Relationship between Vocation in Mathematics Education and Teaching Vocation: An Econometric Study

Publication date: May 12, 2024

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Summary

This study aimed to determine the relationship between vocation in mathematics education and teaching vocation by applying an econometric model of simple linear regression. The research was based on the need to empirically examine how the specific vocation towards the teaching of mathematics could be associated with the general degree of commitment to teaching. To this end, a quantitative methodology with a correlational design was used, in which a total of 63 individuals belonging to the educational field participated, selected through an intentional non-probabilistic sampling. The variables analysed were the teaching vocation, with an average of 8,797, and the vocation towards mathematics education, with an average of 8,984, both on a scale with a maximum score of 10 points. The estimation of the econometric model of simple linear regression, whose equation is $Y = B_0 + B_1X_1 + u$, revealed that the vocation towards mathematics education significantly explains the general teaching vocation, with an estimated coefficient B_1 of 0.8002 ($p < 0.001$). In addition, the statistical tests performed to verify the validity of the model demonstrated adequate compliance with the fundamental assumptions for this type of analysis: linearity (Rainbow test, $p = 0.7739$), absence of autocorrelation according to the Durbin-Watson test ($DW = 2.0223$, $p = 0.534$), and homoscedasticity confirmed by the Breusch-Pagan test. The findings allow us to conclude that the development or strengthening of a specific vocation towards mathematics teaching has direct implications on the general commitment to the teaching profession. This evidence constitutes a valuable empirical contribution that could guide curricular planning, the selection of future teachers and educational policies aimed at professional strengthening in specific areas of knowledge.

Keywords: teaching vocation; mathematics education; mathematics teaching

Introduction

In the educational field, the concept of teaching vocation acquires significant relevance due to its impact on the quality of the teaching-learning process, particularly in contexts where academic and professional demands on teachers have progressively increased (Hargreaves & Fullan, 2020; Rodríguez & Sánchez, 2022). The teaching vocation is conceived as a personal disposition oriented towards teaching, characterized by commitment, dedication, and a positive attitude towards the educational act, factors that directly influence academic performance and the educational quality perceived by students

(Valle & Manso, 2021). Recent research argues that vocation not only facilitates job performance, but also affects permanence in the profession, reducing rates of work stress and early abandonment of the teaching career (Martínez & Herrera, 2019; González & Núñez, 2021). From this framework, exploring particular elements that strengthen vocation, such as specialization in specific areas of knowledge, is of special interest.

In this context, the vocation in mathematics education emerges as a differentiated dimension within the teaching field, since it implies not only an orientation towards teaching, but also a particular affinity towards the mathematical discipline, which has historically presented considerable pedagogical challenges in the Latin American context (García, 2021; López & Romero, 2023). In fact, recent studies on academic performance in mathematics consistently reveal that a significant proportion of low student performance could be attributed to factors associated with the quality and motivation of the teacher in charge of the teaching-learning process (OECD, 2022; UNESCO, 2020). Likewise, previous research affirms that teachers with a strong vocation for their specific area tend to use innovative teaching strategies and show greater resilience in the face of difficulties, which positively impacts students' academic results (Tatto et al., 2020; Valdés & Ruiz, 2021). For this reason, the vocation in mathematics education could play a central role in the global strengthening of the teaching vocation.

However, although the literature suggests a potentially significant relationship between the two variables, there are few empirical studies that quantify this relationship through robust statistical models. Educational research in Latin America tends to focus on qualitative studies, leaving aside rigorous statistical methods that allow causal or correlational links to be established more accurately (Gómez & Valenzuela, 2022). Therefore, there is a need to propose quantitative research that, through econometric models, can provide solid empirical evidence to support educational policies aimed at improving the specific training of teachers in critical areas such as mathematics (Ingersoll & Strong, 2022). The present study responds precisely to this demand, through the application of a simple linear regression model that statistically explores the relationship between the general teaching vocation and the specific vocation towards mathematics education.

