

# Articulation of the transition from secondary education to university studies in experimental sciences

*Articulación de la transición desde la educación media hacia los estudios universitarios en ciencias experimentales*

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## Abstract

This study examines the articulation of the transition between secondary and higher education in the Experimental Sciences programs of the Faculty of Education, Arts, and Communication at the National University of Loja, during the academic period from September 2024 to February 2025. The main objective was to identify the factors associated with this process and determine its level of articulation. To this end, a quantitative approach was used, with a non-experimental, deductive design. Data collection was conducted through a structured questionnaire addressed to undergraduate students. Statistical analysis included the Shapiro-Wilk normality test, Spearman's correlation, and multiple correspondence analysis. The results show that previous academic and external factors are strongly correlated with the transition, while internal, socioeconomic, and student satisfaction factors are weaker. Furthermore, multivariate analysis identified significant associations between gender, age, and degree chosen. In conclusion, the articulation of the transition depends on a complex interaction between various dimensions, which highlights the importance of considering these factors holistically to strengthen support for students in this key process of their educational journey.

**Keywords:** educational articulation, comparative education, higher education.

## Resumen

El presente estudio examina la articulación de la transición entre la educación media y la educación superior en las carreras de Ciencias Experimentales de la Facultad de la Educación, el Arte y la Comunicación de la Universidad Nacional de Loja, durante el periodo académico septiembre 2024-febrero 2025. El objetivo principal fue identificar los factores asociados a este proceso y determinar su nivel de articulación. Para ello, se empleó un enfoque cuantitativo, con un diseño no experimental y de tipo deductivo. La recolección de datos se realizó mediante un cuestionario estructurado dirigido a estudiantes de primer ciclo. El análisis estadístico incluyó la prueba de normalidad de Shapiro-Wilk, la correlación de Spearman y el análisis de correspondencias múltiples. Los resultados evidencian que los factores académicos previos y externos presentan una fuerte correlación con la transición, mientras que los factores internos, socioeconómicos y de satisfacción estudiantil muestran una relación más débil. Además, el análisis multivariado identificó asociaciones significativas entre el género, la edad y la carrera elegida. En conclusión, la articulación de la transición depende de una interacción compleja entre diversas dimensiones, lo que resalta la importancia de considerar estos factores de manera integral para fortalecer el acompañamiento a los estudiantes en este proceso clave de su trayectoria educativa.

**Palabras clave:** articulación educativa, educación comparada, enseñanza superior.

## Introduction

Educational articulation is fundamental for ensuring a successful transition between various levels of the educational system. According to Lalama Flores et al. (2024), this process begins with identifying the requirements of the productive sector. Similarly, Sterling Collazos (2019) notes that in Colombia, the articulation between

secondary and higher education involves developing pedagogical actions that facilitate recognition and dialogue of knowledge between both levels, with the aim of promoting regional development, access to technologies, and strengthening educational equity.

In this context, the transition is understood as the moments of change between educational levels that are crucial in the academic trajectory of students, both socially and academically (Sánchez Echeverri, 2024). Therefore, it is necessary to determine the importance of this transition and the internal and external factors that enable students to successfully adapt to the university environment (Pérez et al., 2020). In Ecuador, access to higher education and its stages are regulated by the Secretariat of Higher Education, Science, Technology, and Innovation (Senescyt).

Upon entering higher education, students face challenges specific to this transition, often with inadequate academic tools to confront these challenges (Padilla & Figeroa, 2015). Factors such as academic performance and family support are essential for a successful transition. Previous studies, such as that of Castillo-Sánchez et al. (2020), highlight deficiencies in prior knowledge and a lack of adequate study habits. Furthermore, internal factors such as maturity, mastery of study techniques, and personal motivation significantly influence success in this stage (Espinoza Sanhueza, 2019).

The transition is especially stressful for students coming from other locales (Morales Rodríguez et al., 2017). Additionally, adaptation to academic life is closely linked to the quality of interactions that students establish with their peers and instructors, as well as the willingness of the latter to provide academic support (Huairé Inacio et al., 2019).

