CONTRIBUTION OF LOCUS OF CONTROL, SELF-EFFICACY, AND MOTIVATION TO STUDENT ACHIEVEMENT: A META-ANALYTIC STRUCTURAL EQUATION MODELLING

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ABSTRACT

This meta-analysis examined whether motivation mediated the relationship between self-efficacy, locus of control, and academic achievement. Thirty-seven studies providing correlation estimates for 40 different samples were included in the analysis. The data from these studies were fitted to three models using a two-stage structural equation modelling method. In stage 1, a total correlation matrix was created by combining the correlations. In stage 2, this matrix was used for examining the models. First, a proposed model was fitted to examine the effect of self-efficacy and locus of control on achievement through motivation. Second, an alternative model was tested by drawing a direct line from self-efficacy to achievement. Third, another model was tested by examining the mediating role of motivation between self-efficacy and achievement. The analyses suggested that academic achievement significantly correlates with self-efficacy (r = 0.218) and motivation (r = 0.237). Motivation significantly correlates with self-efficacy (r = 0.415) and locus of control (r = 0.216). However, locus of control does not correlate with self-efficacy and achievement (p > 0.05). Self-efficacy and locus of control positively influence motivation. Self-efficacy influences achievement both directly and indirectly through motivation. The findings provide a general overview of how these variables correlate and affect student achievement.

KEYWORDS

Academic achievement, locus of control, meta-analysis, motivation, self-efficacy

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Highlights

- *Self-efficacy and motivation are significant correlates of academic achievement.*
- *Self-efficacy and motivation are significantly correlated.*
- *Self-efficacy and locus of control positively influence achievement via motivation.*
- *Self-efficacy both directly and indirectly affect academic achievement.*
- *Locus of control is a non-significant correlate of self-efficacy and achievement.*

INTRODUCTION

As of their existence, influenced by their curiosity and survival instincts, humans have always attempted to accomplish certain things as reasons for living. When we think of humans who managed to light a fire in the early ages of humanity, the feeling they had when they fulfilled the deed they desired is a connotation of joy from accomplishing a task. In today's world, the same feeling resembles the feeling that a person who creates beautiful paintings feels proud of what they achieved in their artwork or the sense of satisfaction that a mechanic experiences by managing to repair a vehicle. Considering these examples in the context of education, the good results students obtain regarding the learning outcomes of any course denote their achievement in education. Although good results obtained in educational environments are referred to by names such as achievement and performance, generally, we can call all these characterizations academic achievement. Lindholm-Leary and Borsato (2006: 176) define academic achievement as 'communicative (oral, reading, writing), mathematical, science, social science, and thinking skills and competencies that enable a student to succeed in school and society'. In other words, academic achievement represents the performance

outcomes that indicate the extent to which a person has achieved certain goals in educational settings, particularly those that are the focus of school, college, and university activities (Steinmayr et al., 2014). Academic achievement is primarily affected by variables such as motivation (Amrai et al., 2011; Feng et al., 2013), self-efficacy (Goulão, 2014; Mahyuddin et al., 2006), socioeconomic status, school environment (Berkowitz et al., 2017), and environment (Baharudin and Luster, 1998).

Although various factors affect academic achievement in education, motivation is one of the most significant ones (Francis et al., 2004). Motivation can be defined as motives that drive us to perform or not to perform an action and as underlying reasons for our behaviours (Křeménková, 2019). Ryan and Deci (2002) divide motivation into three categories, namely intrinsic motivation, extrinsic motivation, and amotivation. Intrinsic motivation refers to one's inherent satisfaction with an action, whereas extrinsic motivation refers to one's doing non-inherent behaviours depending on external reasons (Ryan and Deci, 2000). Amotivation is a state of having no motivation to act. According to these definitions, when motivation is considered an impulse that drives a person to act or enables a movement to continue, it could substantially influence new learning, skills, and behaviours and thereby should be considered in educational environments because of this influence. In this context, we can assume a natural relationship exists between students' motivation and academic achievement, or at least their pursuit of achievement. Considering the definitions and classifications concerning the concept of motivation, the fact that it positively or negatively affects academic achievement is something expected in an educational environment. As such, many research studies have addressed the relationship between motivation and academic achievement (Bozkurt and Bircan, 2015; Johnson et al., 2014; Li and Pan, 2009; Liu and Hou, 2018; Trevino and DeFreitas, 2014).

Another variable whose relationship with academic achievement is examined the most is self-efficacy. The concept of self-efficacy was addressed first by Bandura (1977) in Social Learning Theory. Social Learning Theory suggests that the most fundamental structure behind the actions of individuals is self-efficacy belief. Bandura (1997) defines self-efficacy as a person's belief in their ability to plan and execute actions they need when achieving specific goals. According to him, four major sources shape self-efficacy beliefs: mastery experiences, vicarious experiences, social persuasion, and physiological and emotional states (Bandura, 1995). Although Bandura sees mastery experiences as the most effective way of creating a strong sense of self-efficacy, he emphasizes that they should be considered as a matter of creating an action plan to keep up with ever-changing living conditions rather than keeping up with current habits. He argues that vicarious experiences, the second source of self-efficacy, occur as a result of indirect experiences facilitated by social models. Social persuasion, the third source of self-efficacy, denotes the verbal persuasion of individuals that they can do a task and therefore ensures that the behaviour they think is adequate instead of self-doubt when problems arise in that task. In the last concept, shown as the source of self-efficacy, Bandura touched on physiological and emotional states, emphasizing that sometimes individuals trust physical and emotional states to develop self-efficacy and that stress reactions and tension are signs of poor performance. Considering Bandura's views on self-efficacy, students' beliefs about their academic achievement give them an idea of what they can do next with their current knowledge and skills. In other words, they establish a direct relationship between their self-efficacy and academic achievement. This relationship also influences students' success or failure, depending on their self-efficacy beliefs.

The last variable whose relationship with academic achievement is addressed within the scope of this study is the locus of control. Individuals hold a number of beliefs about the extent to which they have control over their lives. Stating that these beliefs are reinforced in two ways based on internal and external processes, Rotter (1966) defined locus of control as having a sense of control over sources of reinforcement in one's own life. Simply put, locus of control is a general concept, indicating expectancies regarding the extent to which reinforcements stem from internal and external control (O'Brien, 1984). Internal control denotes individuals' beliefs that positive or negative situations they encounter originate from themselves, whereas external control denotes individuals' beliefs that what happens to them is due to situations that do not originate from themselves. The concept of locus of control, grounded in social learning theory, also indicates spaces where forces determining how positive or negative events in life are perceived centre on (Yeşilyaprak, 2004). Locus of control is built on these two levels of generalized expectancies by individuals. Individuals with an internal locus of control believe that reinforcements or events that take place stem from their own behaviours or personal characteristics. However, individuals with an external locus of control understanding believe that the events that happen to them stem from greater and unpredictable external factors, such as chance, luck, fate, and belief (Rotter, 1990). The relationship between academic achievement and locus of control is examined in many studies, and the general conclusion is that these variables are positively correlated. When some of these studies are examined in terms of locus of control, there is a positive relationship between the internal locus of control and academic achievement, and students with an internal locus of control are more successful in their academic lives (Richardson et al., 2012; Findley and Cooper, 1983). In other words, internality predicts higher academic achievement, whereas externality predicts lower academic achievement (Nowicki, 2016).

