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Reading and Math Skills and Their Relationship with Problem-Solving Competencies

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Abstract: Reading and mathematical skills are among the fundamental objectives of education at all levels, from primary to higher education. However, the increasing reliance on digital technologies for information processing and calculation may be altering how these essential abilities are cultivated and sustained. Mastery of these basic skills is also linked to the expression of other, more specialized professional competencies. This study aimed to characterize the relationship between proficiency in reading and mathematics and the manifestation of administrative problem-solving competencies among higher education students. A total of 946 undergraduate students in administrative sciences participated in the study. Reading, mathematical, and administrative problem-solving competencies were assessed using standardized instruments developed and validated by expert judges. The results confirmed positive, significant correlations between mastery of basic academic skills and the manifestation of management-related problem-solving competencies.

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Keywords: reading skills, mathematical skills, management skills, administrative problem-solving competencies, higher education

Habilidades para Leitura e Competência Matemática e sua Relação com a Tomada de Decisão

Resumo: As habilidades de leitura e matemática estão entre os objetivos fundamentais da educação em todos os níveis, do ensino primário ao superior. No entanto, a crescente dependência das tecnologias digitais para o processamento de informações e cálculos pode estar alterando a forma como essas habilidades essenciais são desenvolvidas e mantidas. O domínio dessas competências básicas também está associado à manifestação de outras competências profissionais mais especializadas. Este estudo teve como objetivo caracterizar a relação entre a proficiência em leitura e matemática e a manifestação de competências administrativas de resolução de problemas entre estudantes do ensino superior. Participaram da pesquisa 946 estudantes de graduação em ciências administrativas. As habilidades de leitura, matemática e resolução de problemas administrativos foram avaliadas por meio de instrumentos padronizados, desenvolvidos e validados por juízes especialistas. Os resultados confirmaram correlações positivas e significativas entre o domínio das habilidades acadêmicas básicas e a manifestação de competências de resolução de problemas relacionadas à gestão.

Palavras-chave: habilidades para leitura, competência matemática, gestão, tomada de decisão, educação superior

Habilidades Lectoras y Matemáticas y su Relación con las Competencias de Resolución de Problemas

Resumen: Las habilidades lectoras y matemáticas figuran entre los objetivos fundamentales de la educación en todos los niveles, desde la primaria hasta la educación superior. Sin

embargo, la creciente dependencia de las tecnologías digitales para el procesamiento de información y los cálculos puede estar modificando la forma en que estas capacidades esenciales se desarrollan y mantienen. El dominio de estas habilidades básicas también se asocia con la manifestación de otras competencias profesionales más especializadas. Este estudio tuvo como objetivo caracterizar la relación entre la competencia en lectura y matemáticas y la manifestación de habilidades administrativas para la resolución de problemas en estudiantes de educación superior. En la investigación participaron 946 estudiantes de grado en ciencias administrativas. Las habilidades de lectura, matemáticas y resolución de problemas administrativos se evaluaron mediante instrumentos estandarizados, desarrollados y validados por jueces expertos. Los resultados confirmaron correlaciones positivas y significativas entre el dominio de las habilidades académicas básicas y la manifestación de competencias de resolución de problemas vinculadas a la gestión.

Palabras clave: habilidades de lectura, habilidades matemáticas, habilidades de gestión, habilidades de resolución de problemas, educación superior

Basic reading and mathematics skills have accompanied humanity throughout educational history. It is not known precisely when their introduction into educational systems began, or whether the first schools already considered them part of their teaching structure. Historical accounts indicate that early educational institutions were often focused on practical or philosophical training—preparing artisans, blacksmiths, musicians, or philosophers—rather than on systematic literacy or numeracy. However, as education became formalized and generalized, writing, reading, and calculation emerged as universal foundations for intellectual and professional development (Bruner, 1960; Piaget, 1972; Vygotsky, 1978). These abilities represent the earliest forms of symbolic reasoning and remain essential for acquiring and transmitting knowledge across generations.

These foundational abilities form the basis of cognitive development, as they activate processes of abstraction, logical reasoning, and memory consolidation. From a cognitive-psychology perspective, reading and mathematical learning foster the integration of linguistic and symbolic representations within working memory and executive control systems (Baddeley & Hitch, 1974; Miyake et al., 2000; Sternberg, 1985). Such mechanisms enable individuals to transfer basic academic skills into higher-order reasoning and problem-solving competencies.

Throughout history, humanity has continually sought to improve the means of processing and communicating information. Reading, writing, and calculation have played central roles in these advances, enabling the creation and refinement of technologies such as the printing press, the abacus, and later, mechanical and electrical calculators. The twentieth century marked a revolution in information exchange, with the rise of mass media, computers, and digital systems, which diversified the ways in which language, numbers, and knowledge could be stored, represented, and transmitted (Dehaene, 1997; Perfetti, 1985). These transformations exponentially increased calculation capabilities and democratized access to information for people worldwide.

