Determinants of academic achievement: systematic review of 25 years of meta-analyses[1]

Condicionantes del rendimiento académico: revisión sistemática de 25 años de meta-análisis

https://doi.org/10.4438/1988-592X-RE-2022-398-552

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Abstract

This work is a continuation of the review carried out by Sipe and Curlette (1997), which synthesized the results of 103 meta-analyses published between 1984 and 1993 aimed at studying the variables that influenced academic performance. Knowing the aspects that enhance or hinder students' academic performance is key to improving it. Therefore, in this paper we perform a review of 80 meta-analyses published between 1994 and 2019 with 127 effect sizes that have analyzed the relationship between personal, family, school and teacher variables and students' academic performance. The results provide an overview

[1] This research has been conducted under the support of the *Ayudas para la Formación de Profesorado Universitario* (FPU).

of the characteristics of the meta-analyses identified in relation to their search process, the selection and coding of the primary studies, their methodology, and the characteristics of the selected studies. Also, an estimate of the effect size of each of the determinants of academic performance is calculated from the 127 effect sizes distributed by these meta-analyses. The above shows that the personal variables that have the greatest influence on academic performance are prematurity, student's previous performance, intelligence, and health. Among the family factors, the absence of the father, mistreatment received by the family environment and socioeconomic status stand out. The school aspects that have shown the greatest weight on students´ results are classroom climate, measures to reduce misbehavior and school organization. Finally, among the variables associated with the teacher, the teachers´ own characteristics, their relationship with the students and the quality of teaching have demonstrated to be the most important. For all these reasons, the review conducted in this paper in relation to the determinants of academic performance will facilitate the adoption of better decisions when addressing its improvement.

Key words: Academic achievement, Academic failure, Systematic review, Meta-analysis, Meta-synthesis

Resumen

Este trabajo supone una continuación de la revisión realizada por Sipe y Curlette (1997), en la que se sintetizaron los resultados de 103 meta-análisis publicados entre 1984 y 1993 destinados a estudiar las variables que influían en el rendimiento académico. Conocer los aspectos que potencian o dificultan el rendimiento académico de los estudiantes resulta clave para poder favorecer su mejora y, por ello, en este estudio se realiza una revisión de los meta-análisis publicados entre 1994 y 2019 que han analizado la relación entre variables personales, familiares, escolares y docentes y el rendimiento académico del alumnado. Los resultados proporcionan una visión general de las características de los 80 meta-análisis identificados en relación con su proceso de búsqueda, selección y codificación de los estudios primarios, el procedimiento metodológico seguido y las características de los estudios primarios seleccionados. Asimismo, a partir de los 127 tamaños del efecto reportados por estos meta-análisis, se estima un tamaño del efecto global para cada uno de los condicionantes del rendimiento académico. Lo anterior permite observar cómo las variables personales que ejercen una mayor influencia en el rendimiento académico son la prematuridad, el rendimiento previo del alumnado, su inteligencia y su salud. Entre los factores familiares destacan la ausencia del padre, el maltrato recibido por parte del entorno familiar y el estatus socioeconómico. Los aspectos escolares que han demostrado tener un mayor peso sobre los resultados de los estudiantes han sido el clima del aula, las medidas de reducción del mal comportamiento y

la organización escolar. Por último, entre las variables asociadas al profesor destacan sus propias características, su relación con los estudiantes y la calidad de la docencia. Por todo ello, la presente revisión contribuye a identificar los principales condicionantes del rendimiento académico, lo cual facilitará la adopción de decisiones adecuadas a la hora de abordar su mejora.

Palabras clave: Rendimiento académico, Fracaso escolar, Revisión sistemática, Meta-análisis, Meta-síntesis

Introduction

While deepening in the concept of academic achievement may seem a simple task due to its familiarity, this term encompasses a great complexity both in its definition and in its evaluation (Bentley, 1966; Stevenson, 2021; York et al., 2015). Said complexity is not only due to the fact that academic achievement can cover a wide range of educational outcomes, ranging from the acquisition of a diploma to the students' moral development (York et al., 2015), but also to its relation to some elements that are difficult to quantify (Mozammel et al., 2021). Moreover, the term academic achievement has a number of interchangeable expressions –such as academic performance or academic success– that make its definition and operationalization even more complex worldwide (Stevenson, 2021). In addition, the ambiguity that characterizes academic achievement is also related to the different perspectives from which success, in general, can be approached (Kumar & Lal, 2014).

Consequently, academic achievement can be considered as a multidimensional concept that evidences the learnings of students at different levels. These learnings are not only linked to the contents acquired by the students, but also to their cognitive, emotional, social, and physical development (Kumar & Lal, 2014). Thus, in general terms, academic achievement shows the level of mastery achieved by students in relation to a series of previously established and diverse learning standards (Robinson & Biran, 2006). According to Fan and Chen (2001), said learning standards range from global indicators –such as permanence in compulsory secondary education or grades– to indicators linked to

students' aspirations or to their academic self-concept, also considering more specific elements –such as the results obtained in standardized tests on a specific subject–.

Research on the determinants of academic performance

Regardless of the approach adopted in the conceptualization and assessment of academic performance, there is no doubt that the level of academic achievement of students is one of the main indicators of the quality of education systems. Therefore, the improvement of education systems requires to deepen in the aspects that influence educational outcomes.

Traditionally, students´ intelligence has been considered the most important conditioning factor of academic performance, being the most studied personal variable in educational and psychological scientific research (Ali & Ara, 2017; Ferragut & Fiero, 2012; Gunawardena et al., 2017; Smedsrud et al., 2019). However, more recent investigations seem to confirm that, although intelligence explains an important part of academic performance, there are numerous factors that, being closely interrelated, contribute to explain the variability of educational outcomes (Akbas-Yesilyurt et al., 2020; Bhowmik, 2019; McCoach et al., 2017; Nisar & Mahmood, 2017; Olmos Rueda & Mas Torelló, 2013).