Although both the locus of control and self-efficacy are related to control literature and grounded in social learning theory, locus of control evaluates individuals' beliefs about whether the outcomes are generally attributed to internal or external factors, whereas 'self-efficacy measures one's confidence in being able to achieve an important goal' (Au, 2015: 427). Various studies have examined the correlation between the variables described here. Au (2015) found that internal locus of control and self-efficacy significantly predicted students' perceived control over their course performance. Preston and Latta (1978) reported that locus of control moderated female students' academic motivation scores in predicting their academic achievement.

A meta-analytic study by Richardson et al. (2012) also showed that internal locus of control, self-efficacy, and intrinsic motivation significantly positively correlated with academic achievement. As such, Bahçekapılı and Karaman (2020) found that self-efficacy had a significant direct and indirect effect on student achievement, whereas the external locus of control had a significant negative direct and indirect effect on their achievement scores. Both these variables significantly mediated the relationship between personality traits and academic achievement. Yet, internal control did not influence achievement scores.

In addition, Khorsidi et al. (2019) reported that achievement motivation and locus of control were significant positive correlates of academic achievement, while academic procrastination was a significant negative correlate. Their tested model indicated that motivation mediated the relationship between academic procrastination and locus of control with student achievement, where a decreased academic procrastination and an increased locus of control resulted in increased academic achievement. Furthermore, Wu et al. (2020) tested whether learning engagement and self-efficacy mediated the relationship between intrinsic and extrinsic motivation and academic achievement. Their findings indicated that both intrinsic and extrinsic motivation significantly predicted self-efficacy and exerted a significant indirect influence on student achievement through learning engagement. However, self-efficacy had a non-significant effect on academic achievement. Another study showed that self-efficacy was a strong predictor of intrinsic motivation (Skaalvik et al., 2015). These studies have examined the direct and indirect effects of locus of control, self-efficacy, and motivation on academic achievement tested along with some other variables. Their results showed that each one of these variables could mediate the relationship between the other two variables and achievement. Yet, some theoretical (Yeşilyaprak, 2004) and empirical information discussed earlier generally suggest that motivation may mediate the relationship between self-efficacy, locus of control, and academic achievement. Thus, the researchers proposed the model illustrated in Figure 1 based on these theoretical and empirical insights. No meta-analytic review examined these variables together to discover the best-fitting model that better explains academic achievement, addressed the discrepancies in primary research findings reflected in Table 2. This study aimed to examine whether motivation mediates the relationship between self-efficacy and locus of control and academic achievement and their predictive power by fitting the proposed model graphically shown in Figure 1.

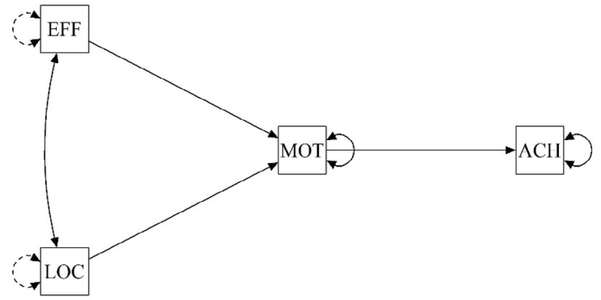

Figure 1: The proposed model

MATERIAL AND METHODS

Literature search

In order to identify the relevant studies, two researchers independently searched the following online databases during July and August 2022 without limiting the search to specific years: Google Scholar, ERIC, Web of Science, ProQuest, and the Turkish Higher Education Counsel (CoHE) Thesis Centre. The following keywords and combinations were used as search terms in English: ('locus of control' OR 'LOC') AND ('achievement' OR 'performance') AND ('motivation' OR 'self-efficacy'). In addition, the reference lists of studies were examined to access more studies. As a result, 151 studies were retrieved.

Study selection criteria

Research reports matching the following study selection criteria are deemed eligible for this meta-analytic structural equation modelling (MASEM) study. First, studies should provide a minimum of three correlation coefficients for the association between any of the variables of focus in this review (i.e., locus of control, self-efficacy, motivation, and academic achievement). Otherwise, the analyses cannot be conducted because of too much missing data. Second, they should use parametric correlation tests, assuming a normal distribution. Third, studies examining the locus of control or motivation should provide the correlation values for both the external and internal locus of control and motivation to obtain a synthetic effect size and include in the analysis. This is because some studies provide correlation data based on only the internal or external subscales of these constructs, whereas others provide the correlations based on their total scores. Fourth, the scores obtained from the tests or scales used in primary studies should have similar interpretations. Fifth, the sample of studies should consist of students.

All 151 studies were screened against these criteria. First, we screened the studies by title and abstract, excluding discussion papers and off-topic studies. As such, the analysis did not include studies providing only one or two correlation

coefficients or using non-parametric tests. Some studies only examined the correlation between the internal locus of control or motivation and other variables and therefore were excluded. In addition, studies reporting unequal sample sizes for the association between the variables were not included. As such, we included 37 studies meeting all the study selection criteria, which yielded 40 correlation estimates. The inclusion and exclusion processes of studies are illustrated in Figure 2.