However, the development of new technologies and the ease of access to information have also brought new challenges. Many individuals now replace reading habits with the consumption of online audiovisual content, while heavy reliance on electronic devices has reduced opportunities for practicing mental arithmetic. Despite these trends, reading and mathematics continue to be recognized as the fundamental pillars of education, particularly at the primary and secondary levels, serving as the basis for developing higher-order cognitive skills such as reasoning, abstraction, and problem-solving (Sternberg, 1985; Sweller, 1988).

Consistent with this conception, multiple studies have explored the relationship between reading or mathematical mastery and broader academic competencies. For instance,

research has addressed the importance of reading at the higher education level (Schüller-Zwierlein et al., 2022), the influence of reading habits on preservice teachers (Can & Biçer, 2021), and associations with musical perception (Partanen et al., 2022). Similarly, in mathematics, studies have examined its relationship with emotional control (Torppa et al., 2024) and with the development of linguistic and cognitive abilities (Al-Hrout et al., 2023).

Nevertheless, most of these studies focus on early education and general learning contexts, leaving unexplored how these foundational abilities relate to advanced professional competencies. There remains a lack of empirical evidence connecting reading and mathematical proficiency with administrative or managerial skills, particularly problem-solving abilities that involve teamwork, communication, and leadership in higher education settings. In particular, this research aimed to characterize how the mastery of these basic skills is associated with the manifestation of administrative problem-solving competencies expected in higher-level careers.

Literature Review

Multiple investigations are reported on the development of reading or mathematics skills in educational systems in different regions, although it should be noted that a search carried out in the Scopus database for both variables identified a total of 7 300 related publications. with reading and only 308 linked to mathematics in educational systems.

As can be seen, both topics are the subject of research across all continents. Research on reading is reported in different geographical areas: Europe (Ferrara, 2023), America (Carvalho & Souza, 2023), Asia (Zahedi et al., 2022), and Africa (Phala & Hugo, 2022). A similar situation can be observed in research on mathematics, where results are also reported across different latitudes (Igarashi & Suryadarma, 2023).

From a cognitive-psychology perspective, reading performance is closely related to linguistic, metalinguistic, and phonological-processing abilities, which depend on the efficiency of working memory and executive control (Perfetti, 1985; Baddeley & Hitch, 1974; Miyake et al., 2000; Stanovich, 1980. These mechanisms enable fluent decoding, semantic integration, and inferential reasoning, linking reading proficiency to memory formation, critical thinking, and higher-order problem-solving competencies.

Research on reading is developed from different perspectives. These seek to investigate the factors that condition their performance, among them those related to physical or psychological conditions, such as: fine motor skills (Buha et al., 2023), cerebral dominance (Li et al., 2022), the presence of stuttering or deafness (Choo et al., 2023); or other conditioning characteristics of the environment, such as: the level of literacy of the home, the improvement mentality of parents, or genetic design (Song et al., 2022; Wang et al., 2025).

Likewise, regarding reading, its manifestation is explored in depth at different levels of education: such as primary, secondary, or higher education; the influence of the type of reading: biographical, historical, comics (Akhmetova et al., 2022; Sidhu et al., 2023; Talwar et al., 2023). Additionally, research is reported that assesses the impact of reading on other skills, such as: creativity, the manifestation of highly talented students, or musical skills (Bezerra et al., 2022; Kağan Keskin et al., 2022). In research on reading, measurement or diagnostic variables are used, such as: fluency, vocabulary mastery, reading speed or time, or understanding (Persici et al., 2022; Sucena et al., 2022).

From a cognitive standpoint, mathematical reasoning activates overlapping systems of memory and abstraction. Studies on numerical cognition demonstrate that learning mathematics engages working memory, visuospatial, and executive processes that support analytical reasoning and problem-solving (Dehaene, 1997; Sweller, 1988). Therefore,

mathematical competence can be interpreted as an applied expression of higher cognitive control and abstract thinking.

Regarding the development of mathematical skills, similarly, the variables that condition performance are delved into, among which are: age, gender, the manifestation of some type of disability (Pina et al., 2021). It also delves into how these types of competencies can influence others, such as the development of musical skills (Spiller et al., 2023). Among the variables that are most evaluated to diagnose this type of ability, the most common is fluency in solving mathematical problems. Additionally, it is pertinent to recognize that there are several investigations that value the mastery of reading and mathematics skills together (Spencer et al., 2022).

Specifically, regarding the analysis of the objective of this study, several investigations are reported that delve into aspects that link reading or mathematics skills with administrative sciences. In this sense, they highlight research that assesses the influence of reading on the generation of leadership capacity, on the administrative skills of a minister, the ability to work in team (Peng et al., 2023). As well as the influence of reading and mathematics on the ability to analyze, interpret and solve problems (Ruiz-Dotras & Lladós-Masllorens, 2022).

