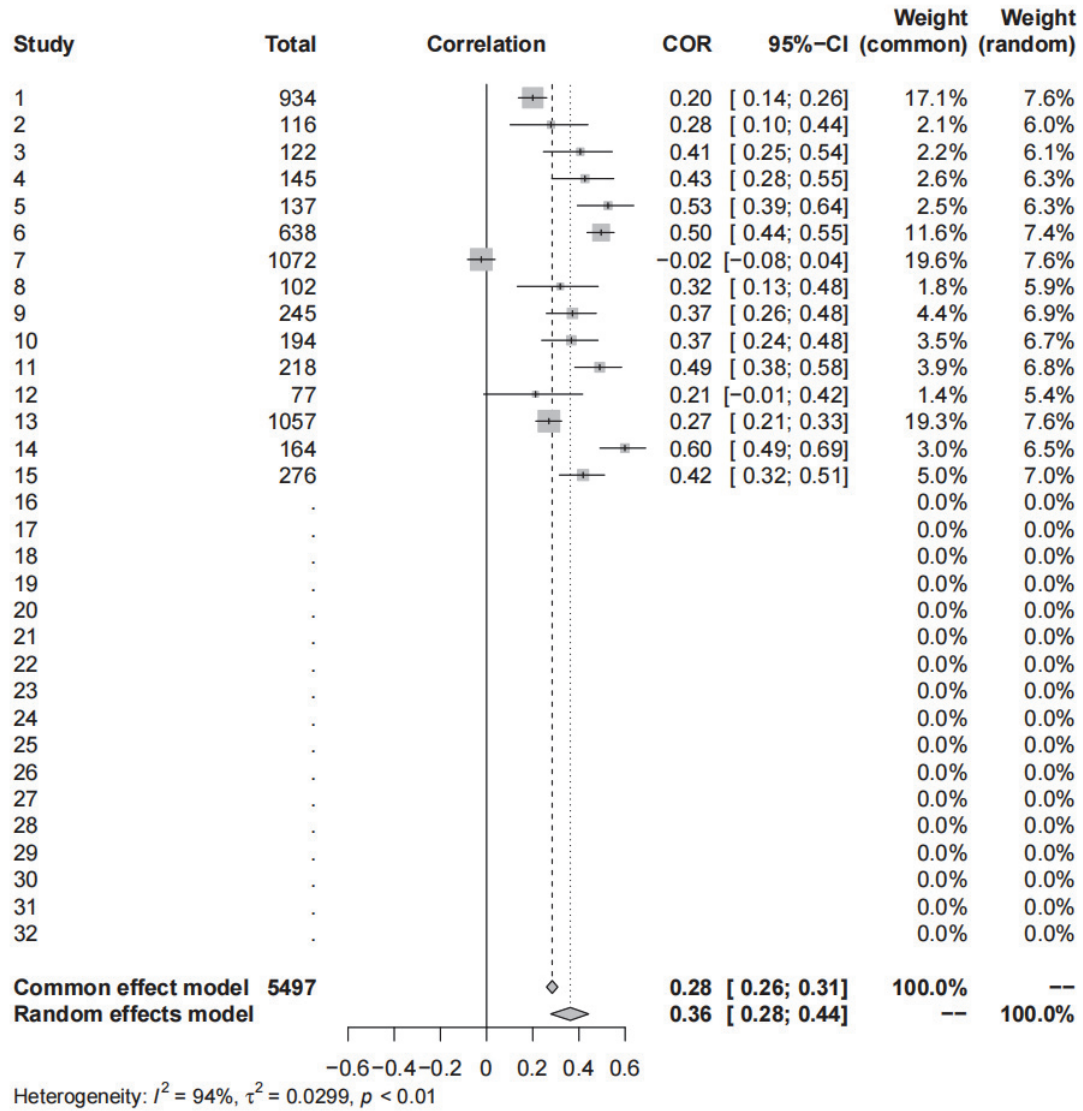
A funnel plot of the studies included in the meta-analysis is shown in <Figure 1>. Evidence of publication bias for the studies included in the meta-analysis is shown in <Figure1>. If publication bias exists, severe asymmetry will appear in the funnel plot. The plots are clustered to one side below the mean effect size line, particularly at the bottom

of the funnel, indicating the potential for publication bias in the study. In this study, when meta-analyzing the data, it was found that although the research subjects were not concentrated at the bottom of the funnel plot, the two sides were not particularly aligned. Therefore, in order to further test its publication bias, we conducted a Begg test on it, and the smoking cessation result found that the p value was 0.8820, which is greater than 0.05. Then we can think that this study has no publication bias.