Valverde López et al. (2022) argue that support networks—family, friendships, instructors, and emotional support—are vital in the university adaptation process. On the other hand, academic performance in first-semester students may be affected by the mode of study, the method of admission (Parra et al., 2012), and geographic factors that facilitate or hinder access to economic, educational, and social resources (Correa, 2023).

Pedler et al. (2022) suggest that a greater sense of belonging among university students is associated with higher motivation, academic self-confidence, commitment, and performance. In Ecuador, the Organic Law of Higher Education (LOES, 2010) regulates admission to higher education, taking into account capacities, academic background, and socioeconomic conditions of applicants.

For the transition from secondary to higher education, the General Regulation of the Organic Law of Higher Education (Ejecutivo & Delgado, 2011) establishes that Senescyt will coordinate the mechanisms for articulation between services and requirements of the Leveling and Admission System, in conjunction with public higher education institutions. According to Senescyt (2023), this process includes stages such as national registration, academic status assessment, academic offerings, enrollment, evaluation, application, assignment, and acceptance of slots.

For instance, the instructions from the National University of Loja (UNL, 2025) indicate that the access process is governed by Ecuadorian regulations and is directed towards applicants registered nationally, provided they meet the citizenship conditions established by the National Leveling and Admission System.

In this context, the present study aims to identify how the transition from secondary education to university occurs in Ecuador, focusing on the articulation of this process among students in the experimental programs at the National University of Loja.

## Methodology

The present research was conducted at the National University of Loja (UNL), located in the city and province of Loja, Ecuador. This institution offers three programs in pedagogy for experimental sciences: Pedagogy in Computer Science, Pedagogy in Mathematics and Physics, and Pedagogy in Chemistry and Biology.

The research approach is quantitative, with an explanatory-descriptive scope and a non-experimental cross-sectional design. A deductive method was adopted, allowing for the analysis of particular cases based on collected data, logically and objectively describing the observed phenomena. Additionally, an exhaustive consultation was conducted in databases such as Scopus, Web of Science, Google Scholar, institutional repositories, as well as in official documents from the Ministry of Education, Senescyt, the Constitution of Ecuador, and regulations specific to UNL.

A structured survey was administered to 90 first-cycle students in the Pedagogy programs for Mathematics and Physics (33), Chemistry and Biology (33), and Computer Science (24) during the academic period from September 2024 to February 2025. The questionnaire, composed of 50 closed questions using a Likert scale, addressed six dimensions: prior academic factors, internal factors, external factors, student satisfaction, academic performance, and socioeconomic factors. The instrument was administered virtually via Google Forms.

To ensure the quality of the instrument, a rigorous validation and reliability process was carried out. Content validity was verified by three education experts who assessed the coherence, relevance, and clarity of the items. Subsequently, reliability was evaluated using Pearson's correlation coefficient, yielding a value of  $r = 0.9865$ , indicating high consistency in responses. Furthermore, Cronbach's alpha produced a value of 0.82, supporting acceptable reliability according to methodological criteria (Oviedo & Campo, 2005).

Finally, data analysis was conducted using RStudio 2024.12.1, employing Multiple Correspondence Analysis (MCA), a fundamental tool for constructing analytical relational spaces. This analysis allows for positioning study units based on a set of variables and graphically representing the multiplicity of resulting relationships (Algañaraz Soria, 2016).

## Results and discussion

To address the first objective, which is to identify the factors influencing the transition from secondary education to higher education in experimental science programs, a study was conducted focusing on the determinants of this process. Table 1 presents the academic factors, adapted from the studies of Suárez Brieva et al. (2017), Agualongo and Garcés (2020), and Pérez et al. (2020), that contribute to a better understanding of this educational articulation.

