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Alberto Quílez Robres

Variables que influyen en el rendimiento académico en Educación Primaria: tradición e innovación.
Variables that influence academic performance in Primary Education: tradition and innovation.

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Tesis Doctoral

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ALBERTO QUÍLEZ ROBRES

“Aprendemos para enseñar
y cuando enseñamos, seguimos aprendiendo,
pues el proceso de enseñanza-aprendizaje dura toda la vida”

A mi abuelo

Agradecimientos

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El nacimiento de la idea de cursar un programa de doctorado viene de lejos. Mi director de TFG me abrió los ojos a este mundo desconocido para mí. Desde aquí mi más sincero agradecimiento a pesar de que en los comienzos fue muy duro conmigo y su exigencia muy alta, ya que decía que las cosas, si se hacen, se hacen bien. Gracias David. El siguiente paso hacia esta etapa formativa se lo debo a mi directora de TFM, ella me introdujo en el mundo de la investigación, me enseñó los pasos a seguir, los métodos para buscar información y me sumergió en el mundo de la estadística porque ella pensaba que un investigador no puede prescindir de una herramienta tan útil. Pero además agradezco enormemente su disponibilidad y accesibilidad. Gracias Sandra. Estos dos pasos me prepararon para culminar la meta que ahora me propongo: obtener el doctorado. No puedo olvidar el apoyo de mi familia, sobre todo el de mi madre, que mostró un gran entusiasmo por el proyecto y me animó en todo momento: si quieres, tú puedes. Con este bagaje había que decidir el tema de la tesis doctoral que desde el principio estaba muy claro ya que iba a seguir las líneas esbozadas en el TFG y TFM. A ello se añadía mi profesión de maestro de Educación Primaria y, además, el contacto con mis alumnos me recordaba la pregunta que siempre me había hecho: ¿por qué algunos aprenden más deprisa y mejor? ¿de que dependían los resultados escolares? ¿solo de las capacidades innatas? ¿o existían otros factores? Quedaba lo último y lo más importante ¿Quién me iba a dirigir la tesis doctoral? Y encontré a Alejandra y a Nieves. Muchas gracias, sin vosotras no lo hubiera conseguido nunca. Gracias Alejandra por tu entusiasmo, empuje y motivación. Para ti no existen obstáculos, los derribas sin más y, enseñas a los demás a hacerlo también. Contigo se aprenden estrategias, habilidades y estilos para alcanzar los objetivos. Cuando el desánimo o la frustración me invadían el ejemplo de tu trayectoria profesional y tus logros académicos me ayudaban a superarlo. Qué decir de Nieves, busca la perfección, es meticulosa y siempre encuentra aquello en lo que puedes mejorar. Siempre terminaba con la frase: está muy bien, pero lo puedes hacer aún mejor. Su experiencia con la estadística ha sido de gran ayuda. También un recuerdo para Raquel, mi compañera doctoranda, gracias por tu amistad y acompañamiento. No puedo terminar este apartado de agradecimientos sin recordar a José Manuel, Psicólogo de profesión y orientador del Colegio Sagrado Corazón Moncayo. Sus enseñanzas y su apoyo unido a su experiencia han sido esenciales. Las dudas sobre cómo aplicar las pruebas y test o cómo obtener los datos

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Consideraciones Preliminares

CONSIDERACIONES PRELIMINARES

Consideraciones preliminares

1) La presente tesis doctoral es un compendio de seis artículos científicos que han sido publicados o están en proceso de revisión en revistas JCR (JIF/JCI).

2) Con el objeto de simplificar y de acuerdo con la Real Academia Española (RAE) se ha utilizado el género masculino a lo largo de este documento para señalar la generalidad de géneros sin minusvalorar a ninguno de ellos.

3) En el desarrollo de los distintos apartados que componen la presente tesis doctoral se han seguido las normas de la Asociación Psicológica Americana (APA, 7ª Edición).

4) Dado que los seis artículos científicos que conforman la tesis doctoral han sido publicados en revistas científicas internacionales en inglés y en español se ha optado por incluir la versión original.

Proyecto de investigación

Los artículos científicos que componen la presente tesis doctoral, se enmarcan en el proyecto de investigación "Variables que influyen en el rendimiento académico en Educación Primaria: tradición e innovación" que cuenta con el Dictamen favorable del Comité de Ética de la Investigación de la Comunidad Autónoma de Aragón: CEICA (No. 04/2019; 27 de 02 de 2019) (ver Anexo I).

Siglas y acrónimos

Para facilitar la interpretación del documento a continuación se detallan las abreviaturas de palabras que se repiten a lo largo de la tesis doctoral.

Abreviatura	Significado
AAL	Academic achievement in Language and Literature
AAM	Academic achievement in Mathematics
ADHD	Attention déficit hyperactivity disorder
ANOVA	Analyses of Variance
APA	American Psychological Association
AWMA	Automated Working Memory Assessment
BRIEF	Behavioral Assessment of the Executive Function
CAT	Children's Apperception Test
CEICA	Comité de Ética de la Investigación de la Comunidad Autónoma de Aragón

CI	Confidence Interval
DT	Desviación Típica
EF	Executive Functions
EP	Educación Primaria
GAA	Global academic achievement
IBM	International Business Machines
IQ	Intelligence Coefficient
JCI	Journal Citation Indicator
JCR	Journal Citation Reports
JIF	Journal Impact Factor
LOE	Ley Orgánica 2/2006, de Educación
LOMLOE	Ley Orgánica 3/2020, que modifica la Ley Orgánica 2/2006
MECES	Marco Español de Cualificación para la Educación Superior
MI	Multiple Intelligences
NARA	Neale Analysis of Reading Ability
OECD	The Organization for Economic Cooperation and Development
OMS	Organización Mundial de la Salud
PISA	Programme for International Student Assessment
PROLEC	Battery of Evaluation of the Reading Processes
SD	Standard deviation
SE	Standard Error
SEM	Structural Equation Modeling
SPSS	Statistical Package for Social Sciences
TIC	Tecnologías de la Información y la Comunicación
TOPEL	Test of Preschool Early Literacy
UE	Unión Europea
UNESCO	United Nations Educational, Scientific and Cultural Organization
VIF	Variance Inflation Factor
WIAT	Wechsler Individual Achievement Test
WM	Working Memory

Compendio de Publicaciones

COMPENDIO DE PUBLICACIONES

La presente tesis doctoral es un compendio de seis estudios científicos publicados, aprobados o en fase de revisión para su publicación a fecha de depósito de esta tesis doctoral en revistas JCR (si bien en estos momentos hay que tomar en consideración los índices JIF y JCI en su clasificación). A continuación, se muestra una relación de dichos artículos con su referencia completa (Tabla 1). Hay que destacar que a pesar de que el presente trabajo expone un objetivo general cada uno de los seis artículos se puede comprender de manera independiente.

Tabla 1. Compendio de artículos científicos que componen la tesis doctoral.

Estudio	Referencia bibliográfica completa

Capítulo I: ***Las funciones ejecutivas y el rendimiento académico en Educación Primaria.***

Estudio 1 Cortés Pascual, A., Moyano Muñoz, N., & **Quilez Robres, A.** (2019). The relationship between executive functions and academic performance in primary education: review and meta-analysis. Frontiers in Psychology, 10, 1582. https://doi.org/10.3389/fpsyg.2019.01582

Estudio 2 **Quílez-Robres, A.**, Moyano Muñoz, N. & Cortés Pascual, A. (2021). Task monitoring and working memory as executive components predictive of general and specific academic achievements in 6-9 year-old children. International Journal of Environmental Research and Public Health, 18, 6681. https://doi.org/10.3390/ijerph18136681

Capítulo II: ***Los factores motivacionales y emocionales en su relación con el rendimiento académico en Educación Primaria.***

Estudio 3 **Quílez-Robres, A.**, Cortés Pascual, A. & Moyano Muñoz, N. (2021). Motivational, emotional and social variables explain academic performance in children aged 6 to 12 years: a meta-analysis. Education Sciences, 11(9), 513. https://doi.org/10.3390/educsci11090513

Estudio 4 Moyano, N., **Quílez-Robres, A.**, & Cortés Pascual, A. (2020). Self-esteem and motivation for learning in academic achievement: the mediating role of reasoning and verbal fluidity. Sustainability, 12(14), 5768. https://doi.org/10.3390/su12145768

Capítulo III: ***Funciones ejecutivas, motivación y autoestima: relación y mediación con el rendimiento académico en Educación Primaria.***

Estudio 5 **Quílez-Robres, A.**, Moyano Muñoz, N. & Cortés Pascual, A. (2021). The role of executive functions and self-esteem on academic achievement: A mediational análisis. International Journal of Psychological Research, 14(2)

Capítulo IV: ***La influencia del estilo de enseñanza y el estilo de aprendizaje en variables motivacionales y emocionales en Educación Primaria.***

Estudio 6 **Quílez-Robres, A.**, Moyano Muñoz, N. & Cortés Pascual, A. (2021). Estilos de enseñanza-aprendizaje e influencia en la motivación y la autoestima. Fuentes

Resumen/ Abstract

RESUMEN/ ABSTRACT

Resumen

Las investigaciones sobre las variables que influyen en el rendimiento académico, entendido como el producto del aprendizaje, son numerosas. En un primer momento los estudios realizados se han centrado en la inteligencia y el cociente intelectual (IQ), pero los trabajos sobre el papel de las funciones ejecutivas y otras variables de carácter personal como son la motivación y la autoestima van ganando peso en las investigaciones. La problemática surge en España cuando año tras año los informes PISA (Programa Internacional para la Evaluación de Estudiantes) no colocan al alumnado español de 15 años en una buena situación con respecto a otros países europeos. También influyen las políticas educativas impulsadas desde la Unión Europea como, por ejemplo, el Informe Delors (1996) al hablar de "saberes": saber, saber hacer y saber ser y estar. Ante esta situación parece justificado realizar una investigación, en el alumnado de Educación Primaria, sobre la incidencia que las distintas variables ejercen en su rendimiento académico, para detectar aquellas carencias que deben ser objeto de trabajo, con el objetivo de alcanzar un aprendizaje significativo y un desarrollo integral de los mismos y así sentar las bases para un buen resultado académico en el futuro.

De modo resumido (Figura 1), y después de revisar el concepto de inteligencia y las distintas teorías que la sustentan, en el apartado de introducción general, los principales objetivos de la presente Tesis Doctoral son:

1) Analizar la relación entre las funciones ejecutivas y el rendimiento académico en los alumnos de Educación Primaria, así como su comportamiento en disciplinas como Matemáticas y Lengua Castellana y Literatura, y la existencia de variables moderadoras como el sexo o la edad (Estudio 1 y 2).

2) Analizar la relación entre los factores motivacionales y emocionales con el rendimiento académico en el alumnado de Educación Primaria, su posible diferenciación por materias como Matemáticas y Lengua Castellana y Literatura, la existencia de variables moderadoras y la mediación de variables cognitivas como el razonamiento y la fluidez verbal (Estudio 3 y 4).

3) Analizar la relación entre variables cognitivas y personales con el rendimiento académico en alumnos de 6 a 9 años y su acción mediadora (Estudio 5).

4) Estudiar la influencia del estilo de enseñanza en el estilo de aprendizaje, la motivación y la autoestima en alumnos de 6 a 9 años, y las diferencias en función del estilo de enseñanza y del estilo de aprendizaje (Estudio 6).

En la realización de parte de la investigación (estudios 2, 4, 5 y 6) participan 134 alumnos de Educación Primaria de 6 a 9 años (en algunos estudios solo han cumplimentado los test 132 y en otros 133), pertenecientes a un centro de enseñanza concertada de la Comunidad Autónoma de Aragón, donde el sexo femenino representa el 47,6% y el sexo masculino el 52,6%. En los estudios 1 y 3 se llevan a cabo sendos meta-análisis con un espacio temporal entre 2009 y 2019 incluyendo el intervalo de edad de los 6 a los 12 años. Las variables evaluadas son: funciones ejecutivas, motivación, autoestima, razonamiento, fluidez verbal, estilo de enseñanza y estilos de aprendizaje.

Los objetivos se diseñan a partir de la revisión de la literatura científica sobre el concepto y las clases de inteligencia, así como de las teorías que la sustentan y, también del concepto de cociente intelectual (IQ) como instrumento utilizado para medir la inteligencia. Se constata la falta de consenso sobre la premisa de que el rendimiento académico depende de un único factor responsable del mismo: la inteligencia. De este modo, se establece el punto de partida de esta Tesis Doctoral al considerar la existencia de otras variables que influyen en el rendimiento escolar.

La respuesta al **primer objetivo** se encuentra en los estudios 1 y 2. De los resultados del meta-análisis se desprende que las funciones ejecutivas son buenas predictoras del rendimiento académico, destacando un mejor comportamiento en el área de matemáticas que se relaciona con aspectos como la codificación, la organización y la recuperación inmediata de la información. Del carácter multifactorial de esta variable señalar que la memoria de trabajo (WM) se encuentra por encima del resto en su función predictora. Por otro lado, el sexo aparece con una función moderadora (49%) que no muestra la edad (posiblemente por el rango de edad vinculado a una etapa psicosocial específica del desarrollo). De la revisión de la literatura se concluye que las funciones ejecutivas han reemplazado al cociente de inteligencia (IQ) como la variable más estudiada con respecto al rendimiento académico y que ambas tienen actualmente el mismo grado de capacidad predictiva, siendo el cociente

de inteligencia (IQ) más importante para nuevos aprendizajes y las funciones ejecutivas para un aprendizaje de carácter repetitivo y centrado en competencias. Los datos extraídos del estudio transversal muestran una relación moderada con el rendimiento académico, pero alta cuando se relaciona factores como la supervisión de la tarea y la memoria de trabajo (WM) siendo, a su vez, los que presentan mayor valor predictivo (32,5%). Por lo tanto, el índice regulador cognitivo señala una mayor relevancia en el éxito académico, en esta edad, que el conductual o el emocional. Esto es debido a que estos factores cognitivos intervienen en la actualización y transformación de los datos para planificar y guiar el comportamiento en procesos como la comprensión del lenguaje y el razonamiento matemático, así como, en una supervisión eficaz que detecte posibles errores en la realización de tareas de lengua (errores ortográficos) o de matemáticas (omisión de símbolos aritméticos).

Para dar respuesta al **segundo objetivo** se llevan a cabo dos estudios (estudio 3 y 4). De los resultados del meta-análisis se desprende que las variables de carácter motivacional y social tienen mayor influencia en el rendimiento académico que las de carácter emocional. En este sentido, la revisión de la literatura señala que, los factores motivacionales y emocionales presentan un efecto de retroalimentación con las buenas calificaciones. Además, los factores emocionales y sociales interactúan entre sí. Por lo tanto, en la escuela juega un papel relevante la interacción social que junto a los aspectos motivacionales y emocionales se traduce en los resultados escolares. No obstante, el área geográfica emerge como variable moderadora para el factor social (76%), motivacional (52%) y emocional (17%). Por el contrario, la edad solo ejerce esa función para el factor social (65%) lo que señala que a mayor edad el comportamiento social mejora al poseer más recursos para solventar las situaciones conflictivas. En el estudio transversal, se explora un modelo predictivo de la motivación y la autoestima con el rendimiento académico, así como el posible papel mediador de capacidades cognitivas como son el razonamiento y la fluidez verbal. Los resultados señalan que dicho modelo predice el 23% con la mediación del razonamiento y la fluidez verbal, pero difieren según él área específica de conocimiento. De este modo, los sujetos con mayor motivación por el resultado y el aprendizaje presentan mejores niveles de fluidez verbal y en Matemáticas el poder predictivo lo poseen la motivación por el aprendizaje y la autoestima, estando ésta última mediada por el razonamiento. Así mismo, una mayor autoestima

predice la capacidad de razonamiento. Estos resultados destacan, por un lado, el papel de la motivación intrínseca que lleva al sujeto a esforzarse y a aprender que, unido a la autoestima del propio alumno, señala una mejora de las capacidades cognitivas y, a su vez, se traduce en un mayor éxito académico.

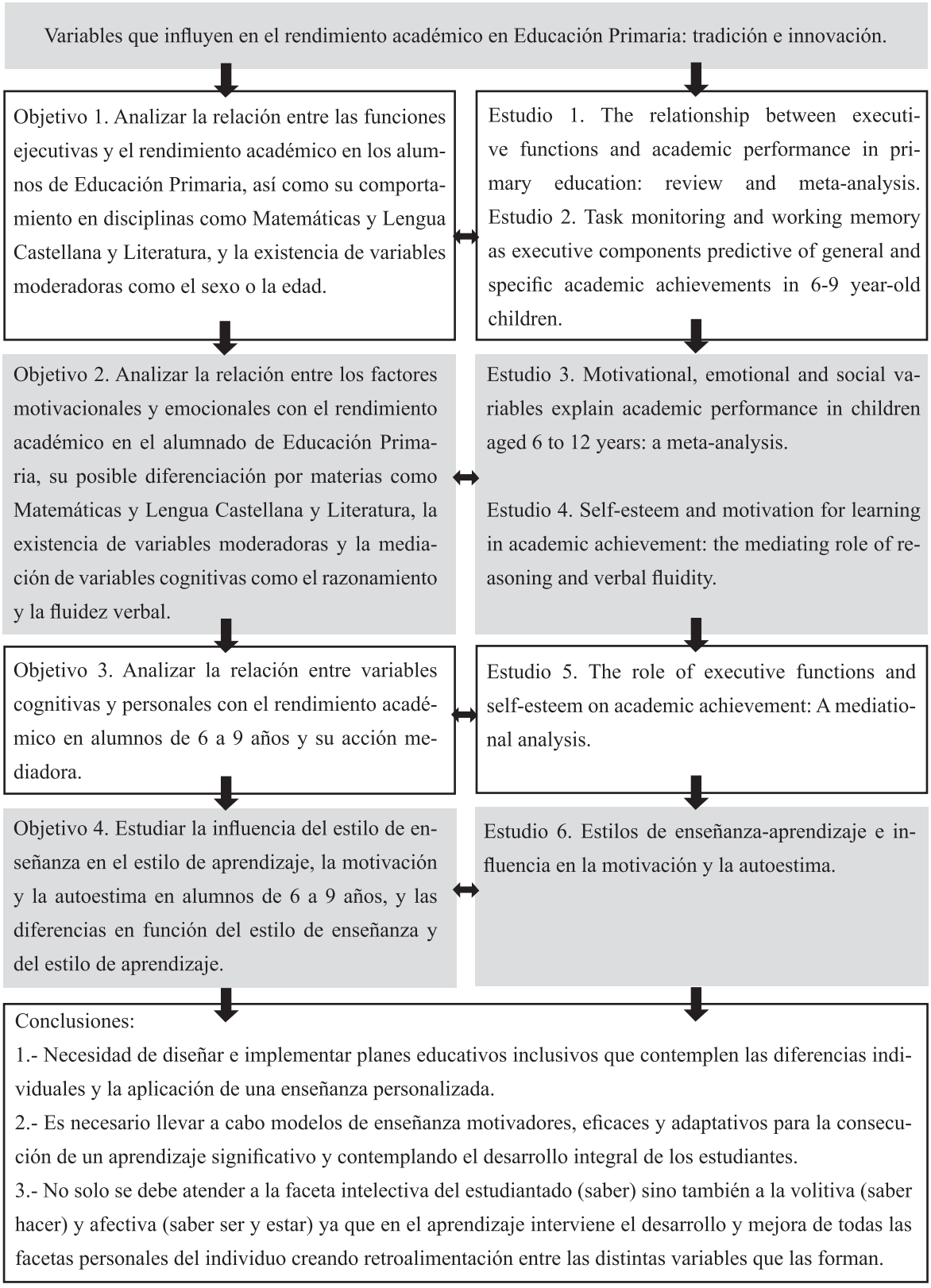
La respuesta al **tercer objetivo** se encuentra en el estudio 5 que analiza no solo el valor predictivo de variables cognitivas (razonamiento, fluidez verbal, funciones ejecutivas), conductuales como la motivación y emocionales como la autoestima sobre el rendimiento académico en alumnos de 6 a 9 años, sino también los posibles modelos predictivos alternativos y la acción mediadora de las diferentes variables. La relación con el rendimiento académico es mayor con el razonamiento seguido de la autoestima. De ello se desprende que junto a un factor relacionado con la inteligencia emerge el componente emocional a la hora de encontrar una respuesta a los resultados escolares. La autoestima y su función en el aprendizaje se vincula con la atención, la motivación por aprender y con la regulación conductual. Además, el modelo predictivo formado por razonamiento, fluidez verbal, funciones ejecutivas y autoestima es el responsable de un 55,4% del éxito académico. Por otro lado, a pesar de que razonamiento, fluidez verbal y funciones ejecutivas se consideran variables de carácter cognitivo, hay una clara diferenciación entre ellas manifestada en la no existencia de relación entre estas tres variables que, a su vez, señala la perspectiva conductual y emocional que también poseen las funciones ejecutivas.

Por último, **el cuarto objetivo** se responde en el estudio 6. Por un lado, se establece una relación entre el estilo de enseñanza y el estilo de aprendizaje y la motivación por el resultado y, por otro, del estilo de aprendizaje con la motivación y la autoestima. Estos resultados señalan la importancia que el estilo de enseñanza tiene a la hora de motivar al alumnado y también en la preferencia que muestran por un estilo u otro de aprendizaje. De tal manera que, se encuentra una diferencia significativa del estilo de enseñanza innovador y mixto con los estilos de aprendizaje kinestésico y mixtos y con la motivación por el resultado. También se encuentra una diferencia significativa con el estilo de aprendizaje visual y la baja autoestima. Todo ello sugiere implicaciones de prácticas innovadoras, ya que la enseñanza se debe adaptar a las diferentes situaciones y tareas y estimular los diferentes canales de entrada de la información para mejorar el conocimiento, la comprensión y las habilidades

de los discentes.

En conclusión, los resultados de esta investigación, sobre todo en función del rango de edad de 6 a 9 años, señalan la necesidad de diseñar e implementar intervenciones que tomen en consideración las diferencias individuales de los discentes en esta primera etapa educativa formal. Se considera necesario diseñar estilos y estrategias de enseñanza que se adapten a esas diferencias y resulten eficaces y motivadoras en el cumplimiento del mandato de un aprendizaje significativo y en el desarrollo integral del alumno. Se busca una escuela inclusiva y un aprendizaje personalizado que ponga en valor a la persona con sus diferencias en función de capacidad, habilidad, interés y cultura. En definitiva, el rendimiento académico no será otra cosa que el producto de ese aprendizaje, de ese desarrollo personal que debe proporcionar las mismas posibilidades de éxito para todos.

Figura 1. Esquema-resumen de la investigación



Fuente: elaboración propia

Abstract

Research on the variables that influence academic achievement, understood as the product of learning, are numerous. At first, the studies carried out have focused on intelligence and intelligence quotient (IQ), but studies on the role of executive functions and other variables of a personal nature such as motivation and self-esteem are reaching relevance in research. The problem arises in Spain when, year after year, the PISA reports (Program for International Student Assessment) do not place 15-year-old Spanish students in a good position compared to other European countries. The educational policies promoted by the European Union, such as, for example, the Delors Report (1996) also influence when speaking of "knowledge": knowing, knowing how to do and knowing how to be and be. Given this situation, it seems justified to carry out an investigation, in Primary Education students, on the impact that the different variables have on their academic achievement, to detect those deficiencies that should be the object of work, with the aim of achieving significant learning and a comprehensive development of the same and thus lay the foundations for a good academic result in the future.

In summary (Figure 1), and after reviewing the concept of intelligence and the different theories that support it, in the general introduction section, the main objectives of this Doctoral Thesis are:

1. Analyze the relationship between executive functions and academic achievement in Primary Education students, as well as their behavior in disciplines such as Mathematics and Spanish Language and Literature, and the existence of moderating variables such as sex or age (Study 1 and 2).

2. Analyze the relationship between motivational and emotional factors with academic achievement in Primary Education students, their possible differentiation by subjects such as Mathematics and Spanish Language and Literature, the existence of moderating variables and the mediation of cognitive variables such as reasoning and verbal fluency (Study 3 and 4).

3. Analyze the relationship between cognitive and personal variables with academic achievement in students from 6 to 9 years old and their mediating action (Study 5).

4. Study the influence of the teaching style on the learning style, motivation and self-esteem in students from 6 to 9 years old, and the differences depending on the teaching style and the learning style (Study 6).

In carrying out part of the research (studies 2, 4, 5 and 6), 134 Primary Education students from 6 to 9 years old participated (in some studies they only completed 132 tests and in others 133), belonging to a center of concerted education in the Autonomous Community of Aragon, where the female sex represents 47.6% and the male sex 52.6%. In studies 1 and 3, two meta-analyzes were carried out with a time period between 2009 and 2019, including the age range of 6 to 12 years. The variables evaluated are: executive functions, motivation, self-esteem, reasoning, verbal fluency, teaching style and learning styles.

The objectives are designed from the review of the scientific literature on the concept and classes of intelligence, as well as the theories that support it, and also from the concept of intelligence quotient (IQ) as an instrument used to measure intelligence. There is a lack of consensus on the premise that academic achievement depends on a single factor responsible for it: intelligence. In this way, the starting point of this Doctoral Thesis is established by considering the existence of other variables that influence school performance.

The answer to the **first objective** is found in studies 1 and 2. From the results of the meta-analysis, it appears that executive functions are good predictors of academic achievement, highlighting better behavior in the area of mathematics that is related to aspects such as coding, organization and immediate retrieval of information. Regarding the multifactorial nature of this variable, it should be noted that working memory (WM) is above the rest in its predictive function. On the other hand, sex appears with a moderating function (49%) that does not show age (possibly due to the age range linked to a specific psychosocial stage of development). From the literature review it is concluded that executive functions have replaced the intelligence quotient (IQ) as the most studied variable with respect to academic achievement and that both currently have the same degree of predictive capacity, being the intelligence quotient (IQ) most important for new learning and executive functions for repetitive and competence-focused learning. The data extracted from the cross-sectional study shows a moderate relationship with academic achievement, but high when factors such as

task supervision and working memory (WM) are related, being, in turn, those with the highest predictive value (32, 5%). Therefore, the cognitive index indicates a greater relevance in academic success, at this age, than the behavioral or emotional. This is due to the fact that these cognitive factors intervene in the updating and transformation of the data to plan and guide behavior in processes such as language comprehension and mathematical reasoning, as well as in an effective supervision that detects possible errors in the realization of language tasks (spelling errors) or mathematics (omission of arithmetic symbols).

To respond to the **second objective**, two studies are carried out (study 3 and 4). The results of the meta-analysis show that the variables of a motivational and social nature have a greater influence on academic achievement than those of an emotional nature. In this sense, the literature review indicates that motivational and emotional factors present a feedback effect with good grades. Also, emotional and social factors interact with each other. Therefore, in school social interaction plays a relevant role, which together with motivational and emotional aspects translates into school results. However, the geographic area emerges as a moderating variable for the social (76%), motivational (52%) and emotional (17%) factors. On the contrary, age only exercises this function for the social factor (65%), which indicates that at an older age, social behavior improves by having more resources to solve conflictive situations. In the cross-sectional study, a predictive model of motivation and self-esteem with academic achievement is explored, as well as the possible mediating role of cognitive abilities such as reasoning and verbal fluency. The results indicate that this model predicts 23% with the mediation of reasoning and verbal fluency, but they differ according to the specific area of knowledge. In this way, the subjects with greater motivation for results and learning present better levels of verbal fluency and in Mathematics the predictive power is possessed by motivation for learning and self-esteem, the latter being mediated by reasoning. Likewise, higher self-esteem predicts reasoning ability. These results highlight, on the one hand, the role of intrinsic motivation that leads the subject to strive and learn which, together with the student's own self-esteem, indicates an improvement in cognitive abilities and, in turn, translates into greater academic success.

The answer to the **third objective** is found in study 5 which analyzes not only the predicti-

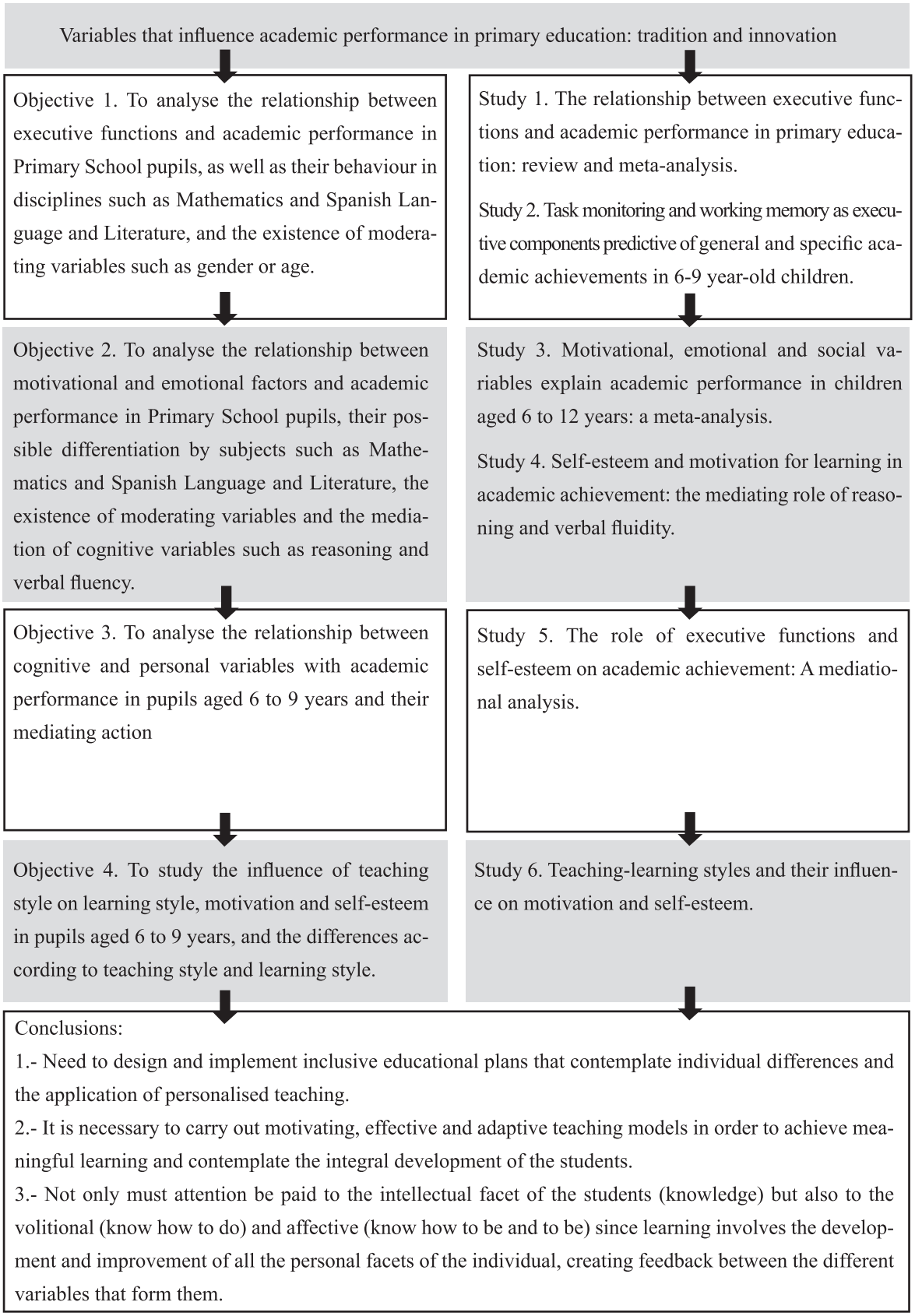
ve value of cognitive variables (reasoning, verbal fluency, executive functions), behavioral variables such as motivation and emotional ones such as self-esteem on academic achievement in students aged 6 to 9 years, but also the possible alternative predictive models and the mediating action of the different variables. The relationship with academic achievement is greater with reasoning followed by self-esteem. It follows that, together with a factor related to intelligence, the emotional component emerges when it comes to finding an answer to school results. Self-esteem and its role in learning are linked to attention, motivation to learn, and behavior regulation. In addition, the predictive model formed by reasoning, verbal fluency, executive functions and self-esteem is responsible for 55.4% of academic success. On the other hand, despite the fact that reasoning, verbal fluency and executive functions are considered variables of a cognitive nature, there is a clear differentiation between them manifested in the non-existence of a relationship between these three variables, which, in turn, indicates the behavioral perspective and emotional that also possess executive functions.

Finally, **the fourth objective** is answered in study 6. On the one hand, a relationship is established between the teaching style and the learning style and the motivation for the result and, on the other, the learning style with the motivation and the self-esteem. These results indicate the importance of teaching style in motivating students and also in their preference for one learning style or another. In such a way that, a significant difference is found between the innovative and mixed teaching style with the kinesthetic and mixed learning styles and with the motivation for the result. A significant difference is also found with visual learning style and low self-esteem. All this suggests implications of innovative practices, since teaching must be adapted to different situations and tasks and stimulate the different input channels of information to improve the knowledge, understanding and skills of the students.

In conclusion, the results of this research, especially in relation to the age range of 6 to 9 years, indicate the need to design and implement interventions that take into account the individual differences of the learners in this first formal educational stage. It is considered necessary to design teaching styles and strategies that adapt to these differences and are effective and motivating in fulfilling the mandate of meaningful learning and in the integral

development of the student. An inclusive school and personalized learning are sought that values the person with their differences based on ability, ability, interest and culture. Ultimately, academic achievement will be nothing more than the product of that learning, of that personal development that should provide the same chances of success for everyone.

Figure 1. Outline-summary of the investigation



Source: own elaboration

Unidad temática

UNIDAD TEMÁTICA

Justificación de la unidad temática

De forma general, esta tesis doctoral tiene como propósito dar a conocer las variables que influyen en el rendimiento académico del alumnado de Educación Primaria. En concreto en las edades de 6 a 9 años, cuando se encuentran en su primera etapa de educación reglada, donde se sientan las bases para el desarrollo posterior. El objetivo general es establecer la relación entre variables cognitivas y personales con el rendimiento académico en alumnos de 6 a 9 años. Para ello se lleva a cabo una revisión de literatura científica que muestra que a pesar de que la inteligencia y su medición del cociente intelectual (IQ) aparece como el mejor predictor del rendimiento académico, surgen investigaciones que señalan la importancia de otras variables. La variable más estudiada y la que se equipara en importancia con la inteligencia son las funciones ejecutivas en su composición factorial y actuación diferencial en áreas educativas, pero también se muestra que esta variable tiene tanto una dimensión cognitiva, como emocional y conductual. Además, los factores motivacionales, emocionales y sociales aparecen como parte esencial en el comportamiento de los discentes en el ámbito académico. Surgen variables moderadoras como la edad, el sexo o el área geográfica, pero también se observa una posible mediación entrecruzada entre las variables de carácter cognitivo y las de carácter personal.

Por ello, se decide realizar dos meta-análisis fundamentados en las edades de Educación Primaria (6-12 años). El primero sobre las funciones ejecutivas y el segundo, más complejo, que aglutina factores motivacionales, emocionales y sociales. Sobre esta base, se realizan estudios transversales concretados en el rango de edad de 6-9 años (etapa clave para un futuro desarrollo) y en variables como funciones ejecutivas, motivación y autoestima, pero introduciendo el razonamiento y la fluidez verbal (variables cognitivas) como posibles mediadoras de la motivación y la autoestima (variables personales). También es necesario conocer no solo la relación con el rendimiento académico general sino también con rendimientos específicos en áreas como las Matemáticas y Lengua Castellana y Literatura. Al final parece indispensable estudiar sobre otras variables, que asoman de manera marginal en la literatura científica consultada, como son el estilo de enseñanza y el estilo de aprendizaje y su influencia en la motivación y la autoestima. La selección de la muestra de conveniencia, el contexto concreto donde se desarrolla y el carácter transversal de los estudios señalan

una línea exploratoria para la generalización de los resultados.

En la introducción se exponen las bases teóricas de la Educación Primaria, el Rendimiento Académico y la Inteligencia. Dentro de este apartado se hace referencia a las diferentes teorías que la sustentan, al cociente intelectual como unidad de medida de la inteligencia y al razonamiento y fluidez verbal como capacidades que se valoran a la hora de medir la inteligencia. También se explora los conceptos de motivación, autoestima, estilos de aprendizaje y estilo de enseñanza. Con esta base se desarrollan los diferentes capítulos que estudian distintas variables y su influencia en el rendimiento académico de los alumnos de Educación Primaria.

El Capítulo I contiene dos estudios que investigan sobre la variable de funciones ejecutivas. El estudio 1 elabora un meta-análisis de las investigaciones realizadas en la década de 2009 a 2019 sobre la relación de las funciones ejecutivas con el rendimiento académico en niños de 6 a 12 años. El estudio 2 investiga sobre dicha relación, pero en alumnos de 6 a 9 años, con una muestra incidental, en un contexto concreto y con un diseño transversal, así como la existencia de posibles variables mediadoras como la edad o el sexo.

El Capítulo II está formado por dos estudios que tratan sobre las variables motivacionales y emocionales. El estudio 3 realiza un meta-análisis complejo sobre los factores motivacionales, emocionales y sociales y su relación con el rendimiento académico, para la edad de 6 a 12 años, durante los años del 2009 al 2019. El estudio 4 analiza la relación entre variables personales como la motivación y la autoestima con el rendimiento académico en niños de 6 a 9 años y la mediación de las variables cognitivas como son el razonamiento y la fluidez verbal.

El Capítulo III contempla una investigación sobre la relación entre variables cognitivas como las funciones ejecutivas, razonamiento y fluidez verbal, personales como la motivación y la autoestima y el rendimiento académico en alumnos de 6 a 9 años, así como los posibles modelos predictivos y mediacionales (estudio 5)

El Capítulo IV contiene un estudio (estudio 6) sobre la influencia que el estilo de enseñanza, que se clasifica en tradicional, innovador o mixto, ejerce sobre el estilo de aprendizaje,

la motivación y la autoestima. A su vez se analiza la influencia que el estilo de aprendizaje, que puede ser auditivo, visual, kinestésico y mixto, desempeña sobre la motivación y la autoestima en los discentes de 6 a 9 años.

Cada uno de los seis estudios relacionados, a pesar de su unidad temática, son independientes y se pueden comprender por sí solos. El denominador común de todos ellos es que tratan de investigar la influencia de variables de carácter cognitivo y personal en el rendimiento académico. Además, responden a la necesidad de aportar evidencias para mejorar el aprendizaje y el desarrollo en alumnos situados en el contexto de los primeros años de la educación formal (6 a 9 años) donde tienen lugar cambios de carácter madurativo que marcan el desarrollo posterior. Por último, responden al propósito general de esta tesis doctoral centrada en el conocimiento científico sobre los procesos cognitivos, motivacionales y emocionales que intervienen en el éxito académico, como producto de un aprendizaje significativo y personalizado, donde apoyar posteriores intervenciones educativas con la elaboración de estrategias de enseñanza-aprendizaje que tengan como finalidad la inclusión de todo el alumnado, independientemente de su capacidad, habilidad, interés o cultura.

Introducción general

INTRODUCCIÓN GENERAL

"Si planificas para un año, siembra trigo.
Si planificas para una década, planta árboles.
Si planificas para una vida, educa personas…"
(Kwan Tzu)

1. Introducción general

El aprendizaje y, en consecuencia, su medición en el ámbito educativo a través del éxito académico, que comúnmente se evalúa por el rendimiento académico, es un tema de interés para las instituciones públicas (Von Stumm & Ackerman, 2013). Un ejemplo de ello son los informes anuales del Programa de Evaluación Internacional de Estudiantes (PISA) que se utiliza como indicador del conocimiento general de los estudiantes en diferentes países (Organisation for Economic Co-operation and Development, 2019). Los temas del éxito o fracaso escolar, el desánimo y el abandono escolar producen gran cantidad de investigaciones para conocer las variables que pueden influir en él, al entender que el éxito se consigue cuando se ha cumplido con los estándares de aprendizaje establecidos (Balkis, 2018). En concreto, y referido al fracaso escolar, el debate se genera cada año cuando se publican los informes PISA (Caro & Kyriakides, 2019; Davis, 2019). A su vez, produce inquietud el papel que los resultados académicos conseguidos en los primeros años de la educación formal tienen en los logros obtenidos a los 15 años (PISA) y la relevancia de las diferentes variables en ellos. No obstante, tal como señala Nieto (2008) las variables estudiadas que condicionan el logro escolar en Educación Primaria han ido cambiando con el tiempo. Al quedar superado el paradigma de la inteligencia como responsable única de los resultados escolares (Sternberg et al., 2019) surgen otras variables como las funciones ejecutivas, la motivación o la autoestima, e incluso otras como pueden ser los estilos de aprendizaje o el estilo de enseñanza, que ayudan a explicar dichos resultados. En este sentido las autoridades educativas presentan planes que apuestan por una escuela abierta e inclusiva para facilitar el aprendizaje, las competencias, la motivación y el bienestar emocional del alumnado (Ursin, 2017).

En definitiva y, para resolver las dudas surgidas sobre la relevancia de las distintas variables en el rendimiento académico, así como la importancia de las mismas en los primeros años de escolarización, con la finalidad de mejorar los resultados y que estos se traduzcan en una mejora de las valoraciones realizadas a los 15 años, se realiza una revisión al mandato que las autoridades educativas establecen para la etapa de Educación Primaria plasmadas en la normativa legal donde se establecen los principios y la finalidad de dicha etapa educativa. Por otro lado, se produce un acercamiento al concepto de rendimiento académico y se realiza un repaso al estado de la cuestión sobre variables como la inteligencia y, el cociente intelectual como elemento evaluador de la misma, contemplando dos de sus capacidades cognitivas como el razonamiento y la fluidez verbal. También se lleva a cabo una revisión de la literatura científica sobre el concepto de motivación y de autoestima y su relación con el rendimiento académico en alumnos que cursan Educación Primaria. Con esta base se efectúan investigaciones que tienen como finalidad obtener unos resultados que aporten conocimiento sobre el comportamiento de las distintas variables en el rendimiento académico durante la primera etapa educativa. Con este bagaje se establecerán los pilares sobre los que se asentarán futuras intervenciones educativas para cumplir el mandato de caminar hacia una escuela inclusiva que atienda a todas las individualidades de los discentes y que se adapte a sus necesidades.

1.1. Educación Primaria

La Constitución Española (1978) establece como derecho fundamental de los españoles el derecho a la educación, el cual tiene por objetivo el total desarrollo de la personalidad y el respeto a los principios de convivencia (art. 27). En la actualidad este derecho fundamental viene desarrollado en la Ley Orgánica 2/2006 (LOE) modificada por la Ley Orgánica 3/2020 (LOMLOE). Esta legislación estatal promueve una educación escolar asequible para todos, que debe proporcionar igualdad de oportunidades y que se debe adaptar a los cambios sociales, ya que calidad y equidad son dos principios indisociables. Su finalidad última es desarrollar al máximo las capacidades intelectuales, culturales y emocionales adaptando la educación a las necesidades de cada uno. Este es un compromiso adquirido en base a los objetivos educativos planteados por la Unión Europea (1990) y por la UNESCO (2004) que

promueven el aprendizaje a lo largo de toda la vida, proporcionando una educación que contemple tanto los conocimientos, como las competencias, que son necesarios para desarrollar los valores democráticos que sustenten la cohesión social (LOE, 2006, Preámbulo).

La atención a la diversidad se establece como principio fundamental de la enseñanza básica que comprende de los 6 a los 16 años, "con el objetivo de proporcionar a todo el alumnado una educación adecuada a sus características y necesidades" (LOE, 2006, art. 2). Por otro lado, en los fines de la educación destaca el pleno desarrollo de la personalidad y de las capacidades para regular su propio aprendizaje (LOE, 2006; LOMLOE, 2020). Dentro de la denominada enseñanza básica se encuentra la etapa de Educación Primaria formada por seis cursos que se desarrollarán entre los 6 y los 12 años. Esta etapa educativa "procurará la integración de las distintas experiencias y aprendizajes del alumnado con una perspectiva global y se adaptará a sus ritmos de trabajo" (LOE, 2006, art. 16.3). La filosofía de la ley pone especial interés en garantizar la inclusión educativa y promueve la atención personalizada mediante mecanismos de refuerzo, flexibilización e introducción de metodologías alternativas, ya que se entiende la diversidad como un principio fundamental.

El currículo básico para Educación Primaria regula e integra los objetivos, las competencias, los contenidos, la metodología, los estándares de aprendizaje y los criterios de evaluación (Real Decreto 126/2014). Siguiendo las recomendaciones de la Unión Europea (UE) se potencia el aprendizaje por competencias (saber hacer) para renovar tanto la práctica docente como el proceso de enseñanza-aprendizaje mediante planteamientos metodológicos innovadores. Estas metodologías innovadoras tendrán en cuenta factores como los conocimientos o las habilidades, pero también variables de carácter personal como son la motivación o las emociones y otros componentes sociales. Se recomienda en esta etapa poner "especial énfasis en la atención a la diversidad del alumnado, en la atención individualizada, en la prevención de las dificultades de aprendizaje y en la puesta en práctica de mecanismos de refuerzo tan pronto como se detecten estas dificultades" (Real Decreto 126/2014, art. 9).

Por otro lado, en base a las competencias que le son inherentes, la Comunidad Autónoma de Aragón (Orden de 16 de junio de 2014, Orden del 21 de diciembre de 2015, Orden ECD/85/2016) establece los principios metodológicos generales de la Educación Primaria.

Entre ellos, y teniendo como perspectiva un aprendizaje significativo, se destaca que las decisiones metodológicas se deben centrar en la atención a la diversidad para combinar todos los recursos disponibles en busca de una escuela inclusiva. También se señala la necesidad de potenciar el desarrollo de las inteligencias múltiples atendiendo a la diversidad de estilos de aprendizaje o de motivación y su relación con la inteligencia emocional. Por otro lado, el aprendizaje conlleva desarrollar habilidades y estrategias, como son la planificación o el razonamiento, para la resolución de problemas de la vida diaria que supone un proceso de adaptación al contexto. Además, se recomienda, en la introducción de nuevas metodologías, la inclusión de las Tecnologías de la Información y la Comunicación (TIC) como recurso didáctico y, finalmente, se destaca la importancia de la actuación de los docentes como modelo a seguir en lo que se refiere al saber y saber ser para impulsar la motivación por el aprendizaje (Orden ECD/850/2016, art. 9).

Como se puede observar conceptos como atención a la diversidad y educación inclusiva se encuentran muy presentes en la normativa educativa y en concreto en la etapa de Educación Primaria. La inclusividad comienza en la toma de decisiones y actitudes que ponen de relieve los valores y la cultura de una sociedad que, a su vez, se ven reflejadas en las propias actitudes de los docentes y en las decisiones del centro educativo (Orden ECD/850/2016, art.15). Las autoridades educativas promueven la innovación y la investigación para mejorar los resultados del proceso de enseñanza-aprendizaje, mediante la transformación de la práctica docente fomentando el trabajo en equipo, la cohesión, la participación y la colaboración en el diseño de intervenciones educativas innovadoras (Orden ECD/850/2016, art.24).

Por lo tanto, existe un mandato concreto de mejora de la calidad de la enseñanza para lo que se propone atención a la diversidad, inclusión, investigación e innovación en la práctica educativa, con la introducción de nuevas metodologías, y dirigido todo ello hacia un aprendizaje significativo que desarrolle las capacidades propias de cada alumno. Por eso, la investigación conlleva analizar todas las variables que influyen en el alumnado tanto a nivel cognitivo, como motivacional y emocional en busca de un desarrollo integral con capacidad de adaptación a los distintos contextos.

1.2. Rendimiento académico

En el ámbito académico los alumnos dirigen todos sus esfuerzos en conseguir una meta, el éxito. Muchos lo consiguen, otros no llegan, pero se trata de poner en juego el esfuerzo y una serie de habilidades para conseguir el objetivo deseado. Tal es la importancia en el ámbito de la educación formal del rendimiento académico que han surgido una gran variedad de investigaciones que tratan de esclarecer los diferentes factores que influyen en él (Martínez-Pérez et al., 2020; Zapata et al., 2009). A groso modo el rendimiento se entiende como el producto o resultado obtenido en un ámbito concreto (Liem & Tan, 2019) y se define como "un nivel de conocimientos demostrado en un área o materia comparado con la norma de edad y nivel académico (Jiménez Hernández, 2000, p. 33), pero también como el conocimiento que una persona adquiere mediante un proceso de formación (López, 2013). La valoración que se realiza es de carácter cuantitativo ya que mediante las calificaciones se resuelve la relación entre lo que se aprende y lo que se logra (Arribas Estebaranz, 2012; Rodríguez et al., 2004), pero surge la duda de si esas calificaciones reflejan el logro de un aprendizaje significativo y de sí se han alcanzado las competencias establecidas a priori (Turull & Roca, 2012).

No obstante, hay que señalar que en este rendimiento influyen factores tanto de carácter social, como personal e incluso institucional. Por lo tanto, el concepto se refiere a la diversidad de factores que actúan sobre la persona que aprende y, que pueden ser orgánicos, cognitivos, sociales, familiares, estrategias, hábitos de estudio, motivación, autoestima, etc. (Garbanzo, 2007; Lee & Stankov, 2016; Nieto, 2008). En definitiva, no se puede entender el rendimiento académico sin tener en cuenta las variables que pueden condicionar o predisponer a los estudiantes hacia la consecución de las metas propuestas (Jung et al., 2017; Caso-Niebla & Hernández-Gúzman, 2007).