Administration as a science is generally defined based on two basic elements: the functions that comprise it (plan, organize, lead and control) and the objectives that are intended to be achieved through the development of the administrative process. As a general rule, two types of fundamental objectives are recognized to which the administrative process is oriented: maintaining or improving what has been gained. To achieve either of these two objectives, problem-solving techniques must be applied through the identification and analysis of the causes and the proposal and evaluation of improvement actions (García-Vidal et al., 2020). This process will be successful to the extent that it is the result of teamwork and

exercising leadership skills. These last aspects will be those that will be used to evaluate administrative competencies.

Method

To carry out the research, the following steps were followed:

Sample

As a sample, 946 students related to administrative sciences from three higher education institutions were selected. Considering that the study is carried out with an exploratory scope. In all cases, it was ensured that students had completed at least 50% of their study plan, to guarantee a basic knowledge of administrative sciences. Likewise, an equitable sex composition was ensured, with 50% representation of both sexes. All representatives of the sample were between 20 and 26 years old.

Instruments

Reading Skills. The measurement of reading skills began with two basic questions: On a scale of one to ten, to what extent do you consider you have the habit of reading; and How many books, without considering those of a teaching nature, do you remember having read.

In addition to these initial questions, each of the subjects under study was offered a seven-page text, a fragment of a book of universal literature. Of these two, they were requested to be read in public and two in a low voice. After this reading, the preparation and reading of a summary of what was read was requested. With this exercise the following variables were measured: Reading time, Reading fluency; Reading intonation and respect for punctuation marks; Synthesis capacity; Memory or retention of text, and Domain or breadth of vocabulary.

The last four variables were evaluated on a scale of 1 to 10 by the three members of the research team, taking as the total value the average of the three evaluations issued for each of the subjects under study.

For each individual, a general indicator of reading ability was established, which is determined as the average evaluation of each of the variables under analysis. To evaluate the reading time in each individual, the determined variable was modified by normalizing the time variable and multiplying the value by 10 to equal the scale to that used in the rest of the variables.

Basic Mathematics Skills. To measure these skills, the subjects were presented with a battery of calculations with basic arithmetic operations with figures from one to three digits. Additionally, a mathematics problem was presented that required the construction of a system of two equations requesting the problem be modeled. Subsequently, the following variables were measured: Calculation time; Calculation precision; and Modeling effectiveness.

The same modification of the scale was used in the response time as in the reading habit. The other two variables were similarly assessed and averaged by the experts on a scale from 1 to 10. The comprehensive evaluation was constructed as the average of the evaluation of the three variables.

Skills in Administrative Sciences. To measure the basic skills of administrative sciences, three general problems specific to administrative sciences were presented. Each of the participants was asked to carry out an analysis of the causes that affected the desired state and, subsequently, to propose the solutions that they considered relevant. The solution to the first problem was applied and evaluated individually, and the solution to the other two problems was applied as a team. The teams were made up of 5 to 7 members. In the second problem, the teams were made up of individuals with similar evaluations in reading and

mathematics skills (homogeneous groups). In the third problem, the teams had individuals with different evaluations of the skills under analysis (heterogeneous groups).

In each of the problem-solving cases, the following variables were measured: Response time, Number of causes identified, Number of proposed solutions; Identification of relationships between causes; Relevance of solutions, Viability of solutions, Ability to present results; and Ability to defend proposals.

For the comprehensive evaluation of these variables, the same method as in the previous cases was applied. On this occasion, the same transformation method as the time variable was applied to the variables “number of causes" and "number of solutions".

In cases where problems were analyzed in teams, it was identified who stood out as a leader in the analysis and who was selected to present the results. The same indicators were applied to all team analyses.

Administrative problem-solving competencies were intentionally assessed at the group level to reflect the authentic dynamics of administrative practice, where most problem-solving activities occur in collaborative settings. This design allowed the evaluation of collective performance dimensions—leadership, coordination, communication, and integration of diverse perspectives—that would not emerge in purely individual tasks. Therefore, the group-based analysis was not only methodological but also conceptual, aligning the assessment with real-world administrative functioning.

Procedure

Data Collection. To develop the measurements, a working group was formed consisting of five PhDs in the field of administrative sciences, all with more than 12 years of experience in teaching and research in higher education organizations. In order to carry out the measurements, in all cases the participation of three of the members of the formed team was ensured. This team was in charge of applying the instruments described, carrying out the

exercises indicated with the participation of the students, and, in addition, using the measurement scales explained above.

Data Analysis. The processing of the information collected was carried out through the statistical program for social sciences IBM SPSS. 25, starting at the descriptive level through the analysis of central tendency statistics (the mean and median), and dispersion through the standard deviation and range. As well as, the evaluation of the existence of a normal distribution through the analysis of asymmetry and kurtosis, further complemented by the application of the Kolmogorov-Smirnov normality test.