**Table 1**

*Determinants in the articulation of the transition from secondary to higher education*

Determinants	Description	Characteristics
Prior Academic Factors (Experience in Secondary School)	Information regarding academic experience in secondary school. Indicators of training received at the secondary level.	Refers to whether secondary training was appropriate; time management during that period; adequate vocational guidance; training in mathematics; training in sciences; development of critical thinking; language skills; appropriate level of demand.
External Factors	Indicators regarding: choice of career, choice of university, and family support received during the first semester of studies.	Emotional support in career choice; family environment; extracurricular activities; socio-emotional support in the transition from secondary to university education.
Internal Factors	Indicators regarding: academic deficiencies in teaching-learning processes, goals set by the university student during the first semester, performance, and academic achievement.	Clear objectives; self-confidence; discipline; academic performance in secondary school.
Student Satisfaction	Indicators regarding satisfaction with the university, the program, and the faculty in the first cycle of university studies.	Adaptation to university methodologies; access to institutional academic resources.
Academic Performance	Constitutes one of the most important factors in the teaching process, encompassing various aspects such as social, family, and individual factors, along with teaching methodologies, prior knowledge, learning tools, and the educational environment, among others.	Academic performance according to expectations; adaptation to university assessments; class attendance; orientation in the university.

Socioeconomic Factors	Economic factor related to individual income and, in some cases, to the economic level of the neighborhood where the person lives.	Transportation costs to university; economic difficulties; institutional financial support.
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**Nota.** Adapted from Suárez Brieva et al. (2017), Agualongo & Garcés (2020), and Pérez et al. (2020)

As evidenced in Table 1, six determining factors were identified that intervene in the articulation and transition from secondary to higher education. These factors were described and supported by relevant information extracted from the aforementioned authors.

To respond to the second objective, which is to establish how the transition from secondary to higher education is articulated among students in Experimental Sciences, a survey was administered to first-cycle students. To analyze the data, the distribution of the variables was evaluated using the Shapiro-Wilk test to determine normality. The results indicated that the dimensions did not follow a normal distribution ( $p$ -value < 0.05), ruling out the use of Pearson's correlation coefficient, which assumes linear relationships and normally distributed variables.

Consequently, Spearman's correlation coefficient was employed, a non-parametric technique that allows for the analysis of relationships between ordinal or non-normal variables, measuring the intensity and direction of monotonic relationships (Rebekić et al., 2015). Table 2 presents the results obtained from the Spearman correlation between the factors and the overall score.

**Table 2**

*Spearman correlation coefficients between the factors and the overall score*

Evaluated factor	Correlation coefficient (r)	Interpretation
Prior Academic Factors	0,709	Very strong positive correlation
External Factors	0,624	Strong positive correlation
Academic Performance	0,383	Moderate positive correlation
Internal Factors	0,201	Weak positive correlation
Socioeconomic Factors	0,140	Very weak positive correlation

**Note.** Authors' own elaboration (2025)

The data presented in Table 2 show the correlations among the analyzed factors. However, student satisfaction exhibited a weak negative correlation, indicating that the level of satisfaction with the educational experience is not directly related to performance measured by the score.

Complementarily, observing Figure 1, which represents the scores obtained across the various factors through a radar chart, it is apparent that the prior academic factor achieved the highest score (100%), while student satisfaction recorded the lowest value. The other factors show intermediate scores, with internal factors exceeding 50%, while the remaining factors are close to this threshold.

**Figure 1**

*Polar radar: average scores obtained from the dimensions influencing the transition*



**Note.** Authors' own elaboration based on R program data (2025)

Figure 1 confirms the previously estimated values, demonstrating that the prior academic factor is one of the main determinants of student transition, while the other factors present lower values. In this sense, the factors influencing the transition largely align with those proposed by Pérez et al. (2020): prior academic factors, internal factors, external factors, student satisfaction, and academic performance, to which the socioeconomic factor was added. This corroborates existing literature, indicating the decisive importance of these elements for an effective transition process.

However, referencing Agualongo and Garcés (2020), who highlight the significant weight of socioeconomic factors in the transition, this study found minimal correlation in that aspect. This difference may be explained by the fact that the National University of Loja is a public and free institution, which facilitates students' ability to maintain a suitable university life without socioeconomic conditions representing a major obstacle.

It is also noteworthy that student satisfaction with the educational experience does not show a direct relationship with the transition. This finding aligns with Álava et al. (2017), who indicate that, in general, students adapt adequately to university methodologies and that this adaptation does not pose a significant challenge. On the other hand, although the correlation with academic performance is moderate, these results support the idea that the skills related to achieving expected academic results—developed both before and during university training—are fundamental for academic integration (Ricardo et al., 2017).