1.3. Inteligencia

El concepto de inteligencia se relaciona con la capacidad de comprender, de resolver problemas o con el conocimiento. Señalar que "la inteligencia capta los efectos genéticos en diversas habilidades cognitivas y de aprendizaje" (Plomin & Deary, 2015, p. 98). Por lo tanto, inteligencia se puede definir como "la capacidad mental general, que implica la aptitud

para razonar, planificar, resolver problemas, pensar de modo abstracto, comprender ideas complejas, aprender con rapidez y aprender de la experiencia" (Gottfredson, 1997, p.13). Ampliando el concepto, para Sternberg (2012), la inteligencia se relaciona con la capacidad de aprender de la experiencia y con la de adaptarse, moldeando y seleccionando entornos. Es decir, se trata de una capacidad amplia y profunda de dar sentido a las cosas que nos rodean (Colom & Flores Mendoza, 2001; Colom & Roman, 2018). La razón, el entendimiento y la comprensión son indispensables para todo tipo de solución de problemas. Las personas tienen la capacidad de hallar procedimientos que le llevan a esa comprensión y adaptación necesarias para poder solucionar cualquier problema de su vida diaria. Esa habilidad o destreza es lo que se denomina inteligencia (Flores Mendoza et al., 2018). Pero para conseguir o para perfeccionar esa habilidad es necesaria la experiencia que se adquiere con el paso del tiempo y con la adaptación al entorno, ya que en cada ocasión y a cada momento se descompone, se analiza y se elige la mejor opción para resolver cualquier situación o problema que se plantea (Triglia et al., 2016).

Al llegar a este punto hay que matizar que inteligencia no es sabiduría. Esta última es una acumulación de conocimiento, mientras que la inteligencia es el uso que se hace de ese conocimiento (Paivio, 2014). Esta diferencia es importante porque en el ámbito académico y desde la idea del aprendizaje significativo, la inteligencia lleva no solo a poseer conocimientos, sino a saber aplicarlos de manera adecuada en cada momento, porque como señalan Pérez & Beltrán (2014), la inteligencia es el conjunto de estrategias aplicadas a la realización de una tarea concreta. Para introducir otro matiz, cabe señalar que según Sternberg (2007) la sabiduría resulta necesaria para utilizar las capacidades individuales enfocadas a conseguir el bien común con metas a largo plazo (equilibrando los intereses personales y extra personales). En consecuencia, se puede inferir que: la inteligencia posee un substrato biológico, que es evaluada en función de individuos y culturas y, que es un potencial que facilita el aprendizaje, la planificación, el razonamiento abstracto, la adaptación y la toma de decisiones (Haier, 2017; Pérez & Medrano, 2013; Sternberg, 2019).

Desde la perspectiva psicológica, Cattell (1963) diferencia dos clases de inteligencia: inteligencia fluida e inteligencia cristalizada, sugiriendo que la inteligencia se compone de

capacidades diferentes que forman la inteligencia general, es decir son complementarias e igualmente importantes en la vida cotidiana. La primera se refiere a una habilidad de componente genético, heredada, mientras que la segunda nace de la experiencia, de la educación y del aprendizaje (McGrew, 2005). Esta teoría es ampliada por Horn (1985) quien incluye factores relacionados con la percepción visual, el procesamiento auditivo, la memoria, la velocidad de procesamiento, el razonamiento cuantitativo y habilidades de lectura y escritura (Gottfredson, 2016). Por otro lado, las investigaciones en psicología educativa (Amin et al., 2015; Thompson et al., 2013) vinculan la inteligencia fluida con las habilidades de aprendizaje y memoria y, sugieren que la inteligencia fluida permanece prácticamente inmutable después de la niñez. En el caso de la inteligencia cristalizada se considera que es el resultado de la educación y la cultura, atribuyéndole gran importancia al aprendizaje particular de cada uno (Colom & Roman, 2018; Hernández et al., 2007). Otra perspectiva se añade con los estudios psicométricos realizados por Rabbitt y Lowe (2000) quienes sugieren que la inteligencia fluida se ve alterada en el proceso de envejecimiento mientras que la cristalizada se mantiene estable.

Desde el punto de vista educativo el modelo propuesto por Sternberg (1999) es de gran interés. Mediante la Teoría Triárquica de la inteligencia (1985) describe tres categorías: la competencial (adquisición y almacenamiento), la experiencia (habilidad para codificar, combinar y comparar) y la contextual (adaptación al entorno) para pasar más tarde a lo que denomina inteligencia exitosa. Está última comprende la habilidad, el aprovechamiento, la adaptación y la capacidad de combinar habilidades de carácter analítico, creativo y práctico (Sternberg, 2019; Sternberg et al, 2010). El propio Sternberg (en Sternberg & Detterman, 2003) señala la existencia de una serie de componentes necesarios para solucionar problemas de rendimiento, de adquisición y meta componentes y, dependiendo de la forma en que se utilicen, aparecen tres tipos de inteligencia: analítica, creativa y práctica (Ellis et al., 2020; Sternberg & Detterman, 2003). El argumento que utiliza Sternberg (2019) es el de la capacidad del individuo a adaptarse a su entorno ya que el campo de la investigación sobre la inteligencia sigue criterios relacionados con el desempeño individual.

De manera crítica y como alternativa al enfoque de la inteligencia general (“g”) Gardner

(1985-1994-1999) presenta su teoría de las Inteligencias Múltiples (MI). Propone la existencia de varias inteligencias, no solo una, donde cada una de ellas es independiente, pero señala que pueden interactuar y que se potencian mutuamente. Deja abierta la posibilidad de ampliar o reducir el número de ellas en investigaciones futuras. Se defiende básicamente la existencia de ocho: la inteligencia lingüística, lógico-matemática, musical, espacial, cinestésico-corporal, interpersonal, intrapersonal y naturalista. Sus criterios de distinción tienen como base las diferentes regiones cerebrales implicadas en cada una. Para Gardner (1995) "una inteligencia implica la habilidad necesaria para resolver problemas dentro de un contexto cultural" (p. 37). El estudio realizado por Castejón et al. (2010) concluye que las inteligencias medidas en spectrum no aparecen como independientes de "g" como defiende Gardner, pero tampoco unitarias como proponen los defensores del modelo de inteligencia general. Por otra parte, la investigación de Visser et al. (2006) avala la existencia de un fuerte factor de inteligencia general en las inteligencias con componentes de habilidades cognitivas, mientras que en las inteligencias con componentes de habilidades sensoriales, motoras o relacionadas con la personalidad presentaban un débil factor "g", a las que se deberían denominar talentos.

Este apartado de inteligencia no quedaría completo sin una mención a la denominada inteligencia emocional como una fuerza motivadora. Mora y Martín (2007) consideran que las teorías de Gardner (1985) y de Sternberg (1985) son fundamentales en la aparición de la teoría de la inteligencia emocional ya que en sus ideas subyace el nuevo concepto que germina en las teorías de Salovey y Mayer (1990), pero sobre todo en Goleman (1996), quien populariza esta teoría relacionándola con el reconocimiento de los sentimientos propios y los de los demás. De lo que se trata es de manejar de forma hábil los sentimientos (Peña-Sarrionandia et al., 2015). La percepción y el uso de la información emocional son habilidades que van más allá de la inteligencia general y permiten a los individuos manejar mejor sus relaciones interpersonales (Mayer et al., 2008, Molero et al., 2020). La inteligencia emocional consiste en una serie de capacidades cómo descubrir, reconocer y manejar emociones y sentimientos para motivar y entablar relaciones con los demás (Aguirre et al., 2017). Se habla de auto-conocimiento emocional, auto-control emocional, auto-motivación, reconocimiento de emociones en los demás (empatía) y de relaciones interpersonales o habilidades

sociales (Goleman, 1999). Hay que subrayar que en cada persona coexisten dos mentes distintas: una sirve para pensar y la otra para sentir, pero, aunque sean independientes y reflejen el funcionamiento de circuitos cerebrales diferentes, una no puede funcionar correctamente sin la otra, de tal manera, que los sentimientos y los pensamientos se condicionan mutuamente (Valles Arándiga & Valles Tortosa, 2000).

1.3.1. Cociente Intelectual

La inteligencia es un constructor abstracto que ha provocado grandes discusiones y numerosos estudios a lo largo del tiempo para cuantificarla. Paul Broca (1861) y Galton (1879) fueron los primeros científicos que pensaron en medir la inteligencia. Creían poder conocer la inteligencia de un ser humano midiendo el tamaño de su cráneo: cuanto mayor fuera, más inteligente sería. Wundt (1907, citado en Rieber, 2013) padre de la psicología experimental, empleó la capacidad de pensar del hombre para medir la inteligencia. Pero el primer test de inteligencia moderno es el elaborado en 1904 por Alfred Binet y Theodore Simon (citados en Roid, 2003) en el cual se miden, mediante escalas cognoscitivas, aspectos como la comprensión, el razonamiento y el juicio. No obstante, fue Terman (1916) el primero en acuñar el concepto de cociente intelectual (IQ), calculandolo mediante la fórmula: edad mental/ edad cronológica x 100; se trata de una evaluación estándar que mide las habilidades cognitivas de un individuo con respecto a un grupo de igual edad (Muñiz, 2010). En 1939 el psicólogo estadounidense David Weschler (2014) crea la Escala Wechsler de Inteligencia para Adultos (WAIS), que hasta la fecha y con numerosas variantes, es una de las más utilizadas para medir el IQ, considerando una puntuación mayor a 115 por encima de la media, entre 70 y 80 por debajo de la media, y por debajo de 70 se sitúan las personas con dificultades cognitivas, de memoria y lenguaje. No obstante, hoy en día existe gran variedad de tipos de test que miden lo que se conoce como "factor g" o inteligencia unitaria y otros que miden distintos tipos de inteligencia; las propias escalas Wechsler en sus últimas versiones presentan el factor "g" y otros cuatro factores: razonamiento perceptivo, velocidad de procesamiento, comprensión verbal y memoria operativa (Gottfredson, 2016; Pérez Medrano, 2013).

Tradicionalmente se ha difundido la idea de que el IQ era el mejor indicador para saber si

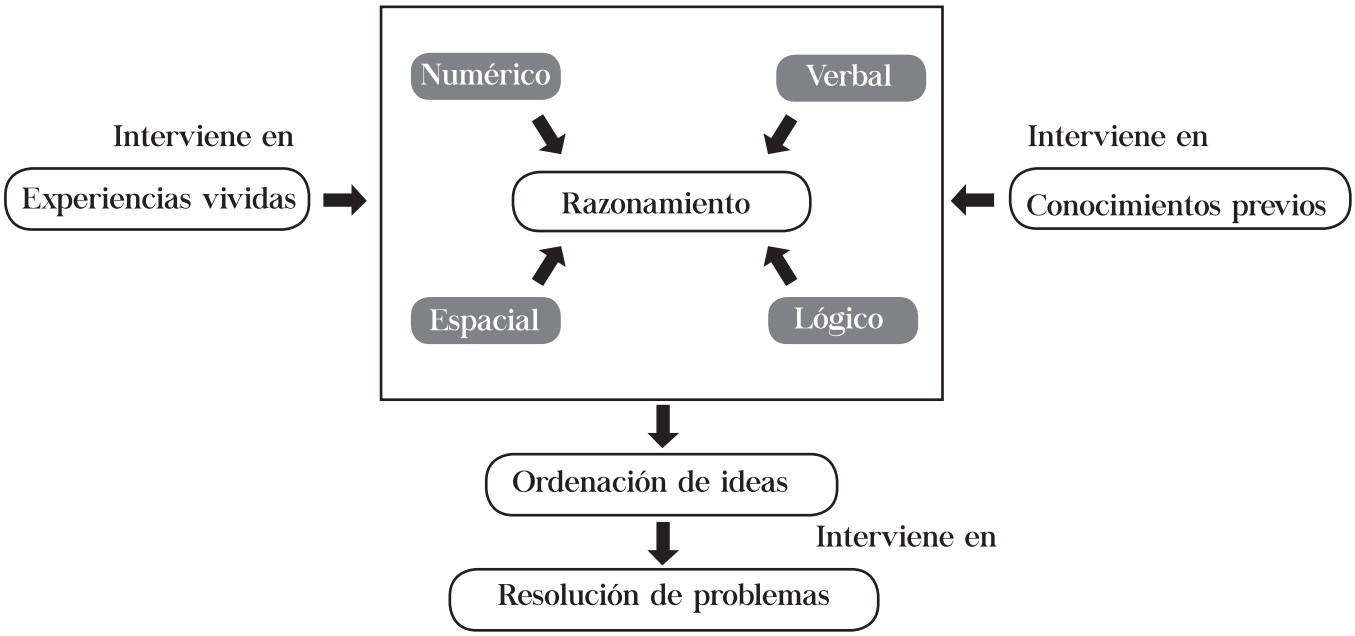
una persona iba a tener o no éxito académico y por ende éxito en su profesión. No obstante, numerosas investigaciones han puesto en tela de juicio dicha afirmación. Un ejemplo se encuentra en los estudios de Sternberg y Davidson (1983) al descubrir una correlación entre el IQ (test psicométricos) y los problemas cuya solución conlleva "insight" (combinación de distintos procesos cognitivos). Por otro lado, Sternberg (1985) en su teoría Triárquica establece que el éxito puede derivar de la inteligencia o de otros factores que no tienen ningún tipo de relación con ella. Cuantificar la inteligencia pasa por tener en cuenta factores como el medio y las características particulares de cada individuo. En la misma línea, Gardner (1985-1994) afirma que la inteligencia no puede ser contemplada desde una perspectiva psicométrica, ya que esa capacidad no es cuantificable mediante instrumentos estándares. Prestigiosas universidades entran en la discusión y de ese modo aparecen los estudios realizados por la University College de Londres que muestran que el IQ de una persona cambia significativamente en función de su edad, así como una diferencia significativa entre sexos y entre individuos pertenecientes a distintas culturas (Flynn, 2016; Furnham et al., 1999). Además, las investigaciones del Instituto de Cerebro y Mente de la Universidad Western en Ontario concluyen que medir la inteligencia humana basándose solo en una prueba estándar es engañoso, no se puede medir las capacidades cognitivas de una persona con un solo factor (Hampshire et al., 2012). Las últimas investigaciones han abierto nuevos campos de estudio al considerar la posibilidad de una herencia transgeneracional del cociente intelectual que explique la variación cognitiva (Golding et al., 2021) y, al analizar los resultados sobre coeficiente intelectual grupal y compararlos con los coeficientes individuales de cada uno de los miembros del grupo (Rowe et al., 2021).

Se puede argumentar que tradicionalmente la medición de la inteligencia general ha seguido criterios de desempeño individual, puntajes de exámenes, calificaciones, trabajo individual, etc. y se ha realizado mediante pruebas de cociente intelectual, presentando un valor razonable como predictor del logro escolar. Esto indica que la inteligencia se correlaciona con resultados individuales específicos que señalan el comportamiento que valora una cultura determinada. De tal manera que se ha mostrado, mediante mediciones de este tipo, que durante el siglo XX ha habido un aumento de las capacidades de las personas para adaptarse a un mundo cambiante y a sus demandas (Flynn, 2016; Gottfredson, 2016).

1.3.2. Razonamiento

El razonamiento es la actividad mental que permite lograr la estructuración y la organización de las ideas para llegar a una conclusión (Datsogianni et al., 2020). Desde una perspectiva psicométrica el perfil cognitivo de los alumnos se puede medir descomponiéndolo en varios factores que pueden ser: razonamiento verbal, razonamiento numérico, aptitud espacial, razonamiento lógico y memoria (Figura 2). Para Ferrándiz et al. (2008) el razonamiento lógico valora la habilidad para analizar todos los datos planteados en un problema, realizar inferencias lógicas y generalizando dar solución al problema aplicando diferentes reglas. Sin embargo, en numerosas ocasiones aparece el concepto de razonamiento abstracto como una habilidad cognitiva de orden superior con capacidad para razonar con información no verbal y, que requiere un proceso secuencial que incluye diversos pasos y tareas (Gómez-Veiga et al., 2018). No obstante, algunas investigaciones como la de Eimontaite et al. (2018) sugieren que plantear el razonamiento como un proceso lógico resulta simplista, ya que el razonamiento dentro del mundo real depende de múltiples factores.

Figura 2. Componentes del razonamiento y finalidad



Fuente: elaboración propia.

En el aula los estudiantes para defender o refutar una idea deben argumentar mediante la razón (enlazando proposiciones que apoyen o justifiquen la idea) y proponer soluciones adaptadas al contexto de cada momento (partiendo de lo ya conocido). Para desarrollar un pensamiento lógico hay una serie de capacidades que lo favorecen y que permiten a los alumnos crear su propio aprendizaje, como la observación, la intuición, la imaginación y el razonamiento lógico (Gómez-Veiga et al., 2018; Hidalgo, 2018). A partir de todas estas consideraciones parece que hay un claro vínculo entre razonamiento lógico y el área de matemáticas, seguramente porque esta materia depende más de las habilidades de razonamiento que otras, ya que presumiblemente esta materia, como todas aquellas de la rama de ciencias, está estructurada más jerárquicamente (Roth et al., 2015). ¿Pero qué factores inciden en el desarrollo del razonamiento lógico? La respuesta, siempre referida al aula de clase será: experiencia, contexto, cultura, intuición, grupo de clase y docente.

Dentro de este proceso hay que señalar dos momentos. El primero, que consiste en la observación o experiencia donde los alumnos parten de conocimientos previos o saberes adquiridos en su entorno que sirven de base para elaborar nuevas ideas. Es decir, establecen relaciones entre lo que les aporta la experiencia vivida y las nuevas construcciones a lo que se podría denominar razonamiento relacional (Dumas et al., 2013). El segundo, donde el proceso mental de análisis lo pueden desarrollar de diferentes maneras y convertirlo en razonamiento inductivo o deductivo. Según el razonamiento empleado la conclusión a la que se llegue tendrá más posibilidades de ser válida. Es decir, el razonamiento lógico tiene que ser válido, hay que conseguir llegar a una solución absolutamente certera (Nieves & Torres, 2013). Para Markovits (2014) el razonamiento lógico es el razonamiento humano explícito y analítico que, en contraste con el razonamiento intuitivo, posee validez para distinguir los argumentos válidos de los invalidantes, basándose en la existencia de ejemplos y contraejemplos que llevan a conclusiones. El razonamiento lógico como habilidad cognitiva permite diferenciar entre un argumento correcto y otro incorrecto, comparar los casos particulares con la norma general establecida y extraer conclusiones generales en base a proposiciones específicas, de tal manera que su relación con el rendimiento académico es notoriamente relevante, ya que los alumnos con altos niveles de razonamiento lógico presentan buen rendimiento académico no solo en matemáticas, sino en todas las disciplinas

(Cerda et al., 2011; Klauer & Phye, 2008).

Gómez-Veiga et al. (2018) en su estudio concluyen que el rendimiento académico se explica, en gran medida, por esa habilidad cognitiva de orden superior que es el razonamiento abstracto. El papel que las habilidades de pensamiento de orden superior, como el razonamiento, desempeñan en la adquisición de conocimientos y en el rendimiento académico siempre se ha estudiado desde la perspectiva de su relación con la inteligencia (Deary et al., 2007; Sternberg et al., 2010; Vock et al., 2011). Tradicionalmente la inteligencia y más concretamente la inteligencia fluida ha sido definida unas veces como una capacidad basada en el razonamiento abstracto (Sternberg, 1985) y otras como la capacidad de identificar y relacionar múltiples representaciones mentales (Cattell, 1987, en Dumas et al., 2013). En numerosos estudios se han encontrado correlaciones significativas entre la inteligencia fluida y el rendimiento académico (Colom & Flores, 2007; Deary et al., 2007) y en otros se ha mostrado una mejora del aprendizaje relacionado con el aumento de las habilidades de razonamiento. Esto se explica por la asociación de la inteligencia fluida a las habilidades de razonamiento necesarias para la comprensión y resolución de problemas complejos, que a su vez se vinculan con la información almacenada por la memoria de trabajo (Greiff & Neubert, 2014; Klauer & Phye, 2008; Süß et al., 2002).

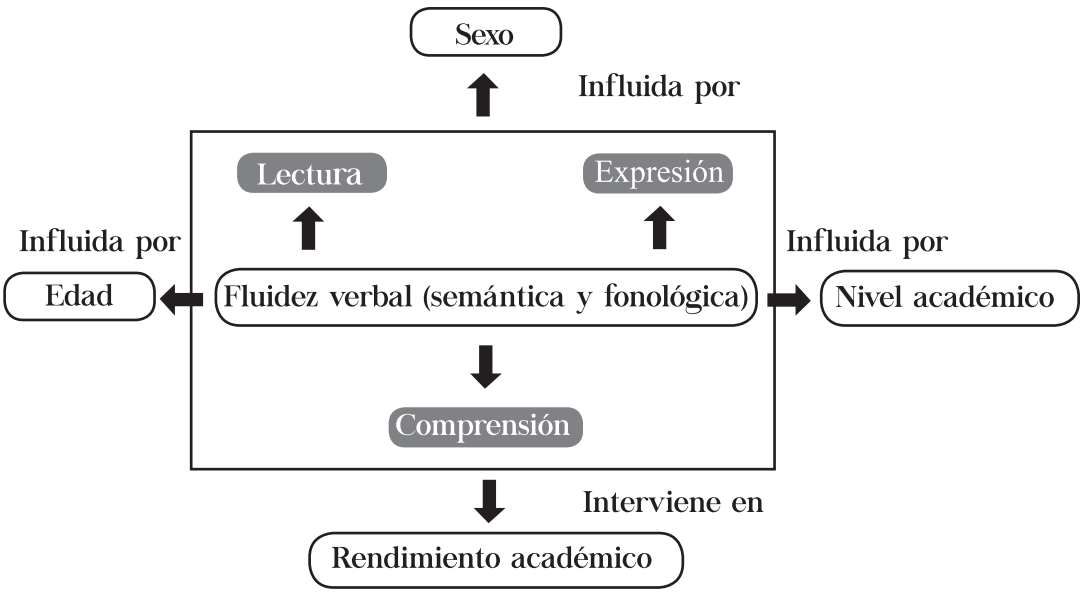
En términos de desarrollo, la adquisición de la comprensión meta-lógica comienza en los alumnos de 11 a 12 años con la comprensión de la validez de las conclusiones lógicas, pero solo a final de la adolescencia y ya en la edad adulta esa capacidad se completa (Moshman, 2004; Santamaría et al., 2013). El razonamiento lógico mejora la capacidad y el desarrollo de los procesos de aprendizaje ya que genera niveles investigativos en los alumnos, adquiriendo habilidades de pensamiento de acuerdo a su etapa de desarrollo. Fomentar en el aula el razonamiento lógico requiere formar en conceptos como observación, manipulación, clasificación, identificación y asociación (Pachón et al., 2016).

1.3.3. Fluidez verbal

Se considera que la fluidez verbal consiste en medir la facilidad y la producción verbal, pero también es un indicador de la conducta de respuesta ante la realización de tareas de carácter novedoso (Ramírez et al., 2005). Para algunos autores la fluidez verbal comprende una

correcta lectura y expresión, así como, una relevante comprensión de los textos (Hudson, 2011; Rasinski et al., 2017). Varias investigaciones encuentran que la edad, el sexo y el nivel educativo influye en el nivel de fluidez verbal y que ésta puede resultar útil como herramienta para evaluar diferentes capacidades y funciones cognitivas (Da Silva et al., 2004; Marino & Alderete, 2009; Morales et al., 2018; Ostrosky-Solís et al., 2004). De todo ello resulta que la fluidez verbal señala las diferencias de los distintos niveles de rendimiento académico, ya que la fluidez verbal tanto semántica como fonológica indica las fortalezas y las debilidades comunicativas de los educandos (Figura 3) (Fumagalli et al., 2017; Guevara & Soto, 2018). Por otro lado, de la relación entre el rendimiento académico y la fluidez verbal se obtiene información para la práctica educativa ya que va más allá de la inteligencia general y explica la variedad de habilidades académicas del alumnado (Floyd et al., 2008; Schneider & McGrew, 2012; Wechsler, 2003). En este sentido la asociación entre dominios académicos vincula la fluidez verbal con la asignatura de Lengua (McArthur et al., 2016).

Figura 3. Componentes y mediadores de la fluidez verbal



Fuente: elaboración propia.

No obstante, uno de los procesos cognitivos que influye de manera importante en el rendimiento académico es el factor verbal ya que, incluso, es la variable que soporta un mayor peso sobre el rendimiento académico en la asignatura de matemáticas por encima de la memoria. Esto se explica porque la mayoría de los aprendizajes se consiguen a través del lenguaje, pero además para realizar tareas de cálculo se ponen en funcionamiento grandes redes de áreas cerebrales en las que se incluyen las áreas del lenguaje (López, 2016; Moll et al., 2015; Willcutt et al., 2013). Por lo tanto, el factor verbal es un componente con un grado importante de influencia en los demás procesos cognitivos. El nivel de desarrollo del lenguaje en los alumnos, teniendo en cuenta tanto la expresión como la comprensión oral y escrita, juega un papel primordial en su aprendizaje, destacando la importancia que el tratamiento de la información de tipo verbal tiene durante la etapa de Educación Primaria (Gómez et al., 2014).

El razonamiento verbal "mide la habilidad para comprender conceptos expresados en palabras. Evalúa la capacidad para comprender y resolver analogías, abstraer, generalizar y pensar lingüísticamente en forma organizada" (González et al., 2008, p.38). Si el lenguaje escrito es un conglomerado complejo de conductas, fruto de numerosos factores y sometido a diversas influencias, pero imprescindible para alcanzar un cierto nivel de desarrollo, y el lenguaje oral es un modo de reflejar la realidad, el dominio de la lectoescritura es imprescindible para adquirir cultura e información, para comunicarse y para el aprendizaje en general (Toro & Cervera, 1995). De tal forma que cuando se habla de factor verbal como predictor del rendimiento académico, se refiere a la suma de razonamiento, comprensión y relaciones analógicas verbales, en definitiva, a la inteligencia verbal. Esta inteligencia verbal se entenderá como aquella capacidad general que permite manejar conceptos verbales, comprenderlos en una variedad de contextos y utilizarlos significativamente (Yuste, 2002; Yuste et al., 2014).

1.4. Funciones ejecutivas

De las numerosas definiciones que los distintos autores han elaborado para el constructo de funciones ejecutivas se deduce que son procesos neurocognitivos, de orden superior, diferentes, pero relacionados entre sí, que implican una serie de habilidades como son la super-

visión, la ejecución, el ajuste de conductas, etc. orientadas a la resolución de problemas y que, por lo tanto, están dirigidas a conseguir un objetivo (Anderson, 2002; Tirapu-Ustárroz et al., 2017; Zelazo & Carlson, 2012). En definitiva y en base a una serie de capacidades adaptativas, las funciones ejecutivas guían la conducta, así como las actividades de tipo cognitivo y emocional. Siguiendo a diferentes autores esta variable es de tipo multifactorial y sus componentes son: la memoria de trabajo (capacidad para manipular la información temporalmente), la inhibición (control de los impulsos), la flexibilidad cognitiva (que genera soluciones distintas para un mismo problema), la planificación (desarrollando estrategias para conseguir el objetivo), la iniciativa (actuar de forma autónoma e independiente), el control emocional (capacidad de regular la respuesta emocional), la supervisión de tareas (capacidad de revisar y evaluar), la organización de materiales (capacidad de ordenar) y el autocontrol (conciencia de su propio comportamiento) (Figura 4) (Anderson, 2002; Gioia et al. 2017; Miyake et al., 2000). Para Baddeley (1996) la memoria de trabajo, la inhibición y la flexibilidad son los procesos básicos de esta variable. Por otro lado, existen evidencias que señalan que sus factores o componentes presentan variaciones y diferencias en función de la edad (Lee et al., 2013; van der Ven et al., 2013; Willoughby et al., 2010).

Figura 4. Componentes de las funciones ejecutivas

Fuente: elaboración propia.

Entre los hallazgos encontrados dentro del ámbito educativo hay que destacar que las funciones ejecutivas tienen un impacto importante en los resultados académicos, desde preescolar hasta la universidad, adquiriendo importancia unos factores sobre otros a medida que avanza el desarrollo y los años académicos. Además, es relevante el carácter predictor sobre el rendimiento académico y los futuros problemas de aprendizaje. Cualquier déficit detectado en los componentes ejecutivos incide en el nivel de desempeño escolar, suponiendo un fuerte condicionante para el posterior desarrollo de las personas a todos los niveles tanto formativo, como laboral o social (Berninger et al., 2017; Diamond, 2016; Duckworth et al., 2019; Mulder et al., 2017).

En cuanto a los factores que componen las funciones ejecutivas hay que señalar que la inhibición ocupa un lugar destacado en el logro escolar de los más pequeños, ya que se considera un buen predictor hasta la edad de 7 años. Esto es consecuencia del desarrollo cognitivo-conductual que tiene lugar entre los 3 y los 7 años que requiere de la integración

de las funciones ejecutivas con las habilidades del lenguaje (Anderson, 2002; Garon et al., 2015; Isquith et al., 2013; Oberer et al., 2018). También existe un cierto consenso en cuanto que la inhibición y la planificación se complementan entre sí por ser necesarias para resolver un texto escrito o para realizar un cálculo matemático (Gerst et al., 2017; Ribner et al., 2017; Sesma et al., 2009). Por otro lado, la flexibilidad se relaciona con el control emocional a la hora de evaluar las respuestas emocionales en situaciones cambiantes que se desarrolla entre los 6 y los 8 años (Gioia et al., 2017), no obstante, no hay consistencia en los resultados de las investigaciones, ya que hay quien encuentra que puede afectar al aprendizaje individual (Mann et al., 2016) y quien le da un papel limitado en el logro escolar (Duncan et al., 2007). Se debe señalar que los déficits en iniciativa, entendida como la capacidad para actuar sin necesidad de una motivación externa, puede provocar dificultades en la fluidez verbal y visual que conlleva un bajo rendimiento escolar (Morris et al., 2019). Como señalan algunos estudios, la supervisión de la tarea se desarrolla de manera incipiente en niños a partir de los 7 años, ya que se relaciona con el estado madurativo que implica un mayor control de las situaciones y la adquisición de experiencia (Alloway & Alloway, 2010; Gioia et al., 2017). En cuanto a la organización de materiales, los déficits detectados en este componente indican personas ineficientes tanto en la escuela como en su vida privada. Un buen desarrollo ayuda a mejorar el rendimiento en tareas complejas (Gioia et al., 2017). Con todo ello y de manera significativa, numerosas investigaciones concluyen que la memoria de trabajo es el componente más relevante, que presenta un desarrollo temprano que va mejorando hasta los 10 años, resultando un buen predictor para el rendimiento académico general y en materias específicas como son las Matemáticas y Lengua, aumentando su importancia cuando se deben realizar tareas complejas (Ahmed, et al., 2019; Alloway & Alloway, 2010; Hall et al., 2015; Mulder et al., 2017; Oberauer, 2019; Tsubomi & Watanabe, 2017; Vandenbroucke et al., 2017).

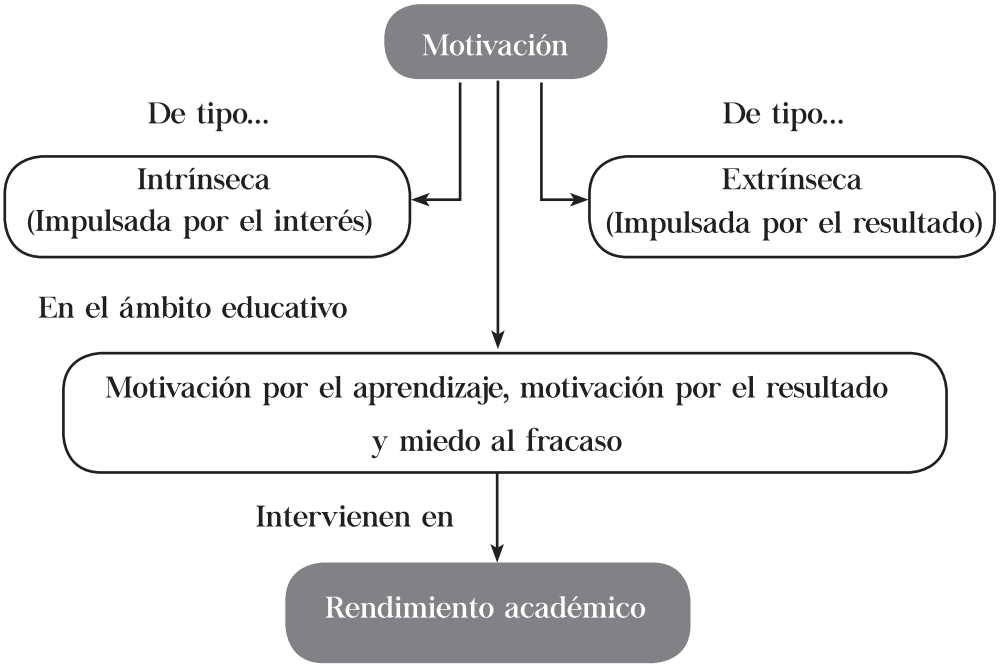
La importancia señalada para la memoria de trabajo viene dada por su función de almacenar y retener la información recibida y su capacidad para dirigirla hacia la resolución de problemas (Baddeley, 2000). Se encarga de actualizar datos, manipularlos y modificarlos para planificar y guiar la conducta, interviniendo en procesos cognoscitivos tan importantes como la comprensión del lenguaje, el razonamiento o el cálculo matemático (Anderson & Reidy,

2012). Todo este proceso es desarrollado de manera coordinada por cuatro módulos: bucle fonológico (responsable de manipular la información auditivo-verbal), agenda viso-espacial (vinculada con la información visual y espacial), ejecutivo central (encargado de la administración de los sistemas de memoria, responsable de distribuir la atención a cada una de las tareas que se deben realizar y de vigilar el ajuste al contexto) y el bucle episódico (contiene episodios fragmentados que combinan información visual y auditiva) (Baddeley, 2010). Por lo tanto, la memoria de trabajo es un sistema mnésico multifactorial de carácter breve, influyente en los procesos que regulan y coordinan las operaciones del control ejecutivo y la atención, e interviene en la resolución de problemas (Baddeley, 2010; Wilhelm et al., 2013).

1.5. Motivación

La motivación está formada por aquellos factores que dirigen la conducta hacia un objetivo y se ve influenciada por el contexto en el que se interactúa (Cook & Artino, 2016). Esta variable se estudia a partir de la Teoría de la Autodeterminación que contempla la motivación en dos vertientes: intrínseca y extrínseca. La primera es impulsada por el interés o el propio disfrute mientras que la segunda viene determinada por factores externos relativos al contexto (Deci & Ryan, 2008). Otras clasificaciones señalan tres tipos de motivación: por aprender (intrínseca), por los resultados (extrínseca) y por miedo al fracaso (intrínseca) (Montero & Alonso, 1992). Las dos primeras se refieren al esfuerzo y la perseverancia dirigidas a obtener un rendimiento académico positivo (Figura 5). Por el contrario, el miedo al fracaso sería un elemento desmotivador que reprime tanto el esfuerzo como la perseverancia (Tapia et al., 2014). En el proceso de enseñanza-aprendizaje la motivación dirigida a conseguir un objetivo, en este caso académico, consigue mejorar el alcance del logro escolar (Ainley & Ainley, 2011). No obstante, este proceso se encuentra influido por diferentes aspectos como son las expectativas del sujeto, los resultados obtenidos en una actividad, el entorno, etc. (Cook & Arino, 2016; Kusurkar et al. 2013; Ryan & Deci, 2000; Weiner, 2010).

Figura 5. Tipos de motivación



Fuente: elaboración propia.

Tal como señalan Guay et al. (2010), sí lo que importa es comprender las motivaciones que mueven a los estudiantes, hay que contemplar dos aspectos. Uno se refiere a la motivación hacia materias escolares específicas y el otro presenta un enfoque multidimensional y, por lo tanto, la motivación va cambiando en función del interés. Diversas investigaciones concluyen que los alumnos con bajas calificaciones presentan una baja motivación con una falta de interés por las tareas escolares (Hong et al., 2009; Regueiro et al., 2015; Weber & Ruch, 2012). También señalan que, durante los primeros años escolares, la motivación intrínseca se relaciona con un buen rendimiento en matemáticas (Garon-Carrier et al., 2016) y, que existe una mayor motivación por la lectura en las niñas y, en los niños por las matemáticas (Garon-Carrier et al., 2016; Quirk et al., 2009). Por otro lado, en estas edades se pueden

encontrar diferencias significativas que se relacionarían con aspectos madurativos con indicios de una mayor motivación a menor edad (Garon-Carrier et al., 2016; Hong et al., 2009; Regueiro et al., 2015).

1.6. Autoestima

La autoestima se entiende como un constructo que hace referencia a la percepción sobre uno mismo, generada en la interacción con los otros, e implica un adecuado desarrollo del proceso de identidad, del conocimiento y valoración de sí mismo y del sentimiento de ser útil y valioso para los demás (Alcaide Risoto et al., 2017; Kiviruusu et al., 2016; Orth & Robins, 2019). Conforma la dimensión valorativa del autoconcepto (Bermúdez et al., 2011). Se relaciona con la competencia social y se halla presente a lo largo del ciclo vital de la persona. No es estable y su consistencia va cambiando en función de las variaciones del contexto (Kernis, 2013; Kiviruusu et al., 2016). Por lo tanto, su desarrollo está conformado por las experiencias adquiridas en el aprendizaje y vividas durante toda la vida, al ser un proceso dinámico que abarca perspectivas individuales (Sari et al., 2018). Esta variable tiene una función de indicador del desarrollo personal, fundada en la propia valoración, que puede ser positiva, neutra o negativa dependiendo de las características tanto cognitivas como psicológicas de la persona. Una autoestima positiva se asocia con la autonomía, la extroversión o en una conducta prosocial. Por otra parte, la autoestima negativa se vincula con la baja confianza en sí mismo, la introversión o la depresión (Hyseni-Duraku & Hoxka, 2018). Existen estudios que señalan que la autoestima se ve influenciada en un 30% por la genética, y otros que se adquiere y se construye a lo largo de la vida (Taberno et al., 2017). Para Marasca et al. (2013) la autoestima se caracteriza por su dimensión psicológica, su multidimensionalidad (diferentes facetas como puede ser la académica en su percepción del desempeño), su aspecto experimental, su estructura jerárquica o su carácter evaluativo entre otros. Además, es determinante en aspectos como el rendimiento escolar, la adaptación a nuevas circunstancias o en las relaciones interpersonales.

En el ámbito educativo algunos autores indican que uno de los factores que explicaría el logro académico es la autoestima (Alam, 2013; Arshad et al., 2015; Papadopoulos, 2021), ya que se considera que durante el proceso de enseñanza-aprendizaje contribuye a mejorar

el rendimiento académico, de tal manera, que se vincula con el éxito o el fracaso escolar (Usan et al., 2019). En este sentido se habla de alta y baja autoestima (López, 2017) y se entiende que poseen una alta autoestima los niños con buen rendimiento escolar porque confían en sus habilidades y se sienten valiosos (Birkeland et al., 2012). Un bajo rendimiento académico se asocia a sentimientos de ineficacia, miedo al fracaso, frustración y a la falta de esfuerzo por aprender (baja autoestima) (De Tejada, 2010; Hyseni-Duraku & Hoxka, 2018). De tal manera, que un niño puede desarrollar tanto una autoestima positiva como negativa. La primera le ayudará a conseguir una correcta adaptación socio-emocional y le motivará hacia el aprendizaje. La segunda, ejercerá un efecto contrario y le provocará miedos, ansiedad, frustración, etc. (Mercado Heredia & Borda de Bravo, 2021). Según Alam (2013) los alumnos que informan mayor autoestima presentan un mayor rendimiento académico al compararlo con aquellos que informan baja autoestima, pero también observan que la cultura y el contexto social tienen mucho que decir en el nivel de autoestima de los discentes. Por lo tanto, existe una correlación entre la autoestima y el logro escolar, así como una relación entre una alta autoestima y una edad menor, pero no hay resultados concluyentes en cuanto al sexo. Las dimensiones de la autoestima van cambiando con la edad como resultado de su propio desarrollo evolutivo (Cuadro-Palomares et al., 2017, Rahmani, 2011; Rastegar et al., 2010).

1.7. Otras variables

En el desarrollo de cada niño intervienen no sólo factores físicos o mentales, sino también del entorno como pueden ser la familia, la escuela o la sociedad que, a su vez, generan diferentes niveles culturales o socioeconómicos. De tal manera, que se producen una serie de interacciones que conforman la realidad de cada individuo. Dentro de esta realidad, la escuela ejerce un papel fundamental en su formación donde confluyen todos los factores señalados que intervienen en su éxito o fracaso escolar (Nieto, 2008). Si hasta ahora se ha hablado de inteligencia, funciones ejecutivas, motivación o autoestima por la relevancia que las investigaciones le han otorgado en el rendimiento académico, otras investigaciones, las menos, que presentan un enfoque de atención a la diversidad y a la inclusión educativa estudian variables como los estilos de aprendizaje o el estilo de enseñanza explorando metodologías de carácter innovador.

1.7.1. Estilos de Aprendizaje

La literatura científica proporciona gran variedad de definiciones de lo que se entiende como estilos de aprendizaje. Algunos autores lo definen como el conjunto de variables personales que se encuentran entre la inteligencia y la personalidad y que explican las diferentes formas que el individuo tiene de abordar, planificar y responder al proceso de aprendizaje (Díaz Mosquera, 2012). Otros lo definen como aquellos rasgos, tanto fisiológicos como cognitivos y afectivos que indican cómo los alumnos perciben, interaccionan y responden en diferentes ambientes ante el aprendizaje (Keefe, 1998 citado en Salas, 2008). Cuando se habla de rasgos cognitivos se hace referencia a la forma en que se estructuran los contenidos, se interpreta la información y se resuelve el problema planteado, seleccionando los medios con los que el individuo opera mejor. Los rasgos afectivos se refieren a las motivaciones que cada persona tiene para aprender. Y por último los rasgos fisiológicos se relacionan con los biorritmos corporales (González Clavero, 2011). En definitiva, el estilo de aprendizaje se refiere al hecho de que cada persona, para aprender, utiliza los métodos y estrategias que mejor se adaptan a su forma de ser. Por lo tanto, cada persona desarrolla sus preferencias o tendencias que son las que definen su estilo de aprendizaje, pero no puede ser considerado como una habilidad en sí misma, ya que es la manera que tiene cada uno de utilizar las habilidades de pensamiento (Sternberg, 2019), ni tampoco como modos fijos de comportamiento, ya que pueden cambiar y adaptarse a las diferentes situaciones y realidades (Sprock, 2018). Cada individuo aprende a distintas velocidades, con mayor o menor eficacia, independientemente de que se posea el mismo tipo de motivación, de formación o de edad. Estilos de aprendizaje, estilos cognoscitivos o preferencias de estilos de aprendizaje se refieren a un mismo concepto, es decir maneras diferentes de aprender (Cisneros, 2004). Son numerosos y variados los intentos por realizar clasificaciones de los estilos de aprendizaje, unos se refieren a sistemas, otros a enfoques y otros a modelos, pero todos ellos ofrecen un marco conceptual que permite entender los comportamientos que se observan dentro del aula (Locke & Schattke, 2019). Si se hace referencia a los sistemas de representación mental se clasifican por: a) El sistema de representación visual (preferencia por contacto visual, se recuerda tanto imágenes abstractas como concretas); b) El sistema auditivo (preferencia por contacto auditivo, permite recordar y oír en nuestra mente sonidos,

voces, etc.); c) El sistema kinestésico (preferencia por interactuar con el contenido, recordar lo que se siente al comer, escuchar música, etc.) (Tocci, 2013). Precisamente el modelo de Programación Neurolingüística de Bandler y Grinder (1982, 1988), conocido por modelo visual-auditivo-kinestésico (VAK) se basa en los tres grandes sistemas en que se representa mentalmente la información recibida (Tabla 2).

Tabla 2 – Modelo Bandler y Grinder

Sistema Visual	Visualizando se establecen relaciones entre ideas y conceptos. Capacidad de abstracción y de planificación.
Sistema Auditivo	Recuerda de manera secuencial y ordenada, pero de manera más lenta. No relaciona ni elabora conceptos abstractos.
Sistema Kinestésico	Aprender es lento, pero profundo. Procesa la información mediante sensaciones y movimientos.

Fuente: elaboración propia.

Por lo tanto, se habla de estilo de aprendizaje visual, auditivo y kinestésico con variables que combinan varios de ellos. Las implicaciones educativas de este paradigma no están exentas de controversia (An & Carr, 2017; Newton & Miah, 2017). Algunos autores defienden los estilos de aprendizaje como una herramienta útil para la enseñanza dentro del aula (por ejemplo, Murray, 2011; Murthy et al., 2013; Sternberg et al., 2008), otros lo rechazan por considerar que adaptar la enseñanza a los estilos de aprendizaje individuales no aporta mejores resultados en el aprendizaje (por ejemplo, Willingham et al., 2015).

1.7.2. Estilo de enseñanza

El conjunto de rasgos peculiares que caracterizan a la persona que enseña y, que de manera indiscutible se refleja en las metodologías empleadas en el aula, se denomina estilo de enseñanza (Dash et al., 2020). La mayoría de los profesores poseen un estilo de enseñanza pro-

pio que ejerce su influencia sobre los educandos (Vaughn & Baker, 2008), el cual, alineado con los estilos de aprendizaje puede dar lugar a una mejora en los resultados académicos (Brunt, 2005). El reconocimiento de su propio estilo de enseñanza fomenta el desarrollo de habilidades, estrategias, métodos y uso de tecnologías para mejorar el proceso de enseñanza-aprendizaje de manera eficiente (Vaughn & Baker, 2001).

Para Grasha y Yangarber-Hicks (2000) existen cinco estilos de enseñanza: experto, autoritario, demostrador, facilitador y delegador. El profesor experto posee conocimientos y ofrece una correcta información a los estudiantes. El autoritario ejerce un rol de administrador de reglas estrictas para guiar al estudiantado. El profesor demostrador sigue un modelo presumiblemente efectivo en su opinión. En el caso del facilitador, guía a los discentes a desarrollar criterios y tomar decisiones. Por último, el delegador fomenta la autonomía de los estudiantes para que desarrollen su trabajo de manera independiente. Dentro de estos cinco estilos de enseñanza los de experto, autoritario y demostrador se asimilan con un enfoque de enseñanza tradicional centrada en el maestro, en cambio, los estilos facilitador y delegador, centrados en el alumno, se asimila a un estilo de enseñanza innovador (Dash et al., 2020). Por lo tanto, en una enseñanza de estilo tradicional el maestro es un mero transmisor de conocimientos, no exento de cierto autoritarismo, que implementa metodologías de corte conductista (Delord & Porlan, 2018). En un estilo de enseñanza innovador, donde el maestro es un guía para aprender a aprender, la educación se concibe como un proceso para desarrollar el potencial del alumnado donde el profesor promueve el proceso de aprendizaje y crea oportunidades y, además, favorece la autonomía, la actitud crítica y la creatividad (Delord & Porlan, 2018). No obstante, son numerosas las ocasiones en que los educadores utilizan estrategias y metodologías variadas apareciendo un estilo de enseñanza de carácter mixto, donde se entrecruzan la transmisión de conocimientos en clases magistrales, con el fomento de la autonomía y la utilización de las nuevas tecnologías de la información para fomentar la motivación y complementar contenidos (Cabero, 2015; Dash et al., 2020). Algunos estudios señalan que las metodologías empleadas en el aula estimulan diferentes canales perceptivos como son el visual, el auditivo o el kinestésico (Reyes et al., 2017) y que aquellas que implican mayor autonomía en los alumnos permiten obtener mejores resultados (Byers et al., 2018). Además, el estilo de enseñanza que aplica metodologías innovadoras, que lucha

contra la rutina y la mecanicidad, promueve una alta motivación por el aprendizaje en los discentes (Carbonell, 2015; Isaza & Henao, 2012). Ahora bien, a pesar de que no se ha podido comprobar que con la implantación de nuevas metodologías el aprendizaje sea más rápido o efectivo, los educadores tienen una percepción generalizada de que se obtiene mayor atención, motivación y se estimula la curiosidad científica en los educandos (Dash et al., 2020) y defienden la combinación con un estilo de enseñanza con metodología tradicional al considerarse de utilidad en el proceso de enseñanza-aprendizaje (Beltrán-Valls et al., 2020).

Objetivos

OBJETIVOS

2. Objetivos

Teniendo en cuenta los antecedentes que se obtienen de la literatura científica revisada para la realización de esta tesis doctoral, en referencia a las variables que influyen en el rendimiento académico en alumnos de Educación Primaria con un rango de edad de 6 a 12 años, para después concretar en el tramo de 6 a 9 años, por considerar de interés el proceso de desarrollo en todos los ámbitos que tiene lugar a esa etapa educativa, se proponen cuatro objetivos generales.

1) Analizar la relación entre las funciones ejecutivas y el rendimiento académico en los alumnos de Educación Primaria, así como su comportamiento en disciplinas como Matemáticas y Lengua y Literatura Castellana, y la existencia de variables moderadoras como el sexo o la edad.

