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Plithogenic Statistical Analysis of Teaching Performance in Student Autonomous Learning

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Abstract. In the current educational context, the effectiveness of teaching performance in blended environments has acquired significant relevance. The present research focused on evaluating the relationship between professional teaching competencies and the achievement of student competencies in the blended context. To this end, perceptions of teacher performance and instrumental, interpersonal, and systemic competencies were evaluated using plithogenic statistics. Among the results, they indicated that the student's perception of teaching performance in relation to classroom management and professional development was positive. However, areas of improvement were identified in interpersonal and technical skills. Observations suggest that teacher performance significantly influences the achievement of student competencies. Consequently, it has been concluded that continuing training programs must be developed for future pedagogical interventions and curricular adjustments in blended environments.

Keywords: teaching performance, blended learning, student competencies, plithogenic statistics.

1 Introduction

In recent decades, alternative basic education has faced a significant mismatch with the growing demands of a globalized world, driven by the rapid advancement of science and technology [1] [2]. This context has highlighted serious deficiencies in the educational system, particularly in basic education, where a pedagogical approach focused on memorization and repetition of content still prevails. This traditional, rigid, and inflexible methodology has limited the development of fundamental competencies in students, such as creativity, innovation, and the ability to solve complex problems [3]. Indeed, this is reflected in low academic performance and widespread dissatisfaction among students and families [4].

Similarly, teaching performance in this context has been insufficient to meet social expectations, leading to a climate of frustration and demotivation [5] [6]. Consequently, this affects the quality of education in blended learning environments, as it significantly depends on the competencies of the students [7]. The area of Mathematical Logic has been impacted by methodologies that do not promote the development of instrumental, interpersonal, and systemic competencies, which are essential for success in an increasingly interconnected and technologically advanced world.

Therefore, this study focuses on evaluating the relationship between teaching performance in the blended learning modality and the development of instrumental, interpersonal, and systemic competencies in students. For this purpose, a plithogenic statistical analysis is proposed to optimize potential solutions in teaching performance in the blended learning modality at the Mother Teresa of Calcutta Pilot Center in San Juan de Lurigancho, Lima.

2 Materials and methods

2.1 Neutrosophic Statistics

Neutrosophic probabilities and statistics are a generalization of classical and imprecise probabilities and statistics [8]. The neutrosophic probability of event E represents the probability that event E occurs, the probability that event E does not occur, and the probability of indeterminacy (not knowing whether event E occurs or not). In classical probability, nsup≤1, whereas in neutrosophic probability, nsup≤3+. The function that models the neutrosophic probability of a random variable x is called the neutrosophic distribution:

$$NP(x) = (T(x), I(x), F(x))$$

Where T(x) represents the probability that the value x occurs, F(x) represents the probability that the value x does not occur, and I(x) represents the indeterminate or unknown probability of the value x. Neutrosophic statistics involve the analysis of neutrosophic events and deal with neutrosophic numbers, neutrosophic probability distribution, neutrosophic estimation, and neutrosophic regression.

It refers to a data set, which is composed, wholly or partially, of data with some degree of indeterminacy and the methods to analyze them. Neutrosophic statistical methods allow for the interpretation and organization of neutrosophic data to reveal underlying patterns.

In summary, neutrosophic logic, neutrosophic sets, and neutrosophic probabilities and statistics have wide applications in various research fields and constitute a novel and developing area of study [9] [10].