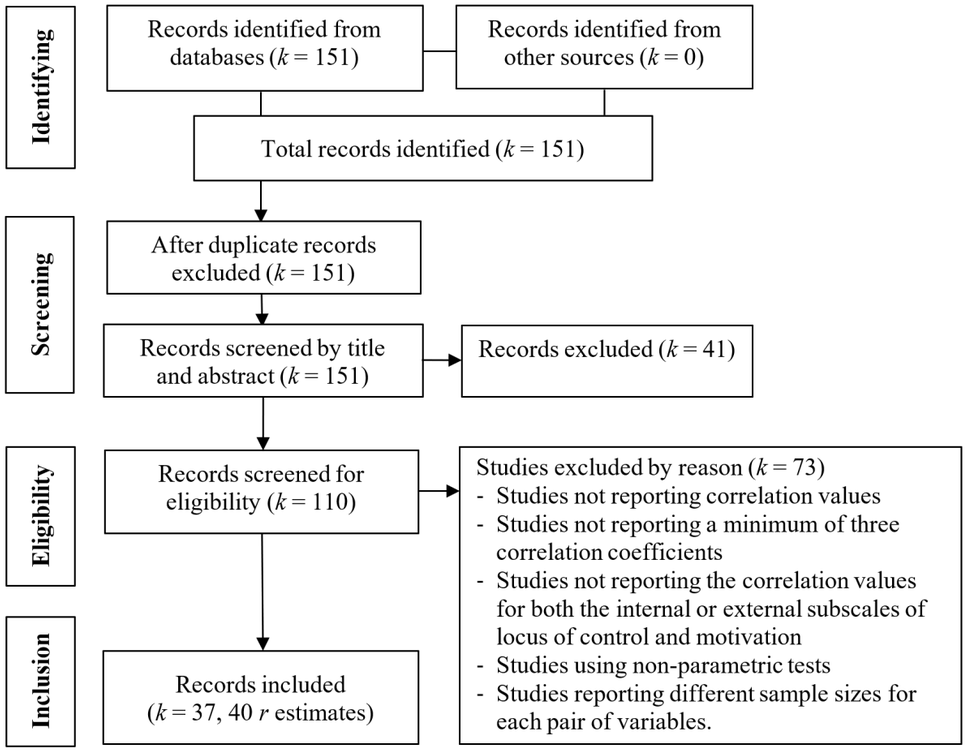

Figure 2: The Inclusion and Exclusion Processes of Primary Studies

Quality assessment

To examine the quality of studies included in the analysis, we employed a quality assessment form for quantitative studies developed by Kmet, Lee and Cook (2004). This form includes fourteen quality indicators with detailed guidelines. However, the authors suggest only using items applicable to research methods used in primary studies and calculating the quality score accordingly. Studies fully, partially, and not meeting the criteria are given scores of 2, 1, and 0, respectively. The total quality score is obtained by summing full and partial scores obtained for a specific study divided by the total possible sum, which is 10 in this study. The threshold for quality scores could be chosen between 55% and 75%, showing relatively liberal and conservative cut-off values. Considering the research methods used in selected studies, we evaluated them using the following five quality indicators: 'Question / objective sufficiently described? Study design evident and appropriate? Subject…characteristics sufficiently described? Results reported in sufficient detail? Conclusions supported by the results?' (Kmet, Lee and Cook, 2004: 5). The quality assessment was conducted independently by two researchers. Accordingly, the overall quality scores obtained for selected studies ranged from 60 to 100% on average, showing sufficient quality to be included in the analysis.

Coding study characteristics

Studies deemed eligible for this MASEM were coded by author name(s), publication year, primary purpose, research method, sex, mean age, country, and publication type. As shown in Table 1, the selected studies were conducted between 1980 and 2021.

ID	Author(s), Year	Primary Purpose	Method	Sample	% Sex		Mean Age	Country	Publication Type
					Male	Female			
1	Akomolafe et al., 2013	To investigate the role of self-efficacy, motivation and self-concept in predicting secondary school students' academic performance.	Correlational	Secondary	51.31	48.70	15.28	Nigeria	Article (EN)
2	Bahçekapılı and Karaman, 2020	To develop a model that predicts the students' academic achievement by their characteristics such as personality traits, self-efficacy, and locus of control.	Correlational	Tertiary	61.90	38.10	30.90	Turkey	Article (EN)
3	Bjørnebekk et al., 2013	To investigate the joint effects of achievement motives, self-efficacy, and achievement goals as predictors of academic achievement.	Longitudinal	Tertiary	19.48	80.52	27.5	Norway	Article (EN)
4	Cazenave, 1993	To correlate self-concept, perception toward school environment, achievement motivation, locus of control, and attendance with reading achievement.	Correlational	Secondary (G6, 8)	39.31	60.69	12.5	USA	Thesis (EN)
5	Dogan, 2015	To explore the relations among student engagement, academic performance, self-efficacy, and academic motivation.	Correlational	Secondary and High	38	62	16.7	Turkey	Article (EN)
6	Ebrahim, 1998	To investigate the effects of locus of control, working memory, motivation components, and verbal ability on foreign language learning.	Correlational	Tertiary	—	—	—	USA	Thesis (EN)
7	Ejiobi-Okeke and Samuel, 2021	To investigate secondary school students' achievement motivation and locus of control as predictors of their academic achievement.	Correlational	Secondary	—	—	—	Nigeria	Article (EN)
8	Fini and Yousefzadeh, 2011	To investigate the relationship between achievement motivation, locus of control and educational achievement.	Correlational	High	47.39	52.61	—	Iran	Article (EN)
9	Goote, 2014*	To examine the relationship between self-esteem, locus of control, and learning motivation to academic achievement.	Survey	Tertiary	—	—	—	USA	Thesis (EN)
10	Graham, 2007	To expand the understanding of possible psychosocial predictive measures of student success.	Casual-Comparative	Tertiary	58.55	41.45	18.7	USA	Thesis (EN)
11	Jadhav, 2007	To examine personality attributes of locus of control, self-efficacy, and conscientiousness on goal commitment and performance.	Correlational	Tertiary	—	—	—	USA	Thesis (EN)
12	Khorsidi et al., 2019	To investigate the relationship between academic procrastination, locus of control and achievement motivation with academic achievement.	Correlational	Tertiary	48.79	51.21	20.92	Iran	Article (PER)
13	Landine and Steward, 1998	To investigate the relationship between metacognition and academic achievement, motivation, locus of control, and self-efficacy.	Correlational	High (G12)	51.85	48.15	18	Canada	Article (EN)