2) Analizar la relación entre los factores motivacionales y emocionales con el rendimiento académico en el alumnado de Educación Primaria, su posible diferenciación por materias como Matemáticas y Lengua y Literatura Castellana, la existencia de variables moderadoras y la mediación de variables cognitivas como el razonamiento y la fluidez verbal.

3) Analizar la relación entre variables cognitivas y personales con el rendimiento académico en alumnos de 6 a 9 años y su acción mediadora.

4) Estudiar la influencia del estilo de enseñanza en el estilo de aprendizaje, la motivación y la autoestima en alumnos de 6 a 9 años, y las diferencias en función del estilo de enseñanza y del estilo de aprendizaje.

Del mismo modo, se describen los objetivos principales de cada uno de los seis artículos científicos que conforman esta tesis doctoral llevada a cabo en su formato de compendio de publicaciones. El objetivo general 1 comprende los estudios 1 y 2 incluidos en el Capítulo I de esta tesis doctoral presentando los objetivos específicos siguientes:

● Estudio 1: a) Analizar la relación entre las funciones ejecutivas y el rendimiento académico en Educación Primaria. b) Estudiar el componente ejecutivo con mayor peso predictivo sobre el rendimiento académico en Educación Primaria. c) Estudiar si las funciones ejecutivas se encuentran dentro de las variables cognitivas de dominio general o específico.

d) Analizar las variables de sexo y edad como moderadoras en la relación entre las funciones ejecutivas y el rendimiento académico en Educación Primaria.

● Estudio 2: a) Analizar la relación entre las funciones ejecutivas y el rendimiento académico en niños de 6 a 9 años. b) Estudiar el peso predictivo de los factores ejecutivos en función de su pertenencia a escalas de carácter cognitivo, conductual o emocional. c) Estudiar la vinculación de las funciones ejecutivas con el desempeño específico en Matemáticas y en Lengua Castellana y Literatura.

El objetivo general 2 incluye los estudios 3 y 4 recogidos en el Capítulo II de esta tesis doctoral presentando los objetivos específicos siguientes:

● Estudio 3: a) Realizar un meta-análisis que integre el carácter predictivo de variables clasificadas en tres grupos motivacionales (motivación, autoconcepto y autoestima) emocionales (inteligencia emocional, competencia emocional y bienestar emocional) y sociales (inteligencia social, competencia social y habilidades sociales) sobre el rendimiento académico en estudiantes de 6 a 12 años. b) Analizar el efecto moderador del sexo, la edad y el área geográfica sobre la relación entre las variables motivacionales, emocionales y sociales y el rendimiento académico en estudiantes de 6 a 12 años.

● Estudio 4: a) Analizar la relación entre los factores no cognitivos (motivación, autoestima) y una posible mediación de las capacidades cognitivas (razonamiento, fluidez verbal) para el rendimiento académico global y específico en Matemáticas y en Lengua Castellana y Literatura en alumnos de 6 a 9 años.

El objetivo general 3 comprende el estudio 5 incluido en el Capítulo III de esta tesis doctoral presentando los objetivos específicos siguientes:

● Estudio 5: a) Investigar la relación y el valor predictivo que variables cognitivas como el razonamiento, la fluidez verbal y las funciones ejecutivas, variables conductuales como la motivación y variables emocionales como la autoestima, tienen sobre el rendimiento académico en alumnos de 6 a 9 años, así como la interacción entre variables y el papel mediador de algunas de ellas.

Para finalizar el objetivo general 4 incluye el estudio 6 recogido en el Capítulo IV de esta tesis doctoral presentando los objetivos específicos siguientes:

● Estudio 6: a) Estudiar la influencia que un estilo de enseñanza tradicional (experto, autoritario y demostrador) o un estilo de enseñanza innovador (facilitador y delegador) ejercen en el estilo de aprendizaje en alumnos de Educación Primaria (6-9 años) y el efecto que los mismos ejecutan sobre la motivación y la autoestima.

Figura 6. Esquema de objetivos

Objetivos generales

Estudio 1. Objetivos Específicos: a) Estudiar el componente ejecutivo con mayor peso predictivo sobre el rendimiento académico en E.P. b) Estudiar si las funciones ejecutivas se encuentran dentro de las variables cognitivas de dominio general o específico.

Objetivo 1. Analizar la relación entre las funciones ejecutivas y el rendimiento académico en los alumnos de Educación Primaria, así como su comportamiento en disciplinas como Matemáticas y Lengua Castellana y Literatura, y la existencia de variables moderadoras como el sexo o la edad.

Estudio 2. Objetivos Específicos: a) Analizar la relación entre las funciones ejecutivas y el rendimiento académico en niños de 6 a 9 años. b) Estudiar el peso predictivo de los factores ejecutivos en función de su pertenencia a escalas de carácter cognitivo, conductual o emocional.

Estudio 3. Objetivos Específicos: a) Realizar un meta-análisis que integre el carácter predictivo de variables clasificadas en tres grupos motivacionales, emocionales y sociales sobre el rendimiento académico en estudiantes de 6 a 12 años. b) Analizar el efecto moderador del sexo, la edad y el área geográfica.

Objetivo 2. Analizar la relación entre los factores motivacionales y emocionales con el rendimiento académico en el alumnado de Educación Primaria, su posible diferenciación por materias como Matemáticas y Lengua Castellana y Literatura, la existencia de variables moderadoras y la mediación de variables cognitivas como el razonamiento y la fluidez verbal.

Estudio 4. Objetivos Específicos: a) Analizar la relación entre los factores no cognitivos (motivación, autoestima) y una posible mediación de las capacidades cognitivas (razonamiento, fluidez verbal) para el rendimiento académico global y específico en Matemáticas y en Lengua y Literatura Castellana en alumnos de 6 a 9 años.

Estudio 5. Objetivos específicos: a) Investigar la relación y el valor predictivo que, variables cognitivas, variables conductuales y variables emocionales, tienen sobre el rendimiento académico en alumnos de 6 a 9 años, así como la interacción entre variables y el papel mediador de algunas de ellas.

Objetivo 3. Analizar la relación entre variables cognitivas y personales con el rendimiento académico en alumnos de 6 a 9 años y su acción mediadora

Objetivos 4. Estudiar la influencia del estilo de enseñanza en el estilo de aprendizaje, la motivación y la autoestima en alumnos de 6 a 9 años, y las diferencias en función del estilo de enseñanza y del estilo de aprendizaje.

Estudio 6. Objetivos específicos: Estudiar la influencia que un estilo de enseñanza tradicional o estilo de enseñanza innovadora ejercen en el estilo de aprendizaje en alumnos de Educación Primaria (6-9 años) y el efecto que los mismos ejecutan sobre la motivación y la autoestima

Metodología general

METODOLOGÍA GENERAL

3. Metodología General

En función de lo establecido por la normativa específica de tesis doctorales por compendio de publicaciones de la Universidad de Zaragoza, se detalla a continuación la metodología utilizada para la implementación de este proyecto de investigación. No obstante, se debe indicar que cada uno de los seis estudios científicos incluidos en esta tesis comprenden una descripción específica y detallada sobre la metodología empleada para el correcto desarrollo de cada uno de ellos.

3.1. Aspectos éticos

En el proyecto de investigación se siguen los principios éticos establecidos y aprobados en la 18º Asamblea Médica Mundial celebrada en Helsinki en 1964, que ha sido modificada en varias ocasiones, siendo la última de ellas en la 64º Asamblea General celebrada en Fortaleza en Brasil en 2013. En ella se hace referencia al consentimiento y confidencialidad de las respuestas en investigaciones realizadas con seres humanos. Del mismo modo, el proyecto cuenta con dictamen favorable del Comité de Ética de la Investigación de la Comunidad Autónoma de Aragón (CEICA) en la reunión celebrada el día 27 de febrero de 2019, Acta N.º 04/2019 (C.P. – C.I. PI19/050). (ver Anexo)

3.2. Diseño

Para llevar a cabo el objetivo 1, correspondiente a los estudios englobados en el Capítulo I de esta tesis, se realiza en primer lugar un diseño de investigación basado en la revisión sistemática y posterior meta-análisis incluyendo el diseño e implementación de un protocolo PRISMA y una evaluación por acuerdo entre observadores. En segundo lugar, y correspondiente al estudio 2, se elabora un diseño ex post facto, descriptivo, correlacional y de corte transversal, basado en la técnica de aplicación de test y cuestionarios psicométricos.

En el objetivo 2 se ha llevado a efecto los diseños y técnicas de investigación del mismo tipo que para el anterior objetivo. Se desarrolla un nuevo meta-análisis dentro del estudio 3 y un estudio ex post facto, descriptivo, correlacional y de corte transversal para el estudio 4 todo ello incluido en el Capítulo II. Por lo tanto, para ambos objetivos se combinan técnicas de revisión bibliográfica y procesamiento meta-analítico con comprobación y réplica sobre muestra de campo.

Dentro del Capítulo III, estudio 5 y, correspondiente al objetivo 3, se implementa un diseño de investigación ex post facto, descriptivo, correlacional, de corte transversal y que incluye técnicas de análisis de mediación para variables relacionadas. Esto permite el estudio no solo de modelos de regresión predictivos y de carácter directo sino también, modelos predictivos alternativos basados en la interacción interna entre variables con carácter mediador. Finalmente, el objetivo 4, en el Capítulo IV de esta tesis doctoral y, a través del estudio 6, incluye un diseño ex post facto, descriptivo, correlacional y comparativo de corte transversal que comprende la combinación de técnicas como las encuestas con la administración de test y cuestionarios estandarizados.

3.3. Procedimiento

Desde un primer momento se ha tenido claro que se quería combinar técnicas de investigación basadas en la revisión bibliográfica y meta-análisis con estudios de campo, en una muestra concreta y de conveniencia, donde replicar los estudios meta-analíticos para posteriormente establecer inferencias y comparaciones. Por todo ello, se procede durante el año académico 2018/2019 a concretar el plan de investigación de esta tesis doctoral presentando el mismo a la dirección del centro educativo donde se ha llevado a cabo el estudio. Tras su consentimiento de participación y la presentación del proyecto de investigación al Comité de Ética de la Investigación de la Comunidad Autónoma de Aragón, se obtiene dictamen favorable para su desarrollo en la reunión del 27 de febrero de 2019, Acta Nº 04/2019 (C.P. - C.I. PI19/050).

Cabe señalar que el procedimiento metodológico de esta tesis doctoral por compendio de publicaciones incluye dos metodologías totalmente diferenciadas. Por un lado, el uso de revisiones sistemáticas y meta-análisis basadas en el establecimiento ético de buenas prácticas de investigación sustentadas en el diseño e implementación de protocolos PRISMA y evaluación de acuerdo entre observadores sin la participación directa de sujetos y, los estudios ex post facto, descriptivos, correlacionales y transversales que cuentan con la participación de sujetos y, por lo tanto, con la aprobación y consentimiento de participación correspondiente siguiendo los protocolos éticos dictaminados en la Declaración de Helsinki (2013). Los primeros métodos descritos se engloban dentro del Capítulo I y II, concretamente para

los estudios 1 y 3, con una función clara de conocimiento del estado de la cuestión. Por otro lado, los estudios 2, 4, 5 y 6, enmarcados en los Capítulos I, II, III y IV se centran en estudios de investigación con participantes. Todos ellos incluyen la medición de variables como el razonamiento, fluidez verbal, funciones ejecutivas, motivación, autoestima, estilos de aprendizaje y estilo de enseñanza.

La administración de las pruebas (test y cuestionarios estandarizados) y la evaluación de las mismas son llevadas a cabo por el doctorando, en horario de mañana y coincidiendo con la hora de tutoría. Cada prueba se cumplimenta en formato impreso en papel y a lo largo de 45 minutos, tiempo indicado por las instrucciones de las diferentes pruebas utilizadas.

Finalmente, para garantizar el anonimato de los participantes y, siguiendo los protocolos de ética, los resultados se traspasan a formato digital y se codifican eliminando cualquier dato de carácter personal. Dichos datos, están custodiados por el doctorando y tratados únicamente con fines académicos para el desarrollo de este proyecto de investigación.

3.4. Muestra

Para el desarrollo del proyecto de esta investigación se realizan las pertinentes recogidas de datos de carácter no probabilístico y por conveniencia. Aunque este tipo de muestreo no posee el nivel de rigurosidad proporcionado por uno de carácter probabilístico, se considera con validez externa suficiente debido a la intencionalidad del investigador por asegurar un porcentaje de representatividad del alumnado, en edades comprendidas entre los 6 y los 9 años, similar al correspondiente a la Comunidad Autónoma de Aragón (Fontes de Gracia, et al., 2010). En la Tabla 3 de esta sección se puede observar los datos demográficos de la muestra motivo de estudio (n=133). Como muestra tipo se asume la de 133 sujetos, ya que es el número de participantes en dos estudios, en otro son 132 y en el último estudio fueron 134 participantes. La recogida de datos se lleva a cabo entre los meses de mayo y junio del año 2019. Por otro lado, al incluir estudios de carácter meta-analítico la investigación de campo, basada sobre esta muestra de conveniencia, se ve reforzada y con posibilidades de comparación para la generalización por el carácter internacional y voluminoso de sendas muestras alternativas (Estudio 1; n=7,947; Estudio 3; n=15,777).

Tabla 3. Datos demográficos de la muestra

Variable		Media	D.T.	Min.	Max.
Edad		7,54	0,95	6	9
		N	**%**		
Sexo		133	100%		
	femenino	63	47,37%		
	masculino	70	52,63%		

A pesar de que cada una de las muestras están descritas en los seis artículos que forman la actual tesis doctoral por compendio de publicaciones, a continuación, se describen detalladamente.

Muestra transversal (n=133): Estudios 2, 4, 5 y 6.

La muestra motivo de estudio para las investigaciones de campo está compuesta por 133 estudiantes de Educación Primaria pertenecientes a un centro educativo de la Comunidad Autónoma de Aragón, ubicado en la ciudad de Zaragoza, en el curso académico 2018/2019. Dicha muestra representa el 59,1% de la totalidad del alumnado del Centro para la edad y etapa educativa motivo de investigación. Los criterios de inclusión del estudio son: (a) haber recibido autorización de participación en el estudio por medio de la firma del consentimiento informado por parte de los progenitores, padres, madres o tutores legales, (b) haber cursado 1º, 2º o 3º curso de Educación Primaria durante el año académico 2018/2019 en el Centro educativo motivo de estudio, y (c) haber respondido correctamente a la totalidad de los diferentes test y cuestionarios administrados. Los participantes presentan una edad media de 7.54 años de edad (DT=0.95), siendo el 47.37% de la muestra chicas (n=63) y el 52.63% chicos (n=70) (Tabla 3). El 35.1% cursa 1º de Educación Primaria, el 31.3% segundo curso y, por último, el 32.8% tercer curso.

Muestra meta-analítica 1 (n=7,947): Estudio 1

La muestra incluida en el presente estudio está compuesta por 7,947 individuos distribuidos en nueve países diferentes. De los estudios incluidos, la muestra más pequeña contiene 60 personas, y el conjunto más grande 2,036 participantes. Los datos analizados indican que el 51.27% de los participantes son varones y el 48.73% mujeres. Estados Unidos está representado por un 45.72% de la muestra; los Países Bajos por el 25.64%; el Reino Unido por un 5.78%; y Noruega con el 14.16% de la muestra. En total, Europa representa el 48.55% de la muestra, América del Norte el 48.28%, América del Sur el 1.44% y Asia el 1.73%. Para la obtención de la muestra se establece una serie de criterios de inclusión y exclusión que vienen indicados en el estudio.

Muestra meta-analítica 2 (n=15,777): Estudio 3

La muestra para el segundo estudio de meta-análisis (estudio 3), se compone de 15,777 individuos de entre 6 y 12 años de edad. De los datos analizados, el 53.04% son mujeres y el 47.96% hombres. Por áreas geográficas, la distribución es la siguiente: el continente americano representa el 11.82% de la muestra, el 80.20% está representado por el continente europeo y finalmente, Oceanía y Asía representan el 3.07% y 4.91% respectivamente. Por otro lado, los estudios incluidos en este meta-análisis también cumplen con unos criterios de inclusión que se encuentran detallados en el correspondiente estudio.

3.5. Variable e Instrumentos

Para el desarrollo de los seis estudios, contenidos en los Capítulos I, II, III y IV de la presente tesis doctoral por compendio de publicaciones, se miden las variables de funciones ejecutivas, razonamiento, fluidez verbal, motivación, autoestima, estilos de aprendizaje, estilos de enseñanza y rendimiento académico que se hallan recogidas junto a sus instrumentos en la Tabla 4 de la presente sección. No obstante, cabe señalar, que en cada uno de los artículos se desarrollan detalladamente la descripción de estas variables y los instrumentos utilizados para su correcta medición:

Tabla 4. Variables, factores e instrumentos de medida.

Variables	Instrumentos	Factores
Funciones ejecutivas	*The Behavior Rating Inventory of Executive Function, Second Edition (BRIEF 2) (Gioia et al.,2014)*	*Índice de regulación cognitiva*
		a) Iniciativa
		b) Memoria de trabajo
		c) Supervisión de tarea
		d) Organización de materiales
		Índice de regulación emocional
		e) Flexibilidad
		f) Control emocional
		Índice de regulación conductual
		g) Inhibición
		h) Supervisión de sí mismo
Razonamiento	*Test de matrices progresivas RAVEN (Raven & Court, 2010)*	a) Razonamiento analógico
		b) Razonamiento abstracto
		c) Razonamiento perceptivo
Fluidez Verbal	*Juegos eficaces de lectura (Grupo Editorial Bruño, 2017)*	a) Velocidad lectora
		b) Comprensión lectora
		c) Comprensión oral
Motivación	*Cuestionario de Motivación hacia el Aprendizaje y Ejecución (MAPE II) (Montero & Alonso, 1992)*	a) Motivación por el aprendizaje
		b) Motivación por el resultado
		c) Miedo al fracaso
Autoestima	*Escala de Autoestima de Coopersmith (Coopersmith, 1967) en su versión escolar y adaptada al español (Miranda et al., 2011)*	

Estilos de Aprendizaje	*Cuestionario VAK (Bandler & Grinder, 1982, 1988)*	a) Canal de aprendizaje predominante: visual, auditivo y kinestésico
Estilos de Enseñanza	*Teaching Styles Inventory (Grasha & Rierchman, 1996) (modificado)*	a) Estilo tradicional b) Estilo innovador c) Estilo mixto
Rendimiento académico	*Evaluación a través de la nota media (valores de 0 a 10) de todas las áreas académicas durante el curso 2018-2019.*	

3.6. Análisis estadístico

A continuación, y de forma resumida, se realiza una descripción de los análisis estadísticos que se llevan a cabo en la elaboración de los seis artículos que conforman esta tesis doctoral. No obstante, se debe señalar, que en cada uno de los estudios se incluye un apartado de análisis estadístico donde se detalla, de manera más completa, el procedimiento analítico seguido.

Las herramientas informáticas o paquetes estadísticos utilizados para la realización de los análisis incluidos en los estudios de esta tesis doctoral son: SPSS IBM en su versión, 25.0 y su complemento process 3.0; el programa específico de meta-análisis, Comprehensive Meta-Analysis (CMA); y el complemento de Microsoft-Excel (2007) EZAnalyze. Por otro lado, el nivel de significancia que se establece como base es de $p<.05$. De forma general, todos los artículos incluyen estadísticos descriptivos de media y desviación típica (M/DT) de las variables incluidas y, se calcula las correspondientes correlaciones entre variables mediante el coeficiente de correlación de Pearson y el coeficiente de rho Spearman que son aplicados en función de las características de las mismas.

Los estudios 1 y 3, enmarcados en los Capítulos I y II respectivamente, se basan en el método de investigación del meta-análisis. Para ello se tiene en cuenta distintos parámetros como

la Q de Cochran, destinada a la comprobación de la hipótesis nula de homogeneidad entre los estudios y la I^2 para el cálculo de la proporción de variabilidad. Siguiendo a Higgins et al. (2003), si la I^2 alcanza valores del 25%, se considera que la variabilidad es baja, moderada si alcanza valores próximos al 50% y alta si supera el 75%. Todo ello puede indicar un error de muestro, una variabilidad real en la varianza y cálculo del tamaño del efecto o, la influencia de una tercera variable de carácter moderador. Ante esto, se aplican análisis y estudios alternativos con el fin de poder detectar y excluir, si es necesario, estudios con valores atípicos. Además, se analizan los resultados arrojados tanto por los modelos de efectos fijos como por los modelos de efectos aleatorios, confirmando la utilidad de estos últimos ante el tamaño de la base de datos utilizada en ambos estudios. De esta forma, un enfoque basado en efectos aleatorios asume la variabilidad de la muestra como real, basada en el análisis de la varianza y en el tamaño del efecto (Borenstein et al., 2011). No obstante, para confirmar la ausencia de sesgo por publicaciones y errores en la inclusión y exclusión de estudios, se realizan dos análisis. El primero, en forma de gráfico de embudo, facilita la verificación de la existencia o no de sesgo independientemente del tamaño de la muestra y mediante la proyección de valores Z, que oscilaron entre 0 y 1 indicando según Palma y Delgado (2006) la ausencia de sesgo. Del mismo modo, se aplica la prueba Egger de estudio sobre el punto de interjección del eje de ordenadas confirmando la ausencia de sesgo en ambos estudios. Para Egger et al. (1997), un valor alto y alejado del eje de interjección indica la existencia de sesgo, no obstante, este hecho no se da. Finalmente, analizando la significancia en la misma prueba, esta resulta en ambos casos, superior a .01 confirmando la ausencia de sesgo indicada por la gráfica de embudo. Finalmente, se aplican sendas meta-regresiones con diferentes modelos, en los que se incluyen variables moderadoras, obteniendo modelos de predicción del rendimiento académico de carácter consistente y significativos.

En cuanto al estudio 2, el tratamiento estadístico de los datos recogidos es de correlación y de regresión lineal. Este método se utiliza para generar modelos predictivos de los diferentes factores de las funciones ejecutivas respecto al rendimiento académico general y respecto al rendimiento académico específico en Matemáticas y Lengua Castellana y Literatura. En primer lugar, se lleva a cabo el análisis de correlación de Pearson estableciendo posibles relaciones sobre variables. Sobre esos resultados se aplican diferentes modelos de regresión

entre los factores ejecutivos destacados y el rendimiento académico global y posteriormente con las materias específicas. Estos análisis, llevados a cabo sobre la muestra de conveniencia, ofrecen modelos exploratorios de predicción del rendimiento académico que siguen la línea marcada por los análisis anteriores de meta-análisis.

En cuanto a los estudios 4 y 5, además de aplicar análisis estadísticos de correlación y regresión, se realizan modelos alternativos de mediación entre variables destacando el poder mediador no solo de las variables emocionales y conductuales como son la autoestima y la motivación, sino que, también se destaca la mediación que ejercen sobre éstas las variables de carácter cognitivo como son el razonamiento, la fluidez verbal y las funciones ejecutivas, de tal manera que, concluyen con modelos predictivos alternativos en las que estas actúan como potenciadoras de las primeras en su relación con el rendimiento académico y viceversa.

Finalmente, en el estudio 6 se realizan análisis de correlación de rho Spearman para variables ordinales. Posteriormente, se aplican análisis sobre la varianza (ANOVA) para la comprobación de hipótesis sobre la igualdad de medias entre dos o más poblaciones. En este caso, esta comparativa permite encontrar diferencias significativas en la autoestima y la motivación en función del estilo de aprendizaje que presentan los alumnos y diferencias significativas en la motivación por el resultado en función del estilo de enseñanza que ejercen los docentes.

Por lo tanto, se destaca la variabilidad de métodos de análisis estadísticos que se aplican a lo largo de la realización de los distintos estudios que permiten obtener diferentes resultados a partir de técnicas tan diversas como son los meta-análisis, estudios correlacionales y de regresión, estudios de moderación y mediación entre variables y finalmente, estudios de comparación ANOVA.

Resultados y discusión

RESULTADOS Y DISCUSIÓN

4. Resultados y Discusión

4.1. Resultados

Atendiendo a las normativas acordadas por la Universidad de Zaragoza en relación a la elaboración y presentación de tesis doctoral por compendio de publicaciones, los resultados y discusión se presentan a continuación respetando el formato original de los artículos científicos que han sido publicados, aceptados o están pendientes de la decisión de la revisión por pares.

Tal como se ha ido repitiendo a lo largo de la redacción de esta tesis, los seis estudios que la integran han sido distribuidos en cuatro capítulos. En razón a que los artículos publicados, aceptados o pendientes de revisión se han publicado en revistas indexadas en JCR (JIF/JCI), aparecen a continuación en función del idioma de publicación: inglés o español. Los cinco primeros artículos han sido elaborados en inglés y el sexto en español. El Capítulo I se titula: "Las funciones ejecutivas y el rendimiento académico en Educación Primaria" engloba los dos primeros estudios. El Capítulo II titulado: "Los factores motivacionales y emocionales en su relación con el rendimiento académico en Educación Primaria" está formado por los estudios 3 y 4. El Capítulo III se titula: "Relación entre variables cognitivas y variables personales con el rendimiento académico en Educación Primaria" se presenta el estudio 5. Finalmente, el Capítulo IV lleva el título: "Estilos de enseñanza-aprendizaje e influencia en la motivación y la autoestima".

4.1.1. CAPÍTULO I: Las funciones ejecutivas y el rendimiento académico en Educación Primaria

4.1.1.1. Estudio 1: ***The relationship between executive functions and academic performance in primary education: review and meta-analysis.***

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The Relationship Between Executive Functions and Academic Performance in Primary Education: Review and Meta-Analysis

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The purpose of this study was to research the relationship between executive functions and academic performance in primary education (6–12 years). Based on 21 samples (n = 7,947), a meta-analysis of random effects demonstrated a moderately significant weighted effect size (r = 0.365) and was found to be a good predictor of academic performance. For the subjects of language and mathematics, the results of the random effects model were similar and slightly higher for mathematics (r = 0.350; r = 0.365). Thus, the theory that executive functions have greater influence on mathematical performance is supported, especially in aspects such as coding, organization, and the immediate retrieval of information. Regarding the different executive function components (working memory, inhibition, cognitive flexibility, and planning), working memory had the highest presence (k = 14, n = 3,740) and predictive weight for performance, with an effect size of r = 0.370 for random effects, with a moderate level of significance. The moderating effect of variables such as gender and age were also analyzed. After performing a meta-regression, gender resulted in a value of R^2 = 0.49; the age variable was not significant. This result is especially important since age has traditionally been considered to be the moderating variable of executive functions. The review reveals a good predictive power of executive functions in the primary education stage, and it is even higher at the early ages, indicating its great significance in describing future performance. The study also revealed the competencies and specific aspects of the executive functions that affect the way in which its components intervene in the academic area, demonstrating the mediating effect of variables such as physical fitness, motor skills, and memory processes.

Keywords: executive functions, academic performance, primary education, relationship, meta-analysis

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INTRODUCTION

The educational community has traditionally been interested in what is known as academic performance. This outcome is closely related to the teaching-learning process focused on a specific objective—achievement in school (Fleischhauer et al., 2010; Von Stumm and Ackerman, 2013). The topics of success or failure in school, discouragement, and dropping out of school have

produced a great deal of research activity (Covington, 2000; Balkis, 2018). This interest is reflected in the study by Nieto (2008), who reviewed 654 studies conducted from 1970 to 1990. The author highlights how the studied variables that condition academic success in primary education have changed over time. In addition, the new century has seen the emergence of new variables that are original and methodological in nature such as group collaboration, collaborative work, project-based learning, and the continuous school day. The literature has traditionally categorized these variables as contextual or personal. The first group of variables includes socio-environmental (family, friends, colleagues), institutional (school, school organization, teachers) and instructional (content, methods, tasks) variables. The second group includes cognitive (intelligence, learning styles) and motivational (self-image, goals, values) variables (Zeegers, 2001; Vermunt and Endedijk, 2011). Therefore, if academic performance is "a construct that can have quantitative and qualitative values, and these values provide some evidence and a profile of the skills, knowledge, attitudes and values developed by the student in the teaching-learning process" (Edel, 2003, pp. 15–16), then brain functions are essential to understanding how this process unfolds. The findings of neuropsychology in this area are very useful for explaining this relationship (Kolb and Whishaw, 2007; Rosen et al., 2018). Therefore, according to Sesma et al. (2009) and Zelazo and Carlson (2012), educational research should focus on executive functions as they are fundamental for language development and thus for literacy (the foundation for learning) as well as for the processing and organization of received information.

Executive functions are understood as the distinct, but related, higher-order neurocognitive processes that control thoughts and behaviors aimed at achieving an objective or goal (Anderson, 2002; Zelazo and Carlson, 2012). Therefore, they regulate behavior and cognitive and emotional activity by means of a set of adaptive capabilities. These functions include working memory (the ability to temporarily manipulate information), inhibition (impulse control), cognitive flexibility (the ability to generate different solutions to a problem) and planning (the development of strategies to achieve an objective); the preceding functions are all considered to be basic processes of this variable (Baddeley, 1996; Anderson, 2002). Miyake et al. (2000) produced another similar classification that distinguished between working memory, inhibition and flexibility. Some of the research has produced evidence indicating that the components of this factorial structure are different and change with age (Willoughby et al., 2010; Lee et al., 2013; van der Ven et al., 2013).

Human memory has been one of the most studied constructs by psychologists (Loftus and Loftus, 2019). If the concept of memory represents the ability to store, retain and recall information, working memory or operational memory refers to storage that is short-term, temporary, and with limited capacity; it is also sensitive to distractions that enable the simultaneous performance of tasks (Baddeley, 2000). Its function is to retain information and manipulate it to perform a task or solve a problem. It receives only the information that a selective awareness recognizes as relevant and useful for performing the activity at hand. In addition, working memory is responsible for updating data and then manipulating and transforming them to plan and guide behavior in crucial cognitive processes such as language comprehension, reasoning, and mathematical calculation (Anderson and Reidy, 2012). Memory is thought to be modular, instead of unitary (Ferbinteanu, 2018). Therefore, memory processes are carried out by three coordinated modules: the phonological loop (responsible for manipulating auditory-verbal information), the visuo-spatial sketchpad (linked to visual and spatial information), and the central executive (responsible for the control of memory systems in directing attention to each task that must be performed and monitoring any changes in context) (Alexander and Stuss, 2000). Therefore, working memory is a multifactorial, short-term mnesic system that is prominently involved in the processes that regulate and coordinate the functions of executive control and selective attention and that are involved in problem-solving (Engle et al., 1999; Baddeley, 2000; Engle, 2002; Wilhelm et al., 2013).

Another component of executive functions, as noted by Matthews et al. (2005), is inhibition or behavioral control, which is the ability to suppress impulsive behaviors; that is, the ability to suppress dominant but irrelevant responses and focus on important information. One could say that inhibitory control moderates behavior, suppresses impulsive reactions to a stimulus, and enables an appropriate and thoughtful response. It allows individuals to make a choice about their own reactions and behaviors—to think before acting. Because this executive component has both behavioral and cognitive aspects, it can be understood in terms of behavioral inhibition (linked to motor control) and cognitive inhibition. The latter's impact on executive functions enables planning, analyzing and choosing the most appropriate response (Anderson, 2002). Therefore, "inhibitory control involves being able to control one's attention, behavior, thoughts, and/or emotions to override a strong internal predisposition or external lure, and instead do what's more appropriate or needed" (Diamond, 2013, p. 136).

Cognitive flexibility refers to quickly reconfigure the mind and to switch between tasks (Braem and Egner, 2018). It involves creating and choosing innovative work strategies (linked to creativity) from a variety of alternatives for performing a task but also the ability to modify the action plan depending on the conditions at any given time (Anderson, 2002; Cragg and Chevalier, 2012). Coulson et al. (2012) state that the need to approach complex problems from different points of view validates this theory of flexibility. There is evidence that the solution to a problem sometimes requires a broader and more creative vision to correctly implement the solution. Some authors such as Decety and Sommerville (2003) and Eslinger and Grattan (1993) recognize two aspects of this variable: on one hand, it is reactive in its ability to provide varying answers; on the other hand, it is spontaneous due to the wide range of ideas produced when faced with a new task.

Lastly, Anderson (2002) understands planning as the foresight to execute a task correctly and apply appropriate strategies. In the context of executive functions, planning refers to problem resolution, although as noted by Baddeley (1996, 2000), the working memory and the central executive must function

properly to enable the ability to think about what should be done and to set priorities for action. However, planning goes further by coordinating these isolated processes in a certain way; an objective is set, the information is analyzed, the strategies that must be applied are selected, and the activities required to achieve the objective are assessed. Thus, achieving academic success is about effectively completing the important and necessary process executed by the executive functions by identifying the problem, defining the problem, finding alternative solutions, and developing an action plan (Anderson, 2002).

One view of academic performance defines it as the "level of knowledge demonstrated in an area or subject compared to the norm for the particular age and level of education" (Jiménez, 2000, p. 33). In addition, "it is the sum of distinct and complex factors that act in the person who is learning" (Garbanzo, 2007, p. 46). This construct refers to the evaluation of knowledge acquired in a school setting. It is dynamic in nature (the process of learning) as well as static (the product of learning) (Suazo, 2007). Therefore, it is presented as an index that assesses the quality of education, its efficiency and its productivity. It is the reflection of the different stages of an educational process whose objective is academic success, a process that is the focus of all the initiatives and efforts of educational authorities (Maturana, 2002). Currently, there is a general consensus in the scientific community on the existence of multiple variables and factors that explain academic performance, which display the complex and interdependent relationship between cognitive ability and emotion-attitude variables (Miñano and Castejón, 2011; Núñez-Peña et al., 2013). Another classification proposed by Passolunghi and Lanfranchi (2012) distinguishes between domain-general capabilities (the cognitive system as a whole) and domain-specific capabilities (which process a particular type of information). Domain-general capabilities notably include cognitive abilities (knowledge) and emotional skills that broadly predict school performance. Domain-specific capabilities (inferential skills, prescriptive processes) include skills that predict future performance in specific fields (development of a competency).

There are numerous articles that relate executive functions to academic performance (see Ahmed et al., 2018; Gordon et al., 2018). Studies such as those by Best et al. (2011), Castillo et al. (2009), and Ostrosky-Solis et al. (2007) conclude that working memory, a main component of the executive functions, is important for academic performance during the first few years of primary school. This variable develops rapidly at a young age and plateaus during adolescence. Align with this, a longitudinal study conducted by Ahmed et al. (2018) indicates that working memory at 54 months significantly predicts working memory at 15 years old. Furthermore, Tsubomi and Watanabe (2017) found that visual working memory, with and without distraction, develops until the age of 10. The study by Hall et al. (2015) on children 5 to 8 years old concluded that primary memory capacity improves with age. In addition, López (2013) study on third grade students found that good academic results in language and mathematics are related to this variable. Therefore, there is clear evidence that memory is a good predictor of academic performance by primary school students. However, this is not the case for the later stages of education because the predictive power of this variable diminishes at around the age of 12. Other authors in this line of research are Aronen et al. (2005), Best et al. (2011), Lee et al. (2009), and St. Clair-Thompson and Gathercole (2006). In addition, original results from Alloway et al. (2010) and Bull et al. (2008) indicated that the association of these variables is sustained over time, emphasizing the specific relationship between visuo-spatial working memory and performance in mathematics (domain-specific); the other executive components predict domain-general learning. Focusing on another facet, studies by Alloway et al. (2008) and Abreu et al. (2014) concluded that learning difficulties are explained by deficiencies in this executive component and are therefore reflected in academic performance.

Various studies have focused on the analysis of other components of the executive functions. For example, behavioral inhibition, that is self-control is shown to be relevant for academic achievement (Duckworth et al., 2019). In a longitudinal study of children 3 to 7 years old, Blair and Razza (2007) found that the relationship between academic performance and attention control and inhibition depend on age and the subject studied. Latzman et al. (2010) studied whether different academic subjects place specific demands on the various components of executive functions, analyzing the link between this variable and the performance of children 11 to 16 years old in science, mathematics, social studies, and reading. Of the various factors studied, cognitive flexibility was associated with reading and science and the control or regulation of reading and social studies capabilities. Gerst et al.'s (2017) study of children 5 to 11 years old found that inhibition and planning were the strongest predictors of mathematical calculation. For Sesma et al. (2009), working memory and planning are needed more when the complexity of a written text increases, and inhibition is related to mathematics and science. As such, these results suggest that there are specific demands placed on the various executive functions depending on the academic domain (Passolunghi and Lanfranchi, 2012). Therefore, there is widespread agreement that the skills related to executive functions, such as recalling and retaining information (working memory), the ability to suppress distractors (inhibition control-attention control), the ability to combine different tasks (cognitive flexibility), and planning (the ability to foresee the correct execution of a task) are essential for academic achievement since changes to these skills decrease the likelihood of success.

The current study analyzed the relationship between executive functions and academic performance in primary education. This was considered necessary as most of the publications on academic performance in primary education over the last decade have found this variable to be more significant for academic performance than the intelligence quotient, the variable traditionally considered to be the best predictor of academic success (Ren et al., 2015). In addition, we studied which executive function component (working memory, inhibition, cognitive flexibility and planning) would have a greater predictive weight since most of the existing studies have found a single component in the 2 to 6 years old age group (Wiebe et al., 2008) and a multifactorial composition after the age of seven

(Jarvis and Gathercole, 2003; Jacobson and Pianta, 2007). It was also important to study whether the executive functions were included within the domain-general or domain-specific cognitive variables, whether their components changed according to the academic subject, whether they predicted performance in specific competencies (Im-Bolter et al., 2006), and whether they have a moderating function in other variables regarding academic performance. Lastly, we analyzed possible moderating variables such as sex or age. Age has traditionally been the variable with the moderating effect. However, this result was not expected for this study as it focuses on primary school students 6 to 12 years old, a group in which males and females have different levels of maturity. Data were obtained for all these study objectives to calculate the effect size of the relationships and the significance of the variability between the samples.

Based on this literature review, our research questions are aimed to explore whether there is a relationship between executive functions and academic achievement among students from Primary education. Also, we will take into account whether this association is influenced by the following aspects: subject –e.g., mathematics, literature…-, gender, and age. For this background, our research questions are about the relationship between executive functions and academic performance in the stage of Primary Education. In addition, a specific study is carried out on this relationship and specific areas such as language and mathematics taking into account other variables such as gender and age.

METHODS

Inclusion and Exclusion Criteria

The following inclusion criteria were established: (a) the studies should provide clear and correlational statistical data between the variable of executive functions or any of its components (working memory, inhibition, flexibility or attention) and academic performance; (b) age, since the research focused on primary school students 6 to 12 years old; (c) articles that studied the same variables from an inverse approach, that is, the relationship between the executive functions and poor academic performance; (d) articles that included in their samples any individuals diagnosed with a DSM-5 mental disorder and did not exclude individuals with normal development; (e) articles that researched samples of individuals with low socioeconomic status; and (f) longitudinal studies conducted in the pre-school stage that focused on predicting future performance and those that started in primary school and progressed through secondary school (17 years). The following criteria were grounds for exclusion from the study: (a) studies conducted in a clinical context –that is, in samples with a typical development-; (b) studies where the entire sample consisted of individuals diagnosed with learning disorders; and (c) studies that failed to fulfill the criterion of statistical clarity. The reason for this last exclusionary criterion is that, per Chalmers et al. (2002), the individual studies had to be integrated into the current study to conduct the analysis; in addition, they had to have a certain degree of similarity and comparability.

Search Strategies

An electronic search was conducted (July–September 2018) on the Scopus, PsycINFO, PubMed Central and Redalyc databases. The search was performed in the English language and applied the terms "academic achievement," "primary education," and "correlation" with a 2009–2018 date range. This filter yielded a total of 1,012 documents that met the search requirements. Next, the titles and abstracts of these articles were reviewed, and 925 were excluded because they corresponded to clinical settings, did not meet the age parameters, followed a non-descriptive methodological approach, or did not offer clear statistical data. The final sample of 87 publications provided information on the variables that were studied the most over the last decade and that were related to academic performance. The most numerous group of articles studied the executive functions and personal motivation factors (41 articles). Considering the divergence between these two topics, it was decided that each would be studied separately, focusing first on the executive functions. An in-depth review of the material selected reduced the number of valid studies to 10 that could be used in the proposed research. This number was considered to be insufficient; thus, the bibliographic references in the articles were reviewed, and those not meeting the language criterion were eliminated in the search scope. A search of the "gray" or "fugitive" literature (Cooper et al., 2009) was also conducted, which included conference databases, doctoral theses, conferences, and meetings. These publications did not yield any information of interest for the present study; however, it was not an exhaustive search. Ultimately, 19 articles were selected (19 in English and 1 in Spanish) that provided 21 samples or databases (Alloway and Alloway, 2010 and Hall et al., 2015 provided two each) for use in a meta-analysis of the predictive capacity of executive functions in the academic performance of primary school students. In addition, the executive function components that recurred in the analyzed studies were working memory, inhibition, cognitive flexibility, and planning. No additional data beyond those published were requested from any author. The current research study will become part of a section on logical reasoning, verbal factors and working memory to be included in a doctoral thesis that consists of a compendium of publications titled "Variables that Influence Academic Performance in Primary Education: Tradition or Innovation" (**Figure 1**).

Coding Procedure

The study complies with the guidelines from the manual of systematic reviews (see Cochrane 5.1, point 1.2.2, Higgins and Green, 2008), in which it is established a set of clear objectives, specific search terms and eligibility criteria for previously defined studies. All studies were coded separately. In some articles, the executive functions are referred to as a single factor, and others refer to the different factors that compose them (working memory, inhibition, cognitive flexibility, and planning). Academic performance was measured in two dimensions: reading, measured in selected studies such as fluency and reading accuracy by reading words (reading comprehension, reading fluency, vocabulary) and mathematics (mathematical reasoning, calculus, arithmetic). A total of 198

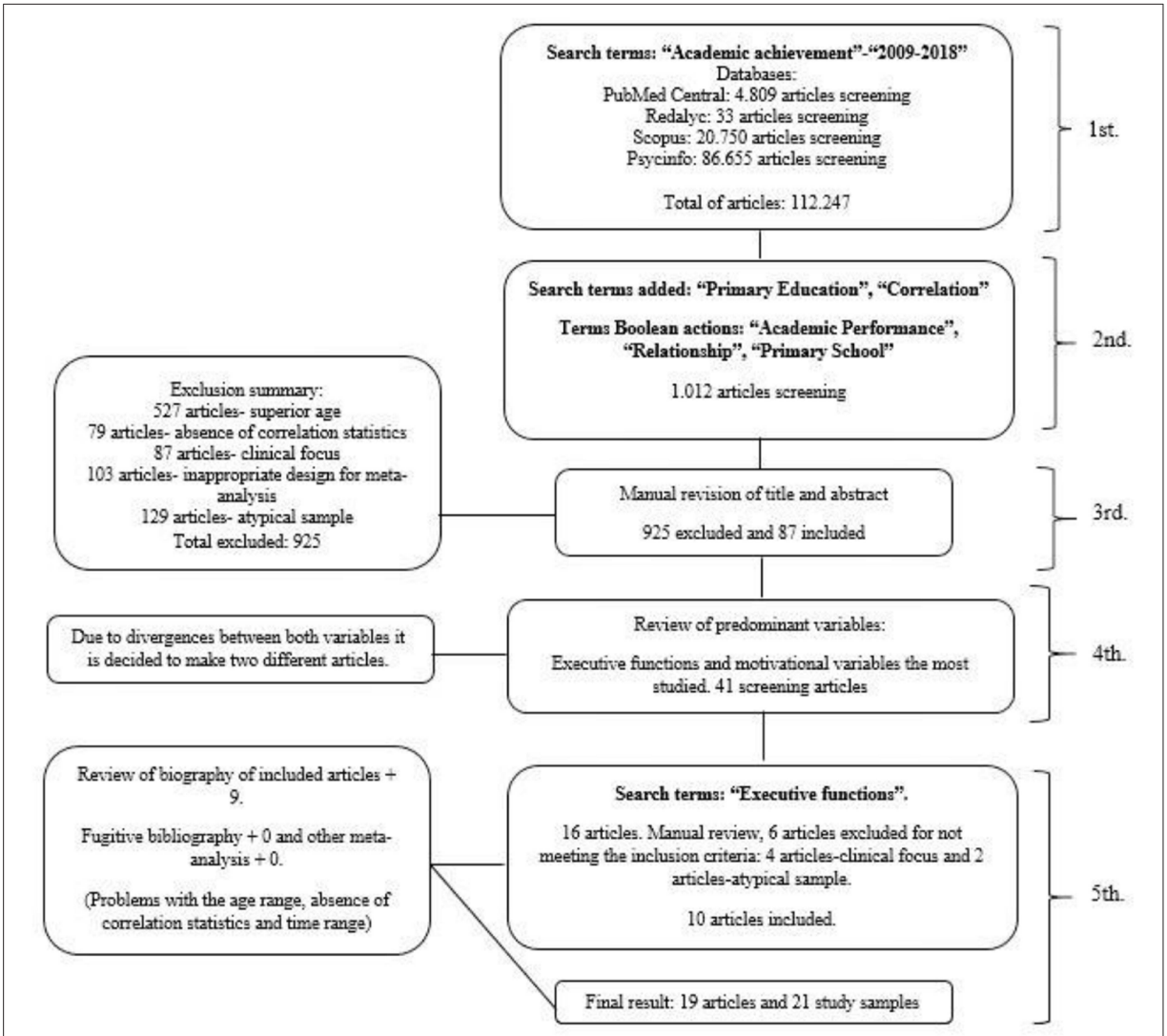

FIGURE 1 | Flowchart of the inclusion protocol.

effect sizes were coded using the correlation itself as a reference, and the corresponding standard error and confidence intervals were calculated. Similarly, these data were integrated using averages and weighting, and the academic performance and the overall executive functions of each study were calculated so that statistical analyses could later be performed individually.

Effect Size

This study's statistical approach applied an analysis of two continuous variables; thus, the correlation coefficients were used as the effect size to establish the relationship between executive functions and academic performance. Regarding the sample correlation coefficients, it was decided to transform them into Fisher *Z*-values, thus ensuring that the variance of the effect size will be based on the sample size. Cohen (2013), an effect size is considered to be small when the correlation coefficients do not exceed 0.10; they are considered to be moderate at 0.30; and they are considered to be large if they exceed 0.50.

Statistical Analysis

To examine the variability of the sampling, the parameters studied were the Cochran *Q* test (to test the null hypothesis of homogeneity between the studies) and the I^2 (proportion of the variability). According to Higgins et al. (2003), if I^2 reaches 25%, it is considered low; It is considered moderate if it reaches 50%; and it is considered high if it exceeds 75%.

This may be due to a sampling error, a real variability in the variance and the size of the effect, or the influence of a third variable acting as a moderator. In this sense, different meta-analyses were applied that excluded studies with atypical data. In addition, the results produced by model 1 (fixed effects) and model 2 (random effects) were analyzed. Due to the number of research studies in the sample (21 databases), it was determined that model 1 is initially more appropriate (Overton, 1998; Schulze, 2007), since a study of fixed effects assumes a real and real size of the effect, and the variability of the sampling supposes an error in the sampling. However, in a random effects model with a more conservative approach, the sampling variability is lower and is not considered a sampling error but a real variability in the variance and in the size of the effect (Borenstein et al., 2011). Therefore, considering both approaches, we decided to perform an initial analysis that included all the studies and then eliminate those that showed outliers. The comparison of the two showed that the sampling variability was affected by some of them ($Q = 119.359$, $I^2 = 83.24$); therefore, they were treated separately to explain the results. To clarify, these research studies were not eliminated, and although the sampling variability decreased ($Q = 43{,}536$, $I^2 = 58{,}655$), even without them, the sample variability did not reach 50%. Therefore, in the presence of variability and heterogeneity, it is established to follow the work based on the random effects model. In addition, a meta-regression of random effects was carried out, taking gender and age as moderators, since numerous studies indicate that executive functions and their cognitive influence vary with age (Ostrosky-Solis et al., 2007; Castillo et al., 2009). The software used to classify and encode data and to produce descriptive statistics was the EZAnalyze add-on (Microsoft Excel, 2007). The integral meta-analysis software (CMA, Biostat, USA) was used for meta-analysis and meta-regression calculation data.

RESULTS

General Description of the Studies Included in the Research

A search of the literature related to the topic and published in the last decade produced a small number of articles. This is because the search was limited to a specific age range (6 to 12 years) corresponding to primary education. In addition, there was a requirement that the studies have clear correlation statistics so that the data could be integrated. The studies describe research conducted in various parts of the world, which enabled us to determine if the results displayed significant differences depending on the dominant culture in the respective countries. Therefore, we found not only diverse cultures but also a variety of educational systems, although it should be noted that the African continent and South Asia were not represented. Of the 21 databases pertaining to the 19 articles selected, a total sample of 7,947 individuals was obtained (**Table 1**). The smallest data set contained only 60 individuals, and the largest data set contained 2,036. Three of the studies did not provide information on the number of participants by gender or on the composition of the sample; the published data indicate that 51.27% of the individuals were male and 48.73% were female. A total of 26.31% of the studies pertained to the United States, representing 45.72% of the participants. The Netherlands had 15% of the studies, representing 25.64% of the participants. The United Kingdom had 15% of the articles but only 5.78% of the participants. The sole Norwegian study stands out with 14.16% of the sample. Therefore, Europe represents 48.55% of the sample, North America 48.28%, South America 1.44%, and Asia 1.73%.