For the processing of neutrosophic numbers, they are defined as numbers of the form a + bI, where a and b are real or complex numbers, while "I" represents the indeterminate part of the neutrosophic number N. The study of neutrosophic statistics refers to a neutrosophic random variable where X_l and $X_u I_N$ represent the lower and upper levels, respectively, that the studied variable can reach within an indeterminate interval $[I_l, I_u]$. Thus, the neutrosophic mean of the variable $(\bar{x}_N)$ is formulated as:

$$X_N = X_l + X_u I_N;\ I_N \in [I_l, I_u] \tag{1}$$

$$\text{Where, } \bar{x}_a = \frac{1}{n_N}\sum_{i=1}^{n_N} X_{il},\ \ \bar{x}_b = \frac{1}{n_N}\sum_{i=1}^{n_N} X_{iu},\ n_N \in [n_l, n_u], \tag{2}$$

is a neutrosophic random sample. However, neutral frames (NNS) can be calculated as follows

$$\sum_{i=1}^{n} N(X_i - \bar{X}_{iN})^2 = \sum_{i=1}^{n} N\begin{bmatrix} \min\begin{pmatrix}(a_i + b_i I_L)(\bar{a} + \bar{b} I_L), (a_i + b_i I_L)(\bar{a} + \bar{b} I_U)\\ (a_i + b_i I_U)(\bar{a} + \bar{b} I_L), (a_i + b_i I_U)(\bar{a} + \bar{b} I_U)\end{pmatrix} \\ \max\begin{pmatrix}(a_i + b_i I_L)(\bar{a} + \bar{b} I_L), (a_i + b_i I_L)(\bar{a} + \bar{b} I_U)\\ (a_i + b_i I_U)(\bar{a} + \bar{b} I_L), (a_i + b_i I_U)(\bar{a} + \bar{b} I_U)\end{pmatrix}\end{bmatrix}, I \in [I_L, I_U] \tag{3}$$

Where $a_i = X_l b_i = X_u$. The variance of the neutrosophic sample can be calculated by

$$S_N^2 = \frac{\sum_{i=1}^{n_N}(X_i - \bar{X}_{iN})^2}{n_N};\ S_N^2 \in [S_L^2, S_U^2] \tag{4}$$

The neutrosophic coefficient (NCV) measures the consistency of the variable. The lower the NCV value, the more consistent the performance of the factor compared to other factors. The NCV can be calculated as follows.

$$CV_N = \frac{\sqrt{S_N^2}}{\bar{X}_N} \times 100;\ CV_N \in [CV_L, CV_U] \tag{5}$$

The neutrosophic scale is applied to evaluate the importance and frequency of the dimensions of teaching performance and the achievement of student competencies. The following criteria are used as seen in the following tables (see Table 1 and 2).

Table 1: Plithogenic scale to evaluate the importance of teaching performance. Source: Own elaboration.

Linguistic expression	Scale	Plithogenic number (T, I, F)	$\mathcal{S}([\mathbf{T}, \mathbf{I}, \mathbf{F}])$	Description
Extremely High (EH)	10	(1.00, 0.00, 0.00)	0.95	Extremely High Achievement of Student Competencies.
Very Very High (VVH)	9	(0.90, 0.05, 0.10)	0.85	Very High Achievement of Student Competencies.
Very High (VH)	8	(0.80, 0.15, 0.20)	0.75	High Achievement of Student Competencies.
High (H)	7	(0.70, 0.25, 0.30)	0.65	Significant Achievement of Student Competencies.
Moderately High (MH)	6	(0.60, 0.35, 0.40)	0.55	Moderately High Achievement of Student Competencies.
Medium (M)	5	(0.50, 0.45, 0.50)	0.50	Moderate Achievement of Student Competencies.
Moderately Low (ML)	4	(0.40, 0.55, 0.65)	0.45	Moderately Low Achievement of Student Competencies.
Low (L)	3	(0.30, 0.65, 0.70)	0.35	Low Achievement of Student Competencies.
Very Low (VL)	2	(0.20, 0.75, 0.80)	0.25	Very Low Achievement of Student Competencies.
Very Very Low (VVL)	1	(0.10, 0.85, 0.90)	0.15	Very Very Low Achievement of Student Competencies.
Extremely Low (EL)	0	(0.00, 0.95, 1.00)	0.05	Insignificant Achievement of Student Competencies.