ID	Author(s), Year	Primary Purpose	Method	Sample	% Sex		Mean Age	Country	Publication Type
					Male	Female			
14	Lewis, 2017	To examine the role of locus of control and self-efficacy in shaping student academic performance.	Correlational Cross-sectional	Tertiary	14.10	85.90	31.55	Trinidad and Tobago	Thesis (EN)
15	Li, Liu et al., 2020*	To investigate the possible mediating and moderating factors in the relationship between peer relationships and science literacy.	Correlational	High (G9)	50.80	49.20	14.74	China	Article (EN)
16	Li, Peng et al., 2020	To examine the mediating and moderating roles of self-efficacy and motivation in the relationship between peer relationships and mathematics achievement.	Correlational	High (G9)	50.84	49.16	14.85	China	Article (EN)
17	Martinez, 2003*	To investigate the predictors of academic achievement.	Survey	Secondary (G7-8)	—	—	13.00	USA	Thesis (EN)
18	Montejano, 2014	To explore how perceived parental involvement, locus of control, self-efficacy, and acculturation predict academic achievement.	Correlational	High (G9,11,12)	49	51	—	USA	Thesis (EN)
19	Nurwendah and Suyanto, 2019	To reveal the relationship among self-motivation, self-efficacy, and achievement.	Correlational	High	—	—	—	Indonesia	Paper (EN)
20	Ogunmakin and Aomolafe, 2013	To examine the contribution of academic self-efficacy and locus of control to students' performance.	Correlational	Secondary	—	—	—	Nigeria	Article (EN)
21	Payne, 2011	To investigate whether self-efficacy, locus of control, and access and proficiency in technology are associated to success.	Correlational	Tertiary	14.53	85.47	29	USA	Thesis (EN)
22	Salami, 2008	To investigate the relationship between psychopathology and students' academic performance and the moderator effects of study behaviour, self-efficacy, and motivation.	Correlational	Secondary	47.90	52.10	16.40	Nigeria	Article (EN)
23	Salazar and Hayward, 2018	To investigate whether self-efficacy constructs positively impact students' motivation, performance, and expectations for achievement.	Correlational	Tertiary	71.90	28.10	—	USA	Article (EN)
24	Skaalvik et al., 2015	To understand the mediating effects of self-efficacy and perceptions of teachers' emotional support on the relationship between past achievement and current motivation for schoolwork.	Correlational	Secondary (G8-10)	49.30	53.70	—	Norway	Article (EN)
25	Snodgrass, 1989	To examine the relationship between locus of control, achievement motivation, knowledge of study skills and academic performance.	Correlational	Tertiary	—	—	—	USA	Thesis (EN)
26	Stevens et al., 2004	To evaluate a theoretical model that describes relationships involving personal qualities, including self-efficacy, and motivational orientation, and variables associated with mathematics achievement.	Correlational	High (G9-10)	—	—	14.72	USA	Article (EN)
27	Suphi and Yaratan, 2012	To assess the relationship between learning approaches, locus of control, demographic factors, self-efficacy and academic achievement.	Correlational	Tertiary	45.60	54.40	21	Cyprus	Article (EN)
28	Tella et al., 2009	To find out the extent to which locus of control, interest in schooling and self-efficacy can predict academic achievement.	Correlational	Secondary	60	40	13.5	Nigeria	Article (EN)
29	Thompson, 2005	To determine the relationships among self-efficacy, internal locus of control, external locus of control, achievement goal orientation, and academic performance.	Survey	Tertiary	56	44	26	USA	Thesis (EN)
30	Turner et al., 2009	To examine the relations among authoritative parenting style, academic performance, self-efficacy, and achievement motivation.	Correlational	Tertiary	34.80	65.20	19.27	USA	Article (EN)
31	Waseem and Asim, 2020	To build the regression model of self-esteem, self-efficacy, and locus of control as the predictors of academic performance.	Survey	Tertiary	61.33	48.67	—	Pakistan	Article (EN)
32	Wilhite, 1990	To examine the relationship between self-efficacy, study behaviour and academic course achievement by comparing self-efficacy and locus of control as predictors of achievement.	Correlational	Tertiary	—	—	—	USA	Article (EN)
33	Willens, 1980	To examine the relationship between the academic achievement and socioeconomic status, verbal ability, locus of control, achievement motivation, and persistence.	Correlational	Tertiary	—	—	—	USA	Thesis (EN)
34	Wu et al., 2020	To shed light on the mechanisms that govern how different types of motivation affect learning engagement and performance.	Correlational	Tertiary	29.70	70.30	—	China	Article (EN)
35	Yağcı, 1999	To investigate the relationship between locus of control, motivation and academic achievement.	Correlational	High (G12)	54.66	45.34	—	Turkey	Thesis (TR)
36	Yang et al., 2018	To explore the contributions of student reading motivation, reading self-efficacy, and family literacy environment to reading achievement.	Correlational	Primary	50.60	49.40	9.7	Abu Dhabi	Article (EN)
37	Yüner, 2020	To describe the current status of the relationships between prospective teachers' academic self-efficacy, academic motivation and academic success.	Survey	Tertiary	25.80	74.20	—	Turkey	Article (EN)

*Note: * Provides correlation estimates for two independent groups, G = Grade, EN = English, TR = Turkish, PER = Persian.*

Table 1: Characteristics of Selected Studies

Most studies were correlational followed by some survey and longitudinal studies. The sample of studies consisted of students from primary to tertiary education levels, including both male and female students. Students were of ages 9.7–30.9 on average, though not all these age ranges represent all studies. Most studies were conducted in the USA (k = 15) followed by other Western, European, Asian, and African countries. The majority of studies (k = 23) were published in peer-reviewed journals followed by master's or doctoral theses (k = 13), and peer-reviewed conference papers (k = 1). Most studies were written in English. Only one was in Turkish and one in Persian. However, both included English abstracts, containing the data needed for this study. All studies examined the relationship between a minimum of three variables. Some studies examining both the internal and external locus of control (Bahçekapılı and Karaman, 2020; Thompson, 2005; Yağcı, 1999) and motivation (Ebrahim, 1998; Turner et al., 2009; Wu et al., 2020; Yang et al., 2018; Yüner, 2020) did not provide correlation coefficients based on total scores relating to these constructs like most selected studies included in the analysis. Therefore, combined correlation coefficients were obtained based on data from such studies. These were combined using subgroup analysis to obtain a single synthetic effect. In this process, the Comprehensive Meta-Analysis Software (Borenstein et al., 2014) was used to handle such complex data structures representing dependent and independent groups. The raw correlation coefficients showing the relationships between the variables and valid sample sizes extracted from the primary studies are listed in Table 2.

Data analysis

A two-stage MASEM approach proposed by Cheung (2015a) was employed in this study to test the appropriateness of several models using R (v.4.2.2; R Development Core Team, 2022), metaSEM R package (v.1.3.0; Cheung, 2015b), and meta R package (v.6.2.1; Balduzzi et al., 2019). In stage 1, the correlation matrices prepared for each study using R codes in Jak (2015) were combined under a random-effects model to obtain summary correlation effect size estimates (weighted r) for the association between each pair of variables, as in pairwise meta-analyses (Cheung, 2015a, 2015b). According to the meta-analysis scholars, primary studies included in meta-analytic reviews are carried out by different researchers using different research designs, populations, and measures in various settings are likely to produce varying results (Borenstein et al., 2009; Cheung, 2015a). Therefore, they suggest pooling the observed effect size estimates under a random-effects model, letting the effect sizes vary across studies. As study characteristics showed (Table 1), studies included in this review are conducted in different countries with different samples and sample sizes, yielding conflicting results (Table 2). Considering scholars' suggestions and variability among the included primary studies, we decided to pool the raw correlation coefficients under a random-effects model. The summary effects were interpreted under Funder and Ozer's (2019) very small (0.05), small (0.10), medium (0.20), large (0.30), and very large (0.40) correlation effect size classification. The significance of heterogeneity between studies was evaluated using the Q statistics. In addition, the magnitude of heterogeneity between effect sizes (I^2) was interpreted per Higgins et al.'s (2003) small (25%), moderate (50%), and high (75%) classification of effect size variability, though these values are not absolute measures of heterogeneity (Borenstein et al., 2017). Publication bias was inspected using funnel plot, Egger's test, and rank correlation test.