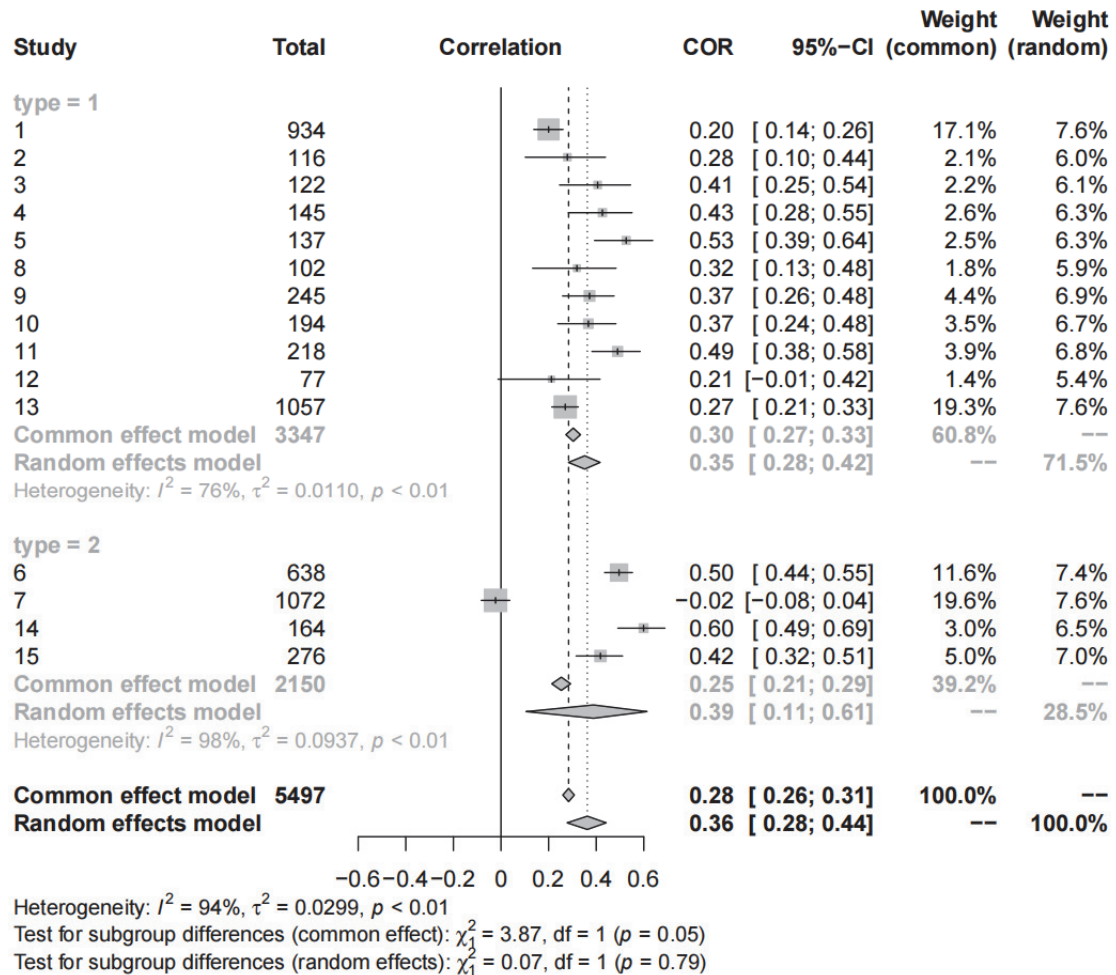
〈Figure 1〉 Fisher's z transformed correlation

The results of the meta-analysis of the relationship between self-efficacy and student achievement are shown in 〈Figure2〉. The results showed a positive relationship between self-efficacy and student achievement. The effect size of self-efficacy on student performance was calculated to be 0.36 [0.28; 0.44], indicating that self-efficacy has a moderate impact on student performance.