Table 2: Plithogenic scale to evaluate the frequency of achievement of student competencies. Source: Own elaboration.

Linguistic expression	Scale	Plithogenic number (T, I, F)	$\mathcal{S}([\mathbf{T},\mathbf{I},\mathbf{F}])$	Description
Extremely High (EH)	10	(1.00, 0.00, 0.00)	0.95	Extremely High Achievement of Student Competencies.
Very Very High (VVH)	9	(0.90, 0.05, 0.10)	0.85	Very High Achievement of Student Competencies.
Very High (VH)	8	(0.80, 0.15, 0.20)	0.75	High Achievement of Student Competencies.
High (H)	7	(0.70, 0.25, 0.30)	0.65	Significant Achievement of Student Competencies.
Moderately High (MH)	6	(0.60, 0.35, 0.40)	0.55	Moderately High Achievement of Student Competencies.
Medium (M)	5	(0.50, 0.45, 0.50)	0.50	Moderate Achievement of Student Competencies.
Moderately Low (ML)	4	(0.40, 0.55, 0.65)	0.45	Moderately Low Achievement of Student Competencies.
Low (L)	3	(0.30, 0.65, 0.70)	0.35	Low Achievement of Student Competencies.
Very Low (VL)	2	(0.20, 0.75, 0.80)	0.25	Very Low Achievement of Student Competencies.
Very Very Low (VVL)	1	(0.10, 0.85, 0.90)	0.15	Very Very Low Achievement of Student Competencies.
Extremely Low (EL)	0	(0.00, 0.95, 1.00)	0.05	Insignificant Achievement of Student Competencies.

2.2 Plithogenic statistics.

Plithogenic statistics is a methodology that focuses on the inclusion of indeterminacy, contradiction, and the interrelation of variables within a plithogenic set and its dimensions [11] [12]. Plithogenic logic presents the following characteristics according to the methodology analyzed in the study materials [13] [14].

3 Results

3.1 Case study. Variable characteristics.

Case study: Teaching performance in student competencies in a blended learning environment.

The case study focuses on the Mother Teresa of Calcutta Pilot Center for Alternative Basic Education in San Juan de Lurigancho. The aim is to analyze how teaching performance in a blended learning environment influences the achievement of student competencies. The analysis seeks a clear understanding of how teaching performance in the blended modality affects the achievement of competencies in students. It is expected to identify significant relationships between the evaluated variables and dimensions (see Table 3).

Table 3: Characteristics of the plithogenic set, performance, and teacher-student competencies. Source: Own elaboration.

COD	Variable	COD	Dimension	Definition
V1	Teaching performance in blended education.	D1	Student knowledge and understanding	Reflects the teacher's knowledge and understanding of the characteristics and needs of the students.
		D2	Classroom relationships and management	Assesses the teacher's ability to build positive relationships and manage the classroom effectively.
		D3	Collaboration and participation in the educational community	Measures the teacher's collaboration with colleagues and participation in institutional management and improvement.
		D4	Reflection and professional development	Values reflection on practice and commitment to professional and ethical development.
V2	Achievement of student competencies.	D5	Instrumental competencies	Evaluates the basic skills and knowledge acquired by students and their ability to apply them.
		D6	Interpersonal competencies	Measures students' interpersonal skills, such as teamwork and effective communication.
		D7	Systemic competencies	Reflects students' ability to apply knowledge and skills in broader and more complex contexts.

The plithogenic set is defined for three variables, V1 and V2. Therefore, a plithogenic set is defined as consisting of 7 attributes, each of which contains values with their respective plithogenic characteristics. It is focused on determining the level of importance of the variable within the plithogenic set. The multi-attribute set of dimension 3 has a cardinality of 3x4 = 12.