It is interesting to note that five articles address only the reading aspect of academic performance; one article addresses only the mathematical aspect, and the rest examine both reading and mathematical skills. Furthermore, of the executive functions, working memory is the factor that appears most often, sometimes in conjunction with inhibition, flexibility or attention. Seven of the studies have a longitudinal design, and two address academic performance from the opposite perspective (poor reading performance). Of these, several stand out: Aarnoudse-Moens et al.'s (2013) study on the effect of premature birth on subsequent performance with a control group, and Sesma et al.'s (2009) studies on groups diagnosed with conditions such as ADHD, dyslexia, and dyspraxia. Sesma et al.'s study examines a group with weak word recognition and another with poor reading comprehension. The socioeconomic status of the families, the educational level of the parents, language difficulties, gender, and age all are examples of the diverse interests represented in these articles. The sources of the samples vary; some were obtained from existing projects, whereas others pertain to the entire country, to a single city, to a single school, to rural areas, or to urban areas (**Table 1**).

The procedures followed to measure academic performance for the most part correspond to the standard achievement tests of each country. The Woodcock-Johnson III test was used by five authors including Welsh et al. (2010) who also used the TOPEL test for reading achievement. Sánchez-Pérez et al. (2018) opted for PROLEC. The WIAT-II tests were selected for the studies by Bryce et al. (2015) and Sesma et al. (2009). Only Alloway and Alloway (2010) used the Wechsler test, and Oakhill et al. (2011) used the Neale Analysis of Reading Ability (NARA) and CAT tests. The studies by Tsubomi and Watanabe (2017) and by Abreu et al. (2014) were exceptions in that the teachers themselves were responsible for evaluating the academic performance of the students. In any case, it is indicated that the reading tests used are aimed at reading words to measure fluency and accuracy. As for the instruments used to measure the executive functions, sometimes a single component was measured such as working memory, etc., and others considered the executive functions as a whole, always depending on the age of the subjects being evaluated. When working memory was addressed, the applied tests were the "Automated Working Memory Assessment-AWMA" (Alloway et al., 2008) and the Wechsler Intelligence Scale for Children (WISC-III and IV). The Stroop Color test was used in the studies on inhibition, and a wide variety of other instruments were used for other components (for example, the duck task for cognitive flexibility or the Tower of London for planning); the use of computers and specific software for these tests was noteworthy.

TABLE 1 | Characteristic of studies included in the meta-analysis.

	References	Country	Population	Males	Females	Age	Performance measurement	Other variables included	Executive functions specified	Distribution of participants
1	Aadland et al., 2017	Norway	$n = 1,129$	588	541	10–11 years	Arithmetic, reading and English	Aerobic capacity, motor skills, arithmetic, reading	Working memory, inhibition, and cognitive flexibility	57 schools in a southern county with more than 100,000 inhabitants
2	Aarnoudse-Moens et al., 2013	The Netherlands	$n = 200$ $n = 230$	212	218	4–12 years	Mathematics	Mathematics (standardized tests), attention (parents and teachers)	Verbal and visuo-spatial working memory, impulse planning, and control, verbal fluency	Three schools in the same city
3	Alloway and Alloway, 2010	United Kingdom	$n = 98$	50	48	5–11 years	Mathematics and language	IQ, reading comprehension, reading, spelling, mathematical reasoning, and numerical operations	Working memory and short-term verbal memory	No information
4	Best et al., 2011	United States	$n = 2036$	unknown	unknown	5–17 years	Mathematics and reading	Identify letters and words, comprehension, vocabulary; calculation, applied problems, and quantitative concepts	Executive functions: planning, attention, simultaneous, and successive	Entire country
5	de Bruijn et al., 2018	The Netherlands	$n = 472$ $n = 473$	208/210	264/263	7–9 years	Mathematics and spelling	Physical fitness, mastery of mathematics and spelling	Inhibition, verbal and visuo-spatial working memory, change of attention	12 schools in the northern part of the country
6	Bryce et al., 2015	United Kingdom	$n = 66$	37	29	5–7 years	Mathematical reasoning and reading of words	Mathematical reasoning and reading of words	Inhibitory control, working memory	Six schools in Bristol (United Kingdom)
7	Abreu et al., 2014	Brazil	$n = 106$	60	66	6–8 years	Reading	Reading, writing, mathematics, spoken language, natural and social sciences	Cognitive flexibility, working memory, inhibition, selective attention.	Various populations, various schools, urban environment
8	Gerst et al., 2017	United States	$n = 93$	41	52	5–11 years	Reading comprehension and mathematical calculations	Conduct, working memory, reading comprehension skills, mathematical calculations	Working memory, inhibition and change	Three schools in a large metropolitan area
9	Gómez-Veiga et al., 2013	Spain	$n = 77$	39	38	8–9 years	Reading comprehension	Spelling and reading comprehension; updating and retaining information; and non-verbal intelligence	Working memory	Two schools in a population of more than 100,000 inhabitants
10	Gray et al., 2015	Canada	$n = 204$	101	103	5–9 years	Mathematics and reading	Addition, subtraction, calculation, and reading ability, and fluency	Lack of attention and working memory	Large, suburban and rural school district, Southern Ontario
11	Hall et al., 2015	United Kingdom	$n = 101$	50	51	5–8 years	Mathematics and reading	Reading, comprehension of sentences, procedures, problem-solving, and reasoning	Primary memory	No information

(Continued)

TABLE 1 | Continued

	References	Country	Population	Males	Females	Age	Performance measurement	Other variables included	Executive functions specified	Distribution of participants
12	Mulder et al., 2017 (44 children of unknown gender)	The Netherlands	$n = 552$	236+22	277+22	3–6 years	Literacy, mathematics	Knowledge and estimation of numbers, mathematical skills, knowledge of letters, phonological awareness, language, reading-writing skills	Selective attention, visuo-spatial working memory, short-term visuo-spatial memory, short-term verbal memory	Entire country
13	Oakhill et al., 2011	United Kingdom	$n = 97$ $n = 100$	unknown	unknown	6–11 years	Reading accuracy and comprehension	Cognitive skills: verbal, numerical, spatial; reading (accuracy, comprehension) and working memory: verbal, numerical and spatial	Working memory	Five schools in the country
14	Oberer et al., 2018	Switzerland	$n = 134$	66	68	5–9 years	Mathematics and reading	Sequences, addition-subtraction, comprehension and reading speed, visual-motor coordination and, physical fitness	Inhibition, changing and updating	Schools in a college town
15	Ribner et al., 2017	United States	$n = 1292$	unknown	unknown	5–12 years	Mathematics and reading	Counting, measuring, arithmetic, verbal and non-verbal operations, letters, words, reading ability	Working memory, inhibitory control, switching attention	Two geographical areas of the country with high poverty rates
16	Sánchez-Pérez et al., 2018	Spain	$n = 142$	74	68	6–12 years	Mathematics and reading skills	Study skills (organization and habits); applied calculations and problems; letter sounds, word reading, intonation, etc.; social skills	Activation control, focus of attention and inhibitory control.	Two geographical areas of the country with high poverty rates
17	Sesma et al., 2009	United States	$n = 60$	30	30	9–15 years	Reading comprehension	Attention, decoding, fluency and vocabulary	Working memory and planning	No information
18	Tsubomi and Watanabe, 2017	Japan	$n = 121$	67	54	7–12 years	Literacy (reading and writing), mathematics, science, music, art, physical education	All subjects assigned	Visual working memory	One school
19	Welsh et al., 2010	United States	$n = 164$	71	93	4–6 years	Beginning literacy and basic arithmetic	Reading skills, arithmetic skills and cognitive skills	Working memory and attention control	Schools in three Pennsylvania counties

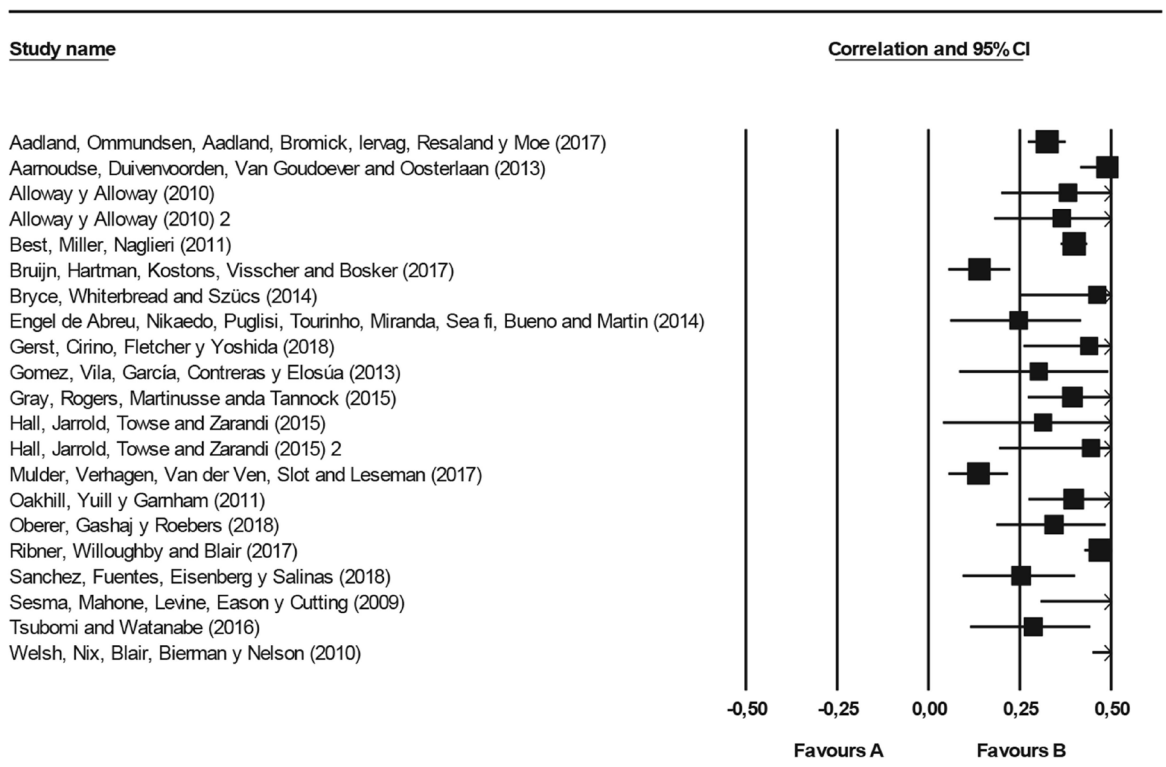

FIGURE 2 | Forest plot effect size (Pearson's r). Executive functions—academic performance.

Effect Size and Statistical Significance

Figure 2 (Forest Plot) and **Table 2** both present the effect size and confidence interval (95%), for the studies with regard to general academic performance and overall executive function. The individual analysis of each sample is presented as well as the weighted results for random effects model. The meta-analysis of the variables concludes that the data obtained have good consistency. The executive functions presented an effect size of $r = 0.365$, with a 95% confidence interval ranging between 0.309 and 0.419 for a sample of $k = 21$ and a population of $n = 7{,}947$. None of the intervals were zero; as such, there is a medium weighted mean effect size with a significance of $p < 0.05$. A second calculation (for most of the studies linking academic performance to mathematics and language) presents the effect size and the confidence intervals of the executive functions for the two academic areas in **Table 3**. The results indicate that the effect size for mathematics is slightly higher ($r = 0.365$), which is consistent with other studies, indicating that executive functions are a better predictor for this area than for language (Brock et al., 2009; Willoughby et al., 2012). Again, there is a medium weighted mean effect size with a significance of $p < 0.05$.

Next, the same procedure was performed for the executive components. Working memory is the factor that is most prominent in the research (in 14 of 21 databases). As such, it was the first factor analyzed with respect to overall academic performance and subsequently with respect to mathematics and language (**Table 4**). The effect size for this first statistical

TABLE 2 | Effect size: executive functions—academic performance.

		Effect size and 95% interval		
Model	***K***	**Point estimate**	**Lower limit**	**Upper limit**
Random	21	0.365	0.309	0.419

TABLE 3 | Effect size: executive functions—academic performance in mathematics and language.

		Effect size and 95% interval		
	K	**Point estimate**	**Lower limit**	**Upper limit**
MODEL FOR MATHEMATICS				
Random	18	0.365	0.304	0.422
MODEL FOR LANGUAGE				
Random	20	0.350	0.287	0.409

TABLE 4 | Effect size: working memory—academic performance, performance in mathematics and language.

		Effect size and 95% interval		
	K	Point estimate	Lower limit	Upper limit
MODEL FOR MATHEMATICS				
Random	11	0.374	0.287	0.454
MODEL FOR LANGUAGE				
Random	13	0.331	0.245	0.411
MODEL				
Random	14	0.370	0.287	0.447

TABLE 5 | Sampling variability: working memory—academic performance.

	Heterogeneity			
K	*Q*	*df*	*p*	I^2 (%)
14	87.910	13	0.000	85.212
*12	*23.628	*11	*0.014	*53.445

**Excluding outlier data.*

calculation is 0.370 for random effects, with a confidence interval of 95% (0.287 to 0.447). The sample consisted of 13 studies with $k = 14$ databases and a population of $n = 3{,}740$ individuals. Eleven articles studied the links between performance in mathematics and working memory, and 13 studied the links to language development. A moderate and average effect size was found for both studies. These results support the theory that the executive functions are a better predictor of performance in mathematics, especially in aspects such as coding, organization and the immediate retrieval of information—what we call working memory (Bull and Scerif, 2001; St. Clair-Thompson and Gathercole, 2006).

Heterogeneity Analysis

The variability among the different samples of the relationship between academic performance and executive functions was significant ($Q = 119.349$, $df = 20$, $p < 0.000$), and the I^2 was 83.242%), which was higher than expected. However, the results of the random effects model were more conservative (since there were fewer than 30 samples). With these results, it was appropriate to test the sensitivity of the sample by performing a second meta-analysis that excluded two studies: de Bruijn et al. (2018) and Mulder et al. (2017). This second meta-analysis yielded the following: $Q = 43.537$, $df = 18$, $p < 0.001$, I^2 of 58.656%, and significant moderate variability. Two findings stand out: the first is the outlier values obtained by the discarded studies, and the second is the possible existence of moderating variables; these will be specifically addressed in another section. The meta-analysis performed for the variables of academic performance and working memory presented similar results (**Table 5**): $Q = 87.910$, $df = 13$, $p < 0.000$ and I^2 of 85.212%; these values again decreased upon excluding the three above-mentioned articles.

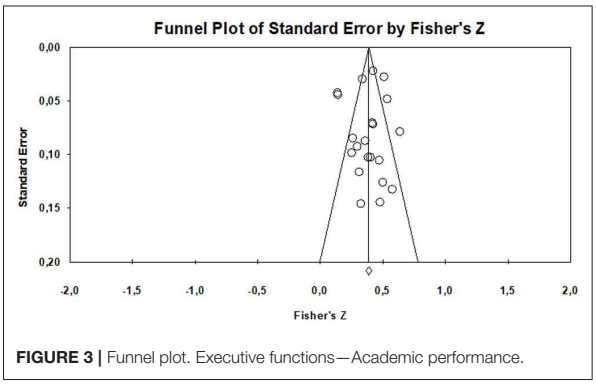

FIGURE 3 | Funnel plot. Executive functions—Academic performance.

Atypical Values or Different Sample Sizes

Once the studies with outlier values (Mulder et al., 2017; de Bruijn et al., 2018) were identified, and although the sampling variability was diminished by excluding them, there were no significant differences in effect size ($r = 0.365$, $Q = 119.349$, $df = 20$, $I^2 = 83.242\%$; $r = 0.398$, $Q = 43.537$, $df = 18$, $I^2 = 58.656\%$). Furthermore, when studies with larger populations were discarded, there were practically no differences in the results ($r = 0.359$, $Q = 85.318$, $df = 17$, $I^2 = 80.075$). Therefore, we decided not to exclude any sample from the meta-analysis since no sample amounted to 50% of the statistical weight. In addition, the differences in effect size were not significant. However, distinct analyses of the three studies were conducted to explain the causes of this reduced variability of the differences indicated by the values for the *Q*-statistic.

Publication Bias Analysis

The funnel plot (**Figure 3**) facilitates the verification of the existence or not of bias regardless of the size of the sample. This graph shows that the results obtained for the Z values from the studies included in this meta-analysis, show small values that range between 0 and 1. As indicated by Palma and Delgado (2006) they would indicate an absence of bias, since that the existence of the same is considered from the significantly distant values of 0. In the same way, when the Egger test is performed, the value in the interjection point of the ordinate axis is 0.24 (close to 0). This author points out that a higher value would indicate the existence of bias (Egger et al., 1997). At the same time, the *p*-value (0.404) is therefore >0.1, so the results of the funnel plot would be confirmed. From all these data it is deduced that the present study does not show any problem related to a possible publication bias.

Moderating Variables

Various studies confirm that both age and gender are two moderating variables of executive functions (Ostrosky-Solis et al., 2007; Castillo et al., 2009; Ganley and Vasilyeva, 2011; Rogers et al., 2011; Bull et al., 2013; López, 2013). Therefore, these variables were analyzed to check their degree of moderation or their power to explain the variance. First, a meta-regression (over random effects) was performed on age as a moderating variable, and no significance was found. A possible explanation

TABLE 6 | Meta-regression with moderating variables: Age and Gender.

Summary of models: random effects (MM), Z-distribution, fisher's Z									
				Test of model (a)			Goodness of fit (b)		
	Model name	TauSq	R^2	Q	df	P-value	Q	df	P-value
(Without moderators)	Model 1	0.015	0.000	0.000	0.000	1.000	119.350	20.000	0.000
(Gender)	Model 2	0.008	0.490	8.540	2.000	0.014	54.160	18.000	0.000
(Age)	Model 3	0.017	0.000	0.020	1.000	0.655	110.420	19.000	0.000

TABLE 7 | Meta-regression: Gender.

Main results for model 2: random effects (MM), Z-distribution, fisher's Z							
Covariate	Coefficient	Standard error	95% lower	95% upper	Z-value	2-sided P-value	VIF
Intercept	0.440	0.034	0.373	0.507	12.82	0.0000	1.757
Male	0.002	0.001	0.000	0.005	2.06	0.0396	48.028
Female	−0.003	0.001	−0.005	0.000	−2.34	0.0195	48.028
Statistics for Model 2							
Test of the model: Simultaneous test that all coefficients (excluding intercept) are zero							
$Q = 8.54$, $df = 2$, $p = 0.0140$							
Goodness of fit: Test to determine if unexplained variance is zero							
$Tau^2 = 0.008$, $Tau = 0.088$, $I^2 = 66.77\%$, $Q = 54.16$, $df = 18$, $p = 0.0000$							
Comparison of Model 2 with the null model							
Total variance between studies (intercept only)							
$Tau^2 = 0.015$, $Tau = 0.124$, $I^2 = 83.24\%$, $Q = 119.35$, $df = 20$, $p = 0.0000$							
Proportion of total between-study variance explained by Model 2							
R^2 analog = 0.49							

for this lack of significance is the age parameter because primary education covers a range of young ages linked to a specific psychosocial stage of development. A second meta-regression (over random effects) was performed that included gender, and moderate significance was found ($R^2 = 0.49$); that is, gender can explain 49% of the variance. Unlike the studies referenced above, the female gender explained this relationship, possibly because of the greater tendency in females toward mature development (Ausubel and Sullivan, 1983); as such, this question was deferred to a future research study. Regarding this model's goodness of fit for the modified sample, the results ($Q = 54.16$ and $I^2 = 66.77\%$) were lower than those of the meta-analysis due to the changed values in the meta-regression. In conclusion, of all the possible moderating variables in the meta-analysis, only gender had the capacity to explain a moderate degree of variance (49%). No significance was found for the age variable because of the sample homogeneity that occurs when researching a specific period of education (see **Tables 6**, **7**).

DISCUSSION

The purpose of this study was to investigate the links between executive functions and academic performance in primary education over the last decade. This review and meta-analysis found that executive functions are considered to be good predictors of academic achievement in normally developed children ($r = 0.365$). Delving deeper, evidence of the following was obtained: (a) the multifactorial composition of the executive functions, in which working memory has the most significant influence on academic performance ($r = 0.370$); (b) the presence of a certain moderating effect of executive functions on other variables of academic performance; and (c) the moderating function of gender ($R^2 = 0.49$).

The literature provides numerous examples of the importance of executive functions in achieving academic success (see Huizinga et al., 2018; Willoughby et al., 2019). Language development is essential for proper learning, and cases of low reading ability demonstrate some deficiency in these skills (Abreu et al., 2014). There is a recognized problem specific to language that is associated with a poor working memory and that prevents normal language development (Im-Bolter et al., 2006). Furthermore, distraction directly influences an individual's ability to focus on and correctly capture external stimuli (Gray et al., 2015). Therefore, if the verbal component and logical reasoning are the foundation for good academic performance, they are themselves related to the development of executive functions. In addition, if they have a robust power to predict subsequent academic success, there is ample evidence that justifies an interest in understanding and examining all aspects of their behavior with respect to academic performance.

The intelligence quotient has traditionally been the most important factor in predicting academic performance (Vukovic and Lesaux, 2013; Ren et al., 2015); however, it diminishes in importance at the university level (Reynolds and Walberg, 1992; Patrikakou, 1996). Some studies conclude that intelligence is the variable with the most variance in explaining school performance (Staff et al., 2014). The data gathered for this review and meta-analysis confirm that, at present, the executive functions and the intelligence quotient have the same degree of predictive capacity regarding school performance, with the intelligence quotient being more important for new learning, and the executive functions being more important for learning that is repetitive and focused on competencies. Therefore, our findings are in line with some recent research (Costa and Faria, 2018; Lotz et al., 2018). Particularly, for Aarnoudse-Moens et al. (2013), the "g" intelligence factor explains poor performance in mathematics during the pre-school years; however, they found similar prediction values for executive functions and the intelligence quotient during primary education. Ribner et al. (2017) obtained similar results, but with respect to good student performance in mathematics and language. These results suggest that mathematical problems are increasingly complex at this stage of education, which is why highly developed cognitive skills are necessary. The research by Best et al. (2011), Hall et al. (2015), or Tsubomi and Watanabe (2017) all highlight the importance of executive functions in the early years of primary education and the rapid development of working memory at a young age, to achieve stability between the ages of 10 and 12. In Alloway and Alloway's (2010) article, this mnesic-executive aspect emerges as a better predictor of future performance (in literacy and mathematical reasoning) than the intelligence quotient. In addition, they highlight the importance of early intervention to improve future results as well as the independence of both variables. These results are explained by the static nature of intelligence as opposed to the executive functions that change with age and neurocognitive maturation. Gómez-Veiga et al. (2013) performed a regression analysis and found that working memory ($\beta = 0.28$) and fluid intelligence ($\beta = 0.30$) explain 33% of the variance in reading comprehension. Similar predictive values are found in the direct correlations between the aspects of memory that are linked to executive functions and academic performance and the aspects of intelligence that are linked to academic performance.

Another important issue is the dilemma raised regarding the homogenous or multifactorial composition of the executive functions that are explained by their own evolution and development (Best et al., 2011). The results of this study support the notion of a multifactorial composition of executive functions within the context of primary education (ages 6–12) because the meta-analysis revealed that working memory is the most studied component (14 of 21 databases), displaying an effect size of 0.370 for random effects, which gives it more predictive power than inhibition. There are numerous studies in this field on pre-school children; however, there are few for the primary education years. There are two aspects to consider. On one hand, Wiebe et al. (2008) found that executive functions in children 2 to 6 years old have a homogenous composition. On the other hand is the opinion that this variable has several related but totally distinct components: working memory, inhibition and cognitive flexibility (Miyake et al., 2000; Bull and Scerif, 2001; St. Clair-Thompson and Gathercole, 2006). Some authors include another factor—planning (Anderson, 2002). Several studies (Isquith et al., 2004; Senn et al., 2004; Huizinga and van der Molen, 2007) conclude that inhibition is the best predictor of academic performance up to the age of seven. After that age, working memory is the most important, and then cognitive flexibility becomes the most important after the age of 11. These findings supposedly indicate that inhibition develops first, with other components emerging later such as working memory and cognitive flexibility. That is, age produces changes in the relationships between the executive function components and academic performance (Jarvis and Gathercole, 2003; Jacobson and Pianta, 2007).

This study sheds light on the question about the modularity of brain, that is, that the brain can be conceptualized as a network which comprises some modules (Baniqued et al., 2018). Therefore, this review of indicates that the executive functions have general, overall characteristics and their components have specific characteristics. The distinct factors of this variable are better related to academic performance depending on the subject matter studied. This is because the specific development of certain skills and abilities is needed for school performance. The results of this meta-analysis are consistent with the literature reviewed, and they highlight the relationship between mathematics and the visuo-spatial aspect of working memory. Moreover, most of the executive function components correlate better with academic performance in mathematics than in language ($r = 0.374$; $r = 0.331$). It can also be concluded that, despite its general nature, by contributing to the development of different aspects of learning, working memory becomes more specific in nature in the development of particular skills. Therefore, it is identified as being a relevant and specific sub-variable depending on whether its auditory-verbal or visuo-spatial aspect is engaged. Similarly, the other executive function components such as inhibition (with verbal or visual distractors), cognitive flexibility, selective attention (of distraction or attention with verbal or visual stimuli), and planning display specific characteristics by significantly correlating with the development of academic skills. de Bruijn et al. (2018) published a study on poor reading performance in which working memory became more important than inhibition. That is, when encountering learning problems, the variables act differently. Gómez-Veiga et al. (2013), Nouwens et al. (2017), Oakhill et al. (2011), and Sesma et al. (2009) all agree that the two aspects of working memory (visuo-spatial and auditory-verbal), are deemed to be predictors of reading comprehension, especially the relationship between the auditory-verbal aspect and the tasks of storage and symbolic recall. Furthermore, Tsubomi and Watanabe (2017) found that visual working memory without distractors selectively predicts performance in mathematics. The study by Welsh et al. (2010) presented results that demonstrate predictive reciprocity between mathematics and the executive functions of working memory and attention. For Aarnoudse-Moens et al. (2013), Gray et al. (2015), and Mulder et al. (2017), inhibition explains the lack

of attention and highlights the visuo-spatial component of the memory function for performance in mathematics. In addition, Gerst et al. (2017) contend that cognitive flexibility and planning are good predictors of that area. Abreu et al. (2014) establish relationships between reading and the executive functions of working memory and cognitive flexibility.

It should be noted that in some of the articles reviewed in this study, the executive functions, in addition to acting as a predictor in direct models of academic performance, have a certain moderating influence on other variables such as physical fitness, motor skills or memory processes. The studies by Aadland et al. (2017) and de Bruijn et al. (2018) introduce the variable of activity or physical aptitude. The latter study examines its relationship with poor academic performance; however, both adopt the perspective of the moderating or mediating effect of the executive components. Aadland et al. (2017) did not find any potential moderating influence of executive function on physical activity and academic performance; however, they did find a slight effect on the ability to work with numbers and motor skills. From the opposite perspective, de Bruijn et al. (2018) demonstrated an indirect relationship between physical fitness and poor academic performance, moderated by the executive functions with respect to mathematics and spelling. In addition, verbal working memory is both a domain-general and domain-specific mediator, and its visuo-spatial aspect is related to poor academic performance in mathematics. Similarly, Oberer et al. (2018) find that executive functions, visual motor coordination, and physical fitness predict subsequent academic performance and that executive functions act as moderators between physical fitness and academic performance. Bryce et al. (2015) find that the variable of cognitive abilities robustly contributes to school performance within a structured model where the executive components act as mediators. All this is based on the close relationship between the two such that the performance of the former will be predetermined by the development of the latter. They conclude that executive functions contribute positively to enabling the youngest students to use their cognitive skills appropriately.

This literature review and meta-analysis confirms that the executive functions display greater predictive power at early ages and have a robust, specific capacity for predicting future academic performance. Thus, it is important to detect academic achievement problems as early as possible to initiate intervention programs. The intent would be to minimize any potential problems that are inherent in learning, particularly those that hinder normal development in language and mathematics. This is confirmed by some of the longitudinal studies reviewed here such as those by Aarnoudse-Moens et al. (2013), Alloway and Alloway (2010), Hall et al. (2015), Oberer et al. (2018), and Welsh et al. (2010). However, in some cases, the relationship patterns between these variables are sustained throughout the longitudinal study for all of the various age groups (Oakhill et al., 2011). Other studies determined that normal, early childhood development helps students who begin their schooling late catch up to the rest of the students (Ribner et al., 2017). Of note are the studies that begin their research in the pre-school stage and conduct follow-ups over 3 to 6 years, with the objective of predicting academic performance in primary school. Best et al.'s (2011) article on a study of children from 5 to 17 years old (the broadest age range) determined that the most intense development of executive functions occurred among the youngest children. It then slowed somewhat in the last years of infancy and declined during adolescence. That study also demonstrated a direct relationship between this variable and academic performance as well as an indirect relationship through the verbal factor and logical reasoning. This connection indicates the link that executive components such as working memory, inhibition and attention have with mathematical competence and language development. On the contrary, Bryce et al. (2015) used a specific structured model based on the moderation of variables and concluded that after the age of seven, executive functions and cognitive abilities decline dramatically in the subsequent 5 years. Despite this discrepancy, our meta-analysis suggests that executive functions are essential for the development of academic skills in primary school.

Characteristics such as age, gender, socioeconomic status, and physical fitness can act as moderators in the relationship between executive functions and academic performance, as shown in previous research (see Thomson, 2018; Kvalø et al., 2019). In the current meta-analysis, two meta-regressions were performed—one for age and one for gender—and no significance was found for the first (age), and a 49% variance was found for the second (gender). A possible explanation for these findings is that during this age range, females mature more rapidly than males. The 7 to 12 age range corresponds to a period of cognitive transition that Piaget (1991) calls the concrete operational stage. Children can make logical inferences and reversible mental operations, and they can formulate hypotheses. In this stage, the reinforcement of mnesic processes and metacognition occurs (memory, knowledge, learning strategies, the monitoring of one's own thoughts, semantic elaboration). It is precisely in this educational period when gender differences between boys and girls become the basis for the diverging cognitive development of the genders. Different aptitudes, behaviors and abilities emerge (Calvo, 2009). Kovacs and Devlin (1998) make a number of observations on this topic: there is a different rhythm of physical, cognitive and psychic maturation for men and women. Females mature at an earlier age, which produces disparities in learning and academic performance. Consequently, females display better writing skills during the first years of school (due to the development of fine motor skills) as well as better verbal skills and abilities. Males have the advantage of better visuo-spatial capabilities due to the effects of testosterone.

There have been numerous studies that examine the differences in academic performance between the genders. Hyde et al.'s (1990) meta-analysis compiled hundreds of studies on the influence of gender on academic performance. Half of the studies showed very minor differences, and a third of the studies found no differences at all. The widely held acceptance of the disparate cognitive abilities of men and women was broken down, and it was suggested that social and cultural factors influenced performance in the various academic fields. There is no evidence that boys are better at mathematics and girls are better at language. The study by Hyde and Mertz (2009)

aligns with the one by Hyde et al. (1990) as it concludes that girls achieve the same results as boys in standardized math tests. In addition, there is no difference in language ability between men and women. Other studies, such as those by Alcaraz and Guma (2001) or Mathiesen et al. (2013), contend that in addition to the divergence that comes from sexual dimorphism, there are differences in brain anatomy such as the larger corpus callosum in females, which facilitates the processing of language, and a larger nucleus of the hypothalamus in males that influences emotions. The latter author determined that the literature on the cognitive development of the two genders presents different results depending on age, the time period, and location. Along this same line, Bethencourt and Torres (1987), Herrera et al. (2000), and Steinmayr and Spinath (2009) determined that girls start school with significantly higher levels of lexical and motor skill development than boys. This could be due to their earlier maturation, which can present differences of almost 2 years during puberty. These authors also assert that overall performance by females is on average slightly higher than male performance during their first years of school. In addition, they note that females have better inhibitory control; however, no gender-based differences in the processes of cognitive flexibility were noted. In the early years of primary education, girls demonstrate better results for working memory, short-term memory and attention. In the later years of primary education, due to age and years of schooling, they achieve a good level of execution, categorization and conceptualization (Reyna and Brussino, 2015). These results, which are better for girls than for boys, will be related to the language capabilities attributed to left-hemisphere brain development, which is delayed in males due to the presence of testosterone (Acosta, 2001). Therefore, the existing literature is completely consistent with the results of our meta-analysis, in which gender emerges as a moderating variable between academic performance and the executive functions during the primary school years.

It is important to note that in the conducted meta-analysis, there are two articles with outlier data. However, this is not due to a bias error but to a real variability in the variance and effect size. This result is due to the particular research design and the treatment of the academic performance variable. In some cases, as in the article by de Bruijn et al. (2018), this variable was studied from the opposite perspective of poor performance. These studies present out-of-range effect sizes: $r = 0.14$ (de Bruijn et al., 2018) and $r = 0.137$ (Mulder et al., 2017). The study by de Bruijn et al. (2018) also present confidence intervals (95% CI) that contain zero, which annuls any statistical significance in the relationship. The same does not occur in the study by Mulder et al. (2017); however, it contains parameters below those established in this meta-analysis (an effect size of $r = 0.365$, with a 95% CI between 0.309 and 0.419 in the relationship between executive functions and academic performance). These studies were conducted in the Netherlands, and in all two there is a variability of the variance that points directly to language and to the distinctiveness of the design or sample. In one of them, works with two groups in which 25% of the sample corresponds to children with poor academic performance (de Bruijn et al., 2018). The last study has the distinct feature of being a longitudinal design that starts with 3 year olds (Mulder et al., 2017). Despite this distinction, no differences were observed in the behavior of the executive function components in relation to language, regardless of the culture, the native language, or the educational system where the research was conducted.

CONCLUSIONS AND LIMITATIONS

Although there are many publications on academic performance and the variables that influence it, the originality of this meta-analysis lies in its focus on the last decade and on primary education. In addition, this study considered and included a variety of samples and research studies conducted in different countries to provide a comprehensive overview of the topic. The publication review made it possible to verify the diversity of the variables related to academic performance, highlighting the executive functions. The primary education stage was the focus of only a small number of studies, compared to the pre-school or secondary education stages; the university stage was studied the most. The number of competency-based measures of academic performance in the studies increased with a corresponding decrease in the use of numerical grades (per quarter and subject), which is considered to be closer to a true measure of learning. There was an increased number of studies with structured models using first-level variables such as the executive functions and other variables deemed to be minor because they are influenced by the former (not because of their direct relationship but because of their moderating power); however, they are also essential for the development of certain competencies and capabilities.

An important finding is that it was possible to confirm that, in the last decade, executive functions have replaced the intelligence quotient as the most studied variable with respect to academic performance and that both currently have the same predictive capacity. The results of this review and meta-analysis support the recognition of the multifactorial composition of executive functions, and they reveal that working memory is the most researched component as well as a better predictor than inhibition. In addition, it is evident that the behavior of the executive function components depends on the subject studied, especially regarding the relationship between mathematics and the visuo-spatial aspect of working memory. Similarly, most of the executive components are better related to performance in mathematics than in language. Given the dilemma of classifying executive functions as a domain-general cognitive variable, the studies reviewed confirm that executive functions can be decomposed into different components (working memory, inhibition, cognitive flexibility and planning) that are distinctly linked to certain types of learning. Furthermore, the moderating role of executive functions was demonstrated with respect to other variables such as physical fitness, motor skills, or memory processes. Similarly, it is evident that the executive functions are an important predictor of academic performance and future learning problems at an early age. However, this variable diminishes in its predictive capacity during secondary education and more so during university-level education where

its development cycle comes to an end. Deficiencies detected in the executive components affect levels of school performance, which in turn has a heavy influence on the subsequent development of people at all levels—training, employment, social life. There is another important finding that must be highlighted: the moderating effect of gender in the relationship between executive functions and academic performance. The explanation is found in the significant maturational development that occurs during the years of primary education. Due to physiological and neurological factors, girls mature more quickly than boys during this stage. The studies reinforce the descriptive and moderating nature of this variable with respect to the development of the various skills needed for acceptable learning in primary school, in addition to its link to the student's maturity.

Since our meta-analysis included studies from different continents, from different socioeconomic levels, and from different rural or urban areas, it indirectly addressed the impact that different educational systems can have on intellectual development. However, no significant differences were found that could have produced variability in the executive component resulting from the sociocultural and educational contexts of the samples. In this regard, the diverse measures of academic performance, expressed in the (mostly) nationwide standardized achievement test results and in the traditional numerical grades given by teachers for the various subjects, have not demonstrated any significant differences. All this indicates that culture, native languages, socioeconomic levels, and the various objective methods of assessing this variable do not affect its development nor the resulting statistical data.

With regard to the limitations of this study, its sampling and research design can be noted. The descriptive and correlational nature of the study meant that the only statistics included were those that directly related to the variables studied and that those that compared groups or established indirect relationships were excluded. If these are linked to the results of our systematic review and the conclusions reached, then future research should consider focusing on the specific nature of the executive functions, using as a reference the statistics from the various structured models as well as their connection to the development of specific capabilities and competencies. Moreover, once the importance of maturity on the development of executive functions has been proven, we suggest a study on the relationship between the two, focusing on gender and not exclusively on age. All this can contribute to the development of specific intervention plans for the executive function components and deficient capabilities that can guide efforts to improve the learning process for students. They can also contribute to furthering the understanding of the links between this variable and academic performance at an early age.

AUTHOR CONTRIBUTIONS

AQ conducted the search, selection, and coding of the research articles. He also conducted the statistical analyses and drafted the initial draft of the manuscript. AC and NM reviewed the coding of the selected articles and reviewed and corrected the initial draft of the manuscript. AC did the coordination work and all three approved the final manuscript submitted.

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Article

Task Monitoring and Working Memory as Executive Components Predictive of General and Specific Academic Achievements in 6–9-Year-Old Children

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Abstract: Academic achievement has been linked to executive functions. However, it is necessary to clarify the different predictive role that executive functions have on general and specific academic achievement and to determine the most predictive executive factor of this academic achievement. The relationship and predictive role between executive functions and their components (initiative, working memory, task monitoring, organization of materials, flexibility, emotional control, inhibition, self-monitoring) with academic achievement are analyzed in this study, both globally and specifically in the areas of Language Arts and Mathematics, in 133 students from 6 to 9 years of age. The relationship obtained in Pearson's correlation analysis does not differ substantially between overall achievement (r = 0.392) and specific achievement (r = 0.361, r = 0.361), but task monitoring (r = 0.531, r = 0.455, r = 0.446) and working memory (r = 0.512, r = 0.475, r = 0.505) had a greater relationship with general and specific achievement. Finally, regression analyses based on correlation results indicate that executive functions predict general academic performance (14.7%) and specific performance (12.3%, 12.2%) for Language Arts and Mathematics, respectively. Furthermore, working memory and task supervision represent 32.5% of general academic performance, 25.5% of performance in Language Arts, and 27.1% of performance in Mathematics. In conclusion, this study yielded exploratory data on the possible executive functions (task supervision and working memory) responsible for good general academic achievements and specific academic achievements in Mathematics and Language Arts.

Keywords: executive functions; working memory; task monitoring; academic achievement; learning

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1. Introduction

The educational community has shown special interest in the study of academic achievement over time. In this field, academic achievement is defined as the product of the learning process resulting from the different variables or factors that influence that process [1,2]. As academic achievement can be understood as quantitative or qualitative value construction related to a profile of skills, attitudes, and knowledge developed by the student in the teaching and learning process [3], the relevant skills and cognitive factors are of great importance for understanding the correct progress of this process [4]. Within the discipline of educational neuropsychology, there are those who highlight the need to study the influence that executive functions have on academic achievement as a consequence of their importance on language development and, therefore, on literacy as a gateway to knowledge [5].

The executive functions are understood as a multifactorial structure that intervenes in different important neurocognitive processes and controls thoughts and behaviors to

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achieve an objective [6–8]. Therefore, these functions act as regulators of cognitive activity and behavior through their special relationships with intrapersonal intelligence [9], as executive processes do not refer only to cognitive processes (cold executive functions) but also to emotional and behavioral ones (warm executive functions) [10]. Several authors have highlighted inhibition, working memory, flexibility, and planning as factors or components of executive functions [11–13]. However, Gioia et al. [14] proposed three indices (of behavioral, emotional, and cognitive regulation) grouped together with nine scales: inhibition or impulse control; self-monitoring or awareness of one's own behavior; cognitive flexibility or the capacity to generate different solutions to the same problem; emotional control, understood as the capacity to regulate one's emotional response; the initiative to act autonomously and independently; working memory, understood as the capacity to manipulate information temporarily; planning, or the development of strategies to achieve objectives; task supervision, such as the capacity to review and evaluate; and, finally, the organization of materials or the capacity to order (Figure 1).

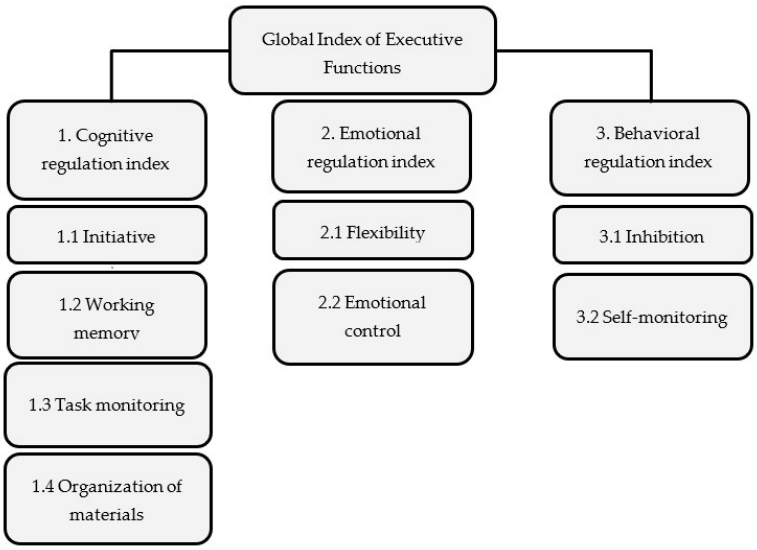

Figure 1. Scheme of indexes and scales of the executive functions according to Gioia et al. Source: own preparation.

Executive functions have a significant impact on academic results from preschool to university, with the executive level recorded at a specific age being related to results obtained at later ages and replacing the importance of one executive factor with another [15–17]. A review of the components of the executive functions can provide information on the involvement of such functions in scholastic achievement [14]. The behavioral regulation index includes inhibition and self-monitoring. Inhibition or the control of one's behavior is understood as the ability to suppress dominant and impulsive responses that are irrelevant to the task at hand [18–22]. Self-supervision, in a broad sense, refers to the ability to plan voluntarily, modulating one's behavior adaptively as needed to meet the established plan. The ability to self-regulate one's behavior is acquired between the ages of 6 and 8 and allows for the anticipation of events, even if a certain degree of impulsivity persists [19,20]. Because of its link to behavior and cognition, inhibition plays a significant role in the achievements of younger children [11,21–23]. It is also considered to be a good predictor of academic achievement up to age seven, since from three to seven years of age, a change occurs as the child progresses toward cognitive behavioral forms that require the integration of executive functions with linguistic skills [24–28]. However, this claim lacks strong consistency and has as many supporters as detractors. This variation of skills

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in early childhood predicts a multitude of results, among which the academic achievements in the Primary Education stage stand out [29]. These differences are explained according to the moment at which this integration takes place since such differences will depend on the child's development [30]. There is also a close relationship between inhibition and self-control or self-supervision, to academic achievement [31], and its variation with age [32,33].

Both flexibility and emotional control comprise the index of emotional regulation [14]. Flexibility involves the choice of appropriate work strategies and the ability to change the focus of one's attention [34–36]; this factor is, therefore, related to good academic achievement [37] in both Mathematics [38] and Language Arts [39], but in a less concrete way in the latter discipline [40]. There is evidence that academic achievement improves at the age of 5 or 6 and becomes significant by the age of 7–11 [41,42]. However, "emotional control evaluates the presence of problems in order to adequately regulate or modulate their emotional responses" [14] (p. 12). Emotional control is related to flexibility in assessing emotional responses during changing situations. Emotional control affects individual academic achievement as it can be a stress-inducing factor [43]. However, some studies assign control only a limited role in academic success [44].

The cognitive regulation index is composed of initiative, working memory, planning, task supervision, and the organization of materials [14]. Initiative "evaluates the presence of problems in order to initiate tasks or activities in an autonomous and independent way or to generate new ideas, answers or problem-solving strategies" [14] (p. 51). In other words, initiative is the ability to act without the need for external motivation to direct one's behavior. Deficits in this component may indicate difficulties in verbal and visual fluency, which will lead to low academic achievement [45].

Working memory represents the capacity to store, retain, and retrieve previous information and can be defined as a multifactorial memory system involved in the coordination and regulation of executive control and selective attention functions [46,47]. Various studies have concluded that working memory is the most relevant component of the executive functions, increasing its importance in the achievement of complex tasks. Working memory is also a good predictor of academic achievement during the first years of compulsory schooling [35,41,48] and presents early development that improves with age until 10 years old [49–51]. This factor has a good relationship with academic achievement in specific subjects such as Language Arts and Mathematics [17,52,53].

Baggetta and Alexander [54] identified planning as a higher order cognitive process necessary for the anticipation and execution of a task in the correct manner using the appropriate strategies. Within the factorial order of executive functions, planning coordinates various processes of analysis, selection, and the application of information and strategies necessary to achieve an objective. In this way, achieving good academic results indicates adequate executive functioning for the correct identification of the problem and its definition, the search for solutions, and the planning of an execution plan [11,49]. There is consensus that the components of inhibition (the scale of the behavioral regulatory index) and planning complement each other and are necessary both to solve a written text and to perform a mathematical calculation. These components are also strong predictors of specific achievements such as Language Arts or Mathematics [38,40,55].

Task supervision and self-monitoring have traditionally been considered using a single scale when studying executive functions [12] and are related to the ability to monitor and control compliance with an established plan. A study by Gioia et al. [14] separated these functions and introduced task supervision as a cognitive index scale, with self-monitoring used as a behavioral index scale. For these authors, task supervision is understood as an evaluation of the effectiveness of the supervision, monitoring, and control of one's work. However, the development of task supervision is incipient in young children, and from the age of seven, becomes a good predictor of achievement in Language Arts and Mathematics. This component is related to maturity and indicates a greater capacity to control situations due to greater experience [42].

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The organization of materials allows one to maintain both the area and the materials needed for study in an orderly and organized way. Difficulties in this component often relate to inefficiencies in both private and scholastic life. Learning to organize simple aspects helps improve the achievement of more complex tasks.

Numerous studies have addressed the relationship between executive functions and academic achievement [39,49,56]. Some of these studies are limited to the examination of one or more of the components of this variable [52,57]. On the other hand, as indicated in Gioia et al. [14], the study of executive functions in children has been approached from a cognitive perspective, forgoing behavioral, emotional, and social aspects, in addition to neglecting the evolutionary factors in this population. These authors recommend "leaving the traditional environment of a neuropsychological assessment and obtaining data from the everyday environment of the person being assessed" (p. 7). For this reason, it is important to examine the executive functions during childhood since a large part of the improvements in these functions occurs after the age of 5, with significant implications for scholastic achievement and emotional control [58].

Previous research has indicated that executive functions are related to scholastic achievement starting from the age of 3 years [17] and that, in general, this relationship is significant, influential, and persistent up to the age of 12 years [57,59]; some have even observed a strong correlation at 8–9 years of age [41]. Nevertheless, some authors have concluded that executive functions have a homogeneous composition between 2 and 6 years of age [60], while others found an individualized composition that was separate and distinguished between working memory, inhibition, monitoring, and cognitive flexibility [57]. Some have also found that the relationships between the components of executive functions and academic achievement vary with age, along with the importance of each function in different areas [57,59]. Blair and Razza [32] concluded that the influence of executive functions on educational achievement depends not only on academic competence but also on other factors such as general intelligence.

Therefore, there is scientific agreement that executive functions and their related skills (recall, self-control, planning, and flexibility of thought) are essential to academic achievement [61]. However, despite an increase in the number of studies published on the subject, various limitations were identified in previous studies. Traditional research has been based on aspects such as planning, inhibition, flexibility, and working memory without considering, e.g., emotional or behavioral factors and the developmental processes that all these components present in the child population with different rhythms of maturation [14].

The aim of this study was to analyze the relationship between executive functions and academic achievement in children aged 6 to 9, given the importance of executive functions in studies of the last decade as a predictor of academic success [53,62]. Furthermore, we specifically investigated which components of this factorial structure (scales of the behavioral, emotional, and cognitive regulatory index) have greater predictive weight and if the executive functions (inhibition, self-monitoring, flexibility, emotional control, initiative, working memory, planning, task supervision, and organization of materials) can be linked not only as general achievement cognitive variables but also understood as essential variables for the specific. To this end, we analyzed their relationship to specific areas such as mathematical and linguistic achievement since these subjects are considered relevant to school success by providing the instrumental basis of knowledge. The following hypotheses were proposed: We expected to find a positive and significant relationship between the global level of executive functions and academic achievement. We expected to find a greater relationship of working memory, inhibition, and flexibility with overall academic achievement, and, in addition, we expected working memory to have a particularly strong relationship with Mathematics. However, previous studies have already indicated that there could be variations depending on the specific ages of the subjects in the sample [53]. It is thus important to study a wide age range since the various psychological (attention, memory, and temporal organization) and anatomical processes occur during aging as the frontal lobe develops [63]. All these factors can help us understand the

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executive functions as a set of multiple and distinct processes. Significant improvements occur during the school years, and inadequate executive function is very likely to explain poor scholastic achievement.