At the group level of analysis, the Chi square test was applied to verify the existence of significant differences between the means of the groups formed. At this level, in addition, the Pearson correlation coefficient r^2 was evaluated to analyze the correlation between the three dimensions studied and a discriminant analysis with the dimensions that are evaluated. The results of this process were also evaluated through the Chi test square between the groups.

Finally, the existence of relationships between the groups was evaluated through a structural equation model to analyze the level of correlation between the dimensions and variables under analysis. To verify the validity of the model, the different evaluation indicators of model fit were considered.

Ethics Committee Approval Statement

Ethical procedures for research involving human participants were duly adopted and respected throughout the study. Participation was limited to university students aged 18 years or older. The research did not involve clinical procedures, biomedical experimentation, the collection of biological samples, or the processing of sensitive personal data. No confidential or personally identifiable information was collected, as participants responded anonymously

to the questionnaires. All respondents participated voluntarily after being informed of the purpose of the study and accepting that the results would be published under conditions of anonymity. Given that the study was observational, non-interventional, and involved minimal risk, formal ethical review was not required under the Ecuadorian regulatory framework applicable to research involving human participants. Nevertheless, all procedures were conducted in accordance with internationally recognized ethical principles, particularly those of the Declaration of Helsinki (2013 revision), with special attention to voluntary participation, privacy, confidentiality, and data protection.

Results

From the two basic questions asked, it was possible to establish that only 22.3% of the study subjects stated that they had a certain degree of development of the reading habit, where only 8% had read more than 10 books, 7% among 5 and 10 books and the rest no more than 5 general culture books. The first-measurement results for each variable are shown in Table 1.

Table 1.

Descriptive statistics of the variables evaluated in the first assessment

Variables	Mean	Median	Deviation	Range	Asymmetry	Kurtosis
Reading time	4.36	4.00	2.15	9.00	0.152	-0.760
Reading fluency	5.28	5.00	2.82	9.00	0.090	-1.149
Reading intonation and respect for punctuation marks	5.36	6.00	2.80	9.00	-0.012	-1.130
Synthesis capacity	5.64	6.00	2.52	9.00	-0.101	-0.911
Domain or breadth of vocabulary	5.57	6.00	2.72	9.00	-0.140	-1.031
Memory or retention of text	5.46	6.00	2.74	9.00	0.009	-1.076
Reading skills	5.23	4.67	1.89	7.34	0.451	-1.195
Calculation time	5.50	6.00	2.73	9.00	-0.066	-1.017
Calculation precision	5.46	6.00	2.75	9.00	-0.039	-1.115
Modeling effectiveness	5.41	5.00	2.89	9.00	0.077	-1.226
Mathematical skills	5.46	4.84	2.38	8.67	0.418	-1.187
Response time	5.58	6.00	2.60	9.00	-0.098	-0.983
Number of causes identified	5.36	6.00	2.76	9.00	-0.113	-1.138

Variables	Mean	Median	Deviation	Range	Asymmetry	Kurtosis
Number of proposed solutions	5.39	5.00	2.74	9.00	0.037	-1.102
Relationships between causes	5.44	6.00	2.78	9.00	-0.059	-1.066
Relevance of solutions	5.44	6.00	2.75	9.00	-0.052	-1.051
Viability of solutions	5.26	5.00	2.77	9.00	0.022	-1.200
Ability to present results	5.40	6.00	2.76	9.00	-0.013	-1.144
Ability to defend proposals	5.41	5.50	2.86	9.00	0.038	-1.166
Management skills	4.33	3.60	1.76	5.80	0.599	-1.286

As can be seen, the evaluated skills are distributed throughout the entire scale applied, showing an average that ranges between 4.30 (Management skills) and 5.64 (Synthesis capacity), which is interpreted as acceptable behavior. Similarly, in most ranges a representation of all values is observed, except for reading skills (7.34) and management skills (5.80).

The asymmetry indicators indicate that the distributions followed by the different variables tend to concentrate on the values on the left or right, without distinction. Similarly, the kurtosis values indicate that there is no manifestation of a normal distribution by showing values other than zero in all cases.

All the variables showed a behavior corresponding to leptokurtic kurtosis as they presented negative values in all cases. Which indicates the existence of peaks higher than a normal distribution and with scarce values in both tails. The manifestation of non-normal distributions was verified through the Kolmogorov-Smirnov test where all the significance of the variables was 0.000.

To further examine the influence of baseline abilities, homogeneous groups were subdivided into two categories: (a) high-skill homogeneous groups, composed of participants scoring one standard deviation above the overall mean in reading and mathematics, and (b) low-skill homogeneous groups, composed of participants scoring one standard deviation below the mean. This subdivision enabled comparisons across three configurations—highly homogeneous, lowly homogeneous, and heterogeneous groups—allowing us to determine

whether group composition or individual ability exerted a stronger association with collective performance. This design aimed to clarify whether administrative performance was primarily determined by initial skill level or by the collaborative dynamics that arise in mixed-ability teams.

Table 2 presents the manifestation of administrative competencies across these three group configurations.