3.2 Teaching performance in blended education

When modeling the variable using plithogenic statistics, frequencies are obtained to determine the level of importance of each dimension in the variable of teaching performance in blended learning. For this purpose, a sample of 127 students was used to measure each dimension according to the plithogenic scale proposed in Table 1. Below, the neutrosophic frequency and neutrosophic statistical analysis of each evaluated dimension are detailed (see Table 4 and Table 5).

Table 4: Plithogenic frequency for the variable teaching performance in blended care. Source: Own elaboration.

Students	Plithogenic frequencies			
	D1	**D2**	**D3**	**D4**
1	(0.73,0.87)	(0.85,0.94)	(0.64,0.8)	(0.59,0.84)
2	(0.77,0.88)	(0.85,0.86)	(0.53,0.83)	(0.59,0.95)
3	(0.78,0.97)	(0.85,0.94)	(0.62,0.87)	(0.6,0.86)
4	(0.66,0.74)	(0.83,0.83)	(0.59,0.76)	(0.54,0.88)
5	(0.7,0.76)	(0.87,0.93)	(0.64,0.76)	(0.51,0.91)
6	(0.6,0.79)	(0.89,0.93)	(0.58,0.83)	(0.52,0.86)
7	(0.66,0.72)	(0.89,0.92)	(0.52,0.8)	(0.56,0.9)
8	(0.7,0.89)	(0.89,0.98)	(0.64,0.88)	(0.51,0.89)
9	(0.8,0.85)	(0.82,0.92)	(0.66,0.78)	(0.53,0.75)
10	(0.68,0.74)	(0.89,0.99)	(0.55,0.72)	(0.59,0.85)
11	(0.77,0.93)	(0.86,0.86)	(0.57,0.77)	(0.58,0.89)
12	(0.69,0.72)	(0.9,0.99)	(0.61,0.87)	(0.54,0.76)
13	(0.5,0.62)	(0.9,0.92)	(0.52,0.78)	(0.6,0.87)
14	(0.58,0.62)	(0.83,0.93)	(0.56,0.71)	(0.53,0.91)
15	(0.64,0.78)	(0.81,0.82)	(0.7,0.85)	(0.54,0.79)
16	(0.52,0.57)	(0.88,0.91)	(0.52,0.71)	(0.5,0.81)
17	(0.76,0.88)	(0.87,0.92)	(0.58,0.69)	(0.5,0.75)
18	(0.79,0.94)	(0.84,0.9)	(0.52,0.69)	(0.6,0.9)
19	(0.57,0.63)	(0.88,0.98)	(0.7,0.83)	(0.54,0.76)
20	(0.76,0.8)	(0.8,0.8)	(0.63,0.84)	(0.56,0.76)
21	(0.63,0.67)	(0.9,0.9)	(0.58,0.83)	(0.6,0.85)
22	(0.61,0.61)	(0.89,0.93)	(0.52,0.66)	(0.5,0.82)
23	(0.57,0.71)	(0.82,0.88)	(0.63,0.91)	(0.57,0.78)
24	(0.67,0.73)	(0.83,0.84)	(0.68,0.97)	(0.54,0.83)
25	(0.63,0.72)	(0.84,0.86)	(0.61,0.88)	(0.52,0.89)
26	(0.55,0.73)	(0.87,0.91)	(0.62,0.76)	(0.57,0.94)
27	(0.65,0.79)	(0.82,0.9)	(0.63,0.92)	(0.51,0.74)
28	(0.53,0.61)	(0.87,0.93)	(0.7,0.99)	(0.56,0.83)
29	(0.63,0.66)	(0.85,0.87)	(0.53,0.65)	(0.58,0.89)
30	(0.73,0.83)	(0.89,0.93)	(0.61,0.88)	(0.54,0.85)
0-127	**(82.96,94.73)**	**(108.43,114.79)**	**(76.17,101.68)**	**(69.92,107.63)**

Analysis of neutrosophic frequencies:

Table 4 shows the neutrosophic frequency for each dimension of teaching performance in blended learning. Each interval represents the range of student perception regarding performance in the various dimensions.