2. Materials and Methods

2.1. Sample

The sample under study comprised 133 elementary students between the ages of 6 and 9, whose distribution by academic year was as follows: 35.3% in the first year of Elementary Education, 31.6% in the second year of Elementary Education, and 33.1% in the third year of Elementary Education. All of the students attended a subsidized center in the city of Zaragoza (Spain). The socio-economic level of the families was medium-high, with average household salaries of between EUR 36,000 and 42,000 per year as reported by parents. The latest report of the Spanish National Institute of Statistics (2016) put the average income of Spanish households at EUR 26,092 per year. For the distribution of the sample according to sex, 47.4% were girls and 52.6% were boys. The average age was 7.54 years, and the standard deviation was 0.95. The values for academic achievement (they can be evaluated between 0 and 10) were obtained from the average grades of all the subjects taken in an academic year. These values ranged from 5 to 9.4 (M = 7.88; SD = 0.94). Finally, it should be noted that the sampling method was incidental with a convenience sample. The sampling strictly followed the ethics protocol of Committee on Research Ethics in the Autonomous Community of Aragon CEICA (reference no. 04/2019; 27 February 2019). The collaboration of the schools and families was requested in the first instance through a letter of collaboration. Subsequently, the informed consent of the parents was collected alongside consent from the minors. In both documents, the experiment was detailed along with the contact information of the reference researcher.

2.2. Measures

Overall academic achievement was evaluated on the basis of the average grades (min. 0; max. 10) obtained by the students in various subjects (Mathematics, Language Arts, Social Sciences, Natural Sciences, Artistic Expression, and English) during the 2018–2019 academic year. The Behavior Rating Inventory of Executive Function, Second Edition (BRIEF 2), in its Spanish adaptation by Maldonado et al., was used to measure executive functions [14]. Raw scores were obtained on nine scales related to executive functions (inhibition, flexibility, emotional control, initiative, working memory, planning, self-monitoring, and task supervision), and raw scores were also obtained for executive functions in general. The clinical scales were combined into three indices: behavioral, emotional, and cognitive regulation, which in turn were combined as a global index of executive function. This is an individual type of questionnaire that must be answered by the parents, teachers, or caregivers of the children being evaluated. In this case, the questionnaires were answered by the parents (family version). BRIEF-2 presents a questionnaire of 63 items (example: "I constantly get up while performing a task") using a frequency-based Likert scale response (never, sometimes, frequently). A result with high scores, in any scale, indicates the existence of problems in the area where the scale is included (for example, a high score in inhibition will indicate difficulty in controlling one's impulses and, therefore, problems in the index of behavioral regulation). The questionnaire's authors indicated high reliability indices through Cronbach's alpha, which was shown to be above 0.85 for all values. In the present study, the Cronbach's alpha value was equal to 0.86 for the overall 9-item scale, which indicates high reliability.

2.3. Procedure

First, the research design was developed and approved by the school where the study was conducted. Subsequently, with the acceptance of the collaboration of the educational center, the research proposal was presented to the Research Ethics Committee of the Autonomous Community of Aragon: CEICA, obtaining a favorable resolution (no. 04/2019;

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27 February 2019). This committee is in charge of evaluating research projects involving people or personal data from BLINDED University. Afterwards, the information regarding the project was sent to the families along with the informed consent for them to authorize the participation of their children. The confidentiality and anonymity of the data were guaranteed through the development of a coding protocol. The center's orientation team participated in the development of the tests and provided the tutors for each course involved (first grade, second grade, and third grade of Primary Education). The questionnaires, in the family mode, were completed by the parents or legal guardians of the students in their natural contexts. The correction and scoring of the test were performed via computerized procedures (TEAcorrige).

2.4. Statistical Analysis

A descriptive statistical analysis was conducted on the demographic variables of the sample. Subsequently, Pearson's correlations were developed to observe the possible relationships between executive functions and their factors (inhibition, self-monitoring, flexibility, emotional control, initiative, working memory, planning, task supervision, and organization of materials) and academic achievement, both overall and specific (Language Arts and Mathematics). Finally, different regression models were applied to examine the predictive power of the executive functions and different scales or factors in different relationships with general and specific academic achievement. It should be noted that in the models tested, the dependent variable was general academic achievement, with specific achievement in Language Arts and specific achievement in Mathematics. The analyses were carried out using the statistical software IBM SPSS Statistics 25.0 [64].

3. Results

First, descriptive statistics were obtained, and correlation analyses were carried out between general academic achievement (GAA); average grade in Mathematics, Language Arts, Social Sciences, Natural Sciences, Artistic Expression, and English; academic achievement in Language Arts (AAL); average grade in Language Arts; academic achievement in Mathematics (AAM); and average grade in Mathematics, along with the scores on general executive function (EF) and each of the factors that compose EF. Neither sex nor age yielded significant results in the correlational analyses with respect to general executive functions ($p = 0.629$ and $p = 0.498$, respectively). The same occurred when performing a correlation analysis between sex and age and each of the executive factors, obtaining significance values greater than 0.05 (Initiative $p = 0.898$, $p = 0.087$; Working memory $p = 0.942$, $p = 0.549$; Task monitoring $p = 0.197$, $p = 0.168$; Organization of material $p = 0.256$, $p = 0.980$; Flexibility $p = 0.162$, $p = 0.242$; Emotional control $p = 0.526$, $p = 0.240$; Inhibition $p = 0.776$, $p = 0.275$; Self-monitoring $p = 0.544$, $p = 0.811$). However, to confirm these data, we proceeded to comparative ANOVA analyses, finding no significance between general executive functions and specific factors in relation to sex and age ($p > 0.05$), and thus these variables were discarded from the analyses. As shown in Table 1, significant correlations were found between general academic achievement and executive functions ($r = -0.392$, $p < 0.01$), specifically for executive initiative factors ($r = -0.272$, $p < 0.01$), working memory ($r = -0.512$, $p < 0.01$), planning ($r = -0.402$, $p < 0.01$), task supervision ($r = -0.531$, $p < 0.01$), and organization of materials ($r = -0.329$, $p < 0.01$). However, when the general executive functions were analyzed with respect to specific achievements such as those in Language Arts and Mathematics, identical significant relationships were found for both disciplines ($r = -0.361$, $p < 0.01$).

Table 1. Descriptive and correlated statistics of general academic performance, performance in Language Arts, performance in Mathematics, and general executive functions and their components.

	$\bar{x}$	SE	σ2	Statistical Kurtosis	Kurtosis Deviation Error	1	2	3	4	5	6	7	8	9	10	11	12
1 GAA	7898	1034	1070	0.797	0.417	1											
2 AAL	7713	1327	1762	0.589	0.417	0.88 **											
3 AAM	7721	1377	1897	0.420	0.417	0.916 **	0.870 **										
4 EF	89,310	17,842	318,338	0.330	0.446	−0.392 **	−0.361 **	−0.361 **									
5 Inhibition	12,275	3066	9401	−0.114	0.446	−0.154	−0.179	−0.110	0.727 **								
6 Self-monitoring	5879	2167	4698	0.460	0.446	−0.080	−0.083	−0.056	0.601 **	0.556 **							
7 Flexibility	11,560	2905	8440	0.553	0.446	−0.117	−0.109	−0.089	0.528 **	0.191 *	0.226 *						
8 Emotional control	11,603	3322	11,041	1016	0.446	−0.026	−0.051	−0.024	0.603 **	0.621 **	0.491 **	0.413 **					
9 Initiative	7465	2212	4894	0.177	0.446	−0.272 **	−0.230 *	−0.284 **	0.710 **	0.304 **	0.306 **	0.373 **	0.158				
10 Working memory	11,396	3513	12,346	−0.152	0.446	−0.512 **	−0.475 **	−0.505 **	0.802 **	0.430 **	0.332 **	0.315 **	0.247 **	0.685 **			
11 Planning	11,887	3229	10,431	−0.354	0.446	−0.402 **	−0.367 **	−0.406 **	0.830 **	0.526 **	0.376 **	0.274 **	0.224 *	0.703 **	0.781 **		
12 Task monitoring	8474	2732	7469	−0.444	0.446	−0.531 **	−0.455 **	−0.446 **	0.702 **	0.436 **	0.252 **	0.230 *	0.224 *	0.472 **	0.630 **	0.632 **	
13 Organization materials	8756	2393	5730	0.793	0.447	−0.329 **	−0.274 **	−0.300 **	0.712 **	0.421 **	0.346 **	0.301 **	0.288 **	0.482 **	0.546 **	0.611 **	0.540 **

GAA (global academic achievement); AAL (academic achievement in Language and Literature); AAM (academic achievement in Mathematics); EF (executive functions). * $p < 0.05$; ** $p < 0.01$.

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Therefore, the scales that visualize significant relationships for all types of academic achievements studied belong to the index of cognitive regulation according to the model of executive functions linked to the measurement questionnaire. We also observed that the executive functions and their components presented a slightly higher correlation with overall academic achievement than with specific achievements. However, although marginal, the correlation values were slightly higher for academic achievements in Mathematics than for general achievements in both initiative ($r = -0.284$, $p < 0.01$) and planning ($r = -0.406$, $p < 0.01$). In addition, following on from non-significant differences, task supervision was more relevant for general academic achievement ($r = -0.531$, $p < 0.01$) than working memory ($r = -0.512$, $p < 0.01$), but working memory was more relevant for specific achievements, such as those in Mathematics ($r = -0.505$, $p < 0.01$) and Language Arts ($r = -0.475$, $p < 0.01$) than task supervision. However, task supervision offered better results for Language Arts ($r = -0.455$, $p < 0.01$) than for Mathematics ($r = -0.446$, $p < 0.01$).

To examine the predictive power of general executive functions on general academic achievement and on specific academic achievements in Language Arts and Mathematics, we performed three linear regressions using the step forward method, taking these variables as the criterion variables for each of the predictive models. Overall, executive functions accounted for 14.7% (GAA), 12.3% (AAL), and 12.2% (AAM) of the variance in student achievement (Table 2). Therefore, higher levels of executive functions positively impacted overall academic achievement, as well as other specific achievements, such as those in Language Arts and Mathematics.

Table 2. Linear regression analysis to predict overall academic performance, academic performance in Language Arts, and academic performance in Mathematics across executive functions.

		Adjusted R^2	df	F	*p*	SE	B	*t*	*p*
Model 1	EF-GAA	0.147	1	20,749	<0.001	0.974	−0.392 ***	−4.55	<0.001
Model 2	EF-AAL	0.123	1	17,105	<0.001	1.246	−0.361 ***	−4.136	<0.001
Model 3	EF-AAM	0.122	1	17,053	<0.001	1.297	−0.361 ***	−4.130	<0.001

GAA (global academic achievement); AAL (academic achievement in Language and Literature); AAM (academic achievement in Mathematics); EF (executive functions). *** $p < 0.001$.

Subsequently, broken down into factors, the predictive power of executive functions on general academic achievement and on specific achievements in Language Arts and Mathematics was analyzed. As shown in Table 3, on this occasion and for the three regression models using the step forward method (where the five scales that correlate with the types of achievement studied (initiative, working memory, planning, task supervision, and organization of materials) were taken into consideration), only the executive factors of task supervision and working memory were significant, as they were able to predict the different global (32.5%) and specific (AAL-25.5%; AAM-27.1%) achievements. In this case, the predictive power for overall achievement was still greater than the ability to explain achievements in specific competencies.

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Table 3. Linear regression analysis to predict overall academic performance, academic performance in Language Arts, and academic performance in Mathematics across factors or components of executive functions.

		df	F	*p*	Adjusted R^2	SE	*β*	*t*	*p*
Model 1EF-GAA	Working memory	2	28,419	<0.001	0.325	0.030	−0.286 **	−2.874	0.005
	Task monitoring					0.039	−0.354 ***	−3.556	0.001
Model 2 EF-AAL	Working memory	2	20,447	<0.001	0.255	0.040	−0.301 **	−2.878	0.005
	Task monitoring					0.051	−0.271 *	−2.588	0.011
Model 3 EF-AAM	Working memory	2	22,181	<0.001	0.271	0.041	−0.362 ***	−3.493	0.001
	Task monitoring					0.053	−0.223 *	−2.153	0.033

GAA (global academic achievement); AAL (academic achievement in Language and Literature); AAM (academic achievement in Mathematics); EF (executive functions). * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

It should be noted that the executive functions as a whole offered less predictive value for academic achievement than the model that only included monitoring of the task and working memory. Therefore, these factors and scales of executive functions remain the most important, regardless of the type of competence, for academic achievements at 6 to 9 years of age.

4. Discussion

The purpose of this study was to analyze the relationship and predictive role between executive functions and their components (initiative, working memory, task monitoring, organization of materials, flexibility, emotional control, inhibition, self-control) and academic performance, both globally and specifically in the areas of Language Arts and Mathematics, in 133 students aged 6 to 9 years. Thus, the main findings are that cognitive executive factors are more relevant than behavioral and emotional factors for the prediction of academic achievement (both globally and specifically in Language and Mathematics). Secondly, within the scales of the cognitive regulation index, the best predictors of overall performance, as well as those specific to Language and Mathematics, were task monitoring and working memory. Thirdly, executive functions, in their general or specific measures, are more influential on general academic achievement than on specific ones. This difference, however, is of a marginal nature, and a future study should be conducted to expand on this issue [26]. Therefore, and in relation to the hypotheses of this research, it can be said that the first hypothesis is fulfilled by establishing a positive and significant relationship between the global index of executive functions and academic performance, both general and specific for Language Arts and Mathematics. The second hypothesis of the research is only partially fulfilled since only working memory emerges as a strong executive factor in the prediction of academic performance and not flexibility and inhibition. Finally, the third hypothesis would be fulfilled since it is shown that working memory is capable of significantly predicting both general academic performance and specific academic performance, specifically in the area of mathematics and Language Arts. Finally, the implications of these results in an educational context refer, above all, to the assessment of the level of executive functions at an early age as a basic cognitive factor for proper personal growth. However, the discussion of these results is presented below, and is specified in the conclusions section.

Executive functions have become an important basis for studying children's behavior and learning, having shown strong validity in predicting academic achievement [65]. Previous research has concluded that cognitive skills are strong predictors of learning behaviors in children aged 7–11 years [61]. The results of the present study also found significant relationships between executive functions and overall academic achievement, as well as in the specific domains of Language Arts and Mathematics [17,37,39,55]. However, some, but not all, of the factors that make up this index are also related to all the types of achievements studied, specifically those that make up the cognitive regulation index (initiative, working memory, planning, task supervision, and organization of materials). In this sense, working memory and planning are developed in infants from age 5 and play an important role in later academic achievement [58]. In addition, planning maintains a

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greater relationship during the ages of 8-9 years and decreases slightly until adolescence. This factor is linked to achievements in Language Arts according to Sesma et al. [55] and in Mathematics according to Gerst et al. [38], which is consistent with the present research.

However, it should be noted that both planning and initiative have a greater influence on specific subjects such as Mathematics because of their instrumental power. However, although task supervision is related to general academic achievement more strongly than the other factors indicated above, working memory occupies first place for academic achievements in Language Arts and Mathematics. Studies carried out in the United Kingdom indicate that students between the ages of 7 and 14 who score low in working memory tend to perform below the average expected for their age. Therefore, this executive factor stands out for its importance in academic achievement during these years [40,57]. Similarly, the ability to monitor one's achievements and behaviors appears to be a mechanism related to executive functions during one's school years. However, in the monitoring of tasks, a connection with language skills is observed, as the level of development of such skills at age 7 contributes to academic results one year later [66]. This is consistent with the results of this study, where homework monitoring was shown to have a greater influence on outcomes in the area of Language Arts than in the area of Mathematics. Similarly, the existence of a relationship between the ability to suppress interference and the monitoring process contributes to the student's active participation in the control of task achievement [42].

The scales that comprise the index of behavioral regulation (inhibition and self-monitoring) and emotional regulation (flexibility and emotional control) have not been found to be relevant in explaining academic achievement in students aged 6–9. Some authors have already noted that inhibition (index of behavioral regulation) is a good predictor of academic achievement up to age 7 [25] and that flexibility (index of emotional regulation) is a good predictor from age 11 [38]. However, the division of executive functions into hot and cold has linked the latter to the self-control skills needed in emotional situations but not to the level of education [8,42]. Skills with an emotional component improve with age, and a weak relationship with scholastic achievement is observed up to the age of 9–10 years but is almost imperceptible in the first years of compulsory schooling [67,68]. In this sense, this work agrees with previous studies that the ability to adapt one's emotions to contexts increases with age [24]. The above result indicates that inhibition seems to develop first, and then other components emerge, such as working memory, flexibility, planning, and organization. That is, the changes produced by age indicate the relevant role of the behavioral regulation index scales up to 7 years of age, followed by those of the cognitive regulation index, which overlaps from 10 years of age with the emotional regulation index scales.

The highest predictive weight in this work for an age range of 6–9 years was found for the scales and factors included in the cognitive index of Gioia et al. [14]. Only working memory and task supervision were good predictors of general achievement, as well as achievements in Language Arts and Mathematics. Tsubomi and Watanabe [51] already noted that working memory develops up to age 10, at which point it reaches adult levels, and that better achievement of this variable relates to higher academic scores in Language Arts and Mathematics in children aged 7 to 9. However, working memory is essential for carrying out activities that implement a sequence of actions, and thus the development of working memory requires the introduction of efficient mechanisms that can restrict information from distractors, ensuring that their capacity is not diminished [51]. This ability to analyze and understand a task does not mean that the students are capable of completing the task efficiently. For task completion, it is necessary to add the capacity of supervision, which allows one to review and assess the execution of the task and thus achieve the desired goal. Therefore, the ability to order and prioritize the information received and evaluate the difficulties and the level of knowledge necessary is relevant in this process [14]. These factors all explain the great significance of the relationship between working memory and the planning and monitoring of a task, as well as organization of the relevant materials [14].

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While the relationship between executive function and academic achievement is identical in the specific domains of Language Arts and Mathematics, the same is not true when this relationship is studied in terms of different factors. Although the behavior is the same, the other components of the behavioral and emotional indexes (there is no significance) relate slightly better to the area of Mathematics, with the exception of task supervision. However, working memory and homework supervision also explain the higher percentage of academic results in Mathematics than in Language Arts. Unlike the present study, some authors consider visuospatial memory and working memory to be good predictors of the mathematical ability of students between 6 and 12 years old, and inhibition, flexibility, and planning to be good predictors of academic achievement in general [33,37]. Nevertheless, there is a certain consensus with respect to working memory in terms of its involvement in the basic processes needed for arithmetic calculations [38,52], as well as in the acquisition of reading skills [39,55] and academic achievement in general [36]. The fluctuations in the predictive power of the size of this effect highlights the need to clarify whether, depending on the type of academic achievement, the different executive factors assume greater or lesser importance in their relationship to general or specific achievements.

In general terms, the purpose of this paper was partially fulfilled by confirming the relationship between general executive functions and academic performance. However, the study did not find that each of the executive factors is important for the age range studied, 6–9 years. Previous studies have shown that inhibition develops up to the age of 7 [25] and that self-supervision and flexibility are strongly linked to this function [22]. Furthermore, emotional control is related to flexibility and depends on the maturity achieved. [27] From age 7, other factors, such as task supervision, working memory, planning, organization, and initiative, assume a prominent role, especially in the 6–9-year-old age range [45]. However, there are a few papers that deal specifically with the roles of initiative, task supervision, and organization of materials in academic achievement.

It should be noted that the current research has certain limitations that further work should address. The main limitation is that the small size of the sample does not allow generalization of the data, although these data provide an approximation to this topic, as it is in line with previous studies that have already noted the importance of the different factors of executive functions according to the developmental stage of the student.

However, the measurement instrument BRIEF-2 (used in this research) falls within the scales of evaluation for the behavior of executive functions and represents the frequency of achievement of an objective in everyday environments [38]. In addition, these behavioral rating scales were evaluated by a single person (parent or legal guardian) in a single environment, which may have led to less concrete knowledge of the executive functions. Nevertheless, previous studies have highlighted the predictive usefulness of questionnaires completed by parents and teachers [26,38].

Initially, we tried to verify the relationship between executive functions and their factor structures with general and specific academic achievements as a result of the learning process at a specific age. However, it would be advisable to carry out a longitudinal study throughout the years of Primary Education (6–12 years), which would provide information on the role that each of the factors plays in academic results according to age. It should also be considered that executive functions explain only 35% of academic achievement. Thus, it would be interesting to investigate other variables that can help to predict the remaining percentage of variance. This would better complete our work by providing a meta-analysis on this subject to gather information and developing intervention proposals that can improve the teaching–learning process in Primary Education and the subsequent academic results.

Finally, it should be noted that the present study raises possible theoretical modifications such as the clarification of the existing controversy regarding the executive functions' inclination to predict general rather than specific performance. However, as observed in this study, when analyzing executive functions as a multifactorial element, some factors present their potential with respect to specific performance. For example, in particular,

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working memory. This suggests the need for a broader, longitudinal study that, in addition to determining this fact, would allow the generalization of the results and their verification at higher ages. On the other hand, there are practical implications, such as the need to evaluate these executive factors at an early age in order to implement specific work plans that allow for the integral development of the student at a cognitive, behavioral, and emotional level.

5. Conclusions

Firstly, it can be concluded that cognitive executive factors are more relevant than behavioral and emotional ones for the prediction of academic achievement (both globally and specifically in Language Arts and Mathematics). The low importance of the behavioral and emotional regulation index scales in relation to the academic results of students from 6 to 9 years old is possibly due to the fact that the behavioral components (inhibition and self-monitoring) and the emotional components (flexibility and emotional control) have an impact at earlier ages or during pre-adolescence [30,49]. All these results should be confirmed with future research and literature reviews for each of the educational stages. For the first years of compulsory schooling, the components and scales used by Gioia et al. [14] to form the cognitive index indicate that early scholastic achievement is a consequence of the improvement of executive functions.

Secondly, within the scales of the cognitive regulation index, the best predictors of general achievement, as well as the specific ones in Language Arts and Mathematics, were task supervision and working memory versus initiative, planning, and the organization of materials. This emphasizes that these factors, unlike others, are involved in updating and transforming data to plan and guide behaviors in processes such as language comprehension and mathematical reasoning [52], as well as in effective monitoring that can detect possible errors in the achievement of language tasks (spelling errors) or mathematics (the omission of arithmetical symbols).

Thirdly, executive functions, in their general or specific measures, have a greater influence on general rather than specific academic achievements. This difference, however, is of a marginal nature, and a future study should be undertaken to expand on this issue [26].

Finally, the implications of these results in an educational context relate, above all, to the evaluation of the level of executive functions at an early age as a basic cognitive factor for proper personal growth. We should also consider the importance of some of the factors of academic achievement with specific learning related to linguistic competence and logical–mathematical thinking. Early detection of atypical development of executive functions can lead to the establishment of specific work plans aimed at improving development and preventing future educational problems.

In short, the present study highlights the relevance of executive functions to scholastic achievement. The importance of the scales of the cognitive regulation index compared to the behavioral and emotional indexes was thus verified. In addition, cognitive regulation scales emerged as better predictors of achievement, task supervision, and working memory. Therefore, a high level in these skills relates to a higher level of school success.

However, a number of limitations should also be addressed by, e.g., using a larger sample size and a more sophisticated mediation test. Finally, as a prospective study, it is recommended that these issues should be studied in depth by means of a longitudinal investigation with a large sample.

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4.1.2. CAPÍTULO II: Los factores motivacionales y emocionales en su relación con el rendimiento académico en Educación Primaria.

4.1.2.1. Estudio 3: Motivational, emotional and social variables explain academic performance in children aged 6 to 12 years: a meta-analysis.

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Review

Motivational, Emotional, and Social Factors Explain Academic Achievement in Children Aged 6–12 Years: A Meta-Analysis

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Abstract: Recent studies highlight the effect of cognitive factors on academic achievement, ignoring motivational, emotional, and social factors. This provides the background for the present study, a meta-analysis on the relationship between academic achievement and motivational factors (motivation, self-concept, and self-esteem), emotional factors (emotional intelligence, emotional competence, and emotional well-being), and social factors (social intelligence, social competence, and social skills) in children aged 6–12 years (37 samples, n = 15,777). The methodology based on the PRISMA protocols was applied: phases of inclusion and exclusion of articles, analysis of effect size, heterogeneity, publication bias, and, finally, meta-regressions and moderation analysis. The results showed a moderate positive effect size (0.321) for motivational and social factors (0.210) and a small positive effect size (0.172) for emotional factors. The moderating effects of age (65% on social factors) and geographical area (52% on motivational factors, 17% on emotional factors, and 76% on social factors) were studied. These results highlight the importance of motivational and social factors regarding academic achievement. In addition, along with the moderating effect of age, that of geographical area emerges strongly given the diversity of contexts studied. Our results highlight the importance that these factors have on academic performance and, therefore, the need to design school plans that address the correct development of these variables.

Keywords: meta-analysis; academic achievement; motivational factor; emotional factor; social factor

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1. Introduction

Educational authorities continually discuss factors that influence school failure or success and present management plans that aim to ensure an open and inclusive school environment to strengthen learning, social skills, motivation, and emotional well-being [1,2]. For many years, educational research has focused on academic achievement as a sign of success, considering achievement as students meeting established learning objectives [3]. The emergence of new concepts such as educational innovation, active learning methods, and changes in educational policies promoted by the Delors [4] have resulted in a clear change in research activity. However, a recent meta-analysis by Cortés-Pascual et al. [5] concludes that in primary education, studies on executive functions, and their relationship with academic achievement predominate. Therefore, it is necessary to conduct further comprehensive studies of motivational, emotional, and social factors [6–8] to expand and integrate existing knowledge about their effect on children's academic achievement.

1.1. Academic Achievement

Navarro [9] defines academic achievement as "a construct capable of presenting qualitative and quantitative values, helping to estimate the evidence and dimension of

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the profile of skills, knowledge, attitudes, and values developed by the student in the teaching-learning process" (pp. 15–16). The same author states academic achievement cannot be studied from a unilateral perspective because of its multifactorial complexity. To explain school achievement, it is essential to consider students' personal beliefs about their own capacities and to not only focus on general intelligence abilities [10–12]. Therefore, motivational, emotional, and social factors (motivation, emotional competence, social skills, and others) are key elements in understanding students' behaviour regarding academic achievement [1,2].

1.2. Motivational Factor Components

Within this factor, two components are the most studied: motivation and self-concept, along with self-esteem by its intimate relationship with the latter [13–15]. Motivation, aimed at achieving a goal, is considered an important variable in the teaching-learning process; however, it is also involved in improving academic achievement [16]. This process is influenced by various aspects such as individual expectations, the results of an activity, self-efficacy, the interaction environment, and others [17–20]. Therefore, according to the different theories underpinning the concept of motivation, motivation can have different aspects. According to the expectancy-value theory, the reference is the perceived value, the expectation of success. This theory infers that behaviour is determined by the expectation of the person reaching a goal as a function of the value of the incentive. In this case, the person is an active element that chooses how and when to act according to the expectations and the value attached to the goal set [17]. On the other hand, attribution theory indicates that the results of a particular activity are explained by causes that students use to justify these results. Effort, skill, and task difficulty are the most important factors affecting achievement. Attributions according to the causal dimension are locus of control (internal versus external), stability where causes may change over time, and control over efficacy or skill [18,19]. However, for cognitive-social theory, self-efficacy is the main driver of motivation. For Cook and Arino [17], this theory is about learning where personal, behavioural, and environmental factors interact. Cognition is responsible for how individuals interpret their environment and self-regulate their actions, thoughts, and feelings. Finally, the self-determination theory [19] is based on the fact that motivation produces good performance when it is driven by interests (intrinsic: personal interest, enjoyment, curiosity, among others) and values (extrinsic) that tend to satisfy the psychosocial needs of the subject at a given moment. For Ryan and Deci [19] there are two categories of motivational behaviour: autonomous and controlled. The first are driven by interest and enjoyment and the latter are performed under some kind of internal or external pressure. Therefore, motivation is a goal-directed process that is in turn influenced by various intrinsic and extrinsic aspects, making a distinction between these two types of motivation. The first, intrinsic motivation, would be that which drives us to do things for the simple pleasure of doing them and the second, extrinsic motivation, would be that based on external pressure through rewards, punishments, or other determinations [16–20]. On the other hand, self-concept has been defined by van Soom and Donche [21] (p. 2) as "a subjective judgment of perceived capacity in an academic or learning context". It is multidimensional, stable, and organized hierarchically and subject to change with experience and age [22,23]. Self-esteem is understood as a one-dimensional construct regarding the positive evaluation by an individual of their own worth, maintaining a positive affective relationship with themselves. It shapes the value dimension of self-concept [24] and is related to social competence and present throughout a person's life. It is not stable, and its consistency changes depending on context variations [25,26].

1.3. Emotional Factor Components

Emotional factors, according to Billings et al. [27], Franco et al. [28], and Lv et al. [29], consist of three components: emotional intelligence, emotional competence, and emotional well-being. All three arise associated with different processes leading to the knowledge,

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understanding, and regulation of emotions. The concept of emotional intelligence refers to the ability to regulate one's feelings and emotions, understand them, and use the information provided to guide actions [30]. If learning is an individual process that takes place in a social context where the different agents involved in the teaching-learning process interact, feelings and emotions play an important role by conditioning personal and social interaction [31]. This interaction must be constructive, adapting behaviour and actions to different situations. This process has been referred to in different ways: emotional competence, emotional intelligence, emotional regulation, and others, [32,33]. Ferragut and Fierro [34] (p. 97) describe the well-being of an individual as "the positive evaluation of their lives, based both on the congruence between aspirations and achievements and on having an optimal emotional and affective state". These emotional skills develop with age and range from the simplest to the most complex. Mastering the former leads to mastering the following and so on. Between the ages of eight and twelve years, children achieve an understanding of complex emotions, their adaptation to the context, and their association with moral or ethical values [28].

1.4. Social Factor Components

Within this factor, different authors mainly study three elements: social intelligence, social competence, and social skills [28,35–37]. For Goleman [38], people have what is called a "social brain", responsible for managing social interactions. He also considers that social intelligence can be trained by being aware of the effect social relations have on individuals themselves and on others. This type of intelligence is involved in the understanding of perceived stimuli, enabling balanced and positive social relationships. On the other hand, social competence refers to the set of skills, abilities, and behaviours needed to create comfortable social relationships [39]. Social skills (emotions, intentions, perceptions, and empathy) are those that allow interactions with others through socially acceptable behaviours. They avoid unacceptable responses by expressing ideas, feelings, and opinions, improving relationships, and strengthening a specific social situation [40–42]. The development of these skills allows successful communication in the school environment, avoiding social maladjustment and achieving effective academic achievement [37,43].

1.5. Motivational, Emotional, and Social Factors and Academic Achievement

To date, there are few studies on the relationship between academic achievement at the ages of 6–12 years and the variables described jointly. However, studies have been conducted independently addressing each of the variables mentioned with academic achievement. Some examples are found in the studies by Billings et al. [27], Franco et al. [28], or Garon-Carrier et al. [44], which respectively address emotional intelligence, emotional and social competence, and motivation.

Within motivational factors, Guay et al. [45] present two approaches in the search for understanding students' motivations. The first addresses motivation toward specific school areas or subjects, and the second examines motivation in the school framework in its multidimensional aspect (intensity-quality). As far as intensity is concerned, there are at least two important aspects to be examined: the structure of emotional intensity and the determinants of variation in intensity. Regarding the first, it is questioned whether intensity is a unitary concept or, on the contrary, a multidimensional one: emotional intensity can in fact be understood as intentionalities of a set of aspects without a close connection. As for the second: it questions the intensity of an emotion, or that of its aspects. Quality, on the other hand, has been described from an emotional point of view as a subjective aspect related to the individual's view of aspects of his or her life and how he or she interprets the context. These two approaches explain how motivational dynamics change depending on subjects and interests. Regarding self-concept, several authors, such as Guay et al. [46], Marsh and Craven [47], or Marsh and Martin [48], have stated that it is reciprocally related to academic achievement. In addition, it is determined by social factors such as comparisons with peers. Other authors found a positive link between academic

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self-concept and academic achievement [49,50]. However, they also differentiated between global academic self-concept (general academic areas) and specific academic self-concept (mathematical self-concept, scientific, and others). Finally, self-esteem showed a positive relationship with academic achievement. Children with good school performance have high self-esteem. In contrast, those with low self-esteem have low academic achievement, do not strive to learn, and have feelings of failure and frustration because they do not feel effective [51,52].

Regarding emotional factors, there are studies that associate the understanding of emotions with learning because they are related to attention, willingness to learn, or behavioural self-regulation [53]. In addition, some authors, such as Ferragut and Fierro [34], differentiate between well-being and emotional intelligence but highlight the importance of these constructs for school achievement, finding a significant relationship between well-being and academic achievement. Here, it should be remembered that school-age children are influenced by several academic factors that affect their emotional well-being [54].

Finally, studies differ regarding social factors (social intelligence, social competence, and social skills), such as those by Caemmerer and Keith [55], and Rocha [56]. For the former, social skills are not a direct predictor of academic achievement, but play a mediating role in the academic domain. For the second, emotional understanding does not directly predict academic achievement because it is influenced by social competence. Further, both the study by Trentacosta et al. [57] and that by McKown et al. [58] suggest that satisfactory social relationships (teachers and classmates) and socioemotional skills lead to good academic achievement.

1.6. Sociodemographic Factors as Regulators between Motivational, Emotional, and Social Factors and Academic Achievement

Several sociodemographic factors impact academic achievement between 6 and 12 years of age. First, gender stands out, where some studies find differentiating characteristics between boys and girls regarding emotional components and unequal maturational development [59,60]. The differences between boys and girls, regarding social factors, seem to be related to interpersonal factors, where boys are more dominant and calculating and girls are more modest and affectionate [61,62]. In the same way, educational factors and socialization vary depending on the social and country context; therefore, behaviour according to gender will take place in a particular socio-cultural environment [63].

Second, regarding age, academic self-concept may change with experience and age [21]. In the same way, from 6 to 12 years of age, emotional skills gradually develop, mastering the simplest and navigating the most complex through a process of adaptation to the context and moral or ethical values [22]. Therefore, a socially competent and socially adapted child is a successful child [64,65]. In particular, age is a determining factor because older students can handle conflicting information in various contexts, a maturational process that allows for greater sensitivity, responsibility, and self-concept about their own academic and personal development [66–68].

Finally, culture is understood as a set of patterns transmitted throughout history, including norms, values, beliefs, and others, that identify its members [69]. Societies are classified into collectivists (cohesion with others) and individualists (prioritizing individual needs) [70]. This is merely a way of showing existing differences regarding social aspects, values, motivation, education, and others, between different countries, probably related to the socioeconomic development achieved, the political system established, and customs among other aspects [71]. Thus, geographical area and cultural context influences affective relationships and emotional manifestations; therefore, the acquisition of different competencies depends on the culture and geographical area of origin and, therefore, on the geographical area that includes that culture [32]. The norms learned, religion—education in short—are part of the socialization process within the family, playing an important role in curriculum development [72]. This sociocultural perspective shows that academic achievement is also determined by the context, norms, and values that may or may not help improve the teaching-learning process.

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1.7. The Present Study

There are many studies related to the variables that influence academic achievement; these studies focus on variables of a cognitive nature, where the intelligence quotient or executive functions stand out [5]. However, there are few studies on motivational, emotional, and social variables, especially integrated into a comprehensive study regarding academic achievement. Therefore, the purpose of this study was to conduct a meta-analysis that integrates the predictive character of these variables classified into three groups motivational (motivation, self-concept, and self-esteem), emotional (emotional intelligence, emotional competence, and emotional well-being), and social (social intelligence, social competence, and social skills)) on academic achievement in students aged 6–12 years and the moderating effect of gender, age, and geographical area, variables that were reported by all the studies included in the meta-analysis and could therefore provide relevant data on their moderating power. Finally, the following research objectives are presented:

(a) Analyse the predictive capacity of motivational variables on academic performance in students aged 6–12 years and moderating effect that gender, age, and geographical area.
(b) Analyse the predictive capacity of emotional variables on academic performance in students aged 6–12 years and moderating effect that gender, age, and geographical area.
(c) Analyse the predictive ability of social variables on academic performance in students aged 6–12 years and moderating effect that gender, age, and geographical area.

2. Materials and Methods

2.1. Search Procedure and Inclusion Criteria

Using various search strategies (following the criteria of Botella and Sánchez-Meca) [73], the first phase of the study was conducted from July to November 2018, followed by a second phase, updating information, in February-March 2019. The electronic databases consulted were PsycInfo, Scopus, PubMed, and Redalyc. These databases were selected in accordance with Botella and Sánchez-Meca [73], who suggest that at least two databases of scientific importance should be consulted when carrying out a meta-analysis. In addition, the selected databases stand out for their relevance in the collection of educational and psychological works and for their interdisciplinarity and diversification of languages. All this ensured a broad search of studies, avoiding a possible error of publication bias. The keywords "academic achievement" and "primary education" and "correlation" were used, limiting the years of publication to "2009–2019". Subsequently, the following cross-terms were introduced, each of them independently with "primary education" and "correlation": "motivation", "self-concept", "self-esteem", "emotional intelligence", "emotional competence", "emotional well-being", "social intelligence", "social competence", "social skills" by carrying out a follow-up table of studies in which the type of variable studied in the research was recorded and to which group of variables it belonged. It should be remembered that this study focuses on groups of variables by their characteristics and not on specific variables. These terms were searched in the abstract and title. Additional search strategies included a review of abstracts and statistical tables. Subsequently, the references of the selected studies were reviewed along with the literature published in Spanish. The studies included in this meta-analysis had to meet several criteria: (a) present correlation statistics between aspects pertaining to motivational, emotional, and social factors and academic achievement, (b) published between the years 2009–2019, (c) sample of 6–12-year-old children, and (d) academic achievement measured directly (grades, standardized results, and others) either globally or by subject (mathematics, language, and others). The exclusion criteria were (a) presenting, as the object of study, only a population with learning disorders, (b) studies without quantitative data suitable for analysis with CMA software, and (c) age range over 12 years. However, studies in which part of the sample exceeded the age range were retained because their duration added research value. The selection process resulted in 19 studies that provided 37 samples, of which 12 addressed motivational factors, 12 emotional factors, and 13 social factors, with a total of 15,777 participants (Figure 1).

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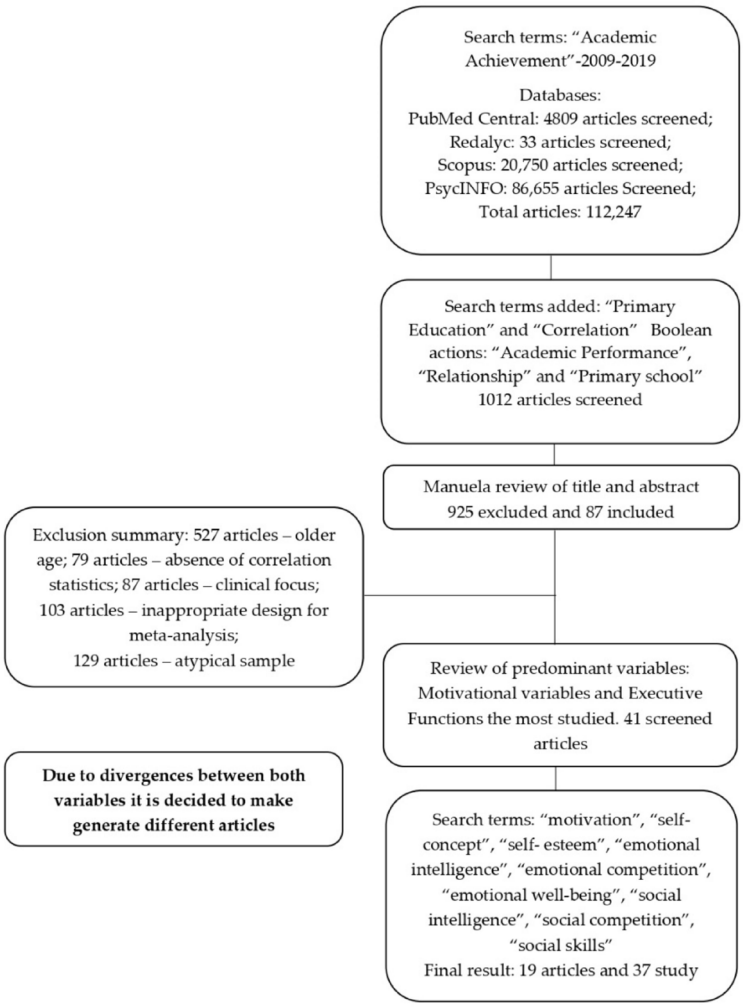

Figure 1. Flowchart of the search strategy.

2.2. Study Selection and Coding Procedure

For coding we used the PRISMA guidelines and point 1.2.2 of the Cochrane Handbook for Systematic Reviews of Interventions, version 5.1, specifically the procedure defined by Higgins and Green [74]. This handbook allowed setting clear objectives and specific search terms, following the eligibility criteria previously defined for the studies. The search and selection process was conducted by the three researchers and distributed in phases. Phase I was conducted by the first researcher, who analysed the titles. Phase II, which included Boolean searches and abstract reviews, was conducted by researchers one and two. Finally, Phases III, IV, and V, which required a deeper analysis of the studies, were conducted by researchers one and three (Figure 1). The procedure that was followed provided a level of agreement of 0.81 for the final sample, almost perfect agreement according to Landis and Koch [75].

Additionally, the types of variables studied in the articles were considered when coding and were classified into motivational, emotional, and social factors. Some factors included only one aspect (for example, motivation or emotional well-being), and the others included two. Each article was analysed individually. Academic achievement was measured in relation to the global assessments conducted by teachers (78.37% of the sample). There were exceptions, taking as a reference the subject of language, specifically,

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the reading level (reading comprehension, reading fluency, and vocabulary), and the subject of mathematics because these were the most commonly reported by the selected studies.

2.3. Statistical Analyses

The following software was used for the statistical analysis of this meta-analysis: EZAnalyce and Comprehensive Meta-Analysis. The software used for descriptive statistical analysis was the EZAnalyze add-in (Microsoft Excel, 2013), and the Comprehensive Meta-Analysis software (CMA, Biostat, Englewood, NJ, USA) was used for meta-analysis calculations. Although each of these analyses is detailed below, it should be noted as an introduction that the statistical study of this meta-analysis is based on the development of different regression models that yield the predictive ability of each group of variables. First of all, the effect size of each of the studies included must be calculated, in this case, Pearson's r. Subsequently, it is necessary to carry out an analysis of the heterogeneity and variability in the data collection in order to identify possible errors that need to be clarified. Finally, it is necessary to determine the non-existence of these errors and possible bias using Funnel Plot analysis and the application of Egger tests.

2.3.1. Effect Size Calculation

A total of 207 effect sizes were coded using correlation indices as a reference and calculating the standard error and corresponding confidence intervals. All statistical data were coded twice, recalculating the different results. Pearson correlations (*r* effect size) were determined independently between each of the variables mentioned and academic achievement. However, to avoid whether such effect sizes could be due to sample size, they were transformed into Fisher Z-values. Subsequently and following the indications described by Cohen [76], the effect size was considered small if the existing correlation was less than 0.10, moderate if the existing correlation was 0.30, and large if the existing correlation was over 0.50.

2.3.2. Heterogeneity, Variability and Publication Bias

To study sample variability, Cochran's *Q* was applied to test the null hypothesis of homogeneity between studies, and I^2 was determined to indicate the proportion of variability. Following Higgins et al. [77], I^2 values of 25%, 50%, and over 75% were considered low, moderate, and high, respectively. This variability may be due to actual variability in the variance and effect size, the influence of a moderating variable, or sampling error. The different meta-analyses applied analysed separately those studies with possible outliers, finding no significant variation in the *Q* and I^2 values. However, in order to ensure that the variability and heterogeneity were not due to publication bias, the *Egger* test was carried out.

2.3.3. Meta-Regression

As described in the previous sections, meta-regression analyses were analysed taking into account a random effects analysis given the true variance variability of variance and effect size [78]. This type of analysis allowed the study of different predictive models and an analysis of the moderating variables of gender, age, and geographical area.

3. Results

3.1. General Description of the Included Studies

This section describes the characteristics of the studies included in this meta-analysis by describing their participants, age, gender, geographical area where the studies were conducted and including reference to the type of variable they address in relation to academic performance.

Selected studies were conducted in various parts of the world. Considering the variables that make up the motivational, emotional, and social factors, it is important to have studies conducted in societies whose values, traditions, and worldviews are very

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different. From a total of 19 articles, 37 databases were extracted, and a total sample of 15.777 participants was obtained. Of the data reported, 52.04% were females, and 47.96% were males. By geographical area, the American continent accounted for 11.82% of the total sample, Europe accounted for 80.20%, Oceania accounted for 3.07%, and Asia accounted for 4.91%. Studies with a high multicultural component, such as those by Pulido and Herrera [60], must also be highlighted. In addition, notably, studies with greater numbers of participants addressed motivational factors [15,44,79,80], while the most homogeneous, in terms of the number of subjects, studied emotional factors. Only McArthur et al. [6] studied bad readers and low self-concept, while most studies (eight) addressed academic achievement from a global perspective (average of all subjects). It should be noted that five studies were longitudinal [13,15,35,44,78]. Gender, age, geographical area, culture, socioeconomic status, and parent education level were interests present in most of the articles studied. The geographical distribution of the studies within each country was very diverse. Studies were conducted in rural and urban areas, in a single school or in several schools of a single city, and in several cities or throughout the country (Table 1).

Table 1. Descriptive Data of the Studies.

Study	Country	Population	Male	Female	Age (Years)	Performance	Factor Studied	Distribution of Participants
Billings et al. (2014)	Australia	n = 407	200	207	9–13	Literacy and arithmetic	Emotional factor	Four schools in the city of Melbourne (Australia)
Brouzos, Misailidi, and Hadjimattheou (2014)	Cyprus	n = 106 n = 99	55; 48	51; 51	8–10; 11–13	Language and mathematics	Emotional factor	Twelve schools, mid-sized urban area of Cyprus
Ferragut and Fierro (2012)	Spain	n = 166	77	89	9–12	All subjects	Emotional factor	One school in the city of Malaga (Spain)
Franco et al. (2017)	Portugal	n = 406	210	196	6–11	Language and mathematics	Emotional factors; social factors	Four schools in Madeira (Portugal)
Garon-Carrier et al. (2016)	Canada	n = 1466	699	767	7–10	Math	Motivational factors	Born 1997–1998 in the province of Quebec (Canada)
Grygiel et al. (2017)	Poland	n = 4226	1889	2337	8–11	Language and mathematics	Motivational factors	The whole country (Poland)
Gustavsen (2017)	Norway	n = 2266	1128	1138	6–14	Language, mathematics, and English	Social factors	Twenty-seven schools in 14 Norwegian municipalities
Jovarini et al. (2018)	Brazil	n = 214	111	103	11–17	All subjects	Social factors	Three schools in the state of Amazonas in Brazil
Lv et al. (2016)	China	n = 419	233	186	9–12	Language, mathematics, and English	Emotional factors	One Liaocheng urban area school (China)
McArthur et al. (2016)	Australia	n = 77	32	45	9–12	Reading, oral language and attention	Motivational factors	The whole country (Australia)

Table 1. *Cont.*

Study	Country	Population	Male	Female	Age (Years)	Performance	Factor Studied	Distribution of Participants
Pulido-Acosta and Herrera-Clavero (2017)	Spain	n = 404	193	211	6–12	All subjects	Emotional factors	Four schools in the city of Ceuta (Spain)
Pulido-Acosta and Herrera-Clavero (2018)	Spain	n = 764	403	361	7–12	All subjects	Emotional factors	Seven schools in the city of Ceuta (Spain)
Quirk et al. (2009)	USA	n = 185	82	103	7–9	Reading: fluency and efficiency	Motivational factors	Four rural area schools in the southeastern US
Rahmani (2011)	Iran	n = 200	100	100	7–11	All subjects	Motivational factors	Tabriz city schools, the industrial zone of Iran
Regueiro et al. (2015)	Spain	n = 1257	573	684	9–16	Language, mathematics, and English	Motivational factors	Eighteen schools in four provinces of northern Spain in urban and rural areas
Selimović et al. (2018)	Bosnia-Herzegovina	n = 846 n = 793	802	837	11–15	All subjects	Social factors	Seventeen schools in Central Bosnia
Wagner and Ruch (2015)	Switzerland	n = 179	92	87	10–12	All subjects	Social factors	Nine classrooms in three schools in the German-speaking area in Switzerland
Walgermo et al. (2018)	Norway	n = 1141	561	580	5–7	Reading	Motivational factors	Sixty-two classes in 19 urban schools in Norway
Zirak and Ahmadian (2015)	Iran	n = 156	80	76	10–11	All subjects	Emotional factor; Social factor	Torbat-e-Heydarieh city schools in northeastern Iran

3.2. Effect Size and Statistical Significance

An independent analysis was performed for each factor following a random effects model. The different effect sizes with 95% confidence intervals and significance $p < 0.001$ were as follows: motivational factor, moderately positive effect ($r = 0.321$) in a sample of $k = 12$ and a population of $n = 15.734$ (Figure 2); emotional factor, small positive effect ($r = 0.172$) in a sample of $k = 12$ and a population of $n = 3931$ (Figure 3); and social factor, moderately positive effect ($r = 0.210$) in a population of $n = 12.023$ (Figure 4).