The large number of empirical studies that have analyzed how these variables predict and explain student learning generates the need to carry out review studies that allow to identify the main determinants of academic performance and their associated effects. For this reason, meta-analyses summarising the empirical evidence on the factors that influence educational outcomes have been conducted since the past century. Said meta-analyses consist on systematic reviews and statistical procedures that provide a quantitative estimate of the mean effect of a variable on the basis of the findings derived from previous studies (Russo, 2007). Also, although less commonly, meta-syntheses on the predictive capacity of certain variables on academic performance have been published, allowing the results from meta-analyses to be compared and summarized (Higgins, 2016).

A meta-synthetic investigation of reference in the field of academic achievement is the review published by Hattie (2017), who analyzed

the influence of students´ own characteristics, their families, and various aspects of schools on academic achievement. In his research, the author highlighted the positive influence of some personal variables such as previous high academic achievement and self-efficacy, as well as the pernicious influence of boredom, depression, use of minority languages, superficial motivation, sleep problems, attention deficit hyperactivity disorder and hearing difficulties. The author also demonstrated the positive effects that certain family variables such as home environment and socio-economic status, as opposed to corporal punishment, excessive television consumption, or benefitting from welfare policies, have on academic performance. Moreover, Hattie (2017) observed the influence that school and teacher variables have on academic performance, highlighting the positive effects of teacher effectiveness and the negative influence of aspects such as student suspension, excessively long summer holidays or school changes.

The meta-synthetic work published by Sipe and Curlette (1997) should also be mentioned. In their investigation, the authors conducted a synthesis of 103 meta-analyses published between 1984 and 1993 which were aimed at studying the variables that influenced academic performance. The research is centered on the influence of different personal, family, school, and teacher aspects on students' academic performance. Also, it provides an in-depth overview of the characteristics of the meta-analyses on which it is based –evidencing the major role of motivation, personal skills, home environment, quality of teaching and classroom social group –.

With the aim of providing an updated overview of the factors that condition the educational outcomes achieved by students and of the characteristics of the meta-analyses that study these factors, this research consists of a systematic review of the meta-analyses that have synthesized the effect of personal, family, school and teacher aspects on academic performance over the last 25 years. Thus, the present study is a continuation of the review carried out by Sipe and Curlette (1997).

Received: 23-09-2021 Accepted: 18-03-2022

Method

This systematic review was conducted following the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA) guidelines, as well as its bias control procedures.

The search and selection processes are described below. The inclusion criteria, the coding procedure and the analysis of the coded information are also described in the following sections.

Search procedure

The search for articles was performed in the two main international databases with multidisciplinary coverage: Web of Science and Scopus. ERIC and APA PsycInfo (EBSCOhost) databases, which are specialized in education and psychology, respectively, were also used.

Given that the purpose of this search was to identify meta-analyses aimed at analyzing the effect of personal, family, school and teacher variables on academic performance, a search equation that combined both terms (meta-analysis and academic performance) was used using the Boolean operator "AND" (Table I).

Received: 23-09-2021 Accepted: 18-03-2022

TABLE I. Terms used in the search equation

Meta-analysis	Academic achievement
"meta analysis" OR "meta-analysis" OR "metaanalysis" OR "meta-analytic" OR "meta analytic" OR "metanalytic" OR "meta synthesis" OR "meta-synthesis" OR "metasynthesis" OR "qualitative synthesis" OR "systematic review" OR "systematic literature review" OR "systematic scoping review" OR "systematic qualitative review" OR "systematic quantitative review" OR "systematic meta-review" OR "systematic critical review" OR "systematic mapping review" OR "systematic search and review" OR "systematic integrative review"	"academic* achievement*" OR "academic* performance*" OR "academic* outcome*" OR "academic* success*" OR "academic* competence*" OR "academic* attain*" OR "academic* improvement*" OR "academic* output*" OR "academic* learning*" OR "school* performance*" OR "school* outcome*" OR "school* achievement*" OR "scholastic* achievement*" OR "education* outcome*" OR "education* achievement*" OR "education* attain*" OR "education* improvement*" OR "education* output*" OR "education* performance*" OR "student* achievement*" OR "student* competence*" OR "student* attain*" OR "student* improvement*" OR "student* output*" OR "student* outcome*" OR "student* learning*" OR "student* performance*" OR "performance* level*" OR "learning* outcome*" OR "learning* attain*" OR "learning* achievement*" OR "learning* performance*" OR "achievement* gain*".

In order to complement and update Sipe and Curlette´s (1997) findings, this search was limited to articles published between January 1994 and December 2019, so that evidence for the 25 years after those years considered in said study could be provided. This process was carried out on October 27, 2020, and resulted in the retrieval of a total of 1230 records. Of these records, 235 came from APA PsycInfo, 187 were from ERIC, 405 belonged to Scopus and 403 were obtained from the Web of Science.

Elegibility criteria

Taking the inclusion criteria proposed by Sipe and Curlette (1997) as a reference, the following inclusion criteria were established for the selection of the studies included in this synthesis:

- Topic: effects of personal, family, school, and teacher variables on students' academic performance. Only studies in which the dependent variable was academic performance, both in general or in a specific subject, and in which the independent variable was personal, family, school or teacher characteristics were selected. Meta-analyses focusing on the effect of specific interventions or methodologies on students' academic performance were excluded.
- Type of study: meta-analysis with at least a mean effect size derived from primary studies reflecting the mean influence of an independent variable on academic achievement.
- Design: quantitative or mixed. It was required that the article provided a measure of the magnitude of the effect. Therefore, systematic reviews with qualitative syntheses of the results or that were based on path analysis and meta-regressions were excluded.
- Population: students enrolled in any stage of the formal educational system, excluding papers focused only on higher education or on any type of non-formal education. Articles analyzing academic performance in specific populations (e.g., students with chronic diseases or people with disabilities) were not considered either.