- In Dimension D1: Student Knowledge and Understanding, the neutrosophic frequency ranges between "Moderately High (MH)" and "Extremely High (EH)," indicating generally high performance in this area, though with notable variability. This suggests that while some students demonstrate excellent understanding, others are at moderately high levels.
- Dimension D2: Classroom Relationships and Management shows values between "Very High (VH)" and "Extremely High (EH)," reflecting consistently high performance in classroom management and relationships. The high neutrosophic frequency in this dimension indicates strong positive consensus, with students perceiving excellent management of the learning environment.
- Dimension D3: Collaboration and Participation in the Educational Community ranges between "Moderately High (MH)" and "Extremely High (EH)." Although collaboration and participation are evaluated positively, there is variability in perceptions, with some evaluations reaching extremely high

levels, showing a disparity in participation within the educational community.

- Finally, Dimension D4: Reflection and Professional Development falls between "Moderately High (MH)" and "Very High (VH)." This indicates a generally positive perception of reflection and professional development, although with greater variability compared to classroom management. It suggests areas where efforts could be made to achieve greater consistency in professional development.

Table 5: Plithogenic statistical analysis of the teaching performance variable in blended care. Source: Own elaboration.

Dimension	$\bar{x}_N$	S_N	CV_N	
D1	0.65 + 0.75 I	0.092 + 0.107 I	0.142 + 0.143 I	0.65 + 0.75 I
D2	0.85 + 0.9 I	0.031 + 0.043 I	0.036 + 0.048 I	0.85 + 0.9 I
D3	0.6 + 0.8 I	0.062 + 0.083 I	0.103 + 0.104 I	0.6 + 0.8 I
D4	0.55 + 0.85 I	0.031 + 0.066 I	0.056 + 0.078 I	0.55 + 0.85 I

Table 5 provides the neutrosophic statistical analysis for each dimension, showing the neutrosophic mean, the neutrosophic standard deviation, and the neutrosophic coefficient of variation. These data allow us to evaluate the consistency of perceptions. Among them, it is observed:

- Student Knowledge and Understanding: The neutrosophic average for D1, ranging between "Moderately High (MH)" and "High (H)," indicates overall performance in the moderately high range. The relatively low standard deviation and coefficient of variation suggest reasonable consistency in perceptions.
- Classroom Relationships and Management: D2 has a neutrosophic average in the range of "Very High (VH)" to "Extremely High (EH)," with very low standard deviations and coefficients of variation. This reflects high consistency and precision in the perception of classroom management and relationships.
- Collaboration and Participation in the Educational Community: The neutrosophic average for D3 falls between "Moderately High (MH)" and "Very High (VH)." Moderate standard deviation and coefficient of variation indicate some variability in perceptions, though a generally acceptable level of consistency is observed.
- Reflection and Professional Development: The neutrosophic average for D4 is between "Moderately High (MH)" and "Very High (VH)," suggesting generally high performance but with greater variability compared to D2. The standard deviation and coefficient of variation indicate reasonable consistency with some differences in evaluations.

3.3 Student Competencies.

For modeling the plithogenic statistics of the variable student competencies achievement using plithogenic statistics, a sample of 17 teachers was analyzed (see Table 6). Consequently, a neutrosophic statistical analysis of each evaluated dimension of the variable is carried out (see Table 7). Each teacher used Table 1 to conduct their evaluations of the analyzed dimensions.

Table 6: Plithogenic frequency for the student competency achievement variable. Source: Own elaboration.