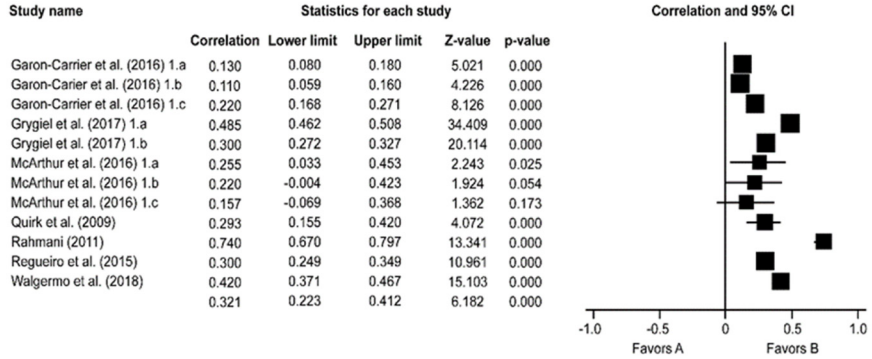

Figure 2. Forest plot, motivational factors.

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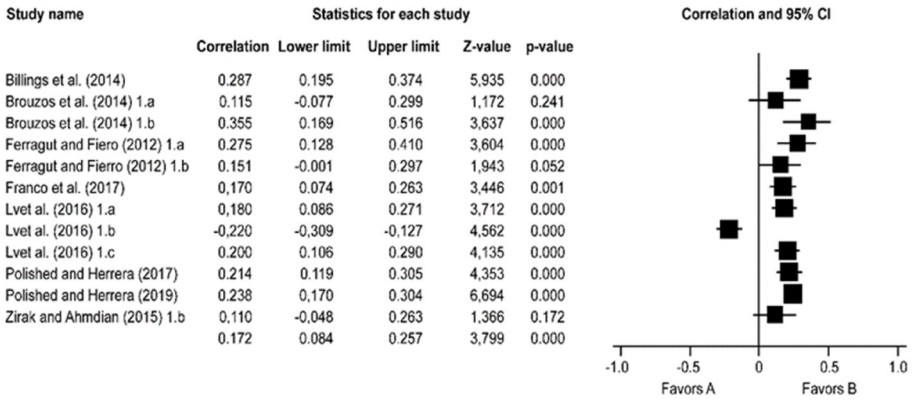

Figure 3. Forest plot, emotional factors.

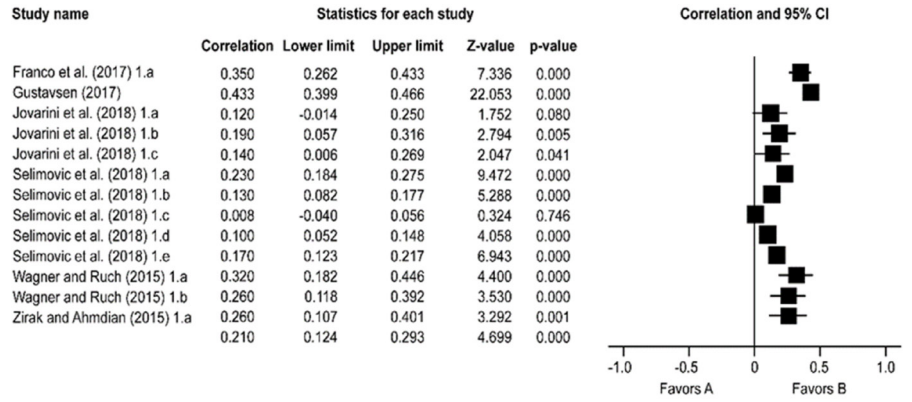

Figure 4. Forest plot, social factors.

3.3. Heterogeneity and Variability Analysis

Variability between the relationship of the different factors studied and academic achievement was significantly high (motivational factor: $Q = 407.016$, $df = 11$, $I^2 = 97.297$; emotional factor: $Q = 83.070$, $df = 11$, $I^2 = 86.758$; social factor: $Q = 261.681$, $df = 12$, $I^2 = 95.414$). In view of the results obtained, sample sensitivity was evaluated by performing a second series of meta-analyses. For emotional factors, the studies by Ferragut and Fierro [34], Lv et al. [29], and Zirak and Ahmadian [81] were excluded, resulting in a decrease (<50%). For social factors, the study by Jovarini et al. [36] and that by Selimović et al. [37] presented atypical data; therefore, the variability in the meta-analysis decreased by excluding them ($Q = 138.608$, $I^2 = 94.950$). Finally, for motivational factors, there were no studies with outliers; therefore, the variability derived from the effect size and variance. In view of these results, there were no exclusions because no sample represented 50% of the statistical weight. Additionally, no significant effect size variability was found for different factors.

3.4. Publication Bias Analysis

The funnel plots shown help verify the presence of bias, regardless of sample size (Figure 5). The plots show that the Z-values for the studies included in this meta-analysis are small (−1 and 1). According to Pérez and Rodríguez [82], these data indicate no bias because the presence of bias is indicated by values significantly different from 0. Further, when performing the *Egger* test, the Y-axis intersection points were−1.246 for motivational factors, 0.24 for emotional factors, and −0.006 for social factors. Therefore, it is deduced that there is no publication bias [83].

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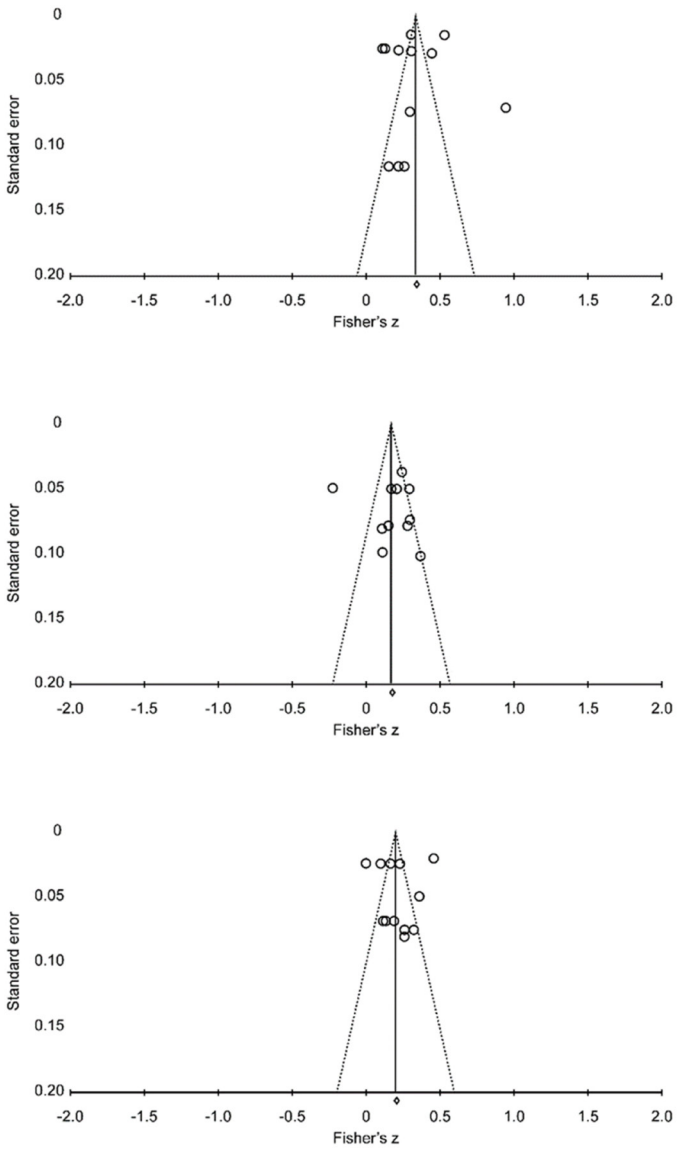

Figure 5. Funnel plot, motivational, emotional, and social factors.

3.5. Meta-Regression and Moderator Analyses

After reviewing the different studies, both gender and age were found to act as moderators of the motivational, emotional, and social factors [27–29,34,37,60,84,85]. Therefore, an analysis of these variables was performed to verify the explanatory power of the variance and its moderator index. First, a meta-regression of the moderating capacity of gender was performed and was not significant, contrary to expectations (Table 2). A second meta-regression that included age found that age only affected social factors (65%) (Table 2). Considering the studies analyzed, the cultural context was included as a moderating variable, and a third meta-regression was performed. The result showed that motivational factors were moderated by cultural aspects (52%), observing differences according to the prevailing geographical area between different geographical areas of the European continent (north-east with the south), Oceania and Asia (Tables 2 and 3). Similarly, for emotional factors, this moderating effect (17%) was different between studies in southern Europe and Oceania (Tables 2 and 4). Finally, for social factors, geographical area explained 76%

of the variance, observing diversity between the different geographical areas of Europe (highlighting the negative values of Eastern Europe) and Asia (Tables 2 and 5).

Table 2. Regression models.

Meta-Regression of Motivational Factors					
Model Name	**TauSq**	**R^2**	**Q**	**df**	***p*-Value**
'Model 1	0.0308	0	407.02	11	<0.001
'Model 2 Male	0.0308	0	407.02	11	<0.001
'Model 3 Female	0.0308	0.01	407.02	11	<0.001
'Model 4 Age	0.0308	0	407.02	11	<0.001
'Model 5 Geographical area	0.0308	0.52	407.02	11	<0.001
Meta-Regression of Emotional Factors					
Model Name	**TauSq**	**R^2**	**Q**	**df**	***p*-Value**
'Model 1	0.0208	0	83.07	11	<0.001
'Model 2 Male	0.0246	0.0208	83.07	11	<0.001
'Model 3 Female	0.0208	0	83.07	11	<0.001
'Model 4 age	0.0208	0	83.07	11	<0.001
'Model 5 Geographical area	0.0208	0.17	83.07	11	<0.001
Meta-Regression of Social Factors					
Model Name	**TauSq**	**R^2**	**Q**	**df**	***p*-Value**
'Model 1	0.024	0	261.68	12	<0.001
'Model 2 Male	0.024	0.01	261.68	12	<0.001
'Model 3 Female	0.024	0	261.68	12	<0.001
'Model 4 Age	0.024	0.65	261.68	12	<0.001
'Model 5 Geographical area	0.024	0.76	261.68	12	<0.001

Table 3. Coefficient values of Motivational Factors Meta-Regression.

Covariate	Coefficient	Standard Error	95% Lower	95% Upper	Z-Value
M1. Simple	0.3324	0.0538	0.227	0.4378	6.18
M2. Male	0	0.0001	−0.0001	0.0002	0.17
M3. Female	0	0.0001	−0.0001	0.0001	0.22
M4. Age	−0.0028	0.0309	−0.0634	0.0578	−0.09
M5. Geographical area-Asia	0.7658	0.1551	0.4618	1.0697	4.94
M5. Geographical area-Eastern Europe	0.2348	0.108	0.0231	0.4466	2.17
M5. Geographical area-Northern Europe	0.263	0.1409	−0.0132	0.5392	1.87
M5. Geographical area-Southern Europe	0.1248	0.1406	−0.1508	0.4004	0.89
M5. Geographical area-Oceanian	0.0295	0.1165	−0.1989	0.258	0.25

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Table 4. Coefficient values of Emotional Factors Meta-Regression.

Covariate	Coefficient	Standard Error	95% Lower	95% Upper	Z-Value
M1. Simple	0.1736	0.0457	0.084	0.2632	3.8
M2. Male	−0.0001	0.0005	−0.0011	0.0009	−0.25
M3. Female	0	0.0006	−0.0011	0.0011	0
M4. Age	0.0012	0.0439	−0.0849	0.0872	0.03
M5. Geographical area-Southern Europe	0.154	0.0913	−0.0249	0.3329	1.69
M5. Geographical area-Oceanian	0.2293	0.1578	−0.0799	0.5386	1.45

Table 5. Coefficient values of Social Factors Meta-Regression.

Covariate	Coefficient	Standard Error	95% Lower	95% Upper	Z-Value
M1. Simple	0.213	0.0453	0.1242	0.3019	4.7
M2. Male	0	0.0001	−0.0002	0.0002	−0.12
M3. Female	0	0.0001	−0.0002	0.0002	−0.17
M4. Age	−0.0705	0.022	−0.1137	−0.0273	−3.2
M5. Geographical area-Southern Europe	0.2142	0.1077	0.0031	0.4252	1.99
M5. Geographical area-Northern Europe	0.3123	0.0977	0.1207	0.5039	3.2
M5. Geographical area-Eastern Europe	−0.0223	0.0687	−0.1569	0.1123	−0.32
M5. Geographical area-Central Europe	0.1476	0.0955	−0.0397	0.3348	1.54
M5. Geographical area-Asia	0.1148	0.1251	−0.1303	0.36	0.92

As shown by the studies mentioned above, age, not gender, was the moderating variable with the greatest explanatory power, but only for social factors. However, geographical area was a better predictor than was age because it affected all three factors.

As shown by the studies mentioned above, age, not gender, was the moderating variable with the greatest explanatory power, but only for social factors. However, culture was a better predictor than was age because it affected all three factors.

4. Discussion

The purpose of this meta-analysis was to conduct integrated research on the relationship between motivational, emotional, and social variables and academic achievement in children aged 6–12 years during the last ten years. The results of this research indicate a moderate effect size for the motivational (0.321) and social factors (0.210) and a small effect size for emotional factors (0.172). Analyses of moderating effects revealed that age explains 65% of social factors and that geographical area explains 52% of motivational factors, 17% of emotional factors, and 76% of social factors, which are the most important findings of this research. Therefore, the present study concludes that academic achievement is closely related to motivational and social factors and, to a lesser extent, to emotional factors. In addition, geographical area plays a moderating role in all three factors while age only plays a role in social factors. These findings are consistent with previous studies in which motivational and social factors, as opposed to emotional factors, were related to academic achievement [55,56,86]. However, it should be noted have not been found studies that address all three factors together regarding school achievement at this educational stage.

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4.1. Motivational Factors

These factors are formed by related motivational constructs, such as motivation, self-concept, and self-esteem. The results of this meta-analysis show a positive moderate relationship between motivational factors and academic achievement ($r = 0.321$; $p < 0.001$). In addition, the review of the selected studies shows that this relationship appears in both the general and specific domains.

Motivation appears to be related to good grades because students with poor grades have low motivation [87]. Thus, high achieving students are more motivated to work on homework assignments than are low achievers [80,88,89]. Regarding the specific domain of academic achievement, the intrinsic motivation for mathematics is positively correlated with mathematics achievement [44], and self-concept and motivation are positively correlated with reading skills and student goals [13,15]. Similarly, the relationship of bad readers with low self-concept suggests poor readers with multiple deficiencies in reading, language, and attention are at greater risk of low academic achievement and general self-concept [6]. Finally, and consistent with the findings of this meta-analysis, studies such as those by Lockett and Harrell [88], Rahmani [14], and Rastegar et al. [86] conclude that there is a correlation between self-esteem and academic achievement.

4.2. Emotional Factors

The findings of this meta-analysis (positive and significative relationship $r = 0.172$; $p < 0.001$) are consistent with previous research on emotional factors, where a weak relationship with academic achievement is present [27]. However, the difficulty of measuring emotional intelligence for the age in question should be noted, as children may have a limited capacity to understand their own emotions and report on them [27]. Within emotional factors and at this age, different aspects must be considered, such as positive or negative affect [29] or character strengths, which relate to positive behaviours in the classroom and help improve academic achievement [90]. Notably, there is a directly proportional relationship between academic achievement and emotional intelligence; therefore, the former increases as the score of the latter increases, with one being the best predictor of the other [60,84,91]. Additionally, personal well-being is related to emotional intelligence and academic achievement [34]. A child is content when emotional stability is reached (family-school), which in turn impacts school achievement.

4.3. Social Factors

The present meta-analysis indicates a significant moderate positive relationship between academic achievement and social factors ($r = 0.210$; $p < 0.001$). However, there are conflicting results, such as those reported by Selimović et al. [37], who conclude there is a low correlation. Other results are consistent with those reported in this study and corroborate this relationship [55,92]. It has also been found that the influence of social skills on school achievement varies according to academic ability [92]. Some studies report a significant relationship between social skills and academic results two years later (the correlation did not decrease in higher grades) [35]. Furthermore, some studies, such as that by Fu et al. [93], suggest that social factors predict the development and trajectory of academic achievement in children aged 6–9 years. As mentioned above, there is an interaction between social and emotional factors, which is evident between emotional understanding and social competence for predicting school success. The latter facilitates the relationship with others but is reinforced by appropriate and sufficient emotional understanding [28]. To conclude, social skills are not a direct predictor for later achievement but play a mediating role in academics through the interrelation between components of emotional and social factors [55].

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4.4. Moderating Effect of Gender, Age, and Geographical Area

4.4.1. Gender

The results of this research do not show a moderating effect of gender; however, the opposite was expected because the population studied is at an age when there is strong biological and cognitive development, with early maturation in females. When the difference according to gender is analyzed in regard to motivational factors, the studies analyzed suggest that girls are more motivated than boys in reading, especially during the early years of primary school [13] and that boys are more motivated than girls in mathematics [44]. The divergence found on the influence of gender on emotional understanding, between studies conducted with samples of secondary school or university students and those with samples of primary education students, suggests that the differences appear in older children and are not well documented in early school years [94]. Regarding social skills by gender, some studies conducted in adolescents show that as children get older, intergroup processes contribute to discrimination based on sex and restrictive roles have consequences on the academic achievement of girls and the socioemotional development of boys [95–97]. The comparison made by Selimović et al. [37] between fifth- and eighth-graders (10–14 years) found a statistically significant difference between the social competence of female and male students (female students have a more positive perception). All the above is consistent with the results of the present study, which found, despite not being significant, a positive moderating trend of female gender on motivational factors and a positive moderating trend of male gender on social factors but a negative moderating trend on emotional factors.

4.4.2. Age

Self-regulation systems are not fully developed in primary education students (6–12 years); therefore, values vary depending on whether the population studied is in the early or last years of this stage [98,99]. Although age was not strictly a moderator of two of the three factors, the data point to maturational aspects and not so much to strict chronological age for emotional and motivational factors. The results suggest that the moderating effect of age is inversely related to motivational factors; therefore, motivation decreases with increasing age. However, age predicts 65% of the variance for social factors, as the social behaviour of students improves with increasing age because they have more resources for solving conflicts. Finally, some divergence is observed due to age and maturity.

Empirical studies yield mixed results in terms of the components of motivation. On the one hand, Regueiro et al. [80] and Garon-Carrier et al. [44] indicate there are statistically significant differences depending on the course and previous academic achievement, highlighting the moderating effect of age on motivation. Hong et al. [88] noted that younger students are more involved and persistent than older students; therefore, the motivation to complete homework assignments decreases as students advance through grade levels. This difference in results occurs depending on whether the relationship studied refers to the general domain or a specific domain [44,100,101].

Academic self-concept is subject to age-related dynamics, decreasing from early childhood to adolescence. In early childhood, it is characterized by the overestimation of one's own abilities, and with increasing age, it is influenced, to a large extent, by social comparisons with peers, with feedback from external factors such as parents and teachers [79]. The findings obtained for this variable also show differences depending on the general or specific domain considered. With the general academic domain, the relationship increases as students advance through grade levels, especially from 10 to 12 years [79]. The reverse occurs with reading performance, as the effect begins earlier than what research had indicated according to Conradi, Jang, and McKenna [102], Quirk et al. [13], and Walgermo et al. [15].

Regarding emotional factors and in full agreement with the conclusions of this meta-analysis, authors such as Austin [98] and Mayer et al. [99] infer that emotional intelligence skills develop with age. There is a null or weak relationship between emotional intelligence and well-being with academic achievement in early school years (6–10 years) and a slight increase in the last years of primary education (11–12 years) [27,34,60,84,85,103,104]. There

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is no doubt a child's ability to adapt and use his or her emotions in daily life increases with age. The school plays a fundamental role because the child can meet arising challenges, associating this aspect with greater well-being, resulting in better academic outcomes.

To understand the learning process and school achievement, social interaction in school must be considered, in addition to motivation and emotions. During this educational stage (6–12 years), age emerges strongly in regard to its moderating effect on social factors, as this research concludes. Various studies, such as those by Cecconello and Koller [105], Selimović et al. [37], or Gustavsen [35], corroborate these results. All found a clear significant difference in social competence and social skills, between 10- and 12-year-old students, with the 12-year-olds scoring higher. However, the results were nonuniform because there was an increase from 6 to 8 years, then a plateau, and an increase again from 10 to 12 years. In summary, the results of this study are fully consistent with previous studies.

4.4.3. Geographical Area

Geographical area emerges strongly in regard to its moderating effect on the three factors addressed in this research (52% for motivational factors; 17% for emotional factors; 76% for social factors). This effect can be explained by cultural differences between different geographical areas of the European continent (north-central-south-east), Oceania, and Asia. In contrast, in countries on the American continents, there are no indications of the moderating effect of geographical area on any of the factors. Therefore, it follows that cultural aspects have a moderating function according to the type of society (individualist, collectivist), strongly influenced by the geographical-climatic and religious context where the studies were developed [47,71].

Within motivational factors, the highest values were obtained for Asia and the lowest for Oceania. An explanation can be drawn taking Chinese culture as an example. China has a collectivist society with a Confucian philosophy that values hard work and respect for education. Academic achievement has a social (group interest) and emotional (greater acceptance) significance that translates into increased motivation to achieve academic success [29]. In contrast, between the different zones of Europe, the highest value occurs in the north and central zones and the lowest in the south zone (the north and central zones are protestant individualists; the south includes mixed Christian and Muslim populations). These data also highlight the differences in educational systems. Take Norway as an example; this country values this educational stage (6–12 years) for its importance for life itself and not only as preparation for the subsequent stage. Activities are scheduled based on participation and free play without looking for specific results contrary to what happens in comprehensive educational systems [106].

For emotional factors, the highest values are obtained for Oceania and the lowest for southern Europe. These data show that geographical area and culture contributes to achieving personal balance (emotional adjustment, perceived well-being) and in turn improving academic performance when the context in which these factors operate is better controlled [71]. Along these lines, in Australian society (individualist), very different cultural habits coexist (Asian, European, Latin American, Arab, and others), where work is valued more than rapid success and a culture of work predominates [27]. Then again, individualist cultures (Australia) focus on individual needs, recognize quality of life, and give greater importance to the emotional world [71]. In the case of southern Europe, an example could be the study by Acosta and Clavero [84], Pulido-Acosta, and Herrera-Clavero [60] conducted in a pluricultural community dominated by Islamic culture and religion (therefore, with a predominantly collectivist society) but where the educational standards are totally Western (Ceuta-Spain). Their results showed emotional competencies are very important in socialization because attaining proper adjustment and control improves academic achievement. In contrast, in a collectivist society, individual needs are subordinated to the common good or group, paying less attention to the emotional world

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(Muslim communities). Thus, there are different levels of emotional intelligence depending on the cultural group to which one belongs [107].

Finally, for social factors, geographical area plays a greater moderating role in northern Europe, followed by southern Europe, central Europe, Asia, and finally eastern Europe with negative values. To develop socially, one must internalize the norms, rules, and values of the society in which one lives [69]. With Norwegian culture as an example, Gustavsen [35] notes that social skills differ according to the students' native language, which indicates the importance of belonging to the dominant cultural group. Franco et al. [28] reach the same conclusions in Portugal, suggesting the importance of maternal education level in the development of social competence in children aged 6–9 years. Eastern Europe is unique in this respect, specifically Poland. The negative values found for the moderating effect of geographical area on social factors can be explained by its communist past, which has strongly influenced its way of life and educational system [37].

Therefore, culture and the different geographical areas translates into differences in educational systems and societal values in specific geographical-climatic and religious contexts. All these elements are related to motivational, emotional, and social factors that influence academic success.

Authors should discuss the results and how they can be interpreted from the perspective of previous studies and of the working hypotheses. The findings and their implications should be discussed in the broadest context possible. Future research directions may also be highlighted.

5. Conclusions

This study concludes by highlighting the relationship of motivational and social variables with academic achievement and the moderating effect of geographical area on the components of social and motivational factors, along with that of age on social factors. The results of this meta-analysis ascribe to motivational factors the same predictive capacity, regarding school performance, as executive functions and intelligence quotient in children aged 6–12 years [5]. These results indicate the need to address the motivational and social factors of students during the last years of primary education. This will facilitate the acquisition of knowledge and skills, leading to academic achievement in the subsequent educational stage, where these factors will become truly relevant. Additionally, the results indicate that emotional factors are not decisive during this educational stage. Nevertheless, it is necessary to implement actions to reinforce this component because it interacts strongly with social factors, as already shown.

Age, not gender, moderates school outcomes in regard to social factors. Unlike in the study by Cortés-Pascual et al. [5] where gender appeared as the main predictor of the relationship between executive functions and academic achievement during this educational stage, in this meta-analysis, age was the predictor. This moderating variable is fundamental for socialization in the peer-teacher relationship in the school context. In general, the importance of motivational factors decreases with age (increasing in the specific domain), and that of emotional and social factors increases with age. The relationship with academic achievement appears in the last courses of this educational stage (10–12 years), and thus, it will become relevant in the subsequent stage. Therefore, cognitive variables will have a greater influence on academic achievement between 6 and 12 years, and their effects will subsequently decrease. In contrast, personal factors (motivational, emotional, social) will gain relevance during the last courses of primary education, showing the importance of maturity.

The most surprising result was the strong moderating effect of geographical area on all three factors and especially its predictive power for social and motivational factors. The values it instils in society (family-school) and, above all, its effects on the creation of educational systems certainly influence academic results. However, there is an interrelation between the effect sizes obtained and the moderating effect of geographical area. Social factors have the second highest effect size, but geographical area has the highest moderating

effect on social factors, for which age has the only moderating effect. Therefore, social factors are important in explaining academic achievement for this age (6–12 years).

The literature review suggests an interconnection between the different factors studied and motivational variables. Additionally, there is a strong relationship between motivation and specific academic domains (reading, mathematics) and feedback between these variables and the school achievement. Emotional factors appear closely linked to social factors; therefore, on some occasions, each one appears as a moderator of the other for academic achievement. These two factors affect motivational factors and act in unison, due to their strong personal character, to predict academic achievement.

Regarding the limitations and foresight of this research, in view of the results obtained, a new study should be conducted to analyse the behaviour of the variables described during later educational stages. Such a study would illustrate how these factors influence academic achievement and its development along with the development of their moderators throughout compulsory education. Furthermore, this new study would provide information on how to impart a predictive counterbalance, regarding age, between traditional variables such as executive functions and intelligence quotient—very powerful at an early age—and the motivational, emotional, and social factors addressed in this study. Finally, the variable "geographical area" should evolve towards an in-depth study of cultural aspects that may influence the way of learning and, therefore, academic performance.

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4.1.2.2. Estudio 4: Self-esteem and motivation for learning in academic and motivation for learning in academic achievement: the mediating role of reasoning and verbal fluidity.

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Article

Self-Esteem and Motivation for Learning in Academic Achievement: The Mediating Role of Reasoning and Verbal Fluidity

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Abstract: The goal of the present study was to analyze the joint role that non-cognitive (motivation and self-esteem) and cognitive (verbal fluency and reasoning) factors play on academic achievement, both as a global score and in relation to specific subjects, such as language and literature and mathematics. We also analyzed the mediating role of cognitive factors. We recruited a sample of 133 primary education students (aged 6–9 years old) (47.6% girls, 52.6% boys), to whom various measures of the above-indicated variables were administered. Several predictive models were tested through a mediational regression analysis. The results indicated the relevance of intrinsic motivation together with self-esteem as predictors of academic achievement mediated by the cognitive abilities verbal fluency and reasoning. These relationships differed depending on the specific subject. We discuss the educational implications of these findings and emphasize, on the one hand, that academic achievement depends on both cognitive and non-cognitive factors and, on the other hand, the malleability of cognitive factors, as they seem to improve based on motivation and self-esteem.

Keywords: self-esteem; motivation for learning; academic achievement; reasoning; verbal fluidity

1. Introduction

Learning and, consequently, its measurement in the educational field through academic success, which is commonly evaluated by academic performance, is a topic of interest for public institutions. An example of this is the annual Programme for International Student Assessment (PISA) [1] reports used as an indicator of students' general knowledge in different countries.

Currently, there are two broad research lines to analyze the predictors of academic performance, understood as the product of the learning process that results from the different factors acting on it [2]. On the one hand, a research line has focused on cognitive factors, such as executive functions [3], general intelligence [4], or cognitive ability. Regarding the last one, academic performance involves abilities such as reasoning [5] and those related to the verbal component [6], from which more information is obtained for educational practice, as these abilities go beyond general intelligence and are useful for explaining the students' variety of academic skills [7,8]. On the other hand, another research line highlights the role of non-cognitive factors, such as motivation [9] and self-esteem [10], as crucial elements in academic performance.

Despite the role that cognitive abilities play in academic performance, very few studies have analyzed specific cognitive abilities, such as verbal fluency and reasoning, in the academic performance

of children aged 6–9 years. Schneider and McGrew [11] conclude that both the verbal component and reasoning are the bases for adequate academic performance, as these factors are key predictors for school success, although cognitive abilities alone do not completely predict school success [12,13]. Among the non-cognitive factors, motivation and self-esteem stand out. On the one hand, motivation is understood as the process that aims to achieve a goal [14,15]. On the other hand, self-esteem is someone's perception of him/herself and of how he/she is valued to achieve the proposed goals [16,17]. Both motivation and self-esteem are considered important in the teaching–learning process, and they also improve academic performance by being influenced by the environment or context in which they interact [18,19].

The study of motivational variables has been commonly approached from the Self-Determination Theory [20], which considers two types of motivation: intrinsic and extrinsic. While intrinsic motivation is internal, driven by interest, curiosity, or enjoyment, extrinsic is determined by context and is, therefore, influenced by sources external to or beyond the subject [20].

In the continuum of intrinsic and extrinsic motivation, Montero and Alonso [21] propose the following types of motivation: motivation for learning, motivation for results, and fear of failure. The first two are the main reason why the student strives, acquires initiative and perseverance, and drains his/her cognitive capacity to achieve favorable academic performance. However, the fear of failure would act as a demotivating element that reduces one's cognitive faculties and represses effort and perseverance oriented to achieve a clear goal [22]. These three components of motivation encompass both the intrinsic character (of learning and fear of failure) and the extrinsic nature manifested by the motivation of the achieved result [14,21]. This decomposition into dimensions allows us to examine how motivation for learning is related—to a greater extent than motivation for results—to school performance in the absence of external pressures [23,24].

Self-esteem is related to academic performance in such a way that it is linked with school success or failure. In an attempt to categorize self-esteem, it has been classified as high and low self-esteem [25]. Children with good school performance have high self-esteem, trust their abilities, are self-effective, and feel valuable [10]. In some studies, poor school performance has been associated with feelings of ineffectiveness, lack of expectations, and also with feelings of failure and frustration [26,27]. In line with this, the school context is a significant variable for students' self-esteem [28]. Briefly, positive self-esteem lays the foundation for high academic achievement [29].

Regarding the influence that non-cognitive factors (motivation, self-esteem) have on cognitive factors (reason, verbal fluency), in relation to the former, it has been shown that the students driven by intrinsic motivation have better cognitive abilities than those regulated by extrinsic reward styles [30]. The enjoyment itself of performing an activity (essence of intrinsic motivation) is an important predictor of performance in a wide variety of domains [31]. In this regard, some studies indicate that the verbal fluency of those with low motivation levels—e.g., apathy [32]—declines [33]. Other authors emphasize that the link between intrinsic motivation and performance in certain subjects differs depending on the cognitive ability type [34,35].

Perceiving that one possesses the cognitive abilities to overcome difficulties and to achieve academic success facilitates the development of healthy self-esteem. Indeed, when cognitive abilities are scarce, students tend to show less self-esteem as they themselves predict the achievement of poor academic results [36]. Therefore, a relationship between self-esteem and reasoning [37] and verbal fluency appears, although this relationship sometimes requires the mediation of other variables [38]. Finally, the relationship linking self-esteem and cognitive abilities has also been analyzed in the opposite direction: that is, focused on the impact that cognitive abilities have on self-esteem [39].

Cognitive abilities explain much of the variability of academic skills in certain subjects. Among the most widely analyzed subjects, we found language and literature and mathematics [40,41]. The association between academic domains links verbal fluency with the language and literature subject, and reasoning with mathematics [41,42]. Moreover, a bidirectional association between intrinsic motivation and competition in a specific domain is observed. The better the results in mathematics,

the more motivation for that subject [43]. Such relations do not seem to exist so clearly in self-esteem because it is globally defined [44].

Gender differences appear in non-cognitive factors and the academic performance of certain subjects. On the one hand, girls (10–18 years old) present lower extrinsic motivation levels and better perceive failure. In turn, they obtain better marks in language and literature and approach learning in a more adaptive way [45]. On the contrary, for self-esteem, boys (10–18 years old) show higher levels than girls, which is related to their better performance in mathematics [46]. Indirect evidence indicates that academic performance in certain subjects—linked with certain cognitive abilities—differs depending on gender, with males feeling more motivated with mathematics and females with the language area [47,48].

To date, very few publications have analyzed the impact that motivation, self-esteem, and their joint impact have on the academic performance of students in elementary education (6–9 years old), and the possible mediation of cognitive abilities, such as verbal fluency and reasoning and gender in specific areas. As the ability to solve academic problems, such as mathematical or reading-related problems, can predict future academic or educational consequences [49,50], their analysis is fundamental at early ages. Academic performance in elementary school predicts academic performance in later education stages, as indicated by several longitudinal design studies done with pupils aged 6–14 years old [40,51,52] and those in secondary education and university education stages [53]. Richaud, Filippetti, and Mesurado [54] highlight that motivational and emotional factors are directly related to learning processes in the education field. However, they point out that knowledge about the connection with neuroscience is still limited, along with the study of personal factors and their impact on learning processes and academic performance.

Studying the relationship between motivation and self-esteem with academic performance in elementary education is justified by motivation tending to decrease with age [55]. In this stage, the consolidation of self-esteem is crucial because, within this range, self-esteem is usually high and unreal at around the age of 8, so the socio-cultural environment should encourage self-esteem to be properly constructed [56].

With a sample of elementary education schoolchildren, our objective was to focus on: analyzing the relationship between non-cognitive factors (motivation, self-esteem) and a possible mediation of cognitive abilities (reasoning, verbal fluency) and gender for global academic performance by considering the average mark obtained by averaging all the subjects taken; and the specific academic performance in language and literature and mathematics. To do so, a predictive model of motivation (learning, outcome, fear of failure) and self-esteem in global and specific academic performance were tested, in which the possible mediating role of cognitive reasoning and verbal fluency was evaluated.

2. Materials and Methods

2.1. Participants

The sample was made up of 133 primary students, who were distributed into courses as follows: 35.3% in year 1; 31.6% in year 2; 33.1% in year 3. They all attended a state-assisted school in the center of a medium-sized city in Spain. The families' socio-economic level was medium–high (30.000–45.000 net euros per year). Of the sample, 47.4% were girls and 52.6% boys, all aged between 6 and 9 years (M = 7.54, SD = 0.95). Regarding academic performance, the values obtained after considering the grades in all their subjects ranged between 5 and 9.4 (M = 7.88; SD = 0.94). The sampling method was incidental.

2.2. Measures

Academic performance was evaluated with the average grades (scores from 0 to 10) obtained by all the students taught during the 2018–2019 academic year.

The Motivation Questionnaire towards Learning and Execution (MAPE-II) [20] was used. This scale assessed motivation. It comprised 74 items that make statements about work capacity, performance, and motivation level. The answer options were Yes/No. Items were grouped into three second-order dimensions: motivation for learning, motivation for results, and fear of failure. The learning motivation dimension was made up of 43 items (e.g., "I am happy when I do difficult tasks") and high scores that detected those students who work harder, obtain better results, and reject non-effort behaviors because they are driven by satisfaction from the task itself. The second dimension was made up of 25 items (e.g., "when I grow up, I want to be someone important"), where the highest scores indicated the search for prestige, demonstration of one's own worth, and anxiety, which resulted in higher performance. The third dimension, or fear of failure, was made up of 12 items (e.g., "when I fail, I get discouraged"), where high scores indicated a lack of confidence in one's own ability, anxiety, and blockage when facing difficulties. Its authors indicated adequate reliability indices through Cronbach's alpha ranging between 0.67 and 0.84.

The Coopersmith Self-Esteem Scale [57] measured self-esteem in children and adolescents. We utilized the school version validated in Spanish [58]. It was used to measure evaluative attitudes toward oneself globally in the school environment. It comprised 58 items and referred to the level of acceptance of the academic type in relation to classmates, teachers, and parents. The response options were True / False (e.g., "I feel discouraged at school"). A high score indicated a more self-supportive profile. Cronbach's alpha values were adequate, with 0.81 for the global scale.

The RAVEN Progressive Matrix Test [59] instrument measured analogical reasoning, abstraction, and perception. It allowed the possibilities or the learning potential to be determined, and general intelligence or the "g" factor to be estimated. It used a series of abstract incomplete figures that appeared gradually and in ascending levels of difficulty. The test applied to children from 5 to 11 years old was called the Progressive Color Matrix and consisted of three series (A, Ab, B) of 12 elements. Series A and B were the same as those applied at other ages, but with color, by introducing series Ab between both. Direct scores were obtained by correcting figures solved appropriately on the three scales. This direct score was transformed into its corresponding percentile score to thus facilitate its interpretation. Reliability by the two halves method indicated values ranging from 0.73 to 0.94.

Effective reading/reading games [60] were used to measure verbal fluency. They evaluated skills and abilities in developing reading skills. They responded to the international PISA criteria and MECES diagnostic tests. They addressed elementary education students, who were first given a text of 30/50 words for year 1 students, 150/250 for year 2, and 300/400 words for year 3 of elementary education. Next, they answered two blocks of questionnaires with no time limit. The first consisted of 10 questions for years 1 and 2, and 20 for year 3. They were closed questions of three types: relation among data, global idea, and inferences. The response options were correct, similar, or false. The second block consisted of five questions for years 1 and 2, and 10 questions for year 3. The answer options were True/False. Cognitive processes, such as memory, attention, flexibility, decoding, or comprehension, were necessary to adequately answer the questionnaires. The total sum provided a measure of verbal fluency.

2.3. Procedure

To conduct this study, we obtained the school's authorization and collaboration. We sent information to parents and, in turn, they authorized their children's participation by completing informed consent forms. Data confidentiality and anonymity were guaranteed. The guidance team participated, as well as the tutors of the involved courses. The different tests were applied in tutoring hours by a single researcher and jointly with the students of each course to ensure privacy conditions, and to guarantee honesty when completing tests. To adjust sessions to school hours, they lasted 45 min each and took place during the last quarter of the 2018–2019 academic year. The sequence of test applications was as follows: motivation, self-esteem, reasoning, and verbal fluency. The study was previously approved by the Research Ethics Committee of the Autonomous Community of Aragon:

CEICA (No. 04/2019; 27 of 02 of 2019). This committee is in charge of evaluating research projects with people or personal data from BLINDED University.

2.4. Statistical Analysis

First, the descriptive statistics of the evaluated variables were performed. Later, in order to observe the relationship between these variables, Pearson correlations were carried out. Third, a regression analysis was used to examine the predictive power of the variables' motivation (learning, outcome, fear of failure), self-esteem, and gender on global academic performance. No cognitive variables (reasoning, verbal fluency) were included in this analysis as possible mediating variables to avoid any effects from obtaining better grades in some subjects or others. To prevent biases, they were only taken into account when analyzing the predictive models on the specific language and literature and mathematics subjects. Therefore, four mediation analyses were independently performed to analyze the likely mediating role of the reasoning and verbal fluency variables between the motivational variables and self-esteem on academic performance in these subjects [61] (following the recommendations of Walters and Mandracchia [62], by which the order of causal relations and the direction thereof were established). In the tested models, the dependent variable was academic performance in language and literature or academic performance in mathematics. The analyses were performed with PROCESS macro [63] in SPSS, which allowed the analysis of the mediating role of variables [61]. Analyses were carried out through bootstrapping with 5000 samples at the 95% confidence level.

3. Results

First, descriptive statistics were obtained and the correlation analysis among motivation, self-esteem, and academic performance was done. As observed in Table 1, there were significant correlations between motivation and academic performance, specifically with motivation for learning ($r = 0.31$, $p < 0.001$), and negatively with fear of failure ($r = -0.25$, $p < 0.01$). However, motivation for results was not significant in relation to academic performance. Likewise, self-esteem and academic performance were significantly correlated ($r = 0.42$, $p < 0.001$). Gender was only correlated significantly, but negatively, with motivation for results ($r = 0.26$, $p < 0.01$). Therefore, to a greater extent, more boys felt more motivated for the result than girls.

Table 1. Descriptive statistics, correlations and collinearity of academic achievement, motivation for learning, for the results, fear of failure, self-esteem, and sex.

	Range	*M*	*SD*	1	2	3	4	5	6	Tolerance	VIF [1]	CI [2]
1. Academic achievement	0–10	7.88	1.03							–	–	–
2. Motivation for Learning	0–43	28.02	5.27	0.31 ***						0.82	1.21	4.55
3. Motivation for the Results	0–25	11.98	4.52	−0.12	0.27 **					0.82	1.21	7.61
4. Fear of Failure	0–12	4.64	2.83	−0.25 **	−0.16	0.15				0.62	1.59	8.43
5. Self-esteem	0–58	41.34	7.45	0.42 ***	0.28 **	−0.11	−0.59 ***			0.59	1.69	16.36
6. Sex	1–2	1.53	0.50	−0.06	0.06	0.26 **	0.02	−0.09		0.91	1.09	27.91

[1] VIF: Variance Inflation Factor; [2] CI: Condition Index. *** $p < 0.001$; ** $p < 0.01$.

A second correlation analysis was performed between academic performance in specific subjects (language and literature and mathematics) and the other evaluated variables, as well as reasoning and verbal fluency. As seen in Table 2, regarding the motivation dimensions, learning motivation correlated significantly with performance ($r = 0.21$, $p < 0.05$) ($r = 0.23$, $p < 0.01$) for language and literature and mathematics, respectively. Fear of failure also correlated negatively with performance in mathematics ($r = -0.20$, $p < 0.05$). Moderate correlations were obtained between self-esteem and with academic performance in both subjects ($r = 0.32$, $p < 0.001$).

Table 2. Correlations between academic achievement in language and literature and mathematics and motivation for learning, for the results, fear of failure, self-esteem, and sex.

	Range	*M*	*SD*	1	2	3	4	5	6	7	8	9	Tolerance	VIF	CI
1. Academic achievement in Language and Literature	0–10	7.71	1.32												
2. Academic achievement in Mathematics	0–10	7.68	1.37	0.87 ***											
3. Motivation for Learning	0–43	28.02	5.27	0.21 *	0.23 **								0.76	1.31	5.11
4. Motivation for the Results	0–25	11.98	4.52	−0.14	−0.06	0.27 **							0.75	1.33	6.94
5. Fear of Failure	0–12	4.64	2.83	−0.16	−0.20 *	−0.16	0.15						0.58	1.71	9.72
6. Self-esteem	0–58	41.34	7.45	0.32 ***	0.32 ***	0.28 **	−0.11	−0.59 **					0.55	1.79	10.04
7. Verbal fluidity	0–166	80.92	30.14	0.37 ***	0.32 ***	0.22 *	−0.16	0.07	0.15				0.82	1.22	13.43
8. Reasoning (percentile)	0–99	70.14	19.00	0.46 ***	0.61 ***	0.15	−0.08	−0.13	0.21 *	0.13			0.91	1.09	19.05
9. Sex	1–2	1.53	0.50	−0.04	0.03	0.06	0.26 **	−0.02	−0.09	0.02	0.08		0.89	1.11	32.47

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

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To examine the predictive power of motivation and self-esteem in academic performance, a multiple linear regression was performed, in which the criterion variable was academic performance. Variables that were significant in the correlation analysis were used in the regression model—specifically, motivation for learning, fear of failure, and self-esteem. We continued with the method of successive steps. As seen in Table 3, self-esteem ($\beta = 0.403$, $p < 0.001$) and motivation for learning ($\beta = 0.289$, $p < 0.001$) were the predictors of academic performance, with self-esteem as the most important predictor. Therefore, the more self-esteem and motivation for learning, the better the academic performance was. Together, they explained 23% of variance. In other words, 23% of academic performance values would be explained by the values obtained in self-esteem and motivation for learning.

Table 3. Hierarchical regression analysis for predicting academic achievement.

	B	*β*	*T*	*p*
Motivation for Learning	0.057	0.289	3.35	0.001
Self-esteem	0.056	0.403	3.85	0.001

Subsequently, the predictive power of motivation and self-esteem on academic performance in language and literature and mathematics was analyzed by a mediational analysis, and by analyzing the mediating role of cognitive abilities—reasoning and verbal fluency, respectively—for each subject. Figures 1 and 2 show the standardized coefficients and their respective standard errors, as well as the level of significance of each variable regarding verbal fluency, reasoning, or academic performance. Figure 1 shows that the predictive variables of academic performance in language and literature were motivation for results and the motivation for learning, mediated by verbal fluency. Self-esteem had a direct effect on performance in Language and literature. Therefore, the subjects with more motivation for both results and learning presented better verbal fluency levels, which, in turn, favored better grades in this subject. Likewise, having more self-esteem favored better grades. This model predicted 28% of variance.

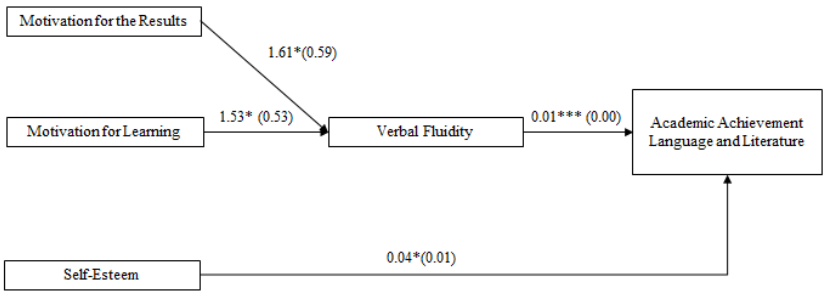

Figure 1. Predictive model for academic achievement in language and literature. *** $p < 0.001$; * $p < 0.05$.

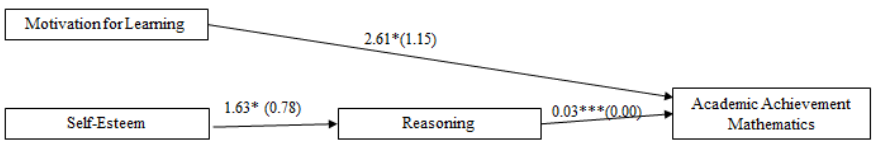

Figure 2. Predictive model for academic achievement in mathematics. *** $p < 0.001$; * $p < 0.05$.

With the predictive model of academic performance in Mathematics, the predictive power of learning motivation and self-esteem was observed—the latter of which was mediated by reasoning ability. Therefore, subjects with more motivation to learn obtained better grades in this subject.

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Likewise, higher self-esteem predicted reasoning ability, which, in turn, favored obtaining better grades. This model predicted 42% of variance.

4. Discussion

The main objective of this study, conducted with elementary students, was to analyze the joint relation of non-cognitive factors (motivation, self-esteem) and cognitive factors (reason, verbal fluency) on academic performance by examining the possible mediating role of cognitive factors when analyzing academic performance in the specific subjects of language and literature and mathematics. The results show that intrinsic motivation—specifically, motivation to learn—predicts overall academic performance and performance in the specific examined subjects, and also in language and literature together with the predictive power of outcome motivation, and both for verbal fluency. Self-esteem is a predictor of global and specific academic performance and, in mathematics, is mediated by reasoning. On the one hand, the role of intrinsic motivation that leads the subject to strive and learn, together with his/her self-esteem, is highlighted because it leads to improved cognitive abilities, which are ultimately translated into more academic success. On the other hand, the relationships between the predictor and mediator variables differ according to the specific subject in which academic performance is analyzed. This allows knowledge about differential predictive factors according to students' interests, competences, or abilities.

Our findings support previous studies on the relationship between motivation and self-esteem with academic performance. Regarding motivation, it is observed that students with intrinsic motivation styles acquire better cognitive abilities and develop verbal fluency and reasoning to a greater extent than those who are regulated by extrinsic reward styles [30]. Developing an activity for enjoyment for the sake of it—a characteristic of intrinsic motivation—is an important predictor of performance in a wide variety of domains [31]. These results fall in line with previous studies in which motivated students obtained better grades [64–67]. Likewise, students with more self-esteem obtain better results, which thus confirms previous studies [15,68]. Self-esteem is related to the motivation to learn and academic performance, in such a way that the students who display adequate school performance also have high self-esteem, and vice versa [69]. Self-esteem is, therefore, linked not only with motivation as a predictor of academic achievement, but also with general student learning [70–73].