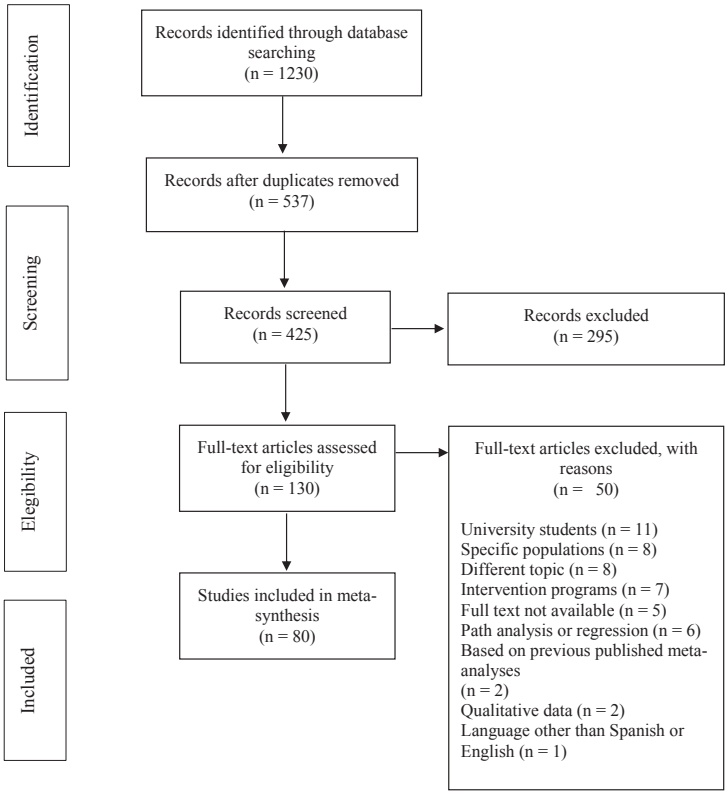
Together with the above, it should be noted that only studies published in scientific paper format and in the English or Spanish language were considered.

Selection process

The study selection process began by eliminating duplicates, which resulted in a total of 537 unique records. After discarding all documents published in a language other than English or Spanish, or in a format different to a scientific paper, the sample was reduced to 425 articles.

A review of the title and abstract was then performed. From this review, 295 publications that did not meet the aforementioned inclusion criteria were excluded. To avoid selection bias, each of the records was reviewed independently by two researchers, with an agreement rate of 91.43%. This percentage reflects the relationship between the number of agreements and the total number of articles reviewed. Finally, the full text review of the 130 articles considered in the previous phase resulted in a final selection of the 80 articles included in the present meta-synthesis. Graph I shows the flow diagram of the search process and the study selection following PRISMA guidelines (Moher et al., 2009).

GRAPH I. Flow diagram of the study selection process



Received: 23-09-2021 Accepted: 18-03-2022

Coding of variables

A data extraction sheet based on the Sipe and Curlette´s (1997) coding was used to code the information derived from each of the selected meta-analyses. Specifically, variables related to the search process, selection and coding of the primary studies, methodological characteristics of the meta-analyses, characteristics of the primary studies, dependent and independent variables involved, and results obtained were considered.

For the search process and selecting and coding of the studies, information on the following aspects was collected:

- *Meta-analysis protocol used*: (1) PRISMA, (2) other meta-analysis procedures, and (3) not specified.
- *Sources*: (1) databases, (2) ancestry, (3) search in specific journals, (4) grey literature, and (5) other sources. Within the category 'databases' a distinction was made between (1.1) Web of Science, (1.2) Scopus, (1.3) ERIC, (1.4) PyshInfo, (1.5) Medline, (1.6) PubMed, (1.7) ProQuest Dissertations and Theses, (1.8) Google Scholar, and (1.9) other databases.
- *Study selection process*, considering whether in the selected meta-analyses: (1) the inclusion criteria were specified, (2) the exclusion criteria were specified, (3) the search years were specified, (4) the keywords used were specified, (5) the bias in the quality of the studies was controlled, and (6) the selection of studies was performed by several investigators. In turn, in those meta-analyses in which the selection of studies was carried out by several investigators, we also coded whether (6.1) the agreement index was calculated and, if so, (6.2) the agreement index provided.
- *Coding of variables*, recording whether (1) the search equation was specified, (2) information on the coding process was provided, and whether (3) the coding of variables was carried out by several investigators. If so, we coded whether (3.1) the index of agreement between coders was calculated and, if so, (3.2) the index of agreement provided.
- Regarding the methodological characteristics of the meta-analyses, the following variables were considered:
- *Control of publication bias*. First, we coded whether the studies (1) provided information about publication bias and, in those cases in which they did, we reported the procedure used: (1.1)

Received: 23-09-2021 Accepted: 18-03-2022

fail-safe number, (1.2) funnel plot, (1. 3) Spearman rank-order correlations, (1.4) trim and fill, (1.5) Egger's test, (1.6) Begg and Mazumdar rank correlation test, (1.7) Kendall's rank correlation, (1.8) moderator analyses, and (1.9) other procedures.

- *Statistics extracted from the primary studies for calculating the mean effect size:* (1) correlations, (2) means and standard deviations, (3) betas, (4) odds ratios, and (5) other statistics.
- *Procedure for the calculation of the mean effect size:* (1) Fisher's z, (2)standardized mean difference (Cohen's d and Hedges' g), (3) odds ratio and (4) R.
- *Effect size estimation:* We coded whether meta-analyses provided information on (1) the confidence interval for the effect size, (2) the presence of outliers, (3) the absence of outliers, and (4) the type of model estimated. Within this last category, we recorded whether they estimated (4.1.) a fixed effects model, (4.2.) a random effects model, or (4.3.) both models (fixed effects and random effects).
- *Heterogeneity analysis:* First, we coded whether studies (1) assessed heterogeneity of effect sizes and, if so, the procedure used: (1.1) Q, (1.2) I^2, (1.3) Tau2, and (1.4) other procedures.
- Based on the characteristics of the primary studies included in each of the meta-analyses, information was obtained on the:
- *Number of articles included in the meta-analyses.*
- *Geographical limitation*, indicating whether geographical limitation was established as an inclusion criterion for the selection of articles.
- *Educational stage*. The educational levels at which the students in the primary sample were enrolled were recorded: (1) early childhood education, (2) primary education, (3) secondary education, and (4) university.
- *Measure of the dependent variable*: (1) general academic performance and (2) performance in a specific subject or area.

The independent variables considered in each of the meta-analyses were also collected and, on the basis of the classification established by Hattie (2009)[2], they were classified according to the categories listed in Table II.