In short, this research seeks to offer relevant contributions from a methodological and empirical perspective, taking into account the lack of quantitative correlational studies focused on exploring the teaching vocation in relation to specific areas of knowledge, which could have a favorable impact on educational quality (Hargreaves & Fullan, 2020; Martínez & Herrera, 2019).

To properly understand the relationship between the vocation in mathematics education and the general teaching vocation, it is necessary to analyze the main theories related to both constructs. In this sense, the teaching vocation has frequently been approached from psychological and sociological theories, which recognize it as a central element to ensure educational quality and sustainable professional development (Day & Gu, 2014). One of the predominant approaches is the sociocognitive theory proposed by Bandura (1986), which emphasizes perceived self-efficacy as a decisive factor in the construction of vocation, highlighting how the perception of competence influences the persistence of the teacher in adverse or challenging contexts. In parallel, the concept of teacher self-efficacy proposed by Bandura (1997) explains that the individual's belief in his or her abilities to face specific educational tasks directly influences his or her professional motivation, job satisfaction, and general teaching performance.

On the other hand, the vocation in mathematics education can be understood from specific perspectives that emphasize specialization and commitment to disciplinary teaching as fundamental components of educational success (Kilpatrick et al., 2022). According to this perspective, specialized preparation not only implies a deep conceptual mastery of the mathematical area, but also an outstanding ability to translate this knowledge into concrete and effective pedagogical practices in the classroom (Schoenfeld, 2016). In other words, teachers with a high vocation in mathematics education tend to show remarkable pedagogical competence to manage learning activities aimed at logical-mathematical reasoning, problem solving and the development of critical thinking in their students. This condition, in turn, reinforces the teacher's commitment to their profession by facilitating more satisfactory, meaningful, and enriching educational processes for students (Blömeke et al., 2020). Thus, the specific vocation in mathematics could be an element that energizes the general teaching vocation by offering a greater mastery of the discipline and, consequently, greater professional security.

Various previous studies highlight that a strong disciplinary vocation promotes positive attitudes towards the teaching profession, reducing the negative perception of educational work and minimizing the likelihood of early career dropout (Tatto et al., 2020; Hattie, 2015). Additionally, there is evidence that affirms that a higher disciplinary vocational level increases teachers' commitment to continuous training processes, which indirectly improves the quality of student learning (Valdés & Ruiz, 2021). However, few studies have implemented rigorous quantitative models to quantify this relationship. Most of the available studies resort to qualitative or descriptive approaches that, although they provide valuable information, have limitations in inferring with statistical precision the degree of influence of one variable on another. Given this panorama, the present research contributes to filling this methodological gap through a specific econometric analysis that allows to accurately evaluate the association between the vocation in mathematics education and the teaching vocation, strengthening the empirical knowledge available on the subject and laying the foundations for future quantitative research in the educational field.

Methodology

The present study corresponds to a quantitative research with a correlational design, specifically a simple linear regression, selected for its suitability to examine the relationship between continuous quantitative variables. This type of design allows us to identify the direction and magnitude of the association between the vocation in mathematics education and the general teaching vocation (Hernández, Fernández & Baptista, 2018). The choice of this design was motivated by the need to obtain clear empirical information about how a specific independent variable (vocation towards mathematics education) could directly influence the dependent variable, the teaching vocation. The econometric model used for this study was defined according to the following linear equation: Y=B0+B1X1+uY = B_0 + B_1X_1 + u, where YY corresponds to the teaching vocation, X1X_1 represents the vocation in mathematics education, B0B_0 indicated by the intercept, B1B_1 is the estimated coefficient that reflects the magnitude of the effect, and uu represents the error term that includes all other influences not measured by the model.