In stage 2, the pooled correlation matrix of multiple correlation matrices obtained in stage 1 was used to test and compare several structural equation models through MASEM (Cheung, 2015a; Jak, 2015). Three models were tested in this review, where the first model tested the mediating role of motivation among the association between the independent variables, self-efficacy and locus of control, and the dependent variable, academic achievement. However, the second model tested the direct effect of self-efficacy on achievement as an alternative model. The third model was tested by excluding locus of control from the model because of not correlating with self-efficacy and academic achievement. To fit the models, an asymmetric matrix (A matrix) specifying the regression coefficients among variables and a symmetric matrix (S matrix) specifying 'the variance-covariances of the variables' (Cheung, 2015a: 162) was created, using the laavan R package (v.0.6.15; Rosseel, 2012). The goodness-of-fit indices of the fitted models were evaluated by examining the RMSEA, SRMR, CFI, and TLI model fit measures following Hu and Bentler's (1999) recommended cut-off values. Accordingly, RMSEA and SRMR values of ≤ 0.05 plus CFI and TLI values of ≥ 0.95 are good model-fit indicators. Also, Hoyle (2012) notes that the TLI value can exceed 1 when a model's χ^2 is smaller than its degree of freedom. However, the AIC and BIC measures were considered while deciding on a superior model among the competitor models, where the smallest value indicated the most suitable model (Schermelleh-Engel and Moosbrugger, 2003).

RESULTS

Summary effects

A random-effects model was employed to combine 40 correlation coefficients extracted from 37 primary studies (N = 16946). Table 3 presents the summary effects (weighted r) with their corresponding 95% confidence intervals (CI) and heterogeneity measures. Accordingly, the analyses yielded very small and statistically non-significant positive summary effect size estimates for the associations between the locus of control and academic achievement (0.053, 95% CI [−0.046, 0.153]) and self-efficacy (0.013, 95% CI [−0.135, 0.162]), respectively. However, statistically significant and moderate positive summary effects were obtained for the associations between self-efficacy and achievement (0.218, 95% CI [0.133, 0.303]), between motivation and achievement (0.237, 95% CI [0.193, 0.280]), and between locus of control and motivation (0.216, 95% CI [0.106, 0.327]). In contrast, a statistically significant and very large positive summary effect was obtained for the association between self-efficacy and motivation (0.415, 95% CI [0.332, 0.499]). These results indicate that higher self-efficacy and motivation can lead to higher academic achievement and higher self-efficacy and locus of control can lead to higher motivation, but locus of control barely leads to higher self-efficacy and academic achievement. The Q-test showed significant effect size variability (Q (108) = 2189.3, p < 0.01). As seen in Table 3, the I^2 values ranged between 80.42% and 96.24%, showing a proportion of high variability across the observed effects due to variation in true effects that is not due to sampling error.

Studies	Valid N	LOC-ACH	EFF-ACH	MOT-ACH	LOC-EFF	LOC-MOT	EFF-MOT
1. Akomolafe et al., 2013	398	n.r	0.390	0.420	n.r	n.r	0.430
2. Bahçekapılı and Karaman, 2020	525	−0.064	0.136	n.r	−0.019	n.r	n.r
3. Bjørnebekk et al., 2013	231	n.r	0.120	0.220	n.r	n.r	0.520
4. Cazenave, 1993	146	0.120	n.r	0.290	n.r	0.310	n.r
5.Dogan, 2015	578	n.r	0.500	0.110	n.r	n.r	0.400
6. Ebrahim, 1998	91	−0.110	n.r	0.202	n.r	−0.095	n.r
7. Ejiobi-Okeke and Samuel, 2021	231	0.326	n.r	0.345	n.r	0.601	n.r
8. Fini and Yousefzadeh, 2011	211	0.15	n.r	0.150	n.r	0.160	n.r
9. Gootee, 2014a	190	0.220	n.r	0.122	n.r	0.135	n.r
10. Gootee, 2014b	124	0.143	n.r	0.168	n.r	0.123	n.r
11. Graham, 2007	234	n.r	n.r	n.r	0.209	0.402	0.195
12. Jadhav, 2007	165	0.188	0.419	n.r	0.193	n.r	n.r
13. Khorsidi et al., 2019	494	0.170	n.r	0.260	n.r	0.270	n.r
14. Landine and Steward, 1998	108	−0.270	−0.380	0.420	0.410	n.r	n.r
15. Lewis, 2017	268	−0.227	0.121	n.r	−0.392	n.r	n.r
16. Li, Liu et al., 2020a	303	n.r	0.120	0.250	n.r	n.r	0.690
17. Li, Liu et al., 2020b	293	n.r	0.050	0.200	n.r	n.r	0.590
18. Li, Peng et al., 2020	527	n.r	0.085	0.202	n.r	n.r	0.639
19. Martinez, 2003a	53	0.117	0.395	0.238	n.r	n.r	n.r
20. Martinez, 2003b	42	0.121	0.558	0.431	n.r	n.r	n.r
21. Montejano, 2014	380	−0.146	0.192	n.r	−0.083	n.r	n.r
22. Nurwendah and Suyanto, 2019	230	n.r	0.302	0.225	n.r	n.r	0.389
23. Ogunmakin and Akomolafe, 2013	364	0.060	0.360	n.r	0.310	n.r	n.r
24. Payne, 2011	117	−0.134	0.219	n.r	−0.346	n.r	n.r
25. Salami, 2008	476	n.r	0.320	0.260	n.r	n.r	0.280
26. Salazar and Hayward, 2018	160	n.r	0.170	0.050	n.r	n.r	0.220
27. Skaalvik et al., 2015	823	n.r	0.635	0.472	n.r	n.r	0.664
28. Snodgrass, 1989	107	−0.030	n.r	0.290	n.r	0.210	n.r
29. Stevens et al., 2004	358	n.r	0.470	0.310	n.r	n.r	0.380
30. Suphi and Yaratan, 2012	99	−0.096	0.337	n.r	−0.191	n.r	n.r
31. Tella et al., 2009	500	0.365	−0.466	n.r	−0.321	n.r	n.r
32. Thompson, 2005	231	0.100	0.052	n.r	0.417	n.r	n.r
33. Turner et al., 2009	264	n.r	0.250	0.095	n.r	n.r	0.406
34. Waseem and Asim, 2020	452	0.399	0.350	n.r	0.254	n.r	n.r
35. Wilhite, 1990	184	0.380	−0.160	n.r	0.100	n.r	n.r
36. Willens,1980	44	−0.420	n.r	0.450	n.r	−0.180	n.r
37. Wu et al., 2020	1930	n.r	0.120	0.056	n.r	n.r	0.276
38. Yağcı, 1999	547	−0.430	n.r	0.317	n.r	0.244	n.r
39. Yang et al., 2018	4146	n.r	0.420	0.150	n.r	n.r	0.100
40. Yüner, 2020	322	n.r	0.120	0.191	n.r	n.r	0.456
Number of Studies		24	29	28	13	11	16