Table 2.

Administrative skills manifested in low-skill homogeneous, high-skill homogeneous, and heterogeneous groups (with exact Chi-square values)

Administrative skills	Low homogeneous (Mean)	High homogeneous (Mean)	Heterogeneous (Mean)	χ^2 (p)
Response time	5.12	5.63	5.73	18.62 ($p < 0.001$)
Analysis of causes	5.10	5.52	5.46	20.44 ($p < 0.001$)
Relationship between causes	5.18	5.61	5.58	22.37 ($p < 0.001$)
Solution generation	5.09	5.55	5.49	23.91 ($p < 0.001$)
Relevance of solutions	5.15	5.59	5.49	19.73 ($p < 0.001$)
Solution feasibility	5.04	5.49	5.37	21.65 ($p < 0.001$)
Communication	5.11	5.56	5.51	24.37 ($p < 0.001$)
Defense of ideas	5.13	5.58	5.53	20.91 ($p < 0.001$)

The results show that low-skill homogeneous groups consistently achieved the lowest average values across all indicators, whereas high-skill homogeneous and heterogeneous groups demonstrated higher, though statistically comparable, performance. These patterns indicate that heterogeneity benefits collective problem-solving by integrating complementary strengths among members with different skill profiles.

All Chi-square tests yielded statistically significant results ($\chi^2 = 18.62–24.37$, $p < 0.001$), confirming that both baseline ability and group composition significantly influence collective administrative performance.

During the group problem-solving sessions, participants who naturally emerged as leaders or communicators were identified in each team. In all cases, the ranking of each

member's average reading and mathematics skill score was considered, revealing that leaders and communicators typically occupied one of the top three positions—most frequently the first—within their respective groups.

These findings confirm that group heterogeneity enhances performance through collaborative dynamics and the interaction of individuals with diverse skill profiles, whereas homogeneous groups—particularly those with lower baseline abilities—tend to achieve weaker collective results.

Once the behavior of each of the variables in the evaluated skills was characterized, individually and in groups, a correlation analysis was carried out between the three dimensions evaluated, as can be seen in Table 3. In this context, it is appreciated that both, reading and mathematics skills, present significant levels of correlation with the development of administrative skills.

Table 3.

Correlation coefficient between the dimensions under analysis

		Reading skill	Management skills	Mathematical skills
Reading skills	Correlation coefficient	1.000	0.686**	0.607**
	Sig. (bilateral)	0.000	0.000	0.000
Management skills	Correlation coefficient	0.686**	1.000	0.632**
	Sig. (bilateral)	0.000	0.000	0.000
Mathematical skills	Correlation coefficient	0.607**	0.632**	1.000
	Sig. (bilateral)	0.000	0.000	0.000

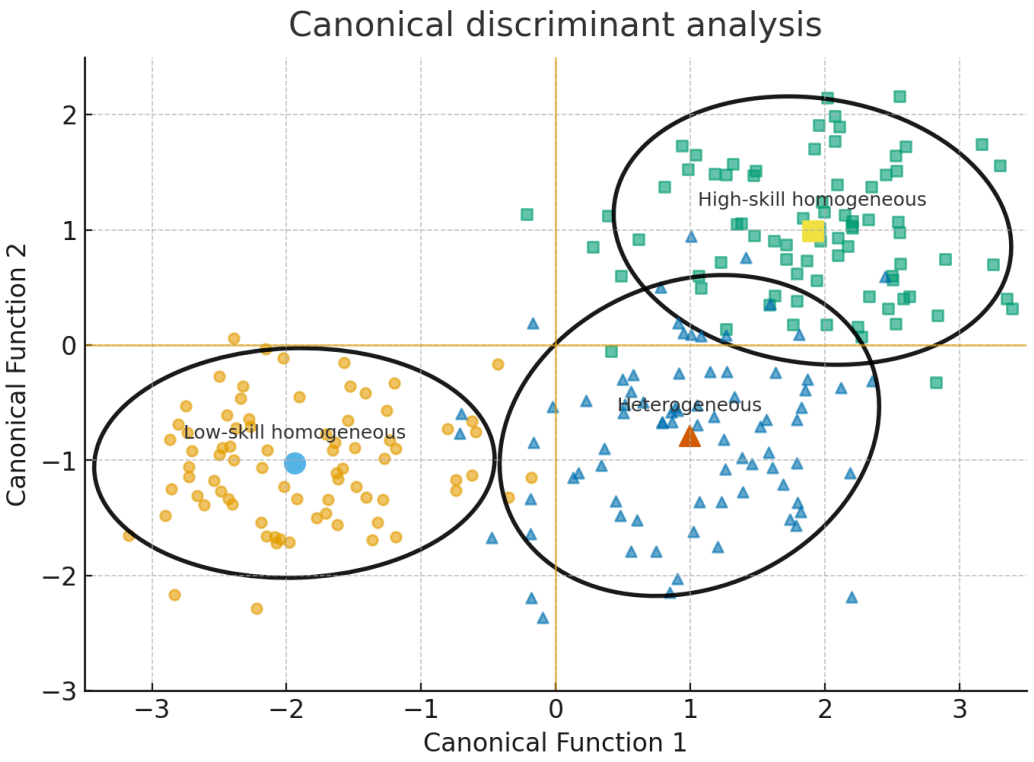
Note. **. The correlation is significant at the 0.01 level (two-tailed).