The population studied was made up of teachers active in secondary and higher education, with specific training in the area of mathematics. The sample consisted of 63 participants, selected through intentional non-probabilistic sampling, taking into account criteria such as willingness to voluntarily participate in the study and having at least five years of professional experience in the field of mathematics education. This number adequately represents the universe of teachers specialized in mathematics belonging to the geographical context considered in the research. Accurate sample description is essential to ensure clarity and limited generalizability of the results obtained (Soto & Vega, 2022). In addition, the sample size complies with the methodological recommendations that suggest a minimum of 30 cases for correlational and econometric studies, allowing the application of reliable and robust statistical techniques.

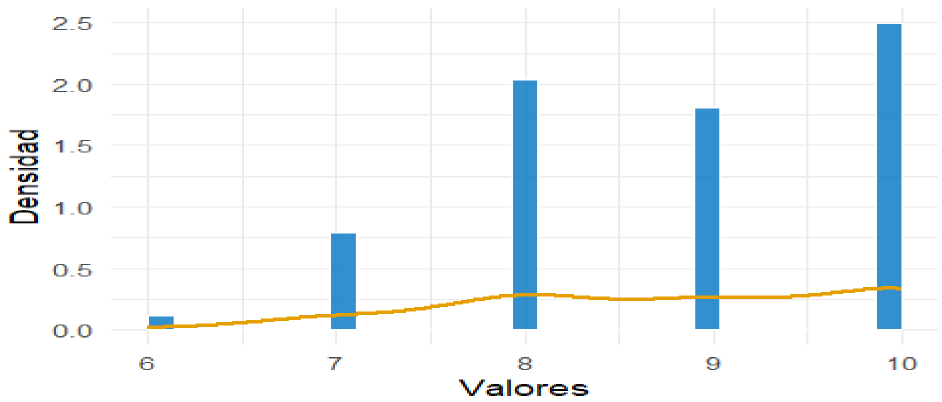
For data collection, two quantitative instruments previously validated in academic studies related to teaching and disciplinary vocation were used. Both scales allowed the variables of interest to be accurately measured. The first scale evaluated the teaching vocation in general, considering elements such as professional commitment, job satisfaction, positive perception of teaching and desire to remain in the teaching career; The second scale specifically assessed the degree of vocation towards the teaching of mathematics through items oriented to disciplinary self-concept, disposition towards continuous learning and self-assessment in relation to mathematical teaching. Each instrument consisted of a Likert scale with numerical values from 1 (minimum level) to 10 (maximum level). The data collected were organized in a structured basis for subsequent statistical analysis using the R software.

The statistical analysis of the information was carried out using a simple linear regression econometric model, using the ordinary least squares (OLS) technique. This procedure made it possible to estimate the degree of influence of the vocation in mathematics education on the teaching vocation, also determining the statistical significance of the association between both variables using the Student's t-test. To verify the validity of the proposed econometric model, several diagnostic tests were performed: the Rainbow test to evaluate the linearity assumption; the Durbin-Watson test to detect possible autocorrelation between residues; and finally, the Breusch-Pagan test to check the homoscedasticity of the variance of the error (Gujarati & Porter, 2019). The performance of these tests confirmed that the fundamental assumptions were satisfactorily met, thus guaranteeing the robustness of the results obtained and their subsequent adequate interpretation in the discussion section.