Note: LOC = Locus of Control, MOT = Motivation, EFF = Self-Efficacy, ACH = Achievement, n.r = no correlation reported

Table 2: Correlation Coefficients Extracted from Selected Studies

Although all funnel plots indicated asymmetrical distributions of the observed outcomes around the mean correlation effects sizes (see the Appendix), Egger's regression test indicated that these asymmetries were statistically non-significant (p > 0.05), except for the mean correlation effect size of the association between self-efficacy and motivation (p < 0.01). However, the rank correlation test indicated no publication bias in any of the meta-analyses (p > 0.05).

Relations	*k*	*N*	Weighted *r*	95% CI		*p*	τ^2	I^2
				LL	UL			
LOC-ACH	24	5673	0.053	−0.046	0.153	0.292	0.048	95.08%
EFF-ACH	29	14527	0.218	0.133	0.303	< 0.001	0.046	95.48%
MOT-ACH	28	13427	0.237	0.193	0.280	< 0.001	0.010	80.42%
LOC-EFF	13	3627	0.013	−0.135	0.162	0.859	0.065	96.24%
LOC-MOT	11	2419	0.216	0.106	0.327	< 0.001	0.029	92.90%
EFF-MOT	16	11273	0.415	0.332	0.499	< 0.001	0.027	92.80%

Note: LOC = Locus of Control, MOT = Motivation, EFF = Self-Efficacy, ACH = Achievement, LL = Lower Limit, UL = Upper Limit

Table 3: Summary effects and heterogeneity measures from stage 1 MASEM

Test of models

At this stage of the analysis, the mediation role of motivation was tested among self-efficacy, locus of control, and academic achievement based on the proposed model (Model 1). In addition, an alternative model was tested by drawing a direct line from self-efficacy to academic achievement (Model 2). Table 4 provides the model fit indices for the models tested using stage 2 of MASEM. As Table 4 indicates, the model tested (Model 1) using motivation as a mediator variable was statistically significant ($\chi^2(2) = 6.955$, $p < 0.05$). However, all other model fit indices indicated a good fit (RMSEA = 0.012, SRMR = 0.046, TLI = 0.937, CFI = 0.979).

Model	$\chi^2(df)$	*p*	RMSEA	RMSEA 95% CI		SRMR	TLI	CFI	AIC	BIC
				LL	UL					
Model 1	6.955 (2)	0.031	0.012	0.003	0.022	0.046	0.937	0.979	2.955	−12.521
Model 2	0.063 (1)	0.802	< 0.001	< 0.001	0.013	0.005	1.024	1.000	−1.937	−9.675

Table 4: Goodness-of-fit indices obtained for each model

According to path coefficients in Figure 3, students' self-efficacy ($\beta = 0.44$, 95% CI [0.35, 0.53]) and locus of control ($\beta = 0.21$, 95% CI [0.09, 0.34]) significantly influenced their motivation. Self-efficacy and locus of control significantly influenced academic achievement through motivation ($\beta = 0.25$, 95% CI [0.21, 0.29]). In addition, self-efficacy and locus of control accounted for 24% of the variance in motivation and all these three variables accounted for 6% of the variance in academic achievement. However, Figure 3 shows that self-efficacy and locus of control do not significantly co-vary, but both directly contribute to student motivation and indirectly to their academic achievement.

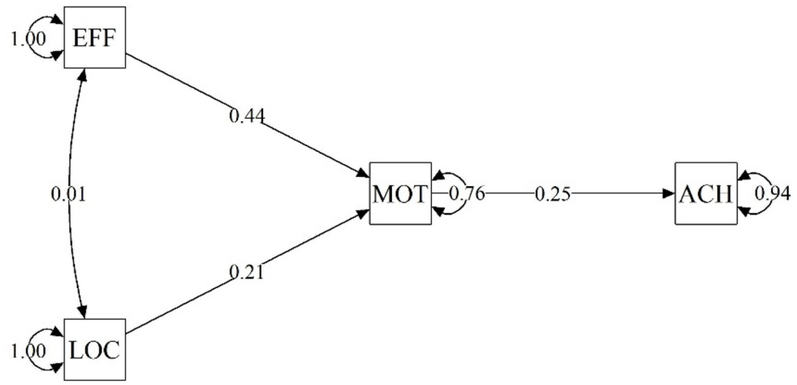

Figure 3: Motivation as a mediator variable (Model 1)

An alternative model (i.e., Model 2) was tested to examine the direct effect of self-efficacy on academic achievement. Although the proposed model (Table 4) indicated a good fit, the alternative model fitted the data perfectly (χ^2 (1) = 0.063, $p > 0.05$, RMSEA < 0.001, SRMR = 0.005, TLI = 1.024, CFI = 1.000). Here, the χ^2 value of Model 2 was smaller than its degree of freedom, and thereby the TLI value slightly exceeded 1, indicating a very well-fitting model. According to the path coefficients illustrated in Figure 4, self-efficacy had a significantly small direct effect on academic achievement ($\beta = 0.14$, 95% CI [0.04, 0.25]. In contrast, it had a significantly higher direct influence on motivation ($\beta = 0.41$, 95% CI [0.32, 0.50]). Both self-efficacy and locus of control accounted for 22% of the variance in motivation and through motivation they significantly influenced academic achievement ($\beta = 0.18$, 95% CI [0.11, 0.24]), accounting for 7% of the variance. These findings show that self-efficacy both directly and indirectly influences academic achievement.