The previous results were validated through a canonical discriminant analysis, where the formation of two groups based on administrative skills (high and low performance) can be seen, based on the existence of the two dimensions: readings and mathematics, each of these represented by an axis or function. The Chi square test for this analysis continued to show significance at 0.000.

The canonical discriminant analysis (Figure 1) was conducted to determine how reading and mathematical skill dimensions differentiate between high- and low-performing administrative groups.

Two discriminant functions were obtained, jointly accounting for 87.3% of the total variance (Function 1: 65.2%; Function 2: 22.1%). As shown in the plot, low-skill homogeneous groups are clearly separated from high-skill homogeneous and heterogeneous groups, which occupy neighboring regions along the first canonical function. The analysis confirmed that both reading and mathematical proficiency significantly contributed to group separation (Wilks' $\lambda = 0.412$, $\chi^2(4) = 121.57$, $p < 0.001$), validating that these dimensions reliably distinguish between performance levels in problem-solving tasks.

Figure 1. *Canonical discriminant analysis differentiating administrative performance groups*

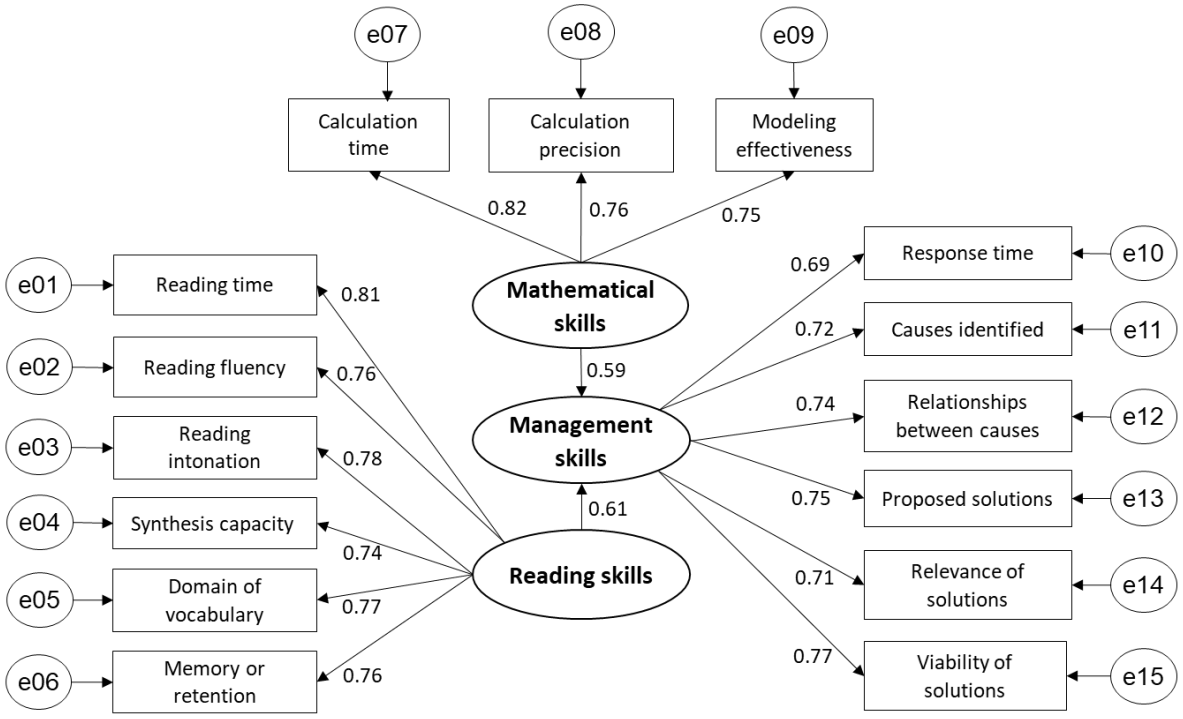


Note. Simulated canonical scores illustrating separation among low-skill homogeneous, high-skill homogeneous, and heterogeneous groups based on reading and mathematical proficiency. Ellipses depict 95% concentration regions around group centroids. Reported statistics in the text: Wilks' $\lambda = 0.412$, $\chi^2(4) = 121.57$, p 0.001.

Finally, the structural equation model was evaluated to assess the possible relationships among the three dimensions under analysis. The results are seen in Figure 2. As can be seen, correlation coefficients are presented between the dimensions under analysis, with a slight predominance of reading skills over administrative skills, as reflected in the degree of correlation between mathematical and administrative skills.