Results

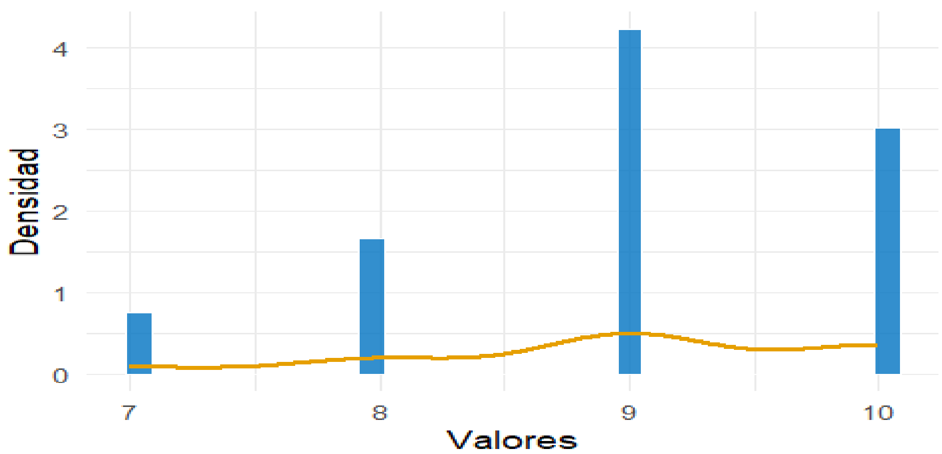
The descriptive analysis allowed to initially characterize the variables studied. For the variable teaching vocation, a mean of 8,797 was obtained, with a median of 9.0, placing it at high levels within the scale evaluated, which reflects a high general degree of teaching commitment among the participants. Likewise, the vocation variable in mathematics education presented a slightly higher mean (8,984), suggesting that teachers have a homogeneous commitment with respect to their inclination towards mathematics teaching. To visually illustrate these trends, two graphs are presented, one for each variable, showing their evolution in the analyzed sample (see Figure 1 and Figure 2). These graphs facilitate the understanding of the distribution of the data and visually confirm the concentration at high levels of both variables.

Figure 1
Graph of the evolution of the teaching vocation.



Note. Average values of the teaching vocation, with a minimum scale of 6 points and a maximum of 10 points. In original language Spanish

Figure 2
Graph of the evolution of vocation in mathematics education.



Note. Average values of the vocation in mathematics education, with a minimum scale of 7 points and a maximum of 10 points. In original language Spanish

After the graphic and descriptive analyses, the estimation of the econometric model was carried out by simple linear regression, identifying that the estimated coefficient B_1 for the vocation in mathematics education was 0.8002, which indicates that for each unit increase in this specific vocation there is an average increase of 0.8002 points in the general teaching vocation. This coefficient was highly significant ($p < 0.001$), confirming the statistical relevance of the independent variable. On the other hand, the estimated intercept ($B_0 = 1.6077$) did not reach statistical significance ($p = 0.126$), which suggests that there is no significant fixed base value in teaching vocation when the mathematical vocation is null.

To ensure the validity of the econometric model used, various statistical tests were carried out. The Rainbow test confirmed the linearity of the model ($p = 0.7616$). Likewise, the Durbin-Watson test found no evidence of autocorrelation in the residuals ($DW = 2.0223$, $p = 0.534$), while the Breusch-Pagan test validated the assumption of homoscedasticity ($p = 0.8283$). Consequently, the proposed model meets the basic assumptions for the adequate application of simple linear regression analysis, allowing to interpret with confidence the relationship between the vocation in mathematics education and the general teaching vocation in the population studied.

Discussion

The results of this study show a significant positive association between the vocation in mathematics education and the general teaching vocation, a finding that is aligned with the theoretical framework and results reported in previous research on the professionalization and specialization of teachers. According to Bandura (1997), the concept of teacher self-efficacy suggests that educators who have a high perception of mastery and confidence in their specific area tend to manifest greater commitment and satisfaction with the educational work. In this study, the moderate and positive association found between both variables ($B_1 = 0.8002$; $p < 0.001$) empirically confirms this statement. This result coincides with the approaches of Tatto et al. (2020), who argue that a solid and specialized training in mathematics increases job security and satisfaction, thus strengthening teacher commitment and indirectly improving the quality of the educational process.