[2] According to the needs derived from the variables identified in our study, 3 new subcategories and 14 indicators were added to the categories proposed by Hattie (2009). Thus, while Hattie established

TABLE II. Categories considered for the classification of the independent variables

Category	Subcategory	Indicator
Student	**Attitudes and dispositions**	Attitude to school subjects
		Cognitive processes and self-regulation*
		Concentration, persistence, and engagement
		Emotional intelligence*
		Happiness and well-being*
		Personality influences
		Procrastination and boredom*
	Background	Creativity
		Intelligence*
		Prior achievement
	Free time use*	Media use*
	Physical attributes	Ethnicity
		Exercise
		Gender (female)
		Health
		Sleep*
		Prematurity
		Other (crossed laterality) *
Family	**Family structure**	Non-resident fathers (father in prison)
	Home environment	Parental involvement in learning
	Socioeconomic and cultural status	Cultural capital*
		Socioeconomic status
	Well-being*	Child maltreatment*
Teacher	**Professional development**	Professional development
	Quality of teaching	Quality of teaching
	Teacher characteristics*	Teacher characteristics*
	Teacher-student relationships	Teacher-student relationships

22 subcategories and 66 indicators, the variables in our study have been classified according to the categories identified in Table II.

Received: 23-09-2021 Accepted: 18-03-2022

School	**Classroom compositional effects**	Class size
		Decreasing disruptive behavior measures*
		Mainstreaming
		Single-sex classes*
	Classroom influences	Climate of the classroom: classroom management
		Peer influences
	Principals and school leaders	Principals and school leaders
	School compositional effects	Out-of-school curriculum experiences
		Summer vacation effect
		School organization*
	Types of schools	Charter schools
		Religious schools

* Subcategories and indicators marked with an asterisk have been added to those proposed by Hattie (2009).

Finally, information of each meta-analysis on (1) the estimated mean effect size and (2) the number of effect sizes from which said effect size was estimated was collected.

Data analysis procedure

Based on the coded information, we first analyzed the extent to which the 80 meta-analyses included the selected aspects related to the search process, selection and coding of the primary studies. We also analyzed the methodological procedure used. The main characteristics of the primary studies included in these meta-analyses were also analyzed. For this purpose, the frequencies of appearance and their respective percentages were calculated. Likewise, the main descriptive statistics (minimum, maximum, mean and standard deviation) were estimated for the number of studies included in these reviews.

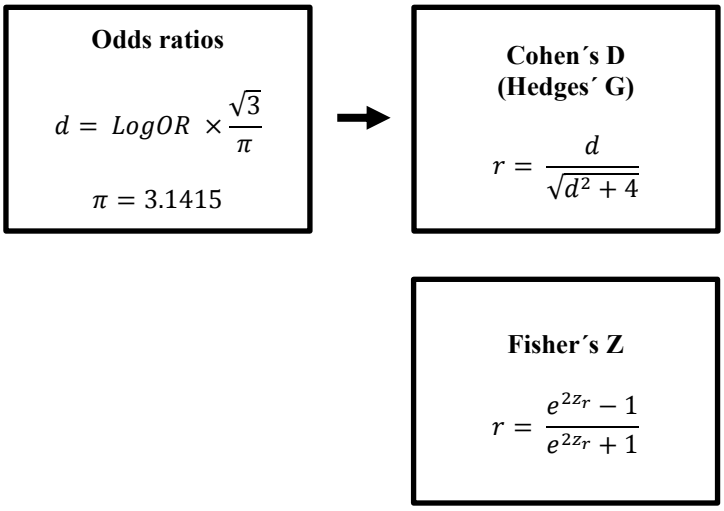
Secondly, the influence on academic performance of the independent variables extracted from the meta-analyses was analyzed. Specifically, the 127 mean effect sizes reported by the 80 meta-analyses were synthesized

Received: 23-09-2021 Accepted: 18-03-2022

according to each of the categories, subcategories and indicators in Table II. The process followed to achieve this purpose consisted of three stages:

- In those meta-analyses in which two mean effect sizes were provided for the same sample of studies –one estimated on the basis of the fixed-effect model and the other from the random-effects model–, only one measure of the magnitude of the effect was selected. For this purpose, the indications provided by the authors on the suitability of each of the two models were considered. For the six publications that did not provide this information, the most appropriate model was selected on the basis of the number of effects included, the heterogeneity of the effect sizes and the authors' intention to generalize the results (Borenstein et al., 2010; Tufanaru et al., 2015).
- Second, we converted all mean effects sizes to the same metric in order to combine them. Specifically, standardized mean differences, odds ratios, and Fisher's z were transformed to R (see Figure I).

FIGURE I. Transformation applied to convert effect sizes to R



Received: 23-09-2021 Accepted: 18-03-2022

- All estimates were calculated using Microsoft Excel. Finally, mean effect sizes reported by the selected meta-analyses were combined for each of the categories, subcategories, and indicators considered through the calculation of their simple arithmetic mean. Along with this mean effect size measure, information on the maximum and minimum mean effect size was calculated. The resulting effect sizes are interpreted according to the criteria established by Cohen (1992): small (.10), medium (.30) and large (.50).

Results

Description of the search process, selection and coding of the studies

The results show that, although a high percentage of meta-analyses (80%) did not specify the protocol used (see Table III), PRISMA was the most widespread procedure in these studies (13.75%).

Regarding the search sources, all the authors used databases in their search, being ERIC (68.75%) and PsycInfo (65%) the most widely used. The ancestry method was selected as a secondary search method in more than half of the studies (65%), with the search in specific journals being the least used complementary procedure for the identification of primary studies (12.5%).

Regarding the study selection process, 97.5% of the meta-analyses indicated the inclusion criteria; however, only half of them (45%) detailed the exclusion criteria. Differences were also observed in the degree of specification of the keywords used in the search, since, although 60% of the authors reported the search terms used, only 38.75% provided the complete search equation.

Another remarkable aspect is that in only 17.5% of the meta-analyses more than one researcher intervened in the selection of the studies. Also, the agreement index between researchers was calculated on 5% of occasions. This percentage is higher for the coding of variables, since 67.5% of the meta-analyses reported the participation of more than one researcher in this process. Of these, 40% provided an index of agreement between coders.