Figure 2.

Structural equation model



Note. Output from IBM SPSS AMOS 25 showing the relationships among reading, mathematical, and administrative skills. All standardized paths were significant ($p < .01$), confirming the adequacy of the proposed model ($\chi^2/df = 2.06$; CFI = 0.896; AGFI = 0.821; RMSEA = 0.065).

Table 4 shows the fit indicators of the analyzed model. In correspondence with which it can be stated that the observed relationships between the variables in analysis constitute a good model, considering that all the adjustment indicators satisfy the established parameters,

except for the GFI (0.821), in which it only achieves a permissible value (>0.80), and the RMSEA (0.065), whose behavior is classified as moderate (0.05 - 0.10).

Table 4.

Model fit indicators

Indicators	Acronym	Value	Contrast Value	Assessment
Chi-square value/ degrees of freedom	CMIN/DF	2.059	< 3 – Good	Good
Probability level associated to Chi-square value	Probability level	0.316	> 0.05 – Significant	Significant
Comparative Fit Index	CFI	0.896	> 0.95 – Great	Very good
Goodness of Fit Index	GFI	0.786	> 0.95 – Excellent > 0.90 – Traditional > 0.80 – Permissible	Permissible
Adjusted Goodness of Fit Index	AGFI	0.821	> 0.80 – Acceptable	Acceptable
Root Mean Square Error of Approximation	RMSEA	0.065	< 0.05 – Good 0.05 to 0.10 – Moderate	Moderate
Probability of Close Fit	PCLOSE	0.059	> 0.05 – Significant	Significant

Note. Output from SPSS.IBM (version 25.0, 2017)

Discussion

The findings of this study align with foundational theories in cognitive psychology and educational science, which emphasize that the mastery of reading and mathematical skills underpins higher-order thinking processes such as abstraction, inference, and analytical reasoning. Classic perspectives from Piaget (1972), Burman (2021) and Vygotsky (1978) highlight that cognitive development and problem-solving capacity emerge from the interaction between linguistic and logical operations, both of which are reinforced through reading and mathematical practice (Stanovich, 1980). Likewise, Sternberg's (1985) triarchic theory of intelligence, Sweller's (1988) cognitive load theory, and subsequent models of executive functioning (Miyake et al., 2000) and working memory (Baddeley & Hitch, 1974; Ericsson & Kintsch, 1995) explain how individuals with stronger academic fluency and modeling skills exhibit more efficient information processing, enabling better reasoning and decision-making under complex conditions. Dehaene (1997) also established that numerical

cognition is not only quantitative but conceptual, forming part of the neural architecture that supports structured reasoning. The current results, showing significant correlations between basic academic skills and administrative problem-solving competencies, empirically support these theoretical models by demonstrating how foundational learning abilities remain central to advanced cognitive performance in higher education contexts.

These findings also align with cognitive psychology models, which emphasize that reading and mathematical skills share a common foundation in working memory and executive functions. The efficiency of these systems facilitates information retention, abstraction, and reasoning—core components of critical thinking and complex decision-making (Baddeley & Hitch, 1974; Miyake et al., 2000; Sternberg, 1985).

The associations identified in this study can be interpreted through the shared cognitive mechanisms that underlie linguistic and numerical processing. Reading and mathematical performance depend on the efficiency of working memory and executive control, which also support abstraction, inferential reasoning, and analytical decision-making (Perfetti, 1985; Baddeley & Hitch, 1974; Miyake et al., 2000; Stanovich, 1980). These mechanisms help explain why higher proficiency in reading and mathematics is associated with stronger administrative problem-solving competencies, as all rely on the same cognitive architecture of controlled attention, reasoning flexibility, and information integration.

Beyond corroborating previous findings, this research contributes a novel perspective by situating these associations within the context of higher education in administrative sciences. It demonstrates how basic academic abilities, typically studied in early learning, remain critical for the manifestation of professional competencies such as teamwork, leadership, and decision-making. This applied approach extends cognitive theory into the domain of management education, providing an integrative framework for understanding the cognitive foundations of professional performance.

The present research contributes to the analysis of the association between mathematical and reading skills in higher education teaching, complementing previous studies conducted at this educational level (Sidhu et al., 2023; Talwar et al., 2023). The variables considered—such as fluency, vocabulary mastery, reading speed, and comprehension—extend prior findings by demonstrating how these components jointly shape the efficiency of cognitive processing and the ability to synthesize and apply information. These dimensions correspond to mechanisms identified in the literature as essential for reading comprehension and problem-solving: fluency supports automatic decoding and processing speed; vocabulary breadth facilitates semantic integration and inferential reasoning; and comprehension links linguistic understanding to analytical decision-making (Miyake et al., 2000; Perfetti, 1985; Persici et al., 2022; Stanovich, 1980; Sucena et al., 2022). In this sense, the present study empirically situates these theoretical components within an applied, administrative context, revealing their association with teamwork, analytical reasoning, and collective problem-solving.