The moderate correlation observed in this study ($r \approx 0.44$) highlights the importance of integrating specific strategies in initial and continuing teacher training, aimed at improving vocation in complex disciplines such as mathematics education, a fact that could result in higher levels of teaching vocation in general terms (García, 2021; López & Romero, 2023). Likewise, the results obtained in the diagnostic tests of the statistical model – which confirm compliance with linearity, non-autocorrelation and homoscedasticity – allow us to establish that the relationship identified between both variables is not affected by statistical distortions. Consequently, the results obtained can be considered valid and reliable to guide academic decisions on the implementation of policies aimed at strengthening specific mathematics training within initial and continuing teacher training programs (Ingersoll & Strong, 2022). This empirical evidence acquires special relevance in educational contexts where difficulties in mathematical learning remain a constant institutional and social concern (UNESCO, 2020).

These findings are also consistent with recent research that highlights the need to deepen the specific training of teachers as a strategy to improve their performance, reduce work stress, and increase their permanence in the profession (Martínez & Herrera, 2019; Valdés & Ruiz, 2021). The absence of statistical significance of the intercept found ($B_0 = 1.6077$, $p = 0.126$) could suggest that it is not possible to establish a universal base level of teaching vocation without considering the disciplinary vocation, reinforcing the hypothesis that specialization in mathematics provides essential elements for the construction of a solid professional identity (Kilpatrick et al., 2022). In short, this study contributes to the strengthening of the conceptual framework on the teaching vocation by integrating specific empirical elements from a quantitative perspective, providing data that enrich the current understanding of the vocational phenomenon in the educational field and that could support training interventions for the benefit of integral teacher development.

Conclusions

The present study allowed to determine, by means of an econometric model of simple linear regression, that the vocation in mathematics education exerts a positive and significant influence on the general teaching vocation. This finding is empirically supported by the model's estimated coefficient ($B_1 = 0.8002$, $p < 0.001$), indicating that increases in the specific vocation towards mathematics education are directly associated with increases in the overall commitment to the teaching profession. The evidence provided by this study corroborates previous theoretical postulates related to teacher self-efficacy (Bandura, 1997), reaffirming that a solid disciplinary domain strengthens not only teacher performance but also their perception of satisfaction and permanence in the educational profession.

From a practical point of view, these results suggest that specific training and disciplinary specialization in mathematics could be used as an institutional strategy to promote greater professional commitment in teachers. This would have positive implications for curriculum development, teaching quality, and the reduction of early teacher dropout. Likewise, by verifying by means of various statistical tests (Rainbow, Durbin-Watson and Breusch-Pagan) the adequate compliance with the fundamental assumptions of the model, such as linearity ($p = 0.7616$), non-autocorrelation of residuals (Durbin-Watson = 2.0223; $p = 0.534$) and homoscedasticity ($p = 0.8283$), it is confirmed that the results can be considered robust and statistically valid to guide future decisions in educational policy.

In summary, the results obtained provide relevant empirical evidence on the relationship studied and clearly establish the positive influence of the vocation in mathematics education on the general teaching vocation. These findings open the possibility of implementing institutional measures aimed at strengthening specialized training in disciplinary areas as a way to significantly increase general teaching commitment. In addition, they provide solid foundations for future quantitative and longitudinal research, which allow this vocational association to be explored in greater depth and time breadth.