TABLE III. Description of the search, selection and coding process of the studies in the 80 meta-analyses considered

Description of the search process, selection and coding of the studies		Yes	Percentage
Protocol	PRISMA	11	13.75%
	Other	5	6.25%
	Not specified	64	80.00%
Search sources	Databases	80	100.00%
	WoS	23	28.75%
	Scopus	6	7.50%
	ERIC	55	68.75%
	PsycInfo	52	65.00%
	Medline	10	12.50%
	PubMed	11	13.75%
	ProQuest Dissertations and Theses	19	23.75%
	Google Scholar	20	25.00%
	Other	58	72.50%
	Ancestry	52	65.00%
	Specific journals	10	12.50%
	Grey literature	26	32.50%
	Other	10	12.50%
	Reviews and previous studies	3	3.75%
	Books and reports	2	2.50%
	Hand search	5	6.25%

Received: 23-09-2021 Accepted: 18-03-2022

Study selection process	Inclusion criteria are specified	78	97.50%
	Exclusion criteria are specified	36	45.00%
	The search years are specified	66	82.50%
	The keywords used are specified	48	60.00%
	The search equation used is included	31	38.75%
	Controlling for bias in the quality of the studies	27	33.75%
	The selection of studies is carried out by several researchers	14	17.50%
	The index of agreement between researchers is calculated	4	5.00%
	Over 80 %	2	2.50%
	Over 90 %	2	2.50%
Variable coding	Information on the coding of variables is provided	68	85.00%
	The coding of variables is carried out by several researchers	54	67.50%
	The agreement index between coders is calculated	32	40.00%
	Over 70 %	3	3.75%
	Over 80 %	6	7.50%
	Over 90 %	23	28.75%

Methodological characteristics

Considering the methodological characteristics of the meta-analyses (Table IV), publication bias was calculated in 68.75% of the systematic reviews. Funnel plot was the most commonly used procedure (31.25%), followed by fail-safe N (26.25%) and trim and fill (25%).

The statistics mainly extracted from the primary studies were correlations (80%), means and standard deviations (25%) and regression coefficients (13.75%). The main procedure for the calculation of the effect size was R (47.5%), followed by estimation of the standardized mean difference (38.75%) and Fisher's z (13.75%).

The model used for the estimation of effect sizes was specified in 90% of the meta-analyses, with the random-effects model prevailing over

Received: 23-09-2021 Accepted: 18-03-2022

the fixed-effects model (63.75% and 11.25%, respectively). In addition, most of the studies selected evaluated the heterogeneity of the effect size (85%), with Q (62.5%) and I^2 (42.5%) being the most commonly used procedures for this purpose.

Finally, the small number of studies reporting the presence or absence of outliers (22.5% and 6.25%, respectively) is noteworthy. In contrast, the confidence interval for the effect size was provided in most of the meta-analyses (85%).

TABLE IV. Description of the methodological procedure followed in the 80 meta-analyses considered

Methodological characteristics		Yes	Percentage
Control of publication bias	Publication bias is calculated	55	68.75%
	Fail-safe N	21	26.25%
	Funnel plot	25	31.25%
	Spearman rank-order correlation	5	6.25%
	Trim and fill	20	25.00%
	Egger´s test	17	21.25%
	Begg and Mazumdar rank correlation test	4	5.00%
	Kendall's rank correlation	9	11.25%
	Moderator analyses	4	5.00%
	Other	13	16.25%
Statistics extracted from primary studies	Correlations	64	80.00%
	Means and standard deviations	20	25.00%
	Beta	11	13.75%
	Odds ratio	4	5.00%
	Other	28	35.00%

Received: 23-09-2021 Accepted: 18-03-2022

Procedure for calculating effect sizes*.	Fisher's z	11	13.75%
	Standarized mean difference (Cohen's d or Hedges' g)	31	38.75%
	Log odds ratio	9	11.25%
	R	38	47.50%
Estimation of the mean effect size	Confidence interval is reported	68	85.00%
	The presence of outliers is reported	18	22.50%
	The ausence of outliers is reported	5	6.25%
	The type of estimated model is specified	72	90.00%
	Fixed effects model	9	11.25%
	Random effects model	51	63.75%
	Fixed effects and random effects models	12	15.00%
Heterogeneity analysis	Heterogeneity between effect sizes is evaluated.	68	85.00%
	The type of procedure used to assess heterogeneity is specified	65	81.25%
	Q	50	62.50%
	I^2	34	42.50%
	Tau2	5	6.25%
	Other	6	7.50%

* Some of the meta-analyses used more than one procedure in the estimation of mean effect sizes.

Characteristics of studies included in meta-analyses

The mean number of primary studies included in the meta-analyses is 58.28, ranging from 2 to 310 publications (Table V). No geographical limitation was established for the primary studies in most cases (81.25%), so the majority of meta-analyses included studies carried out in any country.

Considering the educational stages on which the systematic reviews focused, most of these studies were based on primary investigations that were performed with populations of students from various stages. The highest prevalence was for studies which focused on kindergarten,

primary and secondary education (28.75%), followed by meta-analyses that considered primary and secondary education and university (20%).

Finally, with regard to the dependent variable, most of the selected meta-analyses analyzed the effect of personal, family, school and teacher characteristics on students' overall performance (92.5%), while the remaining 8.75% studied academic performance in a specific academic subject.

TABLE V. Description of the characteristics of the studies included in the 80 meta-analyses considered

	Minimum	Maximum	Mean	Std. Deviation
Number of studies included in the meta-analysis	2	310	58.725	59.58
Geographical limitation	**N**	**Percentage**	-	-
No	65	81.25%	-	-
Yes	15	18.75%	-	-
Educational stage	**N**	**Percentage**	-	-
Kindergarten and primary	1	1.25%	-	-
Kindergarten, primary and secondary	23	28.75%	-	-
Kindergarten, primary, secondary and university	8	10.00%	-	-
Primary	3	3.75%	-	-
Primary and secondary	16	6.25%	-	-
Primary, secondary and university	16	20.00%	-	-
Secondary	5	6.25%	-	-
Secondary and university	5	6.25%	-	-
Measure of DV*	**N**	**Percentage**	-	-
General	74	92.50%	-	-
Specific	7	8.75%	-	-

*In one of the meta-analyses, the mean effect size is estimated both for studies that considered specific performance and for those that considered general performance.