Differentiating academic performance according to a specific subject is crucial to better distinguish the predictive elements that form part of it [48,73,74] if we consider that reciprocity exists between the skills for a specific area and the motivation toward it [75–77]. Traditionally, interest has been shown in the subjects of language and literature and mathematics [65]. Regarding the academic performance for both these subjects, this study finds, on the one hand, the importance of motivation (learning and results) mediated by verbal fluency for language and literature, and the motivation of learning as a direct predictor of performance in mathematics.

Academic achievement in language and literature is predicted indirectly by motivation for both learning and results (intrinsic and extrinsic, respectively) through verbal fluency, and, directly, by self-esteem. On the one hand, and given the cross-sectional nature of the present study, it is likely that the relationship between motivation and verbal fluency is reciprocal and susceptible to an inverse reading. In other words, students with few abilities or skills in the verbal component are barely motivated given their limitations [47,78]. On the other hand, in relation to the direct role of self-esteem, previous evidence is supported insofar as academic performance is influenced by self-esteem [79] and motivation [65–67]. Furthermore, the way in which individuals feel about themselves, as well as their self-concept, which is a variable closely related to self-esteem, are crucial for their success [80], which is consistent with the relevant role that emotions play in education [81]. Together, motivation and emotion direct human attention to what is relevant to store circuits in memory [82].

In the predictive model of performance in mathematics, in which the motivation to learn directly predicts success, previous studies, such as that of Garon-Carrier et al. [40], point out that this subject exposes students to increasing challenges, which leads them to believe that it is more difficult for

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them to study and, therefore, it requires high motivation to learn. Mathematics presents a symbolic and abstract language that requires added effort and entails difficulty when involving maturing brain areas at these young ages [83]. Self-esteem is an indirect predictor mediated by reasoning ability. Previous studies indicate that self-esteem has an indirect effect mediated by skills in relation to intelligence [84]. Thus, higher self-esteem is closely related to mathematical ability [85]. In summary, the students who are more successful in mathematics are highly motivated students to learn, and this is probably the deepest form of motivation with a higher positive evaluation of itself, which influences their reasoning ability.

This research work found no differences in the possible role of gender in predicting academic performance according to the specific subject. Only at the correlational level was it appreciated that girls reported more motivation for results than boys. These data fall in line with previous studies that generally highlight more motivation among girls [86] and more academic success [87], as well as a greater capacity for early self-regulation in various areas [88]. Some authors do not indicate any major differences between boys and girls in childhood [89], and that it is not until adolescence when the difference in socialization intensifies according to gender. Therefore, these possible differences grow. Another likely interpretation is that the effects of gender on academic performance are influenced or moderated by the effect of other variables, such as ethnicity, socio-economic status, or the school context [86]. Given the homogeneity of our sample, similarities in the socio-demographic or contextual variables possibly attenuate possible gender differences.

The present study has certain limitations that are set out below. Firstly, the analyzed sample does not represent all Spanish students. Thus, the generalization of the present results is limited to the socio-demographic characteristics of the employed sample, which was, moreover, incidentally collected. Secondly, the impact of other relevant variables on academic performance, such as families' cultural, educational, and socio-economic contexts, was unknown, as the study was carried out in an education center with a very homogeneous profile as far as these variables are concerned. A subsequent study should analyze the possible differences between the various school settings. Thirdly, as the study is cross-sectional, the cause–effect relations between the examined variables are unknown. Future studies should propose longitudinal designs that provide a better understanding of the studied variables.

5. Conclusions

The findings of the present study have a series of relevant implications for the education field in elementary education. Theoretically, in relation to the analyzed constructs, it is concluded that although cognitive factors and academic performance are closely related, they are not identical, which supports previous theoretical positions [90]. Academic performance depends not only on cognitive factors, but also on non-cognitive factors, such as motivation and self-esteem [68,91]. Specifically, cognitive factors can be improved from non-cognitive factors related to motivation—especially the motivation to learn—and self-esteem. Hence, the malleability of cognitive ability and intelligence is emphasized, and is not a fixed static factor [92]. This leads to relevant theoretical and practical implications where, through the improvement of the non-cognitive factors related to students' "self," they can allow cognitive factors to improve. Despite the predictive models of academic performance, it is necessary to clarify which other variables explain the percentage of variance not herein expressed. For this reason, future research lines should consider jointly studying certain specific executive functions—such as memory, inhibition, planning, etc.—that could explain part of the variance in academic performance. Finally, to achieve school success, it is necessary not only to improve academic skills, but to also promote students' positive perception of their skills [93,94]. In addition, our findings have led us to recommend the development of educational programs that integrate motivation and self-esteem as some of the main goals among children aged 6 to 9 years old. This would significantly improve their cognitive ability and their success in academic performance.

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4.1.3. CAPÍTULO III: Funciones ejecutivas, motivación y autoestima: relación y mediación con el rendimiento académico en Educación Primaria.

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The role of executive functions and self-esteem in academic performance: a mediational analysis

El papel de las funciones ejecutivas y la autoestima en el rendimiento académico: un análisis mediacional

Resumen

Superado el paradigma de la inteligencia como predictor único del rendimiento académico se estudia la influencia de otras variables como el razonamiento, fluidez verbal, funciones ejecutivas, motivación y autoestima. Para ello, se sirvió de un diseño de investigación de carácter exploratorio e incidental en una muestra de 132 sujetos de 6 a 9 años. Se administraron diferentes instrumentos como son: las pruebas RAVEN, Lectura Eficaz, Brief II, MAPE II y Escala Coopersmith respectivamente. Los resultados señalan que el modelo predictivo formado por razonamiento, fluidez verbal, funciones ejecutivas y autoestima explica un 55,4% de los resultados académicos. Como variables mediadoras emergen la autoestima, sobre variables tanto de carácter cognitivo como motivacional, y las funciones ejecutivas sobre variables emocionales y motivacionales. Esto supone implicaciones teóricas y prácticas de carácter educativo con implicaciones prácticas en las aulas de primaria para la implementación de planes de desarrollo de la autoestima y las funciones ejecutivas.

Palabras clave: rendimiento académico, razonamiento, fluidez verbal, funciones ejecutivas, autoestima, motivación.

Abstract

Overcoming the paradigm of intelligence as the only predictor of academic performance, the influence of other variables, such as reasoning, verbal fluency, executive functions, motivation and self-esteem, was studied. For this purpose, an exploratory and incidental research design was used in a sample of 132 subjects aged 6-9 years. Different instruments were administered: RAVEN, Effective Reading, Brief

II, MAPE II and Coopersmith Scale, respectively. The results indicate that the predictive model formed by reasoning, verbal fluency, executive functions and self-esteem explains 55.4% of the academic results. As mediating variables, self-esteem emerges as a predictor of both cognitive and motivational variables, and executive functions as a predictor of emotional and motivational variables. This implies theoretical and practical implications of an educational nature with practical implications in primary school classrooms for implementing plans to develop self-esteem and executive functions.

Keywords: academic performance, reasoning, verbal fluency, executive functions, self-esteem, motivation.

1. Introduction

A recurring theme in the educational community is school failure (de Castro & Pereira, 2019; Fernández-Mellizo & Martínez-García, 2017). Debate about the factors that likely underlie this issue is refueled every time PISA reports are published (Caro & Kyriakides, 2019; Davis, 2019). However, the paradigm of the intellectual capacity of subjects being solely responsible for school achievement is overcome (Sternberg et al., 2010). There is empirical evidence that other cognitive (executive functions), behavioral (motivation) and emotional (self-esteem) variables help to explain academic success (Cortés et al., 2019; Moyano et al., 2020). Yet the dilemma comes into play if the predictive value of academic performance is higher in variables like functions, self-esteem and motivation or intelligence, which play a fundamental role in its reasoning and verbal fluency variants (Best et al., 2011; Birkeland et al., 2012; Mercader et al., 2017). In addition, there is concern about the role that achievements in the first years of regulated education implies for the results obtained at 15 years old of age, an age usually reflected in PISA reports, and the relevance of the different variables for these results when academic performance is understood as the product of the learning process (Lamas, 2015). Nor should we forget the need for integrative models and mediational analyses that better specify the role of different variables.

Accordingly, apart from executive functions, understood as neurocognitive processes that control thoughts and regulate both behavior and cognitive and emotional activity (Zelazo & Carlson, 2012), being a direct predictor, they present a mediating capacity in aspects like cognitive abilities (reasoning, verbal fluency), motor skills or physical fitness (Aadland et al., 2017; Bruijn et al., 2018; Bryce et al., 2015). The different studies that have addressed the relation between executive functions and academic performance point out that it is established from the age of 3 (Mulder, 2017), and it remains significant and moderate until the age of 12 (Jacobson et al., 2011). However, the term executive functions is not free of controversy as different authors treat it as an unifactorial component and a predictor of general performance (Wiebe, 2008), while authors find a multifactorial composition capable of predicting

specific performances (Clair-Thompson & Gathercole, 2006).

The same occurs with variables like self-esteem, understood as the appreciation that we all have of ourselves; that is, an evaluative dimension of our own self-concept (Cid-Sillero et al., 2020) as a predictor of performance in Mathematics through the mediation of reasoning and motivation which, in turn, are mediated by verbal fluency when predicting performance in Spanish Language and Literature (Moyano et al., 2020). Self-esteem plays a motivational function, as pointed out by Hartes and Whitesell (2003), and has been studied as a mediator between variables and academic performance, especially as far as motivation and social factors are concerned, but in adolescent populations (Cid-Sillero et al., 2020; Kaplan et al., 1994; Masselink et al., 2017).

Currently, the research lines that analyze predictors of academic performance focus on cognitive factors like executive functions or intelligence (Colom et al., 2006). In this last variable, reasoning skills and verbal fluency are useful for explaining academic performance (Floyd et al., 2008). Some studies, such as those by Nascimiento et al. (2008), point out that the perception of possessing these cognitive skills helps to achieve academic success and to improve self-esteem. Along the same lines, Evans (2003) points out that significant relations appear between reasoning ability and the development of verbal fluency and high self-esteem. However, this relation sometimes requires the mediation of other variables (Nie et al., 2017).

In response to all these questions, the present work aims to investigate the relation and predictive value that cognitive (reasoning, verbal fluency and executive functions) behavioral (motivation) and emotional (self-esteem) variables have for the performance academic of pupils aged 6-9 years old, as well as the mediating role of some of them. The set objectives focus on studying possible predictive models in academic performance and the action of different psychological variables for pupils aged 6-9 years, and also on analyzing the interaction between interdependent variables and their mediating action in alternative predictive models. Therefore, the following hypotheses are posed:

1. Academic performance would present a significant relation with all the studied variables: reasoning, verbal fluency, motivation, self-esteem, executive functions.
2. The most important predictive model would be formed by the cognitive variables of reasoning, verbal fluency and executive functions.
3. On the whole, executive functions are the variable that has the strongest mediating effect of all the studied variables and academic performance.

2. Method

2.1. Participants

The sample was made up of 132 Primary Education pupils (6-9 years old) from a state-assisted school, divided into three courses: 35.2% in the first year, 31.5% in the second year and 33.3% in the third year. Gender distribution was 47.4% were girls and 52.6% boys with a mean age of 7.54 years and a standard deviation of 0.95. Finally, it should be noted that the employed sampling method was incidental with a convenience sample, and an exploratory, correlational and mediational study.

2.2. Measures

The dependent variable of this study, academic performance, was evaluated with the average grade (values from 0 to 10) of all the academic areas during the 2018-2019 academic year.

The RAVEN progressive matrix test (Raven & Court, 2010) measures analogical, abstract and perceptual reasoning, allows the determination of the learning potential and estimates general intelligence. It consists of a series of incomplete and abstract figures that gradually appear. The applied test, a progressive color matrix recommended for pupils aged 5-11 years, consists of three series with 12 items each. The result of the direct score is transformed into a percentile for interpretation purposes. The reliability by the split-half method indicates the values ranging between 0.73 and 0.94.

For verbal fluency, effective reading games were used (Editoral Bruño, 2017). This test met the international PISA criteria and the MECES reading competence tests. With age-adapted texts, the number of words read per minute is measured and a

series of questions is asked about these texts with true/false responses.

In order to measure motivation, the Motivation Questionnaire toward learning and performance (MAPE-II) was used (Montero & Alonso, 1992). This scale assesses general motivation with 74 items about work capacity, motivation level and performance. The answer options are yes/no, and the global motivation index is obtained by adding the three dimensions (motivation for learning, motivation for results, fear of failure). This instrument presents adequate reliability indices through Cronbach's alpha: 0.75.

Regarding self-esteem, the Coopersmith Self-esteem Scale (Coopersmith, 1967) was used in its school version, adapted to Spanish (Miranda et al., 2011). It consists of 58 quick-response items (true/false) and refers to the level of academic acceptance in relation to the others. The Cronbach's alpha values indicate a reliability level of 0.81 for the global scale by taking these values as high reliability.

Executive functions were measured by the Behavior Rating Inventory of Executive Function, Second Edition (BRIEF 2) questionnaire, with its Spanish adaptation by Maldonado et al. (Gioia et al., 2017). Its application allows scores to be obtained on nine executive scales (inhibition, flexibility, emotional control, initiative, working memory, planning, self-supervision, organisation of materials and task supervision). The BRIEF-2 test (family version) uses a 63-item Likert-type questionnaire (never, sometimes, frequently) answered by both parents. Finally, it should be noted that the reliability indicated by Cronbach's alpha index is above 0.85 for all its values, which denotes high reliability.

2.3. Procedure

Following the ethics protocols, first, the school's authorization and collaboration were obtained. Subsequently, the research design was presented to the Research Ethics Committee of the Autonomous Community of Aragón (CEICA), which obtained a favorable resolution on February 27, 2019, with issuance code "No. 04/2019". Subsequently, the information and authorization for participation were sent to families through the informed consent document to guarantee data confidentiality and

participants' anonymity. The Guidance Department collaborated in the tasks to implementation and evaluation tests. The different tests were applied during tutoring hours by the main researcher with the collaboration of different tutors. Sessions lasted 45 minutes. All these actions were performed at the end of the third trimester of academic year 2018-2019.

2.4. Statistical analyses

First, a descriptive statistical analysis was carried out on the variables under study. Subsequently, as the distribution analysis confirmed that all the variables followed normal distribution, we proceeded to analyze the relation between the variables (academic performance, reasoning, verbal fluency, motivation, self-esteem and executive functions) with Pearson's correlations. Third, a regression analysis was performed to determine the established model's predictive power by taking reasoning, verbal fluency, motivation, self-esteem and executive functions as independent variables, and academic performance as the dependent variable. Once this predictive model was verified, five mediation analyses were performed between the independent variables for academic performance. Here the purpose was to determine how, in addition to a direct relation model, indirect models could be implemented, where each variable internally interacted with the others by mediating their relation with the dependent variable (following the recommendations of Walters and Mandracchia, 2017 for the ordering of causal relationships and their direction). Analyses were carried out with the statistical program IBM SPSS Statistics Viewer 25 and the macro PROCESS (Preacher & Hayes, 2008), which allowed the mediation analysis of the variables by starting with 5000 samples and a 95% confidence level (Hayes, 2012).

3. Results

First a descriptive and correlational analysis was carried out with academic performance, reasoning, verbal fluency, motivation, self-esteem and executive functions. Academic performance correlated positively and significantly with all the independent variables, especially with reasoning (Table 1; $r = .602$; $p < .01$). However, the

variables of reasoning, verbal fluency and executive functions (all of a cognitive nature) did not correlate with one another, but the behavioral and emotional variables of motivation and self-esteem did (r = .321; p <.01). Instead reasoning correlated with self-esteem (r = .217; p <.05), and executive functions correlated with self-esteem (r = .254; p <.01) and motivation (r = .237; p < .05).

Table 1. Descriptive data and correlations among reasoning, verbal fluency, motivation, self-esteem, executive functions and academic performance.

	M	SD	1	2	3	4	5	6
1. Academic performance	7.88	1.034						
2. Reasoning	70.14	19.003	.602**					
3. Verbal Fluidity	80.920	30.48	.326**	.133				
4. Motivation	35.33	8.435	.218*	0.97	0.18			
5. Self-esteem	41.310	7.386	.426**	.217*	.156	.321**		
6. Executive Functions	89.310	17.842	.392**	148.	0.50	.237*	.254	

***p<.001; **p<.01; *p<.05

A second statistical analysis was carried out through regression models in which all the studied variables were included to assess their predictive power on academic performance (Table 2). The successive steps method was applied, which included the reasoning variables (β = .479, p <.001), executive functions (β = .258, p <.001), verbal fluency (β = .234, p <. 001) and self-esteem (β = .214, p <.001). Only motivation was left out of the model because it was not significant. This model explained 55.4% of variance. Therefore, an increase in reasoning ability, verbal fluency and a good development of executive functions and self-esteem would improve academic performance.

Table 2. Linear regression models of the academic performance variable

		Standardized Coefficients			
	R^2	SE	β	t	Sig.
Model 1	.370	.8388		19.294	< .001
Reasoning			.613	8.210	< .001
Model 2	.460	.7765		15.199	< .001
Reasoning			.566	8.097	< .001
Executive functions			.310	-4.438	< .001
Model 3	.517	.7348		14.015	< .001
Reasoning			.522	.7757	< .001
Executive functions			.305	-4611	< .001
Verbal Fluidity			.248	3734	< .001
Model 4	.554	.7056		8.555	< .001
Reasoning			.479	7.266	< .001
Executive functions			.258	-3.953	< .001
Verbal Fluidity			.234	3.646	< .001
Self-esteem			.214	3.211	.002

Next we analyzed the direct and indirect interactions between the independent variables of the predictive model, and even the excluded variable (motivation), in its relation with academic performance to know if there was any mediating action. Self-esteem emerged as a mediator for the cognitive factors, such as reasoning and executive functions, but also for motivation (Figure 1). The mediation of self-esteem between reasoning and academic performance explained 45.2% of variance. In addition, when self-esteem mediated the relation between executive

functions and academic performance, it explained 26.5% of variance. The mediation of self-esteem on motivation predicted 19.8% of variance for academic performance. Therefore, the students with high values for reasoning, executive functions and motivation would have higher self-esteem values which would, in turn, imply better overall grades.

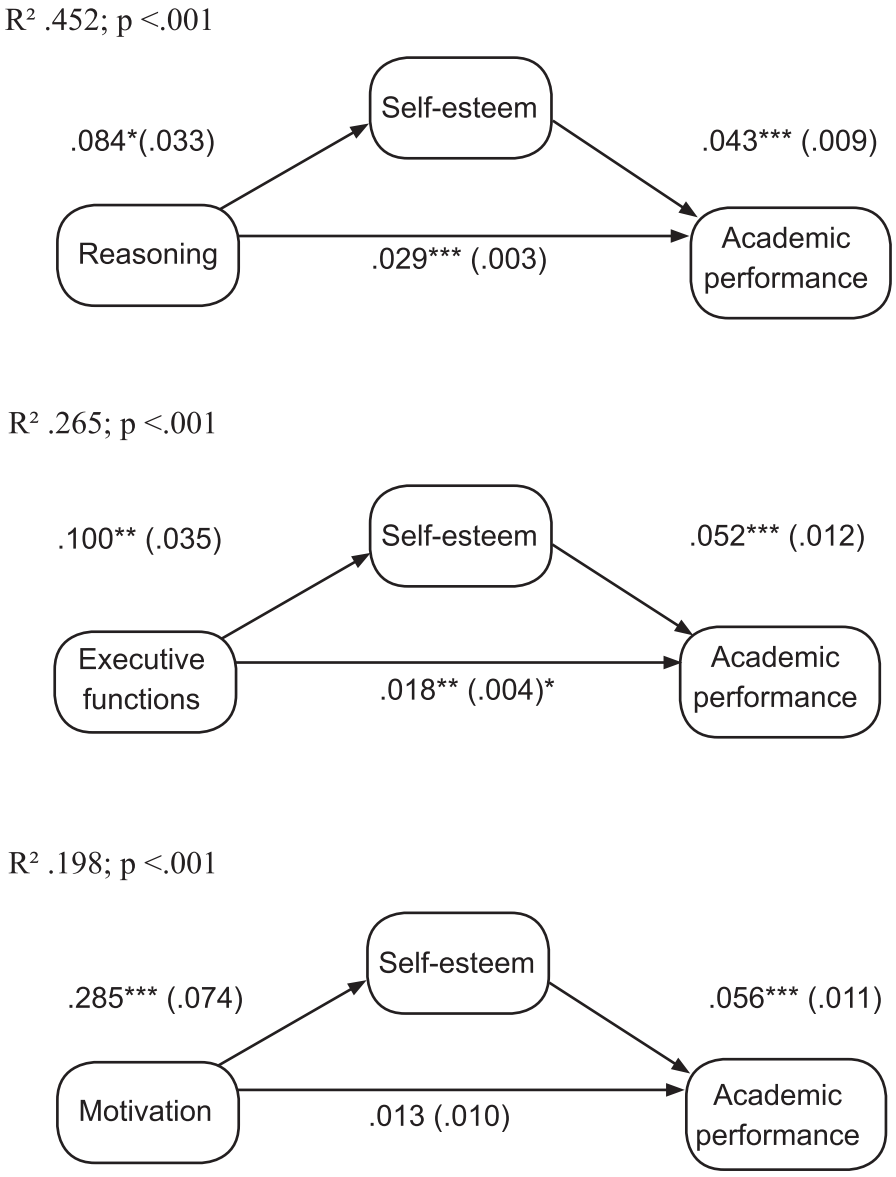

Figure 1. Mediation models: Self-esteem as a mediating variable.

***p<.001; **p<.01; *p<.05

The second mediating variable was executive functions, which acted on the relation between motivation and self-esteem (Figure 2). This mediation model, between motivation and academic performance, explained 18.8% of the academic results and, between self-esteem and academic performance, 26.5%. Thus the students with higher self-esteem and motivation would obtain better results in the evaluation tests of executive functions which would, in turn, imply obtaining better academic results. Therefore, despite the fact that executive functions were good mediators between the behavioral and emotional variables and academic performance, the strongest mediational effect was self-esteem.

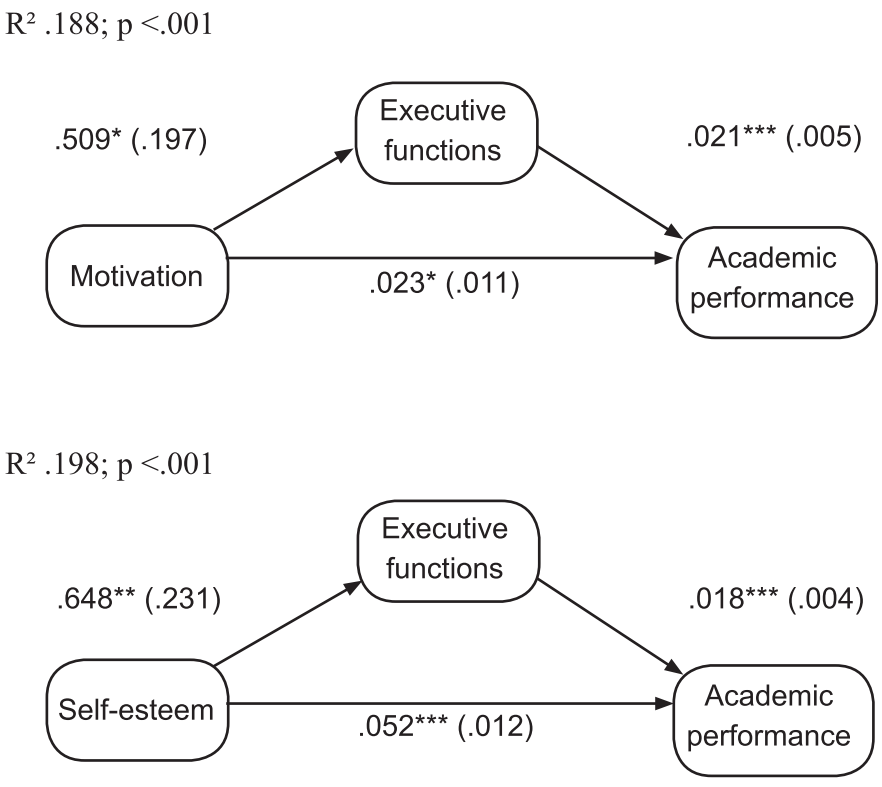

Figure 2. Mediation models: Executive Functions as a mediating variable.

***p<.001; **p<.01; *p<.05

4. Discussion

The objective of this study was to investigate the relation, the predictive value and the mediating effect among the cognitive (reasoning, verbal fluency and executive functions), behavioral (motivation) and emotional (self-esteem) variables on Primary Education pupils' (6-9 years old) academic performance. Our findings indicate that this relation was powerful with reasoning ($r = .602$; $p < .01$), although self-esteem also had a strong impact ($r = .426$; $p < .01$). Therefore, together with an intelligence-related factor like reasoning, self-esteem as an emotional variable is capable of explaining academic results (Bryce et al., 2015; Cid-Sillero et al., 2020). Both reasoning and the verbal component are considered the basis for good school achievement (Schneider & McGrew, 2012), but the results of this study are not consistent because verbal fluency ranks fourth for academic performance. Moreover, self-esteem emerging in reference to learning is linked with attention, motivation to learn and behavioral regulation (Rhoades et al., 2011). Hence the self-esteem of those students who do not feel very effective is low and their school performance is poor while, on the contrary, better self-esteem is related to academic success (Birkeland et al., 2012; Greene & Way, 2005). These results suggest that reasoning, verbal fluency, executive functions, motivation and self-esteem contribute to academic performance. Therefore, the first hypothesis of this study is fulfilled by obtaining a significant relation between all the independent variables and academic performance.

The model that comprises reasoning, executive functions and verbal fluency predicts 51% of the variance for academic performance. However, this model's effectiveness increases when the self-esteem variable is added, and predicts 54% of school performance. Although school success was traditionally explained by subjects' cognitive capacity or intelligence, together with reasoning and verbal fluency, executive functions appear, which are equally placed with intelligence for its predictive power of academic performance (Ren et al., 2015; Willoughby et al., 2019). In addition, executive function contributes to students' use of cognitive skills (Bryce et al., 2015). The results of this research show that our second hypothesis is partially

fulfilled because, although reasoning, verbal fluency and executive functions are considered cognitive-type variables, and they represent most of the predictive model, there is a clear differentiation in them being manifested in no relation existing among these three variables, despite the fact that together they predict more than 50% of school performance. Along these lines, Gioia et al. (2017) pointed out that executive functions should not be studied only from a cognitive perspective, but their composition includes behavioral and emotional factors, as suggested by the results herein obtained. One example of this lies in how important self-esteem is in the predictor model.

On the mediating role of self-esteem and executive functions, previous research confirms our results because self-esteem has a direct effect on reasoning, executive functions and motivation with academic performance, and executive functions do so on motivation and self-esteem. Cognitive reasoning ability allows problem solving and obtaining desired success, which facilitate the development of healthy self-esteem (Nascimento & Peixoto, 2012), but self-esteem also reinforces reasoning ability (Evans, 2003; McArthur et al., 2016). The relation with verbal fluency does not seem so clear as the intervention of other variables is necessary (Moyano et al., 2020; Nie et al., 2017). The mediating effect of self-esteem on executive functions is indicated in the research by Gioia et al. (2017), who pointed out that behavioral, emotional and social aspects also appear in the development of executive functions. Regarding the mediating effect of self-esteem between motivation and academic performance, their interrelation is indicated insofar as students with good performance perceive their self-esteem to increase and feel, in turn, increasingly motivated to perform their academic tasks (Kaplan et al., 1994; Masselink et al., 2017; Regueiro et al., 2015). It should not be forgotten that both motivation and self-esteem have a social component that might vary depending on the context in which they are found (Kiviruusu et al., 2016). The scientific literature has also attributed a mediational character to executive functions in relation to academic performance, but has pointed it out for variables like cognitive skills, motor skills or physical fitness (Aadland et al., 2017; Bruijn et al., 2018; Bryce et al., 2015). The-

refore, our third hypothesis is not fulfilled because the variable with the strongest mediational effect is self-esteem, and not executive functions.

5. Conclusions and Limitations

In conclusion, this study shows how academic performance depends on variables that are cognitive, motivational and emotional in nature. This leads to a mixed predictive model and, in turn, highlights the mediating role of self-esteem among reasoning, executive functions and motivation with academic performance. In relation to the analyzed multifactorial constructions and, despite the relevance that cognitive variables have traditionally had on learning and academic performance, they are not the only ones capable of building an effective predictive model. In fact as this work shows, cognitive factors can become more effective through emotional factors like self-esteem which, in turn, is improved by other variables like executive functions. A feedback relation is established and, therefore, one of flexibility and counterbalance, by emphasizing both types of factors as being malleable and, hence, not static. One of our research contributions, compared to the many studies that have focused on adolescence or on late childhood, is that it centers on younger ages (6-9 years). This age group undergoes neurocognitive maturation and psychosocial development, which are important for someone's integral development. However, the results may be biased because this study is cross-sectional and includes a convenience sample that should be increased.

This leads to important implications for the theoretical and practical field, such as the need to develop specific educational plans to improve motivation and self-esteem in Primary Education pupils, and the essential evaluation and monitoring of cognitive factors like reasoning, fluency verbal and executive functions for their importance in academic performance at early ages (Cortés et al., 2019). Although the presented predictive models well account for variance, it should be noted that other variables not dealt with in this document, such as teacher profile, learning styles or parental control, would help to more precisely explore the multidetermined nature of school performance, which is one of the limitations of our study. Therefore, future research should consider introducing socio-economic, family and personality varia-

bles to complete the predictor model. It is also necessary to increase our studied sample size and to carry out a longitudinal design to generalize the obtained results to reach a higher level of involvement.

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Declaration of compliance with ethical principles

The authors declare compliance with ethical principles, having submitted the research to be inspected by the Research Ethics Committee of the Autonomous Community of Aragon (CEICA)

Certification of authorship

Conceptualización, A.Q.-R., N. M. and A.C.P.; formal analysis, A.Q.-R. and N. M.; research, A.Q.-R.; writing: preparing, revising and editing of the original drafts, A. Q.-R., N. M. and A.C.P. All the authors read and accepted the published version of the manuscript.

4.1.4. CAPÍTULO IV: La influencia del estilo de enseñanza en el estilo de aprendizaje, la motivación y la autoestima en Educación Primaria

4.1.4.1. Estudio 6: Estilos de enseñanza-aprendizaje e influencia en la motivación y la autoestima

4.1.4.2.

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Estilos de enseñanza-aprendizaje e influencia en la motivación y la autoestima

Teaching-learning styles and influence on motivation and self-esteem

Resumen

La literatura científica señala que no existen modos fijos de aprendizaje, ni de enseñanza, así como la información tampoco es recibida por un solo canal de entrada. Por ello, el propósito de este estudio fue analizar la relación entre el estilo de enseñanza, el estilo de aprendizaje, la motivación y la autoestima en alumnos de 6 a 9 años, así como, las posibles diferencias en función del estilo de enseñanza y del estilo de aprendizaje con respecto a la motivación y la autoestima. La muestra de 134 alumnos de 1º, 2º y 3º de Educación Primaria respondió al test VAK, Cuestionario MAPE-II y Escala de Autoestima de Coopersmith. Los docentes cumplimentaron el cuestionario Teching Styles Inventory. Los resultados señalan una relación significativa del estilo de enseñanza con el estilo de aprendizaje (.195*) y con la motivación por el resultado (.233**) y, del estilo de aprendizaje con la motivación (.182*) y la autoestima (-227**). Y, una diferencia significativa del estilo de enseñanza innovador y mixto con los estilos de aprendizaje kinestésico y mixtos y, con la motivación por el resultado. Además, el estilo de aprendizaje visual presenta diferencias significativas en relación a la baja autoestima. Todo ello sugiere implicaciones de prácticas educativas adaptadas a las diferentes situaciones y tareas y estimular los diferentes canales de entrada de la información para mejorar el conocimiento, la comprensión y las habilidades de los discentes.

Abstract

The scientific literature indicates that there are no fixed modes of learning or teaching, nor is information received through a single input channel. Therefore, the purpose of this study was to analyse the relationship between teaching style, learning style, motivation and self-esteem in pupils aged 6 to 9 years, as well as possible differences according to teaching style and learning style with respect to motivation and self-esteem. The sample of 134 pupils from 1st, 2nd and 3rd years of Primary Education answered the VAK test, MAPE-II Questionnaire and Coopersmith's Self-Esteem Scale. The teachers completed the Teching Styles Inventory questionnaire. The results show a significant relationship between teaching style and learning style (.195*) and outcome motivation (.233**), and between learning style and motivation (.182*) and self-esteem (-227**). And, a significant difference of innovative and blended teaching style with kinaesthetic and blended learning styles and with outcome motivation. In addition, the visual learning style shows significant differences in relation to low self-esteem. All this suggests implications of educational practices adapted to different situations and tasks and stimulating different channels of information input to improve learners' knowledge, understanding and skills.

Palabras clave / Keywords

estilo de enseñanza, estilo de aprendizaje, motivación por el resultado, autoestima.
teaching style, learning styles, motivation for the result, self-esteem.

1. Introducción

Con la introducción en el ámbito educativo de metodologías activas y procesos de innovación educativa han emergido estudios sobre variables que describen características personales del educador y del educando como son el estilo de enseñanza, los estilos de aprendizaje, la motivación y la autoestima (Dash et al., 2020; Locke & Schattke, 2019; Sprock, 2018). Todo ello dirigido hacia la intervención educativa que tiene como finalidad mejorar el aprendizaje del alumnado, que debe ser significativo, promoviendo el desarrollo integral de la persona y, apostando por un escuela diversa e inclusiva.

El conjunto de principios, estrategias y comportamiento de la persona que enseña y, que de manera indiscutible se refleja en las metodologías empleadas en el aula, se denominará estilo de enseñanza (Grasha, 2002). Para Grasha & Yangarber-Hicks (2000) existen cinco estilos de enseñanza: el experto, el autoritario, el demostrador, el facilitador y el delegador. El profesor experto posee conocimientos; el autoritario ejerce un rol de administrador de reglas estrictas para guiar al estudiantado; el demostrador sigue un modelo propio que en su opinión es el más efectivo; el facilitador, ejerce de guía para que los discentes desarrollen criterios propios y tomen sus propias decisiones; por último, el delegador fomenta la autonomía y el trabajo independiente. Dentro de estos cinco estilos de enseñanza, algunos autores los agrupan en dos estilos. Uno comprendería el estilo experto, autoritario y demostrador al asimilarse con un enfoque de enseñanza tradicional centrada en el maestro. Otro grupo estaría formado por el estilo facilitador y delegador que estarían centrados en el alumno y se asimilaría a un enfoque de enseñanza innovadora (Dash et al., 2020). Por lo tanto y simplificando hablaremos de estilo de enseñanza tradicional y estilo de enseñanza innovadora, señalando que existirán estilos mixtos que combinarán distintos estilos. En el estilo de enseñanza tradicional el educador pasa a ser un mero transmisor de conocimientos, no exento de cierto autoritarismo, que implementa metodologías de corte conductista (Delord & Porlán, 2018; Sead, 2013). El estilo de enseñanza innovador concibe la educación como un proceso de desarrollo del potencial del alumno, el cual, se convierte en el protagonista de su propio aprendizaje. Prepara para la vida, no para los exámenes y favorece la autonomía, la creatividad y la actitud crítica. Busca aumentar el interés en el discente y promueve su compromiso con el proceso de aprendizaje. El maestro se convierte en guía, creador de oportunidades para el aprendizaje (Delord & Porlán, 2018; Tularan & Machisella, 2018). No obstante, son numerosas las ocasiones en que los educadores utilizan estrategias y metodologías variadas apareciendo un estilo de enseñanza de carácter mixto, dónde se entrecruza la transmisión de conocimientos en clases magistrales, con el fomento de la autonomía y la utilización de las nuevas tecnologías de la información (TIC) para fomentar la motivación y complementar contenidos (Dash et al., 2020).

Así mismo, el estilo de aprendizaje es el conjunto de métodos para recopilar, procesar, interpretar y organizar la información, pero considerando que cada individuo tiene un estilo diferente de aprendizaje que se manifiesta en la manera de absorber, procesar y retener la nueva información (Díaz Mosquera, 2012). Por todo ello esta variable no debe considerarse como una habilidad en si misma sino en la forma que cada uno tiene de utilizar las habilidades de pensamiento (Sternberg, 1994). Esto supone que no serán modos fijos de comportamiento, sino que pueden cambiar y adaptarse a las diferentes situaciones y tareas a realizar (Griffiths, 2012; Sprock, 2018). El modelo de Programación Neurolingüística de Bandler y Grinder (1982, 1988), conocido por modelo visual-auditivo-kinestésico (VAK) se basa en los tres grandes sistemas en que se representa mentalmente la información recibida. El sistema visual establece relaciones entre ideas y, conceptos y posee capacidad de abstracción y, planificación. El sistema auditivo recuerda de manera secuencial y ordenada, pero lenta, no relacionando ni elaborando conceptos abstractos. Por último, el sistema kinestésico procesa la información mediante sensaciones y movimientos. Es un aprendizaje más lento, pero más profundo (Sprock, 2018; Tocci, 2013). Por lo tanto, se hablará de estilo de aprendizaje visual, auditivo y kinestésico con variables que combinarán varios de ellos. Las implicaciones educativas de este paradigma no han estado exentas de controversia (An & Carr, 2017; Newton & Miah, 2017). Algunos autores defienden los estilos de aprendizaje como una herramienta útil para la enseñanza dentro del aula (por ejemplo, Murray, 2011; Murthy et al., 2013; Sternberg et al., 2008), otros lo rechazan por considerar que adaptar la enseñanza a los estilos de aprendizaje individuales no aportaba mejores resultados en el aprendizaje (por ejemplo, Willingham et al., 2015).

En cuanto a la motivación se puede definir como la implicación de una serie de procesos en la activación de la conducta en una dirección, dónde intervienen la estimulación que se recibe del medio ambiente y las condiciones del medio interno (Locke & Schattke, 2019). La motivación está dirigida por intereses y valores hacia la consecución de una meta que presenta comportamientos de carácter autónomo (interés) y controlado (contexto) (Cook & Arino, 2016; Ryan & Deci, 2020). Para Montero y Alonso (1992) existen tres dimensiones

en la motivación: la motivación por el aprendizaje (impulsada por la satisfacción de la propia tarea), la motivación por el resultado (búsqueda de prestigio y reconocimiento) y el miedo al fracaso (falta de confianza en su propia capacidad). Por lo tanto, la motivación por el aprendizaje y la motivación por el resultado, la primera dirigida al disfrute y la segunda a la demostración de la propia valía, explicarían la constancia, el esfuerzo y, la iniciativa del alumnado en el contexto educativo (Moyano et al., 2020).

Por otro lado, la autoestima se refiere al modo en cómo se valora la persona, la percepción que de sí misma tiene para alcanzar los objetivos planteados (Kiviruusu et al., 2016; Orth & Robins, 2019). Una alta autoestima genera confianza en las propias capacidades. Por el contrario, la baja autoestima provoca sentimientos de fracaso y frustración (Birkeland et al., 2012; López, 2017). El contexto escolar donde se desarrolla el aprendizaje (maestros, compañeros, organización, etc.) influye de manera significativa en la autoestima del alumnado (Hyseni Duraku & Hoxka, 2018). El estudio realizado por Ferradás et al. (2019) establece cuatro perfiles en función de la motivación y la autoestima (alta o baja). Paradójicamente, para estos autores, las bajas expectativas llevan a la realización de un trabajo duro por parte de los estudiantes que generalmente conlleva alcanzar el éxito académico. Esta relación con el proceso de aprendizaje posibilita un mayor conocimiento del mismo, pero la unión de estas variables también resulta un buen factor predictor del aprendizaje de los estudiantes (Kriegbaum et al., 2018).

El estilo de enseñanza y en consecuencia las metodologías que se aplican en el aula son motivo de estudio dado que algunas inciden más positivamente que otras en el aprendizaje. En este sentido dependiendo de la metodología que se emplee, se estimulará mayor capacidad en alguno de los canales perceptivos: visual, auditivo o kinestésico (Reyes et al., 2017). Estudios previos han señalado que aquellas metodologías con mayor implicación y autonomía del alumnado permiten mejores resultados que en aquellas donde el alumno tiene un papel más pasivo y menos autónomo (Byers et al., 2018). Además, el estilo de enseñanza innovador y creativo que permite al estudiante una participación activa y cooperativa promueve una alta motivación que estimula el aprendizaje (Isaza & Henao, 2012). En los últimos años son numerosos los defensores de la innovación educativa como una lucha contra lo mecánico y rutinario de la educación tradicional (Imbernón, 2012). Si bien no se ha podido comprobar que el aprendizaje sea ni más rápido ni más efectivo, sí que es cierto, que brinda herramientas que pueden favorecer el aprendizaje y que son difíciles de aplicar en clases tradicionales como sería el caso de adaptar contenidos a los distintos estilos de aprendizaje de los alumnos (Tularan & Machisella, 2018). Por otro lado, los educadores son conscientes de que su estilo de enseñanza puede llegar a motivar a los estudiantes hacia la curiosidad científica (Dash et al., 2020). En ese sentido hay una percepción generalizada que señala que una metodología innovadora ayuda a mantener la motivación y la atención, no obstante, se defiende la combinación con la metodología tradicional al considerarse de utilidad (Beltrán-Valls et al., 2020). Además, estudios como el de Solar et al. (2010) evidencian que la autoestima escolar está altamente relacionada con un estilo de aprendizaje profundo y elaborado mientras que la autoestima general se relacionará mejor con un estilo activo. Del mismo modo García Colión (2019) señala que el discente con un nivel alto de autoestima tiende a utilizar un estilo de aprendizaje de tipo reflexivo vinculado con procesos cognitivos más complejos.

Con base en lo expuesto anteriormente el estilo de enseñanza emerge como determinante motivacional y en cierta manera como facilitador de ciertos estilos de aprendizaje que se relacionan con la autoestima. A pesar de que se han investigado (sobre todo a nivel universitario) los diferentes estilos de enseñanza clasificándolos en: experto, autoritario, demostrador, facilitador y delegador (Dash et al, 2020; Grasha & Yangarber-Hicks, 2000), el presente estudio se interesa por la influencia que un estilo de enseñanza tradicional (experto, autoritario y demostrador) o un estilo de enseñanza innovador (facilitador y delegador) ejercen en el estilo de aprendizaje en alumnos de Educación Primaria (6-9 años) y el efecto que los mismos ejecutan sobre la motivación y la autoestima. Por lo tanto, surge la pregunta de sí en un estilo de enseñanza innovador es más factible que, en un estilo de enseñanza tradicional, adaptar los contenidos a los distintos estilos de aprendizaje de los alumnos para conseguir mayor motivación por el aprendizaje y aumentar la autoestima del alumnado. Todo ello con la finalidad de mejorar las competencias pedagógicas e implantar estrategias de enseñanza-aprendizaje en las aulas de Educación Primaria.

De esta forma, las hipótesis de investigación son las siguientes:

H1: Se espera encontrar una relación significativa entre las variables de estilo de enseñanza, estilos de aprendizaje, motivación y autoestima.

H2: Se espera encontrar diferencias significativas a favor del estilo de enseñanza innovador respecto al desarrollo de estilos de aprendizaje kinestésico y mixtos.

H3: Se espera encontrar diferencias significativas a favor del estilo de enseñanza innovador respecto al desarrollo de una alta motivación y autoestima.

H4: Se espera encontrar diferencias significativas a favor de los estilos de aprendizaje kinestésico y mixto en su relación con una buena motivación por el resultado y la autoestima.

2. Metodología

2.1. Participantes

El método de muestreo fue de carácter incidental y por conveniencia resultando una muestra de 134 estudiantes (47.1% niñas; 53.9% niños) con edades comprendidas entre los 6 y 9 años (*M*=7.52) y, pertenecientes a los cursos de 1º (31.2%), 2º (35.5%) y 3º (33.3%) de Educación Primaria. La muestra estaba distribuida en nueve aulas (de un mismo centro educativo) de tal forma que en los maestros estuvieran representados los tres tipos de estilos de enseñanza (innovador, mixto y tradicional).

2.2. Instrumentos

Para medir el estilo de enseñanza se utilizó el cuestionario Teching Styles Inventory o TSI (Grasha & Rierchman, 1996), el cual presenta cinco tipos de estilos diferentes: experto, autoritario, demostrador, facilitador y delegador. A este cuestionario se le ha realizado una pequeña adaptación, al agrupar las respuestas correspondientes al estilo experto-autoritario-demostrador en estilo de enseñanza tradicional y las respuestas correspondientes al estilo facilitador-delegador en estilo de enseñanza innovador ya que se adaptaban a los conceptos que se manejan sobre educación tradicional y educación innovadora. Consta de 40 ítems orientados a determinar la preferencia de enseñanza. Cada uno de ellos se contesta SI/NO. Un ejemplo de tipo de pregunta es: ¿los conceptos son lo más importante en el aprendizaje del estudiante? (respuesta afirmativa: estilo experto). Para hallar el estilo de enseñanza predominante se suman las puntuaciones asignadas a cada ítem y el estilo que mayor puntuación obtenga es el que le corresponde al educador. La revisión de las propiedades psicométricas de la prueba, utilizando el alfa de Cronbach, constató que el coeficiente de fiabilidad y consistencia interna varía entre 0.5 y 0.7 de promedio (Ó Fathaigh, 2000).
La variable estilos de aprendizaje se midió mediante el cuestionario VAK (Bandler & Grinder, 1982, 1988) que permite conocer el canal de aprendizaje predominante en el educando: visual, auditivo y kinestésico. A través de la PNL (Programación Neurolingüística) facilita la comprensión de las vías de entrada, procesamiento y salida de la información preferentes para el individuo. Se considera un instrumento rápido y fácil de comprender teniendo en cuenta la edad de los participantes. Consta de 40 ítems donde no existen preguntas correctas o erróneas, sino que la respuesta dada conforma un perfil de aprendizaje. Se valora por 0, 1 o 2 cada respuesta y el total de puntuación se traslada a la tabla que indica el canal sensorial predominante en el alumno. Los resultados de las respuestas pueden dar lugar a estilos mixtos (por ejemplo, auditivo-kinestésico). El nivel de confiabilidad según la prueba de Alfa de Cronbach es de 0.85.
El instrumento de medida para la motivación fue el Cuestionario de Motivación hacia el aprendizaje y la ejecución (MAPE-II) (Montero & Alonso, 1992) que consta de 74 ítems y plantea opciones de respuesta sí/no. Se distribuye en tres dimensiones: motivación para el aprendizaje (43 ítems), motivación por el resultado (25 ítems) y miedo al fracaso (12 ítems). Este instrumento, según sus autores, presenta índices de fiabilidad adecuados según la prueba Alfa de Cronbach que oscilan entre 0.75.
En cuanto a la autoestima, se utilizó la Escala de Autoestima de Coopersmith (Coopersmith, 1967) en su versión escolar y adaptada al español (Miranda et al., 2011). Consta de 58 ítems de respuesta rápida (verdadero / falso) y referidos al nivel de aceptación de tipo académico en relación a los demás. Una puntuación alta indica una percepción alta de sí mismo. Los valores Alfa de Cronbach indicaron un nivel de fiabilidad del 0.81 para la escala global, entendiendo estos valores como una fiabilidad alta.

2.3. Procedimiento

En todo momento se siguieron los protocolos de ética establecidos obteniendo, en primer lugar, la autorización y colaboración de la escuela. Posteriormente, se presentó y solicitó evaluación de la investigación al comité de ética de investigación de la Comunidad Autónoma de Aragón (CEICA) obteniendo resolución favorable el 27 de febrero de 2019, con código de expedición “No 04/2019”. A continuación, se procedió a la explicación del proyecto a las familias y petición de participación a través de una carta de consentimiento informado garantizando la confidencialidad de los datos y el anonimato. También se solicitó a los profesores implicados su aceptación a colaborar en el estudio. Para el desarrollo de la evaluación e implantación de las pruebas se contó con la colaboración de los miembros del Departamento de Orientación del centro motivo de estudio.

Las pruebas se aplicaron en el último trimestre del curso 2018-2019, llevándolas a cabo en las primeras horas de la mañana y en sesiones de 45 minutos.

2.4 Análisis estadístico

Se comenzó con un análisis estadístico de carácter descriptivo sobre las variables motivo de estudio. Posteriormente, se llevaron a cabo correlaciones de Spearman para confirmar hipótesis de relación entre variables. Finalmente, las variables que mostraron significatividad en el estudio de correlación fueron sometidas a un análisis comparativo de varianza ANOVA. En primer lugar, se analizó la diferencia existente entre los estilos de aprendizaje, la motivación por el resultado y la autoestima en relación al estilo de enseñanza. Posteriormente se analizaron las diferencias en motivación por el resultado y autoestima en función del estilo de aprendizaje. Los análisis se elaboraron con el programa estadístico IBM SPSS Statistics Visor 25.