Regarding the general objective of the study, aimed at analyzing the articulation in the transition from secondary to higher education in experimental science programs, an analysis based on a Burt matrix was conducted, with the results presented in Table 3 for multiple correspondence analysis. This matrix is a statistical technique that allows for discovering latent structures in complex datasets, including multidimensional categorical data (Mathai et al., 2022). The categories analyzed include levels (high, medium, low), gender (male/female), the three programs studied (Computer Science, Mathematics and Physics, Chemistry and Biology), and age ranges (17-19, 20-22, 23-25, 26 or older).

**Table 3**  
*Burt Matrix Applied to Survey Data of the Dimensions*

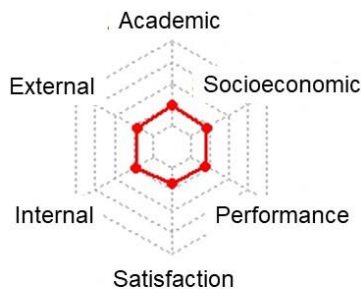
Column 1	HIGH Score	MEDIUM Score	Male	Female	Chemistry & Biology	Computer Science	Mathematics & Physics	Age 17-19	Age 20-22	Age 23-25	Age 26+
<b>HIGH</b>	85	0	36	49	33	22	30	19	15	28	23
<b>MEDIUM</b>	0	5	2	3	1	2	2	2	0	1	2
<b>Male</b>	36	2	38	0	16	8	14	7	5	12	14
<b>Female</b>	49	3	0	52	18	16	18	14	10	17	11
<b>Chemistry &amp; Biology</b>	33	1	16	18	34	0	0	6	3	14	11
<b>Computer Science</b>	22	2	8	16	0	24	0	10	8	1	5
<b>Mathematics &amp; Physics</b>	30	2	14	18	0	0	32	5	4	14	9
<b>Age 17-19</b>	19	2	7	14	6	10	5	21	0	0	0
<b>Age 20-22</b>	15	0	5	10	3	8	4	0	15	0	0
<b>Age 23-25</b>	28	1	12	17	14	1	14	0	0	29	0
<b>Age 26+</b>	23	2	14	11	11	5	9	0	0	0	25

**Note.** Authors' own elaboration based on R program data (2025)

Table 2 shows that the "high" category clearly dominates with 85 cases, while the "medium" category has minimal representation, with only 5 cases. This suggests a very unequal distribution, indicating that the majority of the individuals analyzed belong to a group where the transition has been positively achieved. According to the values recorded in this study, most respondents report a high transition level, as the factors mentioned are highly valued. This finding aligns with Sánchez Echeverri (2024), who suggests considering psychological, emotional, and cultural aspects in the transition process.

Additionally, the perception radar of the factors associated with the transition (Figure 2), generated from the data analyzed using RStudio (2025), illustrates how each axis represents a study variable. The distance from the center of the radar reflects the average value of each dimension, allowing for a comparative visualization of student perceptions regarding the factors considered in their transition process.

**Figure 2**  
*Perception radar of factors associated with the transition*



**Note.** Authors' own elaboration based on data from RStudio (2025)

The perception radar presented derives from Multiple Correspondence Analysis (MCA), a fundamental tool for analytical construction of relational spaces. This approach allows for relational positioning of the units of analysis based on a specific set of variables, graphically and analytically illustrating the resulting multiplicity (Algañaraz Soria, 2016).