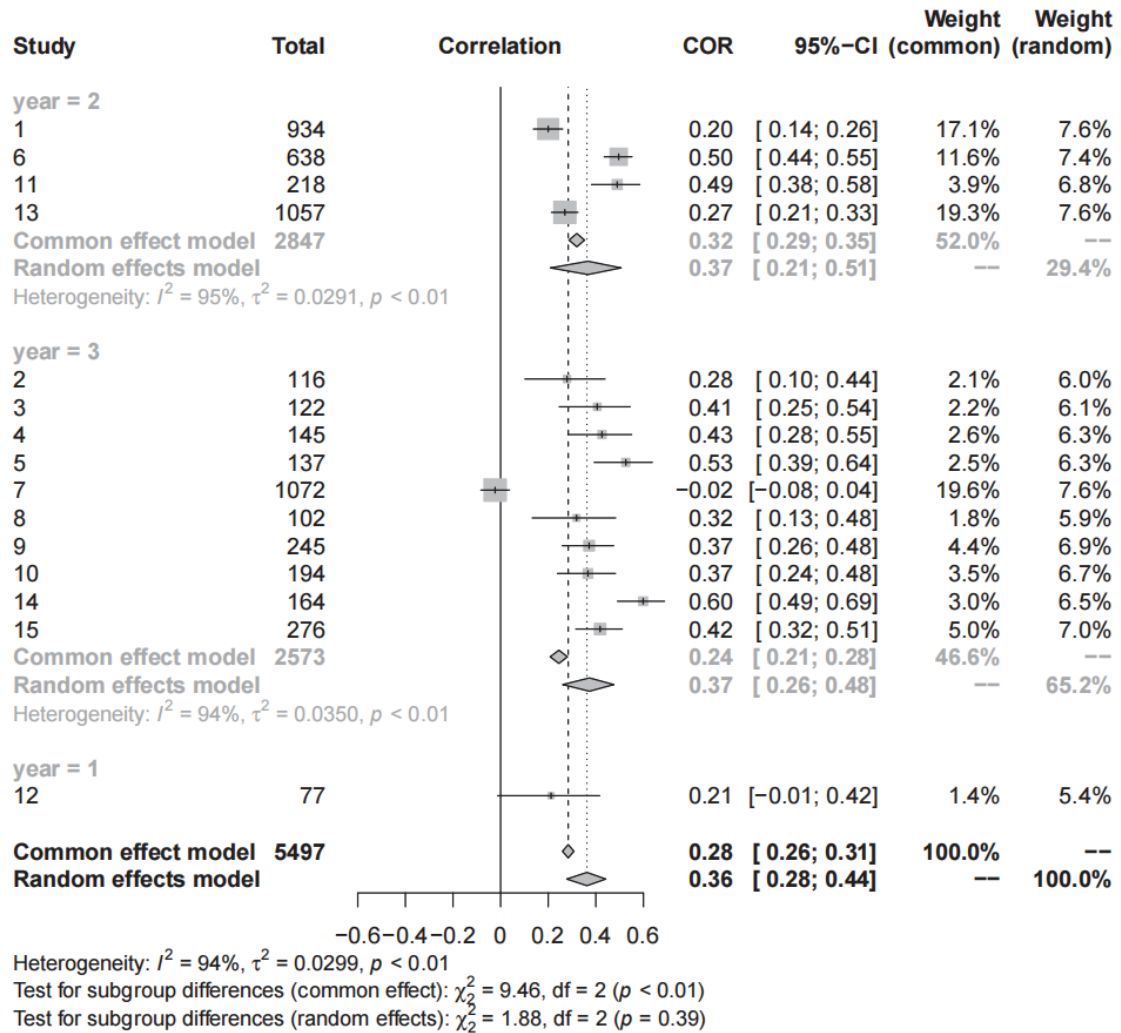
〈Figure 2〉 Forest plot of effect sizes (r) from all studies included in the systematic review

〈Figure 3〉 shows 2000-2010 [$r = .36$], 2010-2020 [$r = .037$], and above 2020 [$r = .37$]. Since I^2 of the three sets of data is greater than 50%, a random effects model is used. According to the explanation in the figure, the random effect value $p=0.39$, which shows that the impact of publication year on self-efficacy on achievement is not statistically significant.