Teachers	Plithogenic frequencies		
	D5	**D6**	**D7**
1	(0.51,0.53)	(0.72,0.77)	(0.66,0.91)
2	(0.69,0.97)	(0.76,0.89)	(0.68,0.93)
3	(0.7,0.75)	(0.56,0.71)	(0.69,0.97)
4	(0.63,0.64)	(0.51,0.63)	(0.66,0.96)
5	(0.6,0.86)	(0.66,0.78)	(0.67,0.93)
6	(0.46,0.64)	(0.68,0.81)	(0.69,0.97)
7	(0.56,0.67)	(0.5,0.62)	(0.68,0.98)
8	(0.46,0.71)	(0.52,0.62)	(0.69,0.97)
9	(0.56,0.67)	(0.56,0.67)	(0.66,0.95)
10	(0.42,0.67)	(0.54,0.64)	(0.65,0.94)
11	(0.66,0.9)	(0.6,0.69)	(0.65,0.94)
12	(0.62,0.74)	(0.74,0.78)	(0.66,0.91)
13	(0.68,0.9)	(0.72,0.89)	(0.66,0.94)
14	(0.5,0.58)	(0.71,0.77)	(0.65,0.95)
15	(0.66,0.67)	(0.64,0.74)	(0.66,0.91)
16	(0.64,0.79)	(0.53,0.55)	(0.65,0.9)
17	(0.7,0.84)	(0.5,0.57)	(0.67,0.93)
1-17	**(10.05,12.53)**	**(10.45,12.13)**	**(11.33,15.99)**

Analysis of plithogenic frequencies:

- The results in Dimension D5 show that the neutrosophic frequencies for teachers range between values indicating achievement from "Medium (M)" to "High (H)" in terms of instrumental competencies. However, this variability suggests that not all students achieve a high level, indicating a need to strengthen certain areas. Critical points to enhance in D5 include improving students' technical and methodological skills to ensure that all reach at least a "High" level.
- In Dimension D6, the neutrosophic frequencies also range between "Medium (M)" and "High (H)," similar to Dimension D5. However, some students achieve higher levels, close to "Very High (VH)," indicating significant variability in interpersonal competencies. Critical areas to address in D6 include promoting communication and teamwork skills to standardize competency levels among all students and raise the overall standard.
- Dimension D7 shows a greater concentration of results at the levels of "High (H)" and "Very High (VH)," indicating generally superior performance in systemic competencies. Although the average level is high, there is an opportunity to further enhance advanced systemic skills, such as solving complex problems and integrating interdisciplinary knowledge, to ensure that students consistently achieve the highest levels of performance.

Table 7: Plithogenic statistical analysis of the student competency achievement variable. Source: Own elaboration.

Dimension	$\bar{x}_N$	S_N	CV_N
D5	0.59 + 0.74 I	0.092 + 0.123 I	0.156 + 0.166 I
D6	0.61 + 0.71 I	0.094 + 0.102 I	0.154 + 0.144 I
D7	0.67 + 0.94 I	0.015 + 0.024 I	0.022 + 0.026 I

Analysis of the consistency of the dimensions and neutrosophic evaluation:

- The statistical analysis of D5 indicates that the average achievement of students in instrumental competencies falls between "Medium (M)" and "High (H)," with moderate dispersion in results. This suggests that while some students reach a good level of instrumental competencies, others do not exceed a moderate level. It is crucial to enhance consistency in this aspect by focusing on the uniform development of practical and methodological skills.
- In Dimension D6, the average achievement also ranges between "Medium (M)" and "High (H)," with moderate dispersion. This reflects that, similar to D5, there is significant variability in interpersonal competencies. Interventions should focus on developing greater coherence in these competencies by promoting collaborative learning experiences and leadership skills among all students.
- Dimension D7 stands out with an average achievement approaching "Very High (VH)," with significantly less dispersion than in the other two dimensions. This suggests greater consistency in students' performance in systemic competencies. However, it is essential to maintain and enhance this high level of performance by ensuring that students continue to develop complex skills, such as the ability to integrate and apply knowledge in multivariate contexts.