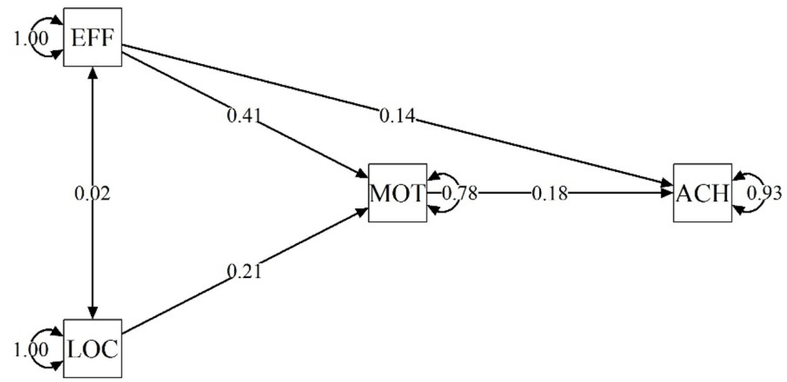

Figure 4: Direct effect of self-efficacy on achievement (Model 2)

As the locus of control was a statistically non-significant correlate of self-efficacy and academic achievement, the mediation role of motivation was retested by excluding the locus of control from the model (Model 3). This model was tested based on fifteen studies providing all three correlation coefficients between self-efficacy, motivation, and academic achievement. According to pairwise meta-analyses conducted under a random-effects model between these variables (Table 5), the correlation effect size estimates for the association between self-efficacy (0.274, 95% CI [0.186, 0.362]) and motivation (0.216, 95% CI [0.156, 0.276]) were positive and statistically significant, indicating a moderate effect. Contrarily, the analysis yielded a very large positive significant effect size estimate for the association between self-efficacy and motivation (0.429, 95% CI [0.345, 0.513]). The effect sizes were also heterogeneous (χ^2 (42) = 1048.32, $p < 0.01$), and the I^2 index ranged between 88.75% and 95.75%, showing high variability among the observed effects due to variation in true effects.

Relations	*k*	*N*	Weighted *r*	95% CI		*p*	τ^2	I^2
				LL	UL			
EFF-ACH	15	11039	0.274	0.186	0.362	< 0.001	0.028	95.75%
MOT-ACH			0.216	0.156	0.276	< 0.001	0.012	88.75%
EFF-MOT			0.429	0.345	0.513	< 0.001	0.025	95.19%

Table 5: Summary effects and heterogeneity measures from stage 1 MASEM with three variables

These combined correlation effect sizes were used to fit Model 3 (Figure 5). Since this model was saturated with a zero degree of freedom, no model fit index was produced. According to path coefficients, self-efficacy had a very large direct effect on motivation ($\beta = 0.43$, 95% CI [0.34, 0.51]) and a moderate direct effect on achievement ($\beta = 0.22$, 95% CI [0.11, 0.34]). It explained 8% of the variance in motivation. Self-efficacy also had a small indirect effect on achievement through motivation ($\beta = 0.12$, 95% CI [0.03, 0.21]). Altogether, self-efficacy and motivation accounted for 9% of the variance in academic achievement.

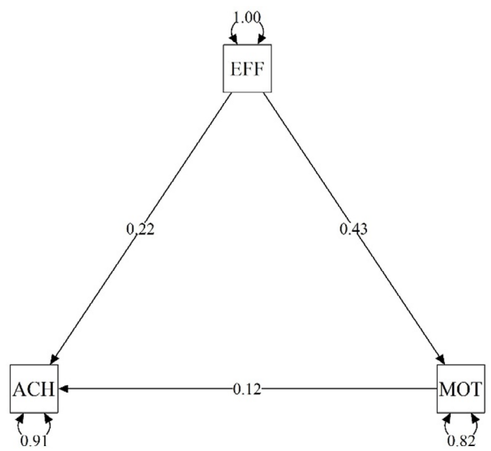

Figure 5: The mediation role of motivation between self-efficacy and achievement (*k = 15*)

DISCUSSION AND CONCLUSION

This study examined the relationship between students' academic achievement, self-efficacy, motivation, and locus of control through MASEM. For this purpose, correlation coefficients between these four variables were collected from the literature. In the first stage of MASEM, we calculated the mean effect size estimates for the association between these four variables by extracting 40 correlation coefficients from 37 studies and combining them under a random-effects model. According to the results, there were moderate and significant ($p < 0.05$) correlations between academic achievement, self-efficacy, and motivation ($r = 0.218$ and $r = 0.237$, respectively). In contrast, there was no significant relationship between academic achievement and locus of control ($p > 0.05$). According to these results, students' academic achievement increases as their self-efficacy and motivation increase. However, no such relationship exists between their locus of control and academic achievement. The findings regarding the association between academic achievement, self-efficacy, and motivation are congruent with the past meta-analytic reviews examining the association between academic achievement and self-efficacy (Goetze and Driver, 2022; Honicke and Broadbent, 2016; Multon, Brown and Lent, 1991; Richardson et al., 2012; Stajkovic et al., 2018, Talsma et al., 2018) and the association between academic achievement and motivation (Richardson et al., 2012). For instance, Honicke and Broadbent (2016) conducted a meta-analysis of 53 studies examining the relationship between self-efficacy and academic performance. They obtained a moderate correlation effect size for the association between these two variables ($r = 0.33$). Another meta-analysis study reported significantly positive correlation effect sizes for the association between academic achievement and motivational ($r = 0.321$), social ($r = 0.210$), and emotional factors ($r = 0.172$; Quílez-Robres et al., 2021). All these existing meta-analyses indicated that self-efficacy and motivation are positive correlates of academic achievement. Supporting the finding regarding the association between locus of control and academic achievement, a meta-analysis conducted with 23 studies yielded a very small non-significant mean correlation effect size estimate (0.02, 95% CI [-0.11, 0.12]; Çoğaltay, 2017). Yet, other past meta-analyses contradict this finding (Richardson et al., 2012; Findley and Cooper, 1983). For instance, Richardson et al. (2012) found a small and significant correlation effect size regarding the association between internal locus of control and students' academic performance ($k = 13$, $r = 0.13$, 95% CI [0.04, 0.22]). However, Yeşilyaprak (2004) argues that locus of control is not a variable that directly enables and initiates learning but directly influences student achievement expectations from learning outcomes and motivation, indirectly affecting their learning performance.