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Effects of the variables considered on academic performance

This section describes the main variables related to academic performance, taking as a reference the categories considered in Table II. In general terms, the results show the high effect that teacher characteristics have on academic performance in comparison to other variables, with a mean effect size of 0.25. In contrast, the mean effect size for student characteristics was 0.08, and for family and school variables, 0.06. However, according to Hattie (2009), these effect sizes encompass a great internal complexity derived from the diversity of variables that compose them and from the variation in the effect sizes associated with each of them. Due to this, they should be interpreted with caution. Consequently, our study is centered in the effects associated with each of the individual indicators, examining said effects in more detail.

Effects of student characteristics on academic performance

Although the mean effect size for the relationship between students' characteristics and their academic performance is 0.08, there are remarkable differences in the mean effect sizes associated with the variables that conform this category (Table VI). First, the effect size of the factors associated with *background* stands out, being positively related to academic performance ($\bar{r}$ = 0.34). More specifically, *intelligence* and *previous academic performance* have proven to be the aspects most closely linked to educational results, both showing mean effect sizes that, according to Cohen (1992), are medium-high ($\bar{r}$ = 0.40 and $\bar{r}$ = 0.34, respectively).

Attitudes and dispositions have an overall effect size of 0.16. However, some components of this subcategory, such as *cognitive processes* and *self-regulation, concentration, persistence and engagement*, and *emotional intelligence*, have mean effect sizes equal to or greater than 0.2. Regarding the effect of *personality influences*, it is worth noting that, despite the fact that certain personality types are negatively related to academic performance, the effect sizes for some others are high ($\bar{r}$= 0.50). By contrast, *procrastination and boredom* have an inverse relationship with academic performance ($\bar{r}$ = -0.15).

Finally, *physical attributes* and *free time use* in media are negatively associated with academic performance, although the overall effect sizes for both categories are close to zero. Of note, however, are effect sizes for *lack of health* ($\bar{r}$ = -0.29) and *prematurity* ($\bar{r}$ = -0.32), these being the *physical attributes* with the most pernicious effect on academic performance.

TABLE VI. Synthesis of the effect of student characteristics on academic performance

	Mean	Minimum	Maximum	N summary effect sizes	N effects
Attitudes and dispositions	.16	-.16	.50	33	-
Attitude to school subjects	.12	-	-	1	29
Cognitive processes and self-regulation	.20	.07	.40	9	2,296
Concentration, persistence, and engagement	.22	.11	.29	6	584
Emotional intelligence	.20	.20	.20	2	1,350
Happiness and well-being	.16	-	-	1	151
Personality influences	.16	-.08	.50	12	884
Procrastination and boredom	-.15	-.16	-.13	2	103
Background	.34	.22	.54	4	-
Creativity	.22			1	782
Intelligence	.40	.25	.54	2	62
Prior achievement	.34	-	-	1	11
Free time use	-.07	-.16	.08	7	-
Media use	-.07	-.16	.08	7	206
Physical attributes	-.07	-.39	.31	19	-
Ethnicity	.09	-	-	1	87
Exercise	-.01	-.18	.31	3	28

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Sleep	.05	-.14	.16	6	99
Gender (female)	.06	-.00	.11	2	538
Health	-.29	-.39	-.11	3	87
Prematurity	-.32	-.36	-.27	3	N/A
Other (cross laterality)	-.02	-	-	1	27
TOTAL STUDENT	.08	-.39	.54	63	-

Effect of family characteristics on academic performance

As in the previous section, although the students' family characteristics have a small mean effect on academic achievement when considered as a whole ($\bar{r}$ = 0.06) (Table VII), the mean effect sizes for each of the subcategories also vary for each of the categories. The fact that the *father is away from home* and, more specifically, in a situation of internment in a penitentiary center, presents the greatest negative mean effect on academic performance ($\bar{r}$ = -0.36). Although this effect comes from a single meta-analysis, it can be affirmed that this situation of absence increases the risk of low achievement among students.

A low mean effect size was observed with respect to *parental involvement in learning* ($\bar{r}$ = 0.09). However, this effect varies greatly depending on the specific aspects of this family involvement, with mean effect sizes ranging from -0.16 to 0.36.

The mean effect size of the *socioeconomic and cultural status* of the students is 0.14. Although the mean effect size of *socioeconomic status* is slightly higher than that corresponding to *cultural capital*, the effects are medium-low in both cases. Finally, the *lack of well-being* of the children, concretized in situations of *maltreatmen*t, presents a mean effect size that can be considered as medium-low ($\bar{r}$ = -0.15).

TABLE VII. Synthesis of the effect of family characteristics on academic achievement

	Mean	Minimum	Maximum	N summary effect sizes	N effects
Family structure	-.36	-	-	1	-
Non-resident fathers (father in prison)	-.36	-	-	1	13
Home environment	.09	-.16	.35	18	-
Parental involvement in learning	.09	-.16	.35	18	> 1,804*
Socioeconomic and cultural status	.14	.07	.27	5	-
Cultural capital	.13	.10	.16	2	345
Socioeconomic status	.15	.07	.27	3	981
Well-being	-.15	-.32	.19	3	-
Child maltreatment	-.15	-.32	.19	3	105
TOTAL FAMILY	.06	-.36	.35	27	-

* Two of the meta-analyses did not report the number of effects from which the mean effect size was estimated.

Effect of teacher characteristics on academic achievement

Teacher characteristics analyzed in the selected meta-analyses are positively linked to student academic achievement when considered as a whole ($\bar{r}$= 0.22) (Table VIII). Among them, *quality of teaching* is the most strongly linked to the students' results. While the overall effect for that subcategory is medium ($\bar{r}$ = 0.29), the mean effect size values for some aspects of *teacher quality* –such as teacher self-regulation– are notably larger ($\bar{r}$= 0.44).

Similarly, although overall the mean effect size for *teacher characteristics* can be considered as medium-low ($\bar{r}$= 0.21), some specific characteristics, such as leadership, present higher values.