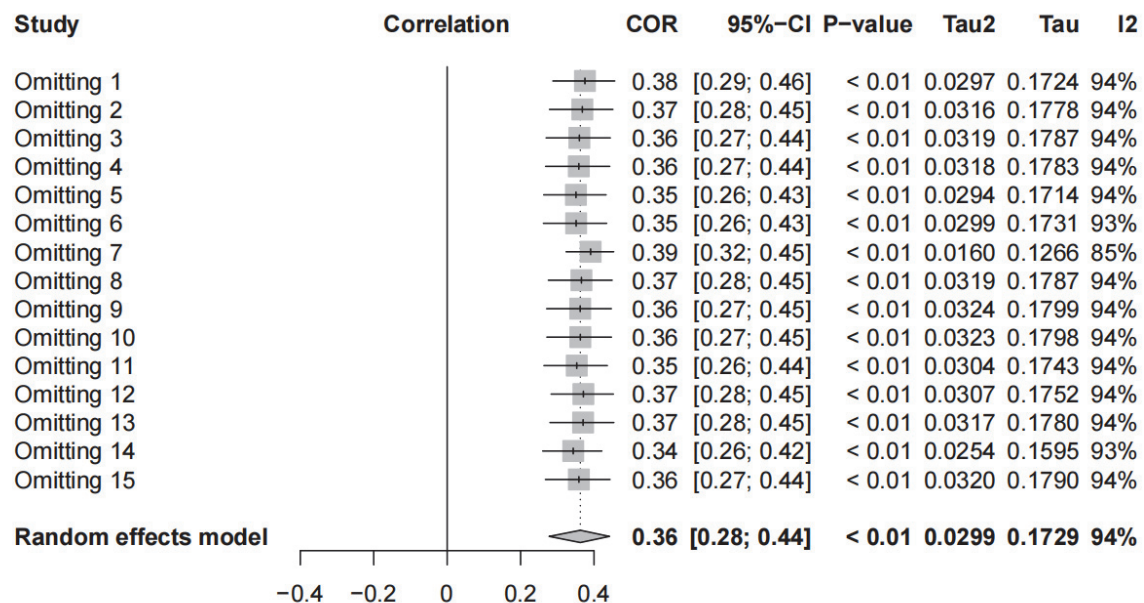
⟨Figure 3⟩ Forest plot of effect sizes (r) from the three subgroups of paper type

⟨Figure 4⟩ shows that Publication type is the second moderating variable analyzed in this study. The results show that the impact of self-efficacy on student performance is at a medium level in both journal articles [$r=.35$] and master's thesis [$r=.39$]. And the effect of publication type on self-efficacy on achievement is not statistically significant.



〈Figure 4〉 Forest plot of effect sizes (r) from the three subgroups of publication year

According to the sensitivity analysis in 〈Figure 5〉, We believe that through sensitivity analysis of eliminating each result one by one, we found that eliminating any results has no substantial impact on the overall results, so we believe that the results are reliable.



〈Figure 5〉 sensitivity analysis

Indeed, taking into account all the above aspects, further research in this area is urgently needed. Not only to better understand this relationship (if it exists in the first place), but also to take into account the interference of a host of other motivational factors that are said to predict academic achievement. These factors must be clearly defined and viewed critically to the extent to which they influence academic performance and how they interfere with each other. Furthermore, if self-efficacy is indeed influential, then we should make it clear that self-efficacy and its subtypes are just individual motivational components in a complex network that can influence each other and collectively contribute to academic achievement. Therefore, the sum of academic achievements cannot be judged by a single factor. Therefore, future research may ask the question: What is the role of self-efficacy in predicting academic achievement? What motivational factors interact with academic self-efficacy to achieve higher academic achievement? Also in this case, other moderator variables of the correlation deserve further study. It might also be interesting to examine other factors that influence academic self-efficacy, such as gender or demographic background.

V. Conclusion

The significance of this study is that it uses meta-analysis to analyze previous studies on the relationship between self-efficacy and academic achievement in a more systematic and scientific manner. And the relationship between academic achievement and various variables was studied. In previous studies, there were some papers measuring self-regulation and self-efficacy, but few Korean research papers were collected as research subjects and directly measured self-efficacy and academic achievement using meta-analysis. After extracting the data and analyzing it, the results of the study are as follows. First, the average effect size between self-efficacy and academic achievement was 0.36, which is a large effect size in the effect size interpretation method proposed by Cohen (1992). Second, moderating effects were analyzed to identify variables that represent differences in effect sizes. In terms of effect sizes for different publication types, the effect size for master's theses was large at 0.37, but the difference was not significant.

Based on the results of the study, the importance of self-efficacy should be recognized in the future and the effectiveness of student learning should be improved by applying self-efficacy more often.