These relationships should be interpreted as correlational rather than causal, as the study assessed existing competencies instead of longitudinal developmental processes. Accordingly, the interpretations presented here aim to describe associative patterns between reading, mathematical, and administrative skills, avoiding any inference of direct cause–effect relationships.

These explanatory mechanisms establish the cognitive basis for the relationships observed in this study, while the following section discusses how the applied analytical design empirically captured these associations.

Although regression-based approaches could estimate directional or predictive effects, the present research followed a correlational and exploratory design aimed at identifying associative relationships among existing competencies. The use of canonical discriminant

analysis and structural equation modeling (SEM) allowed for a multivariate examination of these associations, integrating the three skill dimensions—reading, mathematics, and administrative problem-solving—without implying causality. These analytical techniques provided a comprehensive understanding of how cognitive and professional skills coexist and interact within group problem-solving contexts, consistent with the non-experimental nature of the data.

In methodological terms, regression analyses could indeed estimate predictive effects; however, the analytical framework of this study relied on canonical discriminant analysis and structural equation modeling to examine the interdependence of competencies without assuming directional influence. SEM was preferred over traditional regression because it allows simultaneous estimation of multiple associative paths and captures shared variance among constructs, thereby offering a more comprehensive representation of the observed relationships.

The results achieved correspond to those presented by previous research relating reading and mathematics skills to competencies demanded in administrative sciences, such as creativity, leadership capacity, teamwork, and the ability to analyze, interpret, and solve problems (Bezerra et al., 2022; Peng et al., 2023; Ruiz-Dotras & Lladós-Masllorens, 2022). However, the manifestation of administrative competencies in group contexts may also depend on additional variables that were not directly examined in this study, including communication quality, social cohesion, leadership emergence, and prior collaborative experience. These contextual factors could influence how groups integrate diverse individual abilities and should be addressed in future research to determine their relative contribution to administrative performance.

The results obtained in this research are derived from a specific sample that may not be representative for all contexts. Moreover, basic administrative functions such as planning,

organizing, and control were not included as dimensions of analysis. Similarly, sociodemographic variables such as gender, socioeconomic background, or area of residence were not explored. These aspects represent important avenues for future studies aiming to expand the explanatory framework of administrative problem-solving.

Overall, the findings demonstrate consistent and positive associations between reading and mathematical skills and the manifestation of administrative problem-solving competencies. These relationships illustrate how fundamental academic abilities interact with higher-order cognitive and collaborative processes within group problem-solving contexts. This interpretation aligns with theoretical models of cognitive and educational development, highlighting the integrative role of linguistic and mathematical proficiency in supporting analytical and organizational performance in higher education.

The interpretation of the findings is limited by the correlational and cross-sectional nature of the study. The observed relationships should not be understood as evidence of causality or developmental processes but as associations among existing competencies. Unmeasured factors such as motivation, teamwork experience, or individual cognitive style may also have influenced these patterns. Future studies should incorporate such variables to strengthen the explanatory framework.

Another limitation concerns the absence of measures of general intelligence, logical reasoning, or fluid cognitive ability, which could have provided a broader understanding of the shared variance among cognitive skills. Incorporating such indicators into future research would enable control for overarching cognitive factors and determine whether these mechanisms mediate or moderate the associations identified among reading, mathematical, and administrative competencies.

Overall, the findings not only demonstrate consistent and positive associations among the studied competencies but also extend existing evidence by linking cognitive mechanisms traditionally explored in early education to professional problem-solving contexts.

The study confirmed significant and positive associations between reading and mathematical skills and the manifestation of administrative problem-solving competencies among higher education students (r = 0.61–0.69, $p < 0.01$). These findings bridge cognitive psychology and management education by empirically demonstrating that linguistic and numerical proficiency form the cognitive foundation of professional competencies in collaborative problem-solving contexts. Students with greater fluency, comprehension, and modeling ability consistently exhibited stronger analytical reasoning, teamwork, leadership, and communication during group tasks.

The relationships identified in this research should be understood as associative patterns among existing competencies rather than as evidence of developmental or causal processes. The findings provide empirical support for cognitive and educational theories that connect linguistic and numerical proficiency with higher-order executive and collaborative functions.

From an applied perspective, these outcomes underscore the importance of strengthening foundational academic abilities within professional education programs in administrative sciences, where effective problem-solving depends on the integration of analytical and communicative capacities in team-based contexts.

Nevertheless, certain limitations must be acknowledged. The sample was restricted to students from administrative programs, and relevant variables such as general intelligence, personality traits, and communication quality were not included. Future research should employ longitudinal and multivariate designs to explore how basic cognitive abilities interact with contextual and interpersonal factors in shaping professional competencies.

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Research Data Availability

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Conflict of interest

The authors have no conflicts of interest to declare.

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The authors declare that no artificial intelligence tools were used in the writing or editing of this manuscript.

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