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TABLE VIII. Synthesis of the effect of teacher-associated variables on academic performance

	Mean	Minimum	Maximum	N summary effect sizes	N effects
Professional development	.12	-	-	1	-
Professional development	.12	-	-	1	11
Quality of teaching	.29	.10	.44	3	-
Quality of teaching	.29	.10	.44	3	> 98*
Teacher characteristics	.21	.19	.26	2	-
Teacher characteristics	.21	.19	.26	2	1,076
Teacher-student relationships	.16	-	-	1	-
Teacher-student relationships	.16	-	-	1	N/A
TOTAL TEACHERS	.23	.10	.44	7	-

* One of the meta-analyses does not report the number of effects from which the mean effect size is estimated.

Effect of school characteristics on academic achievement

The results show that the mean effect size for school characteristics is 0.06 (Table VIII). Moreover, there is little variability among the second-level subcategories, which have overall effect sizes that, in general, can be considered as low.

Regarding the different subcategories, the mean effect size for *principals and school leaders* is 0.14. However, there are remarkable differences in the mean effect sizes reported depending on the aspects of leadership considered in each of the meta-analyses, with values ranging from $\bar{r} = 0.04$ to $\bar{r} = 0.49$.

The mean effect size for the *school compositional effects* is 0.12, with *school organization (school culture)* having the highest mean effect size within this subcategory ($\bar{r} = 0.25$).

The subcategories related to the classroom –*classroom compositional effects* and *classroom influences*– present mean effect sizes close to zero.

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Within the former, the negative mean effect of the *measures aimed at reducing disruptive behavior (school suspension)* stands out ($\bar{r}$= -0.21). In relation to classroom influences, the mean effect size for the association between *classroom management* and academic achievement ($\bar{r}$ = 0.24) is remarkable, reaching a value of 0.42 in one of the selected studies. By contrast, *peer influence (bullying)* is negatively related to academic achievement, presenting a mean effect size of -0.13.

Finally, the types of school show a negative mean effect size on academic achievement, although there are differences within the subcategory. Thus, a small but negative mean effect size is observed for *charter schools* ($\bar{r}$ = -0.09), while the mean effect size is positive for *religious schools* ($\bar{r}$ = 0.13).

TABLE IX. Synthesis of the effect of school-associated variables on academic achievement

	Mean	Minimum	Maximum	N summary effect sizes	N effects
Classroom compositional effects	.02	-.21	.10	10	-
Class size	.10	-	-	1	120
Decreasing disruptive behavior	-.21	-	-	1	43
Mainstreaming	.06	-	-	1	143
Single-sex classes	.04	.02	.06	7	114
Classroom influences	.05	-.14	.42	4	-
Climate of the classroom: classroom management	.24	.05	.42	2	N/A
Peer influences	-.13	-.14	-.12	2	58
Principals and school leaders	.14	.04	.49	8	-
Principals and school leaders	.14	.04	.49	8	426
School compositional effects	.11	.04	.23	4	-
Out-of-school curriculum experiences	.09	-	-	1	3

Received: 23-09-2021 Accepted: 18-03-2022

School organization	.23	-	-	1	25
Summer vacation effect	.06	.04	.09	2	63
Types of schools	-.03	-.14	.13	4	-
Charter schools	-.09	-.14	.01	3	> 244*
Religious schools	.13	-	-	1	N/A
TOTAL SCHOOL	.06	-.21	.49	30	-

* One of the meta-analyses did not report the number of effects from which the mean effect size was estimated.

Conclusions

The present meta-synthesis, which is proposed as a continuation of Sipe and Curlette´s (1997) work, was aimed at analyzing the relationship between personal, family, school and teacher characteristics and students' academic achievement. Specifically, we have synthesized the results of 80 meta-analyses published between 1994 and 2019, which provided 127 effect sizes.

In their meta-synthesis, Sipe and Curlette (1997) noted that the Glass procedure, followed by Hedges, was the most commonly used for conducting meta-analyses. However, the most used method in the selected studies of our research was PRISMA. Since it was first published in 2009, it did not appear in the review conducted by these authors (Moher et al., 2009).

An evolution in the search procedures is also observed. Only 84% of the meta-analyses provided information on the search process in the study by Sipe and Curlette (1997), in contrast to the 100% of articles on which this meta-synthesis is based. Furthermore, the most commonly used procedure in the meta-analyses carried out before 1994 was ancestry (68%). It is also noteworthy that 32% of them did not use the computer as a search tool; this contrasts with the widespread use of information and communication technologies today (Dobrota et al., 2012). However, the high number of authors using ERIC –which constitutes the main database specialized in education– is an aspect that coincides with the work done by Sipe and Curlette (1997).

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There have also been notable advances towards a greater description and detail of the search processes. This is a very important issue given that replicability constitutes one of the paths to confirm the validity of a new scientific finding (National Academies of Sciences, Engineering, and Medicine, 2019). Sipe and Curlette (1997) identified that many details about the search procedures were not present in the selected meta-analyses, thus hindering the replicability of the studies. For example, only 29% of the meta-analyses indicated the start year and 26% the end year, while 82.5% of the meta-analyses included in our synthesis provided this information. Similarly, whereas in the previous review only 27% of the meta-analyses listed the keywords used, this percentage rises to 60% in our work. Advances are also observed in the information provided on the variables coded, from being described in less than half of the meta-analyses prior to 1994, to being described in 85% of the studies included in this meta-synthesis. Furthermore, whereas in the former revision only 20% of the selected meta-analyses used two coders in the study selection process, this percentage has now risen to 67.5%. There has also been a notable increase in the information provided on the rate of agreement, rising from 3.26% to 40%.

With regards to the methodological procedures, there has been a notable increase in the proportion of meta-analyses reporting the confidence interval: 85% of the meta-analysis in this synthesis compared to the 22% reported by Sipe and Curlette (1997). This fact could be explained by the greater difficulties in performing statistical calculations prior to the development of new techniques, in contrast to the present existence of computer technology and the widespread accessibility of specific data analysis software, all of which has led to a rapid evolution in statistical methodology in recent years (Barreto-Villanueva, 2012; Sagaró & Zamora, 2019). Also, similar values are observed in both works in relation to the percentage of studies reporting the presence of outliers, with these values hovering at around 25% in both cases (26% vs 22.5% in the present work).