Reference

- Azizli, N., Atkinson, B. E., Baughman, H. M., & Giammarco, E. A. 2015. Relationships between general self-efficacy, planning for the future, and life satisfaction. *Personality and Individual Differences*, 82, 58-60.
- Bandura, A. 1997. *Self-efficacy: The exercise of control*. Macmillan.
- Borenstein, M., Hedges, L. V., Higgins, J. P., & Rothstein, H. R. 2010. A basic introduction to fixed-effect and random-effects models for meta-analysis. *Research synthesis methods*, 1(2), 97-111.
- De Fátima Goulão, M. 2014. The Relationship between Self-Efficacy and Academic Achievement in Adults' Learners. *Athens journal of Education*, 1(3), 237-246.
- Doi, S. A., Barendregt, J. J., Khan, S., Thalib, L., & Williams, G. M. 2015. Advances in the meta-analysis of heterogeneous clinical trials I: the inverse variance heterogeneity model. *Contemporary clinical trials*, 45, 130-138.
- Guzzo, R. A., Jackson, S. E., & Katzell, R. A. 1987. Meta-analysis analysis. *Research in organizational behavior*, 9(1), 407-442.
- Gao, Y., Yu, H., Zou, X., Zhang, Y., & Guan, X. 2023. The impact of junior high school students' academic self-efficacy on academic procrastination: the mediating role of academic emotions. *Advances in Psychology*, 13, 3497.
- Hedges, L. V., & Olkin, I. 1984. Nonparametric estimators of effect size in meta-analysis. *Psychological bulletin*, 96(3), 573.
- Huang, F., Huang, Z., Li, Z., & Zhang, M. 2021. Relationship between parental involvement and mathematics achievement of Chinese early adolescents: Multiple mediating roles of mental health and mathematics self-efficacy. *International Journal of Environmental Research and Public Health*, 18(18), 9565.
- Hunter, J. E., & Schmidt, F. L. 2004. *Methods of meta-analysis: Correcting error and bias in research findings*. Sage.
- Kim, H. J. 2023. *The effects of sense of control, learning satisfaction, and self-efficacy on academic achievement in real-time online classes*. Master's Thesis, Korea University.
- Kim, M. J., Noh, G., & Kim, J. 2021. The impact of grit of prospective childcare teachers on career adaptability in a non-face-to-face learning environment due to COVID-19: Focusing on the mediating effect of cognitive flexibility. *Proceedings of the Korean Society of Life Science Conference*, 78-78.
- Kim, W. J., & Lee, J. 2022. The impact of learning satisfaction and academic self-efficacy on academic achievement of nursing students who experienced non-face-to-face lectures in the COVID-19 situation. *Edutainment Research*, 4(3), 67-77.
- Komarraju, M., & Nadler, D. 2013. Self-efficacy and academic achievement: Why do implicit beliefs, goals, and effort regulation matter?. *Learning and individual differences*, 25, 67-72.
- Lee, K. H., & Kim, J. 2014. Study on the relationship between college students' academic self-efficacy, learning motivation, class satisfaction and academic performance. *Andragogy Today*, 17(4),

33-57.

- Liu, H., Liu, Q., Du, X., Liu, J., Hoi, C. K. W., & Schumacker, R. E. 2021. Teacher-student relationship as a protective factor for socioeconomic status, students' self-efficacy and achievement: a multilevel moderated mediation analysis. *Current Psychology*, 1-16.
- Li, X., Pu, R., & Phakdeephrot, N. 2022. The influence of achievement motivation on college students' employability: a chain mediation analysis of self-efficacy and academic performance. *Frontiers in psychology*, 13, 972910.
- Liu Rong. 2023. *The relationship between negative life events and academic adjustment among high school students: a moderated mediation model*. Doctoral dissertation, Shandong Normal University.
- Payne, K. L., Wilson, M. R., & Vine, S. J. 2019. A systematic review of the anxiety-attention relationship in far-aiming skills. *International Review of Sport and Exercise Psychology*, 12(1), 325-355.
- Popay, J., Roberts, H., Sowden, A., Petticrew, M., Arai, L., Rodgers, M., ... & Duffy, S. 2006. Guidance on the conduct of narrative synthesis in systematic reviews. *A product from the ESRC methods programme Version, 1*(1), b92.
- Rousseau, D. M. 1997. Organizational behavior in the new organizational era. *Annual review of psychology*, 48(1), 515-546.
- VanVoorhis, C. W., & Morgan, B. L. 2007. Understanding power and rules of thumb for determining sample sizes. *Tutorials in quantitative methods for psychology*, 3(2), 43-50.
- Wang, G., & Zhao, Y. (2022). Meta-analysis about teacher autonomy-support and student academic achievement: The mediation of Psychological need satisfaction, Motivation and Engagement. *Psychological Development and Education*, 38(03), 380-390.