There was a very large significant ($p < 0.05$) correlation between students' course motivation and self-efficacy ($r = 0.415$), whereas there was a significant ($p < 0.05$) moderate correlation between motivation and locus of control ($r = 0.216$). However, there was no significant relationship between students' self-efficacy and locus of control ($p > 0.05$). According to these results, as students' motivation towards a course increases, their self-efficacy and internal locus of control increase. Contrarily, there is no such relationship between students' self-efficacy and their locus of control. Supporting the findings of this study, past research also shows that motivation positively correlates with self-efficacy (Ariff et al., 2022; Wu et al., 2020), locus of control (Preston and Latta, 1978), and learning performance (Cocca and Cocca, 2019). In contrast, the correlation effect size for the association between self-efficacy and locus of control rejected the results of some primary studies reporting a significant correlation between the two variables (e.g., Bahçekapılı and Karaman, 2020; Drago et al., 2018). For instance, Drago et al. (2018) reported that self-efficacy and locus of control were significant predictors of academic performance. As with the relationship between locus of control and academic achievement, self-efficacy and locus of control had no significant direct relationship but they may indirectly influence each other through other variables not included in this review.

In the second stage of MASEM, we established various models (proposed, alternative, and three-variable models) between academic achievement, motivation, self-efficacy, and locus of control and tested their goodness-of-fit. In model 1 (proposed model), we examined the effect of self-efficacy and locus of control on academic achievement with the mediation of motivation. Considering its goodness-of-fit indices, this model indicated acceptable model data fit. According to the path graphic (Figure 3), self-efficacy had a significant very large effect on motivation ($\beta = 0.44$) and locus of control had a significant moderate effect ($\beta = 0.21$). Self-efficacy and locus of control accounted for 24% of the variance in students' motivation towards a course. Motivation had a significant moderate effect on academic achievement ($\beta = 0.25$). Further, self-efficacy and locus of control accounted for 6% of the variance in academic achievement through motivation. Supporting these findings, Li, Peng et al. (2020) concluded that self-efficacy significantly predicts motivation, and the variables of peer relationships and motivation significantly predict academic achievement. Alternatively, Wu et al. (2020) found that motivation significantly influences self-efficacy. Bandura (1995: 18) claims that 'the higher students' beliefs in their efficacy to regulate their motivation and learning activities, the more assured they are in their efficacy to master academic subjects'. The model examined by Khorsidi et al. (2019) supported the finding regarding the moderate effect of locus of control on motivation and the effect of motivation on academic achievement, while they reported that locus of control had a small effect on achievement.

In addition to the proposed model, we established a direct relationship between self-efficacy and academic achievement in model 2 (alternative model). According to the goodness-of-fit indices of this model, the model perfectly fitted the data. Considering the path graphic (Figure 4), self-efficacy had a very large significant effect on motivation ($\beta = 0.41$), while locus of control had a significant moderate effect ($\beta = 0.21$). Self-efficacy and locus of control accounted for 22% of the variance in students' motivation towards a course. Motivation and self-efficacy had a significantly small effect on academic achievement ($\beta = 0.18$ and $\beta = 0.14$, respectively). In this model, all variables accounted for 7% of the variance in academic achievement. Both the proposed and alternative models explained a considerable amount of variance in motivation, and the effect sizes were similar. Yet, this model showed that self-efficacy may have a smaller direct effect on achievement but a very large effect on motivation. In other words, supporting Bandura's (1995) claim quoted earlier, students who have higher self-efficacy may develop higher motivation and thereby demonstrate higher academic performance. Bandura (1995) also confirms the correlation between self-efficacy beliefs and academic achievement but adds that the magnitude of this association varies across cultures. Similarly, Zimmerman (1995: 208) argues that 'self-efficacy fosters engagement in learning activities' and 'such beliefs affect level of achievement as well as motivation'. Additionally, a meta-analytic cross-lagged study by Talsma et al. (2018) found that self-efficacy and academic performance positively affect each other. Put differently, self-efficacy significantly affects academic performance. However, academic performance has a significantly larger subsequent effect on self-efficacy than the effect of self-efficacy on performance. Therefore, considering these comments, drawing a direct line from self-efficacy to academic achievement and a line to motivation may have improved the goodness-of-fit of this model, through one cannot ignore the role of locus of control here. However, although control beliefs are important, they are insufficient to motivate students to pursue academic activities (Zimmerman, 1995). If students do not believe that they are capable of mastering 'academic demands, they tend to avoid them even though outcomes are academically achievable' (Zimmerman, 1985: 217). Therefore, both self-efficacy and locus of control together seem to play critical roles in improving student outcomes. All these findings relating to model 2 parallel studies discussed in support of findings related to the proposed model.

As the locus of control had a non-significant correlation with academic achievement and self-efficacy ($p > 0.05$), we excluded it from the model and established a three-variable model with the mediation of motivation. In this case, the model was saturated and the goodness-of-fit indices were not calculated. In saturated models, defined as perfectly fitting model with zero degrees of freedom (Hoyle, 2012), all variables are correlated with estimated means (Cheung, 2015a), where the correlations between variables are evaluated. When the model was examined, the direct effect of self-efficacy on academic achievement was significant and moderate ($\beta = 0.22$), while its effect on motivation was significantly very large ($\beta = 0.43$). However, motivation had a significantly small effect on academic achievement ($\beta = 0.12$). Self-efficacy and motivation accounted for 9% of the variance in academic achievement. Although there are only small differences between the amounts of explained variance by the three models, the saturated model is somewhat better than the other two models in explaining the total variance in academic achievement. Removing the locus of control from the model increased the direct effect of self-efficacy on achievement compared to the second model. Yet, locus of control and self-efficacy play a significant role in predicting student motivation, thereby positively influencing their academic achievement. All the predictor variables examined in this review can exert a considerable direct or indirect positive influence on students' academic achievement. However, self-efficacy and locus of control account for motivation better than all these three variables together explaining academic achievement.

Limitations and implications

This study is limited from several perspectives. First, the analyses showed that locus of control and self-efficacy did not directly correlate with each other. Other variables such as peer relationships, self-concept, self-esteem, and learning engagement may mediate the correlation between these two variables, as motivation mediated the relationship between locus of control and academic achievement. Future studies could examine other alternative models by including these and similar variables. Second, the correlation data did not represent all studies, as studies examining the relationship between at least three variables were included in the analysis, and no study examined all variables in the same study (see Table 2). Including studies with one or two correlations in the study can cause too many missing values that may not allow the program to run the analysis. Therefore, primary studies focusing on the relationship between all these variables are needed to enable further analyses through meta-analytic reviews of this kind. Third, the effect sizes obtained in this review were heterogeneous. Therefore, the mean correlation effect sizes could have been influenced by extraneous variables such as different data collection tools used in primary studies and various education levels that future studies may want to address through moderator analyses. In addition, the conclusions drawn from this study are limited to the findings of primary studies retrieved from only five databases and the search terms used. Searching more databases and journals could have yielded more relevant studies. These limitations may reduce the generalizability of our findings, which future studies may address by replicating this study.

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APPENDIX

FUNNEL PLOTS FOR EACH PAIRWISE META-ANALYSIS