Sipe and Curlette (1997) also provided information on the procedures used to calculate the heterogeneity of the effect size, detecting that 13 publications (12.6%) used the Q test. This aspect contrasts with 62.5% of the meta-analyses that used the Q test in our study. Moreover, since the Q test only reports the presence or absence of heterogeneity, I^2 is an

interesting complement for its quantification (Huedo-Medina, 2006). In our study, 42.5% employed this procedure.

Our results show that there is also a greater use of fail-safe N to calculate publication bias, since the percentage has increased from 9% to 26.25%. This increase is in line with the findings of Heenee (2010), who detected an exponential increase in the use of fail-safe N in meta-analyses between 1979 and 2008. However, our study reveals that other procedures –such as the funnel plot (31.25%) and trim and fill (25%)– are nowadays used to a greater extent than fail-safe N.

Considering the results derived from the effect sizes of student variables[3], Sipe and Curlette (1997) identified the highest mean effects for *motivational aspects*, followed by those related to *student skills*. These results are in partial agreement with those obtained in the present research, where both *student background* ($\bar{r}$ = 0.34) and student *persistence, concentration and engagement* ($\bar{r}$ = 0.22) are the most strongly related to the personal aspects of academic performance. Hattie's (2017) findings are also in this line, since he observed that the variables linked to these aspects presented mean effect sizes close to d = 0.5 ($\bar{r}$ = 0.24). *Leisure time use* is also presented as a student variable related to performance in Sipe and Curlette's (1997) study, although their mean effect size comes from a single paper. In their synthesis, studies on *leisure time use* have been found in relation to media use, which is negatively linked to student achievement. This may be associated with the large amount of time spent on media not only during adolescence but also at very early ages (Hadders-Algra, 2020; Spina et al., 2021). Beyond these findings, our research has also demonstrated the importance of *cognitive processes and self-regulation*, *emotional intelligence*, *health* and *non-prematurity* in academic performance.

With respect to family characteristics, although Sipe and Curlette (1997) only studied the *home environment*, their results are consistent with those obtained in this paper, being the variable with the smallest mean effect size of all those considered. In this vein, although Hattie (2017) did not provide an overall effect size either for family characteristics in general, or for home environment in particular, he reported higher mean effect sizes than those obtained in our synthesis for the categories of *parental*

[3] Sipe and Curlette (1997) did not provide results for all the categories established in this meta-synthesis.

Received: 23-09-2021 Accepted: 18-03-2022

involvement ($\bar{r}$= 0.24; versus $\bar{r}$= 0.09) and *socioeconomic status* ($\bar{r}$= 0.25; versus $\bar{r}$= 0.15). These results are also consistent with the investigation of Castro et al. (2015), who found medium effects on the variables related to parent-child communication.

In relation to the factors associated with teachers, Sipe and Curlette (1997) highlighted the effect of *quality of instruction*. This variable not only presented one of the largest mean effect sizes in our synthesis ($\bar{r}$ = 0.29), but also yielded a similar result to that reported in the work by Hattie (2017)[4] ($\bar{r}$= 0.24). Our findings also demonstrated the influence of *teacher characteristics* on students' academic performance. However, it should be recalled that our study has excluded from its analysis any research directly related to the effect of specific interventions or methodologies. It is possible that personal or behavioral variables of teachers, as well as classroom management variables, may be directly implicated in many of those studies.

Finally, although Sipe and Curlette (1997) only considered the influence of the *classroom social group* within the scope of school factors, its low effect size is again consistent with our results for this category. However, we have also detected other variables with higher mean effect sizes, such as the *climate of the classroom (classroom management)*, the *school organization (school culture)* and the pernicious role of *measures to reduce disruptive behavior*.

Although the aim of this work was to temporarily extend the research carried out by Sipe and Curlette (1997), we have also identified new personal, family, school and teacher variables that influence students' academic performance.

The comparison of the results of both studies shows that, although some personal variables –such as cognitive and attitudinal characteristics–, or the quality of teaching have historically maintained their status of predictors of academic performance, the most recent research is considering and demonstrating the role that variables like family involvement, socio-economic status or the climate and culture of classrooms and schools have on academic achievement. Therefore, this study shows an evolution in the explanatory factors of academic performance. Although, in some cases, this evolution might be due to changes in present-day societies, on

[4] In Hattie's (2018) study, teacher quality was measured through student perception.

Received: 23-09-2021 Accepted: 18-03-2022

most occasions, it may be a consequence of an evolution in the variables considered and in the approaches adopted by the scientific community.

Our results thus provide a holistic and updated overview of the factors that may influence students' academic performance. This constitutes an opportunity for achieving the goal of giving fair and quality education to all students (Iglesias-Díaz & Romero-Pérez, 2021; Vera Sagredo et al. 2021) and for designing and implementing educational policies and interventions. Said interventions would be aimed, on the one hand, at strengthening those factors that contribute to improving academic performance and, on the other hand, at neutralizing the negative effects of the variables identified as pernicious. As shown in our study, said variables are related to having the father in prison, facing situations of abuse as a child, having health problems, or making excessive use of technology, as well as to being influenced by the peer group or receiving measures to reduce misbehavior.

Furthermore, systematized evidence on predictors of academic performance provides an opportunity for international organizations to access updated research on the factors that have proven their influence on student performance. This may help to facilitate the updating and inclusion of new variables in international assessments.

Moreover, our results evidence a methodological improvement in the procedures employed, which incorporate greater rigor in the techniques and specific search processes. However, as Sipe and Curlette (1997) pointed out, the main limitation of meta-analyses and, consequently, of meta-synthesis, is that it is likely that there are variables with influence on academic performance that have not been incorporated in systematic reviews. Similarly, it should be noted that, in a meta-synthesis, it is not possible to have information about aspects such as the controlled variables or the procedures and instruments used by the primary studies, nor is it to ensure homogeneity in the definition of the variables by these studies. Therefore, when interpreting the results, it is necessary to consider that meta-syntheses echo the limitations of the meta-analyses contained in them. Furthermore, when analyzing the findings, it should be remembered that this type of research does not reflect the interactions between variables, but it rather establishes the basis for the aspects that should be considered in confirmatory studies.

In this sense, meta-syntheses such as the one presented here provide solid evidence to draw a comprehensive map of the variables that

influence academic performance and to establish the basis for a deeper understanding of the relationships between them.

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Received: 23-09-2021 Accepted: 18-03-2022