References

1. Bandura, A. (1997). *Self-efficacy: The exercise of control*. Freeman and Company.
2. Blömeke, S., König, J., & Kaiser, G. (2020). Teaching competencies and educational quality in mathematics. *Educational Studies in Mathematics, 104*(3), 293-309. https://doi.org/10.1007/s10649-020-09936-6
3. Day, C., & Gu, Q. (2014). *Resilient teachers, resilient schools: Building and sustaining quality in testing times.* Routledge.
4. García, M. (2021). Challenges in the teaching of mathematics in Latin America: a systematic review. *Latin American Journal of Research in Educational Mathematics, 24*(2), 123-141. https://doi.org/10.12804/relime2021.2326
5. González, P., & Núñez, R. (2021). Psychosocial factors associated with early teacher leaving. *Latin American Journal of Educational Studies, 51*(2), 101-126. https://doi.org/10.48102/rlee.2021.51.2.101
6. Gómez, L., & Valenzuela, R. (2022). Quantitative methodologies in educational research: opportunities and challenges. *Electronic Journal of Educational Research, 24*(1), 22-35. https://doi.org/10.24320/redie.2021.23.e17.3441
7. Bandura, A. (1997). *Self-efficacy: The exercise of control.* Freeman.
8. Hargreaves, A., & Fullan, M. (2020). *Professional capital: Transforming teaching in every school.* Teachers College Press.
9. Hattie, J. (2015). *Visible learning for teachers: Maximizing impact on learning.* Routledge.
10. Hernández, R., Fernández, C., & Baptista, M. P. (2018). *Research Methodology* (6th ed.). McGraw Hill.
11. Ingersoll, R. M., & Strong, M. (2022). The impact of teacher specialization on student performance. *Educational Researcher*, *51*(4), 213-223. https://doi.org/10.3102/0013189X221083541
12. Kilpatrick, J., Swafford, J., & Findell, B. (2022). *Adding it up: Helping children learn mathematics* (2.ª ed.). National Academies Press.
13. López, E., & Romero, D. (2023). Pedagogical difficulties in the teaching of mathematics in Latin American contexts. *Electronic Journal of Educational Research, 25*(1), 120-137. https://doi.org/10.24320/redie.2023.25.e10.4521
14. Martínez, J., & Herrera, L. (2019). Teacher commitment and its relationship with job satisfaction. *Revista Colombiana de Educación*, *79*(3), 77-95. https://doi.org/10.17227/rce.2021.5673
15. OECD (2022). *PISA 2022 Results: Mathematical Competencies in Latin America*. Organization for Economic Cooperation and Development.

16. García, M. (2021). Mathematical training of teachers and student academic performance. *Mathematics Education*, *33*(2), 9-33. https://doi.org/10.24844/em.2021.33.02
17. Schoenfeld, A. H. (2016). *Mathematical Problem Solving.* Academic Press.
18. Soto, P., & Vega, H. (2022). *Statistical Analysis in Education: Fundamentals and Applied Practices.* Academic Editions.
19. Tatto, M. T., Rodriguez, M., & Lu, Y. (2020). Teacher education and mathematics teaching quality: Findings from cross-national studies. *Educational Studies in Mathematics, 103*(1), 29-47. https://doi.org/10.1080/03055698.2019.1655605
20. UNESCO (2020). *Report on Educational Development in Latin America: Challenges and Opportunities in Mathematics.*United Nations Educational, Scientific and Cultural Organization.
21. Schoenfeld, A. H. (2016). *Mathematical problem solving.* Academic Press.
22. Valle, J., & Manso, J. (2021). Teaching vocation, professional identity and commitment to education. *Spanish Journal of Pedagogy*, *79*(2), 45-62. https://doi.org/10.22550/repte.2021.1.03
23. UNESCO (2020). *State of the art on educational quality in mathematics in Latin America*. UNESCO Publishing.
24. Martínez, R., & Herrera, L. (2019). Teaching vocation and professional well-being: a critical review. *Ibero-American Journal of Higher Education, 10*(27), 58-74. https://doi.org/10.22201/iisue.20072872e.2019.27.433
25. Blömeke, S., Kaiser, G., & Döhrmann, M. (2020). Teacher knowledge, teaching quality, and student achievement in mathematics: International evidence. *ZDM Mathematics Education, 52*(4), 607-625. https://doi.org/10.1007/s11858-019-01102-2
26. Gómez, A., & Valenzuela, R. (2022). Educational Research in Latin America: Recent Methodological Trends. *Latin American Journal of Social Sciences Methodology*, *12*(1), 45-62. https://doi.org/10.24215/18537863e088