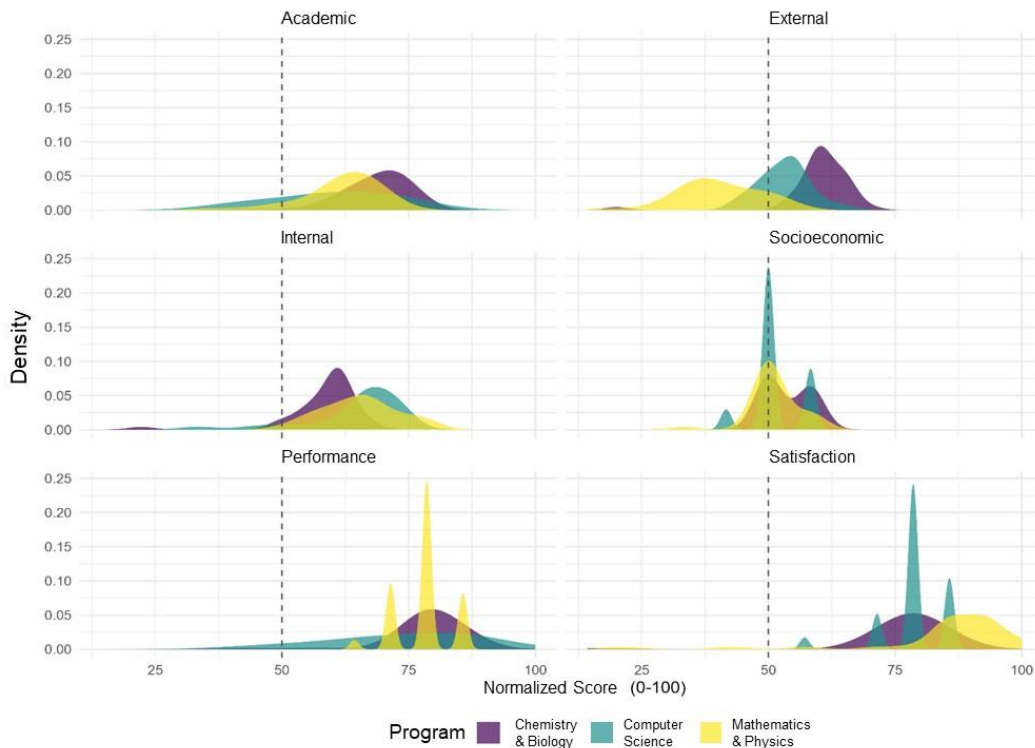
MCA transforms categorical data into a reduced dimensional space, where each category is represented as a point on a Cartesian plane. The axes (Dimension 1 and Dimension 2) correspond to the principal dimensions explaining the greatest variance in the data. In this case, factor analysis reveals that the first two dimensions explain 40.2% of the total variance, providing a solid initial basis for interpreting the relationships among the variables.

Dimension 1 (horizontal) establishes a significant contrast: the "high" and "female" categories are strongly associated on the positive side, suggesting a possible overrepresentation of females in high-performance groups or a preference. The Computer Science program also trends toward this side. On the negative side, the "medium" category opposes "high," while "male" and the Mathematics and Physics program show some proximity.

Dimension 2 (vertical) highlights the association of the Computer Science program with younger age groups (17-22 years) at the top. In contrast, the bottom links individuals aged 26 or older with the Mathematics and Physics program. Overall, a pattern emerges where femininity relates to the "high" level, masculinity is associated with the Mathematics and Physics and Chemistry and Biology programs, and age influences preference for Computer Science (for younger students) and Mathematics and Physics (for older students). The "medium" category and age group 23-25 appear to have less influence on these first two dimensions.

In line with these findings, responses varied according to the factor analyzed across each of the surveyed programs, as depicted in Figure 3.

**Figure 3**  
*Distribution of responses by factor and program*



**Note.** Authors' own elaboration based on data from RStudio (2025)

Thus, Figure 3, as a density graph, allows for visualization of the behavior of scores across the different dimensions analyzed according to the level of transition.

### Conclusions

Based on the analysis conducted, it is concluded that the articulation between secondary and higher education in the Experimental Sciences programs of the Faculty of Education, Arts, and Communication shows significant progress, particularly regarding students' prior academic preparation. This factor, linked to the knowledge and skills acquired during secondary education, serves as a fundamental axis facilitating a successful transition to the university environment.

However, the research indicates that this articulation is not homogeneous. External factors, such as emotional and family support, although not the direct responsibility of educational institutions, have a considerable influence on students' adaptation processes.

On the other hand, the limited impact of internal and socioeconomic factors suggests a need to reconsider institutional approaches regarding support strategies that promote student retention and academic success.

Although most of the analyzed students achieve a high level of transition, gaps persist that hinder full integration. This indicates that the articulation between the two educational levels must extend beyond academic content, incorporating comprehensive policies and curricular adjustments that respond to the diverse realities and needs of students.

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