3. Resultados

En primer lugar, se llevó a cabo un análisis descriptivo (Tabla 1) y correlacional (Tabla 2) entre las variables motivo de estudio (estilo de enseñanza; estilos de aprendizaje; motivación en sus tres dimensiones: por el aprendizaje, por el resultado y miedo al fracaso; y autoestima). El estilo de enseñanza correlacionó de forma significativa con los estilos de aprendizaje (ρ = .195; p< .05) y con la motivación por el resultado (ρ = .233; p< .05), pero no lo hizo ni con la motivación por el aprendizaje, ni con el miedo al fracaso (dimensiones de la motivación), ni con la autoestima. A su vez, los estilos de aprendizaje correlacionaron, además, con la motivación por el resultado (ρ = .182; p< .05) y con la autoestima (ρ = -.227; p< .01). En esta última la correlación es inversa por lo que la relación se establecerá con la baja autoestima. La primera hipótesis se cumple parcialmente.

Tabla 1
Estadísticos descriptivos sobre las variables de estudio.

	N	Mínimo	Máximo	Media	Desv. Estándar
Estilo de Enseñanza	15	1	3	2.03	0.825
Estilos de aprendizaje	134	1	4	2.14	1.042
Motivación por el resultado	134	1	21	11.93	4.550
Autoestima	134	14	54	41.31	7.386

Tabla 2
Correlaciones entre variables motivo de estudio

		1	2	3	4
Rho de Spearman	1. Estilo de Enseñanza				
	2. Estilo de Aprendizaje	.195*			
	3. Motivación por el Resultado	.233**	.182*		
	4. Autoestima	-.131	-.227**	-.151	

* p<.05
** p<.01 (bilateral).

El análisis ANOVA realizado para comprobar sí el estilo de enseñanza influye en los estilos de aprendizaje, en la motivación por el resultado y en la autoestima (Tabla 3), se aprecia que, de forma parcial (segunda y tercera hipótesis), ya que se encuentran diferencias significativas en la influencia del estilo de enseñanza respecto a los estilos de aprendizaje (F= 3.309; p<.05) y la motivación por el resultado (F= 3.166; p<.05), pero no ante la autoestima (F=1.259; p=.287). De tal manera que, un estilo de enseñanza innovador influye directamente sobre la motivación por el resultado haciendo que ésta aumente (M = 13.22; DT = 4.638) es decir, el educando parece que encuentra motivos sustanciales para dar importancia a su resultado en la tarea. En cambio, un estilo de enseñanza tradicional basado en el método repetitivo provoca una menor motivación por el resultado en los estudiantes (M=10.91; DT= 4.242).

Tabla 3

El perfil docente en los estilos de aprendizaje, en la motivación y en la autoestima

ANOVA

	Suma de cuadrados	gl	Media cuadrática	F	Sig.
Estilos de aprendizaje	6.943	2	3.471	3.309	0.040
Motivación por el resultado	126.825	2	63.413	3.166	0.046
Autoestima	136.910	2	68.455	1.259	0.287

Los resultados señalan que el estilo de enseñanza también marca la consolidación o mezcla de estilos de aprendizaje siendo los más vinculados, a los estilos de enseñanza innovador y mixto, el estilo kinestésico o el mixto kinestésico-auditivo y kinestésico-visual (68% de los estudiantes poseían alguno de estos estilos de aprendizaje). En cambio, cuanto más se acerca al estilo de enseñanza tradicional más proliferan los estilos de aprendizaje de carácter visual o mixto visual-auditivo (92% de los alumnos que contaban con un docente de corte tradicional presentaban estos estilos de aprendizaje).
En cuanto a la cuarta hipótesis sobre la influencia del estilo de aprendizaje sobre la motivación y la autoestima (Tabla 4) los resultados señalan que sí lo hace sobre la autoestima (F=3.438; p<.05), pero no sobre la motivación por el resultado (F= 1.977; p=.121). Esto indica que, existe diferencia significativa en la autoestima de los estudiantes en función de su estilo de aprendizaje. En esta ocasión, es el estilo de aprendizaje visual el que proporciona mejores medias sobre la autoestima (M= 43.652; DT= 7.914) seguido de los estilos mixtos (M= 42.411; DT= 4.861), los auditivos (M=39.432; DT= 8.341) y kinestésicos (M= 39.258; DT= 5.378). Por lo tanto, la baja autoestima se vería más influenciada por el estilo de aprendizaje visual y mixto.

Tabla 4
El estilo de aprendizaje en la motivación y en la autoestima

ANOVA

	Suma de cuadrados	gl	Media cuadrática	F	Sig.
Motivación por el resultado	120.793	3	40.264	1.977	0.121
Autoestima	533.607	3	177.869	3.438	0.019

y las subsecciones (1.1, 1.2., etc.). Las citas en el texto deben seguir las indicaciones de la 7ª Edición de APA.

4. Discusión

El objeto de este estudio ha sido investigar la relación entre el estilo de enseñanza, el estilo de aprendizaje, la motivación y la autoestima. También interesaba conocer la existencia de diferencias significativas en los estilos de aprendizaje, la motivación y la autoestima en función del estilo de enseñanza. Y, también, la diferencia en la motivación por el resultado y la autoestima según el estilo de aprendizaje predominante en los estudiantes. Los resultados concluyen con la existencia de una relación de baja a moderada entre el estilo de enseñanza y el estilo de aprendizaje y la motivación por el resultado. También se encuentra relación de baja a moderada entre el estilo de aprendizaje y la motivación por el resultado y la autoestima. La diferencia significativa se presenta a favor del estilo de enseñanza innovador tanto para los estilos de aprendizaje como para la motivación por el resultado y también entre el estilo de aprendizaje visual y mixto y la baja autoestima. De esta investigación resulta que el estilo de enseñanza tradicional se relaciona con los estilos de aprendizaje visual y mixto visual-auditivo (92%). En cambio, los estilos de aprendizaje más vinculados al estilo de enseñanza innovador y al mixto son el estilo kinestésico o el mixto kinestésico-auditivo y kinestésico-visual (68%). El estilo de enseñanza tradicional al utilizar exclusivamente una metodología expositiva se asocia con el estilo de aprendizaje visual, ya que es la forma en que representa mentalmente la información recibida relacionando ideas y conceptos, y el auditivo, que recuerda de manera secuencial y ordenada la información. El estilo de enseñanza mixto, además de la clase magistral, se apoya en las nuevas tecnologías (TICS) por lo que se añade un nuevo canal que será el kinestésico que procesa la información mediante sensaciones y movimientos. Por último, el estilo de enseñanza innovador introduce metodologías activas y manipulativas como pueden ser el aprendizaje por proyectos, o el colaborativo estimulando varios canales de entrada de la información siendo el estilo de aprendizaje preferente el kinestésico junto con los mixtos kinestésico auditivo y visual (Beltran-Valls, et al., 2020; Sprock, 2018; Tocci, 2013; Velasco-Rodríguez, 2011). La literatura científica no es concluyente sobre el tema. Por ejemplo, la investigación de Romo et al. (2006), en alumnos

de Formación Profesional, afirma que se utiliza un estilo u otro en función de la costumbre de uso y la experiencia vivida y, que los participantes cambiaron su estilo de aprendizaje disminuyendo los de carácter visual y auditivo a favor del kinestésico al pasar a la modalidad de prácticas laborales. Por el contrario, Velasco Rodríguez et al. (2011) concluyeron que el enfoque pedagógico no influía significativamente en el estilo de aprendizaje en alumnos de Bachillerato. Todo ello indica que no hay modos fijos de aprendizaje y que el alumnado se adapta a las diferentes situaciones y tareas a realizar (An & Carr, 2017). También hay que tomar en consideración que, la mayoría de los aprendizajes se construyen a partir de múltiples tipos de información y, para que esta información adquiera significado y comprensión hay que ir más allá de un dominio específico sensorial. No obstante, no se han encontrado investigaciones que relacionen los estilos de aprendizaje con un estilo de enseñanza concreto más bien será la metodología que aplique en el aula la que estimule la capacidad de un canal perceptivo concreto junto con la preferencia de aprendizaje del alumno (Reyes et al., 2017).

El estilo de enseñanza de los docentes tiene un impacto directo en los educandos por ello investigaciones previas han clasificado el estilo de enseñanza en función de la metodología y las estrategias utilizadas en el aula. También han estudiado la relación en función del sexo y la edad, especialmente en la educación superior (Dash et al., 2020). Precisamente los docentes de menor edad muestran mayor acuerdo en que la enseñanza se articule en función de la variedad de estilos de aprendizaje y en la necesidad del uso de tecnologías adaptadas a cada estilo con la finalidad de mejorar las competencias en los discentes (Guraya et al., 2014). No obstante, estas implicaciones educativas no muestran unanimidad entre los investigadores. Algunos consideran que los estilos de aprendizaje es una herramienta útil en el aula (Sternberg et al., 2008) y otros opinan que no aportan nada (Newton & Miah, 2017; Willingham et al., 2015).

El hallazgo de la relación entre el estilo de enseñanza y la motivación por el resultado señala una diferencia significativa con el estilo innovador. Este estilo utiliza metodologías que permiten que el alumnado participe activamente promoviendo la motivación y estimulando el aprendizaje (Isaza & Henao, 2012). Por ello estudio previos concluyen que una metodología activa mantiene la motivación y la atención, aumentando la participación y la colaboración (Beltrán-Valls et al., 2020). También se ha considerado que la acción o conducta, en este caso en el aprendizaje, viene inducida por estímulos externos (incentivos) o motivos internos (Ryan & Deci, 2020). Estos estímulos externos se relacionan, tal como se señala en este estudio, con el tipo de estilo de enseñanza innovador que incentivará al alumnado para alcanzar una determinada meta aumentando la energía y la capacidad necesarias. No obstante, no hay unanimidad en las investigaciones y se defiende la combinación de metodologías tradicionales e innovadoras (Beltrán-Valls et al., 2020).

En cuanto al estilo de aprendizaje se ha encontrado relación con las variables de motivación y autoestima que posibilitan un mayor conocimiento del proceso de aprendizaje. Algunos estudios han informado sobre una mejora en el aprendizaje cuando se conjugan las practicas docentes con los estilos de aprendizaje de tal forma que aumenta el desempeño y la motivación en los estudiantes (Murray, 2011; Murthy et al., 2013). No obstante, solo existe diferencia significativa entre el estilo de aprendizaje y la autoestima. Esta significatividad viene dada en primer lugar para el estilo de aprendizaje visual seguido del estilo mixto, tras ellos el auditivo y el kinestésico. En línea contraria se encuentra lo concluido por Solar et al. (2010) quienes señalan que una buena autoestima general y escolar se relaciona con un aprendizaje activo y profundo que se vinculará con el estilo de aprendizaje kinestésico y con sus variantes mixtas (kinestésico-visual y kinestésico-auditivo). Del mismo modo, García Colión (2019) relaciona la alta autoestima con un estilo de aprendizaje reflexivo que estaría referido al estilo de aprendizaje kinestésico y mixto. Estos resultados llevan a sospechar sobre una posible relación entre la baja autoestima y el estilo de enseñanza tradicional. Esto se apoyaría al tomar en consideración la predominancia de los estilos de aprendizaje visual y mixto con este estilo de enseñanza y la diferencia significativa de estos estilos con la baja autoestima. Por lo tanto, estudios futuros tendrían que explorar esta línea de investigación.

5. Conclusiones

De acuerdo con los resultados del presente estudio existen una serie de implicaciones relevantes en esta primera etapa de Educación Primaria. En primer lugar y de acuerdo con investigaciones anteriores se recomienda la utilización de las metodologías activas en el aula, pero sin descartar las clases magistrales tradicionales como favorecedoras del proceso de enseñanza-aprendizaje (Beltrán-Valles et al., 2020). En segundo lugar, queda de manifiesto que el estilo de aprendizaje del alumnado guarda relación con el estilo de enseñanza, por lo tanto, si se opta por un estilo mixto a la hora de impartir docencia, también resultaría

muy conveniente fomentar un estilo de aprendizaje de carácter mixto donde todos los canales sean utilizados para recibir, codificar y procesar la información (Sprock, 2018; Tocci, 2013). Todo ello a pesar de que la literatura científica no ha encontrado evidencias empíricas de que el uso de los estilos de aprendizaje dé como resultado un mejor aprendizaje (Ar & Carr, 2017), pero si hay una creencia común entre los docentes de que se aprende mejor cuando se recibe la información en el estilo de aprendizaje preferido (Newton & Miah, 2017). En tercer lugar, de los constructos analizados, se concluye que el estilo de enseñanza influye en la motivación por el resultado y el estilo de aprendizaje lo hace sobre la autoestima. Es decir, emergen dos variables de carácter personal que van cambiando en función de los propios intereses y de las variaciones del contexto (Kiviruusu et al., 2016) y, que deben tomarse en consideración para elaborar programas de enseñanza-aprendizaje con diferentes enfoques que mejoren el conocimiento, la comprensión y las habilidades del alumnado.

Las limitaciones de este estudio vienen dadas por la selección de una muestra de conveniencia y un contexto concreto donde se desarrolla el proceso que impiden una mayor generalización de los resultados. También el carácter transversal obstaculiza el establecer relaciones de causa efecto ya que se desconocen. Por ello estos hallazgos deben tratarse como exploratorios y generalizarse con cierta cautela en otros entornos tanto regionales como nacionales. No obstante, futuros estudios deberían ampliar la muestra y los contextos, pero manteniendo el rango de edad, ya que es necesario conocer y considerar las diferencias individuales de los discentes en esta primera etapa educativa formal para diseñar estilos y estrategias de enseñanza que resulten más eficaces y motivadores para proporcionar, en el futuro, el desarrollo integral del alumnado. Se trata de buscar el camino hacia una escuela inclusiva y un aprendizaje personalizado que ponga en valor a la persona en su variedad de capacidades, habilidades, intereses y contextos externos al aula. Para ello es necesario implementar diferentes métodos de enseñanza que atiendan y promuevan una enseñanza igualitaria, inclusiva y diversa que proporcione las mismas posibilidades de éxito para todos.

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4.2 Discusión global

Tal como se plantea en la Introducción de esta Tesis Doctoral, el rendimiento académico del alumnado depende de numerosas variables que se entrecruzan y se retroalimentan y que ayudan a explicar el porqué de los resultados escolares, ya que no existe una única razón para entender el logro escolar en los discentes (Nieto, 2008). A pesar de la existencia de numerosas investigaciones en torno a las variables que influyen en el éxito académico, es escasa la investigación llevada a cabo en población infantil de 6 a 12 años y que, a su vez, integre variables de carácter cognitivo y personal. Por ello el objetivo principal de esta tesis es abordar el estudio de las variables que influyen en el rendimiento académico en la población que cursa Educación Primaria, la existencia de variables moderadoras y la mediación entre variables a la hora de predecir el logro escolar. Todo ello para crear un cuerpo de conocimiento que sirva de base para la elaboración de intervenciones educativas específicas, en función de las necesidades de los alumnos, en cumplimiento del mandato de atención a la diversidad y a la inclusión educativa, que permita alcanzar un aprendizaje significativo que lleve al desarrollo integral del alumnado (LOE, 2006, LOMLOE, 2020).

En los dos meta-análisis realizados, el primero sobre las funciones ejecutivas y el segundo sobre factores motivacionales, emocionales y sociales, de manera consistente con estudios previos, las funciones ejecutivas presentan un carácter multifactorial (Anderson, 2002; Gioia et al., 2017; Miyake et al., 2000), que varía con la edad (Lee et al., 2013; van der Ven et al., 2013; Willoughby et al., 2010), y cuyos componentes se comportan y adquieren importancia dependiendo del área académica (Alloway & Alloway, 2010; Anderson & Reidy, 2012). Además, dentro de las variables moderadoras clásicas como son la edad y el sexo destaca esta última relacionada con el proceso de madurez que tiene lugar durante los años estudiados (Mathiesen et al., 2013). Por otro lado, se constata la retroalimentación que tiene lugar entre los factores motivacionales, emocionales y sociales (Guay et al., 2010), pero también con el rendimiento escolar en función de materias e intereses (Garon-Carrier et al., 2015; Rahmani, 2011; Regueiro et al., 2015; Walgermo et al., 2018). Debido al carácter internacional del meta-análisis, emerge con fuerza la variable moderadora del área geográfica relacionada con la adaptación al contexto (Marsh & Craven, 2006; Stricker et al., 2019), sin que exista una clara diferenciación por la edad o el sexo (Hyde &Mertz, 2009).

Al concretar, mediante los estudios transversales, en un periodo de edad más reducido (6-9 años) se encuentra:

1) La confirmación de que el índice cognitivo de las funciones ejecutivas interviene de manera más significativa en el logro escolar que el índice emocional o el índice conductual, por lo que se hablaría de la importancia que unos factores adquieren sobre otros al producirse, con la edad, cambios en sus relaciones con el rendimiento académico (Best & Miller, 2010). Se constata el carácter predictor de la memoria de trabajo, pero aparece también el de la supervisión de la tarea relacionada con la eficacia en el control y seguimiento del propio trabajo, la cual, tal como señalan estudios anteriores, presenta una conexión con las habilidades lingüísticas y con el resultado académico global, pero con una mayor influencia en los resultados específicos en el área de lengua (Bryce et al., 2015; Roebers et al., 2012).

2) El efecto mediador de capacidades cognitivas como el razonamiento y la fluidez verbal con la motivación y la autoestima en los rendimientos específicos de Matemáticas y Lengua Castellana y Literatura. Comprobada la fuerza predictora de la motivación y la autoestima en el rendimiento académico se realizan análisis de regresión mediacional que confirman el papel mediador de la fluidez verbal en la motivación para explicar el resultado académico en el área de lengua y el del razonamiento en la autoestima para explicar el logro en el área de matemáticas. De acuerdo con la literatura científica tanto el componente verbal como el razonamiento son las bases para un rendimiento adecuado, no obstante, por sí solos no predicen completamente el logro escolar (Schneider & McGrew, 2011). En este sentido, los alumnos motivados muestran mejores rendimientos en sus capacidades cognitivas en comparación con aquellos desmotivados por el aprendizaje (Sosic-Vasic et al., 2015) y, por otro lado, la autoestima ejerce un efecto sobre destrezas relacionadas con la inteligencia general como el razonamiento (Giofrè et al., 2017).

3) Las variables de carácter cognitivo como son funciones ejecutivas, razonamiento y fluidez verbal unidas a la autoestima forman un modelo predictor que explica más del 50% del éxito académico. No obstante, hay que señalar que las variables cognitivas no presentan relación entre ellas lo que lleva a considerar que, hay una clara diferenciación que no se puede comprender totalmente si no se tiene en cuenta que las funciones ejecutivas incluyen

también un carácter conductual y emocional (Gioia et al., 2017). Por lo tanto, como señalan algunos autores, junto a factores cognitivos, la autoestima, con su carácter emocional, se abre camino para explicar los resultados académicos (Bryce et al., 2015; Cid- Sillero et al., 2020), ya que se vincula con la atención, la motivación por aprender y con la regulación conductual (Rhoades et al., 2011).

4) El estilo de enseñanza influye en la motivación por el resultado y en el estilo de aprendizaje y, este último en la autoestima. Además, existe una diferencia a favor del estilo de enseñanza innovador (facilitador y delegador) con la motivación y con el estilo de aprendizaje de tipo kinestésico y, del estilo de enseñanza tradicional (experto, autoritario y demostrador) con el estilo de aprendizaje visual y auditivo. La literatura científica no es concluyente, pero señala, por un lado, que no existen modos fijos de enseñanza, ni de aprendizaje y que la información tampoco es recibida por un solo canal de entrada (Dash et al., 2020; Sprock, 2018; Tocci, 2013) y, por otro, que el estilo de enseñanza aplicado en el aula repercute en el aprendizaje estimulando mayor capacidad en alguno de los canales perceptivos (Reyes et al., 2017). Por lo tanto, se incide en la necesidad de combinar metodología tradicional e innovadora por considerar relevante su utilidad pedagógica (Beltrán-Valls et al., 2020). Tampoco hay unanimidad a la hora de justificar los estilos de aprendizaje en el aula. Para algunos es una herramienta útil de enseñanza (por ejemplo, Murray, 2011; Murthy et al., 2013; Sternberg et al., 2008) y, otros, lo rechazan por considerar que adaptar la enseñanza a los estilos de aprendizaje individuales no aporta mejores resultados en el aprendizaje (por ejemplo, Ar & Carr, 2017; Newton & Mish, 2017; Villingham et al., 2015). No obstante, algunas investigaciones defienden la existencia de relación entre la autoestima y el estilo de aprendizaje (García Colión, 2019) y otras no lo encuentran (Ferradás et al., 2019).

En conclusión, se muestra cómo el rendimiento académico depende de variables tanto de carácter cognitivo, como motivacional y emocional. Por otro lado, existe un efecto mediador de las capacidades cognitivas sobre las variables personales a la hora de explicar el rendimiento académico. Además, la unión de las variables cognitivas con la autoestima señala el modelo predictor de mayor efecto sobre el logro escolar y finalmente, el estilo de enseñanza y el estilo de aprendizaje señalan un camino por explorar en relación a lo que ocurre en el contexto escolar entre docentes y discentes.

Limitaciones y prospectiva

LIMITACIONES Y PROSPECTIVA

5. Limitaciones y prospectivas

A pesar de que cada uno de los seis estudios incluidos en el apartado anterior contienen de manera específica sus correspondientes limitaciones y prospectivas, se considera necesario incluir un detalle de las limitaciones, tanto de carácter general como transversal, referidas a la globalidad de la presente tesis. También se debe reflexionar sobre las prospectivas que hay que tener presentes para futuros diseños de investigación, con la finalidad de mejorar los planteamientos que se han elaborado y contribuir a solucionar o resolver las limitaciones observadas.

En primer lugar, los dos trabajos de meta-análisis sirven para determinar el estado de la cuestión que arroja la revisión sistemática sobre los estudios dedicados a la temática motivo de investigación en los últimos 10 años. De esta forma, se obtienen resultados generales sobre los niveles de desarrollo óptimo tanto para las variables de carácter cognitivo como para las variables de carácter motivacional y emocional en su relación con el rendimiento académico global y específico (Matemáticas y Lengua Castellana y Literatura), en términos de predicción, para una muestra compuesta por estudiantes de lo que en el Sistema Educativo Español se conoce como Educación Primaria. Ambos meta-análisis tienen un enfoque correlacional y estudian variables moderadoras como son el sexo, la edad y el área geográfica. Cabe indicar que para una mayor precisión de los resultados meta-analíticos se debería ampliar con la inclusión de otros tipos de estudio basados en diferentes análisis estadísticos y de carácter comparativo como son los ANOVA, T-Student o Chi cuadrado que aportarían mayor diversidad de resultados y capacidad de análisis comparativo. Además, otras variables como son las de carácter contextual (ambiente de aula, familia, formación de los padres, seguimiento de las tareas, etc.) sería conveniente explorarlas en un nuevo meta-análisis que complementará a los actuales o, incluso, tomar estas nuevas variables como moderadoras en la relación con las variables estudiadas y el rendimiento académico. Finalmente, la literatura consultada ofrece conclusiones sobre la variación en la predicción del rendimiento académico entre las variables cognitivas, motivacionales y emocionales produciéndose un contrabalanceo entre ambos tipos a medida que los estudiantes presentan mayor edad. La realización de nuevos meta-análisis así como la réplica de estos sobre una

muestra de estudio perteneciente a estudiantes adolescentes y universitarios confirmaría esta apreciación.

En segundo lugar, los estudios de campo dedicados, por un lado, a determinar el poder predictivo de estas variables en su conjunto sobre el rendimiento académico de estudiantes de entre 6 y 9 años y, por otro lado, a estudiar el poder mediador y de relación entre variables, se presentan como estudios transversales sobre una muestra de conveniencia. Aunque los resultados son sustanciales y de utilidad para la labor de orientación educativa y de diseño de intervenciones concretas en el aula, ya que determinan la importancia de trabajar ciertos aspectos específicos de carácter personal para optimizar y mejorar el aprendizaje y rendimiento académico, requieren de una ampliación de la muestra y de un seguimiento longitudinal. Si bien, todo ello estaba contemplado en el diseño inicial de la tesis, el marco contextual de la misma enmarcada temporalmente en tiempo de pandemia por Covid-19, no ha permitido el acceso y seguimiento de la muestra por la no presencialidad de los participantes en el centro educativo para poder llevar a cabo las actuaciones pertinentes. De esta forma, se contempla como limitación el diseño actual y se recomienda una ampliación de la muestra, así como un seguimiento longitudinal de la misma con el fin de poder generalizar los resultados obtenidos, establecer relaciones de causalidad y confirmar la relación directa entre los estudios de meta-análisis y los estudios de campo. Todo ello con el fin de poder diseñar y desarrollar planes específicos de apoyo educativo que atiendan de forma transversal el correcto desarrollo de estas variables influyentes en el aprendizaje de los educandos.

En tercer lugar, a pesar de que puede resultar muy ambicioso, a la vez que difícil, convendría contemplar otro tipo de variables de estudio que analizarán partes predictivas del rendimiento académico que no han sido incluidas en este estudio. La investigación actual se ha centrado en variables de carácter cognitivo y de carácter personal-motivacional-emocional tales como el razonamiento, la fluidez verbal, las funciones ejecutivas, la autoestima, la motivación y los estilos de enseñanza y de aprendizaje. Tal vez, la ampliación de variables que suplementen a estos grandes grupos como serían, por un lado, el estudio de la inteligencia y de la memoria, y por otro, el bienestar personal y la capacidad de socialización, darían una visión más amplia sobre el tema. Además, resultaría muy positivo la introducción de

un nuevo bloque contextual que tratase los contextos educativos formales (escuela) e informales (familia). De esta forma, ahondar en los estilos de enseñanza de los docentes y las metodologías de aprendizaje utilizadas en la escuela, así como la implicación, seguimiento y formación de los padres, en la realización de las tareas escolares, contribuiría a un estudio más completo del rendimiento académico y factores que lo determinan.

En cuarto y último lugar, la bibliografía consultada plantea la posibilidad de que a lo largo de las etapas educativas el rendimiento académico sufra un contrabalanceo entre variables, tomando mayor peso unas en detrimento de otras, que inicialmente tenían mayor capacidad de predicción. Esta sospecha debería ser comprobada con la ampliación de la muestra más allá de la Educación Primaria e incluir estudiantes de Educación Secundaria y Universitarios. Aunque esta propuesta sea altamente complicada por el tiempo y disposición que lleva obtener una muestra de tales dimensiones, así como la medición y seguimiento de la misma, no debería ser descartada si la carrera investigadora de este doctorando se va a centrar en el aprendizaje, rendimiento académico y variables que influyen en él.

Conclusiones

CONCLUSIONES

6. Conclusiones

En función de los cuatro objetivos planteados, los resultados encontrados y las limitaciones anteriormente mencionadas, a continuación, se detallan las conclusiones que se han obtenido en cada uno de los seis estudios contenidos en la presente tesis doctoral:

Objetivo 1: Analizar la relación entre las funciones ejecutivas y el rendimiento académico en los alumnos de Educación Primaria y, su comportamiento en disciplinas como Matemáticas y Lengua Castellana y Literatura, así como, la existencia de variables moderadoras como el sexo o la edad.

Estudio 1: The Relationship Between Executive Functions and Academic Performance in Primary Education: Review and Meta-Analysis.

Se confirma la composición multifactorial de las Funciones Ejecutivas, el comportamiento diferenciado dependiendo del área académica y el mayor valor predictivo de la memoria de trabajo entre los componentes ejecutivos. De tal manera, que la mayoría de ellos se relacionan mejor con el área de matemáticas que con la de lenguaje, destacando especialmente la relación del aspecto visuoespacial de la memoria de trabajo con las matemáticas. Por lo tanto, las funciones ejecutivas no son solo una variable de dominio general, sino también específico, ya que los diferentes componentes están claramente vinculados a desempeños sobre ciertos tipos de aprendizaje. Se evidencia que las funciones ejecutivas son un predictor importante del rendimiento académico y de los futuros problemas de aprendizaje a una edad temprana. En este sentido la revisión de literatura sugiere, que este predictor disminuye su potencialidad durante la educación secundaria y más aún en la etapa universitaria donde su ciclo de desarrollo llega a su fin. Por otro lado, emerge el sexo femenino con un efecto moderador entre las funciones ejecutivas y el desempeño académico. La explicación se encuentra en el desarrollo madurativo que se produce en los años motivo de estudio, ya que, debido a factores fisiológicos y neurológicos, las niñas maduran más rápidamente que los niños durante esta etapa de la vida. Por otro lado, los estudios consultados refuerzan la faceta descriptiva y moderadora de esta variable respecto al desarrollo de las diversas habilidades necesarias para un óptimo aprendizaje en la escuela primaria, además de su vinculación con la madurez del estudiante. Por último, de los resultados obtenidos, se concluye que

no existen diferencias significativas en su relación con distintos sistemas educativos, zonas geográficas o escalas sociales.

Estudio 2: Task monitoring and working memory as executive components predictive of general and specific academic achievements in 6-9 year-old children.

Dentro de los factores ejecutivos los denominados cognitivos son más relevantes que los conductuales y emocionales para la predicción del rendimiento académico tanto a nivel global como a nivel específico (Matemáticas y Lengua Castellana y Literatura). Se destaca la relevancia de las funciones ejecutivas para el logro escolar, y, por lo tanto, un alto nivel en estas habilidades se relaciona con un mayor nivel de éxito escolar. Por un lado, la escasa importancia de las escalas del índice de regulación conductual y emocional en relación a los resultados académicos en estudiantes de entre 6 y 9 años de edad se debe posiblemente a que estos componentes (inhibición, autocontrol, flexibilidad y control emocional) tienen un mayor impacto a edades más tempranas o incluso durante la preadolescencia. Y, por otro lado, dentro de las escalas del índice de regulación cognitiva, los predictores de logro general, así como específicos que mejor se posicionaron fueron la supervisión de tarea y la memoria de trabajo. Esto profundiza el conocimiento que se tiene sobre estos factores que, a diferencia de otros, están involucrados en la actualización, transformación y planificación de datos y, del comportamiento ante procesos como la comprensión del lenguaje y el razonamiento, así como sobre el monitoreo efectivo sobre tareas de lenguaje (errores ortográficos) o matemáticas (omisión de símbolos). Por último, se determina que las funciones ejecutivas tienen mayor relación y poder predictivo sobre las medidas de desempeño general que sobre las de carácter específico lo que resulta inconsistente con las conclusiones del meta-análisis realizado con anterioridad. No obstante, la diferencia encontrada en el presente estudio es de carácter marginal no pudiendo concluir en dicha afirmación sin la realización de un estudio con muestra más amplia y de carácter longitudinal que posibilite la generalización de los resultados y el establecimiento de relaciones causales.

Objetivo 2: Analizar la relación entre los factores motivacionales y emocionales con el rendimiento académico en el alumnado de Educación Primaria, su posible diferenciación por materias como Matemáticas y Lengua y Literatura Castellana, la existencia de variables mo-

deradoras y la mediación de variables cognitivas como el razonamiento y la fluidez verbal.

Estudio 3: Motivational, emotional and social variables explain academic performance in children aged 6 to 12 years: a meta-analysis.

Este estudio destaca la relación de las variables de carácter motivacional y social con el rendimiento académico que a su vez se relacionan con dominios académicos específicos (Matemáticas y Lengua Castellana y Literatura). Por otro lado, existe un efecto moderador, que lo ejerce la edad y no el sexo, sobre los factores sociales. La revisión de la literatura vincula los factores motivacionales con los más pequeños y los factores sociales y emocionales con los más mayores, que ven aumentada su relevancia durante los últimos cursos de la Educación Primaria, mostrando la importancia de la madurez en estos factores.

La existencia de un fuerte efecto moderador del área geográfica es especialmente destacable con los factores sociales y motivacionales. De todo ello se concluye la importancia de los factores sociales, referidos al contexto escolar, en su relación con el éxito académico en alumnos de 6 a 12 años y su retroalimentación con los factores motivacionales, así como, su vinculación con dominios académicos específicos. Por otro lado, se constata la interconexión entre los factores emocionales y los sociales donde cada uno aparece como moderador del otro para el rendimiento académico. A su vez, estos dos factores afectan a los motivacionales que, actuando al unísono, debido a su fuerte carácter personal, predicen el éxito académico.

Estudio 4: Self-Esteem and Motivation for Learning in Academic Achievement: The Mediating Role of Reasoning and Verbal Fluidity

La motivación y la autoestima predicen el desempeño general y el específico, si bien la motivación está mediada por la fluidez verbal en relación al área de lengua y el razonamiento ejerce un papel mediador en la relación de la autoestima con las matemáticas. La motivación lleva al sujeto a esforzarse por aprender y unida a la autoestima mejora las capacidades cognitivas que se traducen en un mayor éxito académico. No obstante, estas relaciones difieren en función de las variables predictoras y mediadoras dependiendo de la asignatura concreta en la que se analiza el rendimiento académico. Por lo tanto, el rendimiento académico no

solo depende de factores cognitivos, sino también de variables como la motivación y la autoestima, incluso se podría afirmar que capacidades cognitivas como el razonamiento y la fluidez verbal mejoran al vincularse con estas variables. De lo que se deduce cierta flexibilidad y maleabilidad de estas capacidades y se enfatiza el carácter dinámico de las mismas. En definitiva, la mejora de las habilidades académicas implica no solo desarrollar las capacidades cognitivas sino también promover la percepción positiva de los estudiantes sobre sus propias habilidades.

Objetivo 3: Analizar la relación entre variables cognitivas y personales con el rendimiento académico en alumnos de 6 a 9 años y su acción mediadora

Estudio 5: The role of executive functions and self-esteem on academic achievement: a mediational analysis.

Se concluye que el rendimiento académico depende de variables tanto de carácter cognitivo, como motivacional y emocional. Esto se determina a través de un modelo predictivo de carácter mixto que, a su vez, corrobora el papel mediador de la autoestima para la relación del razonamiento, las funciones ejecutivas y la motivación con el rendimiento académico. Por otro lado, y en cuanto a las construcciones multifactoriales analizadas y, a pesar de la relevancia que tradicionalmente han tenido las variables cognitivas sobre el aprendizaje y el rendimiento académico, estas no son las únicas capaces de construir un modelo predictivo eficaz. De hecho, como se puede observar en este estudio, los factores cognitivos pueden aumentar su efectividad a través de factores emocionales como la autoestima que a su vez se ve mejorada por otras variables como las funciones ejecutivas. Por lo tanto, se establece una relación de retroalimentación de flexibilidad y contrabalanceo emergiendo ambos factores como maleables y no estáticos.

Objetivo 4: Estudiar la influencia del estilo de enseñanza en el estilo de aprendizaje, la motivación y la autoestima en alumnos de 6 a 9 años, y las diferencias en función del estilo de enseñanza y del estilo de aprendizaje.

Estudio 6: Estilos de enseñanza-aprendizaje e influencia en la motivación y la autoestima.

Los resultados de este estudio y de acuerdo con investigaciones anteriores recomiendan el uso de metodologías activas en el aula, pero sin descartar las clases magistrales tradicionales con el fin de promover un espacio educativo y proceso de enseñanza-aprendizaje versátil, diverso y atendiendo de forma personalizada a los diferentes ritmos y estilos de aprendizaje. También, se pone de manifiesto que el estilo de aprendizaje del alumnado guarda relación con el estilo de enseñanza y, por lo tanto, si se promueve un estilo de enseñanza de carácter mixto, también sería conveniente promover y fomentar un estilo de aprendizaje adaptativo, mixto, donde el estudiante pueda aprovechar toda la potencialidad que ofrecen los diferentes canales de percepción, recepción, codificación y procesamiento de la información. No obstante, se destaca que la literatura científica actual no ha encontrado acuerdo empírico sobre la influencia del uso de los estilos de aprendizaje como consecuencia de un mejor y más efectivo aprendizaje. Por otro lado, de los constructos analizados, se concluye que el estilo de enseñanza influye en la motivación por el resultado y el estilo de aprendizaje sobre la autoestima. De esta forma, emergen dos variables de carácter personal que van cambiando en función de los propios intereses y del contexto y, además, deben de tomarse en consideración a la hora de diseñar e implementar programas educativos con diferentes enfoques para la mejora del conocimiento, comprensión y habilidades del alumnado.

Aportaciones principales

APORTACIONES PRINCIPALES

7. Aportaciones principales

En este apartado se describen la contribuciones teóricas y prácticas más relevantes que la presente tesis doctoral aporta al campo de la investigación educativa, para la mejora de los procesos de carácter cognitivo, motivacional y emocional durante la etapa de Educación Primaria (6 a 12 años) que sirven de base para implementar intervenciones educativas, que tengan como finalidad la atención a la diversidad, la inclusión educativa y que se adapten a las realidades individuales del alumnado.

La principal aportación es la de una serie de implicas teóricas y prácticas centradas en una edad concreta (6-12 años), dentro de la primera etapa educativa del alumnado, donde tienen lugar el desarrollo de una serie de procesos tanto biológicos como cognitivos que, a su vez, modifican aspectos emocionales y sociales. Todo esto con una fuerte implicación para su futuro, ya que de ello depende que se alcance el correcto desarrollo integral como persona y educando, que les permita alcanzar el éxito académico, personal, social y laboral.

En primer lugar, como aporte teórico, el estudio 1 plasma el estado de la cuestión sobre la relación de las funciones ejecutivas y el rendimiento académico del estudiantado de entre 6 y 12 años. Mediante una revisión sistemática y meta-analítica se contribuye a esclarecer la vinculación de esta variable no solo con el desempeño general, como tradicionalmente se ha considerado, sino también sobre el desempeño específico. Este último vendría relacionado especialmente con la memoria de trabajo, tal como se concluye al realizar una descomposición de los factores ejecutivos y analizar tanto los desempeños generales, como los específicos en las áreas lingüística y matemática. Completando el aporte anterior, el estudio 2, centrando en una muestra de estudiantes de 6 a 9 años (primera etapa de educación reglada) señala que, el poder predictivo sobre el rendimiento académico de la dimensión cognitiva, se encuentra por encima de la conductual y emocional. Pero, esta vez junto a la memoria de trabajo emerge la supervisión de tareas entre los componentes de las funciones ejecutivas con una clara implicación práctica para prevenir y predecir el fracaso escolar o el déficit de desarrollo de algunas capacidades como el razonamiento y la comprensión verbal.

En segundo lugar, el estudio 3, realiza un aporte teórico relevante sobre el estado de la cuestión de estas variables predictivas del desempeño escolar durante los últimos 10 años. Se

destaca la importancia de los factores motivacionales y sociales por encima de los emocionales, pero, sin embargo, la revisión de la literatura científica analizada en el estudio sugiere la importancia de los factores emocionales como moderadores y potenciadores sobre la relación existente entre las variables motivacionales y sociales y el rendimiento académico. Del mismo modo, cabe destacar que la revisión de este estudio propone un contrabalanceo en la importancia de variables a la hora de predecir el éxito escolar, situando en la edad de 6 a 12 años las variables cognitivas y motivacionales por encima del resto y, perdiendo importancia a medida que se avanza en la edad a favor de otro tipo de variables como son las emocionales. Del mismo modo, el estudio 4, señala una implicación práctica con la aparición de un efecto mediador de las capacidades cognitivas de razonamiento y fluidez verbal con respecto a la motivación y a la autoestima respectivamente y se pone de manifiesto que los factores cognitivos mejoran cuando existe motivación por el aprendizaje y una alta autoestima.

En tercer lugar, completando las aportaciones anteriores, el estudio 5, contribuye con el diseño de modelos predictivos mixtos, en los que se incluyen variables cognitivas, motivacionales y emocionales, a la efectividad de predecir el rendimiento académico. Como aportación novedosa señalar que la autoestima es la variable mediadora que mejor se comporta entre el razonamiento y las funciones ejecutivas en referencia al rendimiento académico. Esto supone implicaciones prácticas a la hora de crear modelos educativos que mejorando las habilidades emocionales contribuyan a un progreso de las habilidades cognitivas que se plasmen en el éxito académico futuro.

En cuarto lugar, la aportación teórica y práctica del estudio 6, determina la existencia de una relación entre el uso de determinados estilos de enseñanza y el estilo de aprendizaje que va a desarrollar el estudiante. Como aportación novedosa se destaca que el estilo de aprendizaje influye en la autoestima del educando lo que, añadido al conocimiento sobre la influencia del estilo de enseñanza sobre la motivación, se sugiere que la formación de un profesorado versátil, con dominio de metodologías y herramientas que, posibilite la transmisión de la información por diferentes canales, atendiendo de forma personalizada a los diferentes ritmos y potencialidades de los estudiantes y, que promueva una educación centrada no sólo en los

contenidos sino en el desarrollo de habilidades, mejorando los resultados escolares.

Finalmente, a nivel metodológico, esta tesis doctoral pone de relieve el uso de la revisión sistemática y el meta-análisis aplicados a las Ciencias de la Educación como un método de investigación eficaz para establecer revisiones sobre el estado de la cuestión que se desea investigar, incluso ayudando a detectar sesgos y errores de investigación respecto a posteriores planteamientos que comparten temática. Además, facilitan el estudio de variables moderadoras difíciles de controlar como son la cultura, la metodología e incluso la propia herramienta psicométrica utilizada para la medición y evaluación de ciertas variables permitiendo al investigador diseñar sus posteriores estudios de campo con mayor rigor, validez y confiabilidad.

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8. Referencias bibliográficas

***Nota:** las referencias bibliográficas que aparecen a continuación son las que se han utilizado durante el desarrollo de los diferentes apartados de la tesis doctoral, con la excepción de las que pertenecen al apartado de resultados y discusión, ya que aquellas que corresponden a los seis estudios científicos integrados en él, se encuentran relacionadas al final de cada uno de los artículos.

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Apéndice

APÉNDICE

9. Apéndice

9.1 Características bibliométricas de las publicaciones

Tabla 1. Características de las revistas donde se han publicado o han sido sometidos los artículos de la tesis doctoral.

	Revista	Factor de impacto (b,c)	Área, cuartil y posición
I	*Frontiers in Psychology*	2.990	SSCI, Psychology, Multidisciplinary - Factor JIF Q2 (42/140) Factor JCI Q2 (54/194)
II	*International Journal of Environmental Research and Public Health*	3.390	Public, Environmental & Occupational Health – SSCI - (This article belongs to the Special Issue Teaching and Learning Process: Psychological Variables in Education, New Applied Technologies and Physical Activity) - Factor JIF Q1 (41/176) Factor JCI Q2 (130/373)
III	*Education Sciencies*	1.03	Education & Educational Research – ESCI - Factor JCI Q2 (247/722)
IV	*Sustainability*	3.251	Environmental Studies, SSCI - (This article belongs to the Special Issue Sustainable Development Goals (SDGs): The Challenges of the 2020-2030s for Quality Education) - Factor JIF Q2 (60/125) Factor JCI Q3 (160/302)
V	*International Journal of Psychological Research*	0.800	SSCI - Psychology, Multidisciplinary - Factor JIF Q4 (123/140) Factor JCI Q3 (145/194)
VI	*Fuentes (a)*	0.53	Education, Educational Research - ESCI - Factor JCI Q4 (564/723)

Notas: a = Artículo sometido a revisión a fecha de depósito de la tesis doctoral.
b = Factor de impacto en ISI Web of Knowledge – Journal Citation Reports.
c = El factor de impacto de los siete artículos y la posición corresponde al año 2020, por lo que se considera provisional en todos ellos.

9.2 Contribución del doctorando en las publicaciones

1) Cortés Pascual, A., Moyano Muñoz, N., & **Quilez Robres, A.** (2019). The relationship between executive functions and academic performance in primary education: review and meta-analysis. *Frontiers in Psychology, 10*, 1582. https://doi.org/10.3389/fpsyg.2019.01582

El doctorando realizó la búsqueda, selección y codificación de los artículos de investigación. Posteriormente llevó a cabo los análisis estadísticos y redactó el borrador inicial del manuscrito. La Dra. Cortés Pascual y la Dra. Moyano Muñoz realizaron labores de revisión, corrección y coordinación durante todo el proceso. Por último y con el visto bueno de las Doctoras directoras de la tesis, el doctorando redactó el artículo final y realizó labores de revisión hasta la aceptación de su publicación.

2) **Quílez-Robres, A.**, Moyano Muñoz, N. Cortés Pascual, A. (2021). Task monitoring and working memory as executive components predictive of general and specific academica achievements in 6-9 year-ols children. https://doi.org/10.3390/ijerph18136681

El doctorando junto con la Dra. Cortés Pascual y la Dra. Moyano Muñoz llevaron a cabo la conceptualización, así como el diseño de la metodología empleada. Posteriormente el doctorando llevó a cabo los análisis estadísticos y realizó la redacción del borrador inicial que fue revisado por las directoras de tesis para preparar y enviar el manuscrito final. Las labores de revisión y seguimiento de la edición fueron realizadas por el autor principal.

3) **Quílez-Robres, A.**, Cortés Pascual, A. & Moyano Muñoz, N. (2021). Motivational, emotional and social variables explain academic performance in children aged 6 to 12 years: a meta-analysis.

El primer autor realizó la búsqueda, selección y codificación de los artículos de investigación. Posteriormente llevó a cabo los análisis estadísticos y redactó el borrador inicial del manuscrito. El resto de autores realizaron labores de revisión, corrección y coordinación durante todo el proceso. Por último y con el visto bueno de las directoras de la tesis, el doctorando redactó el artículo final y realizó labores de revisión hasta la aceptación de su publicación.

4) Moyano, N., **Quílez-Robres, A.**, & Cortés Pascual, A. (2020). Self-esteem and motivation for learning in academic achievement: the mediating role of reasoning and verbal fluidity. *Sustainability, 12*(14), 5768. https://doi.org/10.3390/su12145768

El doctorando realizó la toma de datos, elaboró y revisó la base de datos. Además, junto a la Dra. Moyano Muñoz, realizó los análisis estadísticos y redactó la primera versión del artículo. La Dra. Cortés Pascual revisó y coordinó todo el proceso. Posteriormente, junto al resto de autores, realizó labores de revisión pertinentes hasta su publicación.

5) **Quílez-Robres, A.**, Moyano, N. & Cortés Pascual, A. (2020). The role of executive functions and self-steem on academic achievement: a mediational analysis. *International Journal of Psichological Research, 14(*2),

El doctorando llevó a cabo las labores de recogida y revisión de datos. Además, como primer autor y responsable del manuscrito, realizó los análisis estadísticos y redactó la primera versión del artículo. Por último, junto con el resto de autores, realizó labores de revisión hasta su publicación.

6) **Quílez-Robres, A.**, Moyano, N. & Cortés Pascual, A. (2020). El perfil docente y los estilos de aprendizaje influyen en la motivación y la autoestima en estudiantes de Educación Primaria. *Estudios sobre Educación.*

El doctorando llevó a cabo la recogida de datos y su revisión. Asimismo, realizó los análisis estadísticos y redactó el artículo. Finalmente, junto al resto de coautores, realizó tareas de revisión.

9.3 Cartas de aceptación de trabajos pendientes de publicación

UNIVERSIDAD DE SAN BUENAVENTURA MEDELLÍN

International Journal of PSYCHOLOGICAL RESEARCH

International Journal of Psychological Research with ISSN 2011-7922, of the Universidad de San Buenaventura, Medellín - Colombia.

STATED THAT

The manuscript entitled "**El papel de las funciones ejecutivas y la autoestima en el rendimiento académico: un análisis mediacional**" was accepted and published in Vol. 14(2) July - December 2021. This article is authored by Alberto Quílez-Robres, Nieves Moyano and Alejandra Cortés-Pascual.

In witness whereof, the editor in chief of the journal and the associate editor have executed this document on the twentieth day of April 2021.

JORGE MAURICIO CUARTAS
Editor in cheif

DOUGLAS LONDOÑO
Associate Editor

San Benito: Carrera 56C 51 – 90 Medellín (Antioquia)
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Anexo

GOBIERNO DE ARAGON
Departamento de Sanidad

Informe Dictamen Favorable
Trabajos académicos

C.P. - C.I. PI19/050

27 de febrero de 2019

Dña. María González Hinjos, Secretaria del CEIC Aragón (CEICA)

CERTIFICA

1º. Que el CEIC Aragón (CEICA) en su reunión del día 27/02/2019, Acta Nº 04/2019 ha evaluado la propuesta del Trabajo:

Título: Variables que influyen en el rendimiento académico en Educación Primaria: Tradición e Innovación.

Alumno: Alberto Quílez Robres
Directoras: Alejandra Cortés Pascual y María de las Nieves Moyano Muñoz

Versión protocolo: V 2.0 de 23 de febrero de 2019
Versión documento de información y consentimiento: V 2.0 de 23 de febrero de 2019

2º. Considera que

- El proyecto se plantea siguiendo los requisitos de la Ley 14/2007, de 3 de julio, de Investigación Biomédica y los principios éticos aplicables.
- El Tutor/Director garantiza la confidencialidad de la información, la correcta obtención del consentimiento informado, el adecuado tratamiento de los datos en cumplimiento de la legislación vigente y la correcta utilización de los recursos materiales necesarios para su realización.

3º. Por lo que este CEIC emite **DICTAMEN FAVORABLE a la realización del proyecto**.

Lo que firmo en Zaragoza

GONZALEZ HINJOS MARIA - DNI 03857456B

Firmado digitalmente por GONZALEZ HINJOS MARIA - DNI 03857456B
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