3.4 Improvement proposals to enhance each dimension

To improve teaching performance and address the areas identified in the neutrosophic evaluation dimensions, it is essential to develop specific actions based on the plithogenic categories assigned to each dimension. The following concrete actions are proposed for each dimension to enhance overall performance and address critical areas:

- To improve Dimension D1: Student Knowledge and Understanding, it is proposed to implement a continuous training program for teachers that includes advanced teaching techniques and content updates. Periodic diagnostic assessments are also recommended, along with promoting the use of interactive educational technologies to adapt teaching methods to student needs.
- For Dimension D2: Classroom Relationships and Management, which shows very high performance, the focus should be on training in interpersonal skills and advanced management techniques. Additionally, implementing constructive feedback between teachers and students will improve classroom dynamics and strengthen the learning environment.
- In Dimension D3: Collaboration and Participation in the Educational Community, it is recommended to encourage more joint projects and school events that integrate teachers, students, and parents. Developing satisfaction surveys would also help adjust collaboration strategies to strengthen community engagement.
- Finally, for Dimension D4: Reflection and Professional Development, personalized professional de-

velopment plans for teachers should be established, with an emphasis on pedagogical reflection. Mentorship and coaching programs, along with periodic performance evaluations, would improve teaching practice and facilitate continuous improvement.

To improve the achievement of students' competencies and address the areas identified in the dimensions of neutrosophic evaluation, the following strategies are proposed:

- To improve the achievement of instrumental competencies (D5), it is essential to review and update the curriculum to ensure a solid foundation in technical skills. Additional workshops should be implemented for students facing difficulties, and a mentoring program should be established where outstanding students support their peers. This approach will enhance overall performance and foster collaborative learning.
- In the dimension of interpersonal competencies (D6), it is crucial to improve communication and teamwork skills. Integrating activities such as group presentations and debates into the curriculum, along with group dynamics and team projects, is recommended. Additionally, offering leadership training programs will prepare students for coordination roles in academic and professional contexts.
- To enhance systemic competencies (D7), promoting interdisciplinary projects and fostering creativity through methodologies like design thinking is advised. These strategies enable students to develop a more focused perspective by applying innovative solutions to complex problems. Implementing a continuous evaluation system with regular feedback will maintain and improve the high level of systemic competencies.

3.5 Plithogenic intersection integrated into the dominant dimensions

To enhance the results within the plithogenic set of teaching and student competencies performance, the neutrosophic intersection of each variable is conducted based on the dominant dimensions. Therefore, the plithogenic intersection matrix is presented (see Table 8).

Table 8: Plithogenic intersection worksheet. Source: Own elaboration.

Aspect	Details
Variable 1:	Teaching performance in blended care.
▪ Selected dimension	**D2:** Relationship and management in the classroom.
▪ Neutrosophic evaluation	Extremely high (EH).
Variable 2:	Achievement of student competencies.
▪ Selected dimension	**D7:** Systemic competencies.
▪ Neutrosophic evaluation	Very high (VH).
	Plithogenic intersection of dimensions
Dimension D2	▪ The teacher's ability to build effective relationships and manage the classroom efficiently is essential in blended contexts. So it directly impacts the quality of interaction and support provided to students.
Dimension D7	▪ Systemic competencies reflect students' ability to apply knowledge in broader contexts. Ensures that the skills acquired are useful and transferable to various situations.
	Synergy between D2 and D7
Intersection and empowerment	▪ Strengthening D2: Improving classroom relationships and management (D2) allows teachers to provide a more inclusive and adaptive learning environment. ▪ D7 Facilitation: Better classroom management facilitates the development of systemic competencies (D7) in students. The more effective application of knowledge in diverse contexts is enhanced. ▪ General impact: The improvement in the teacher-student relationship and classroom management enhances contextualized learning and the ability of students to integrate and apply their skills in more complex situations.

The degree of contradiction between the values for each dominant attribute is defined below:

- $c_N(D_2, D_7) = 0.20$

As can be seen, the dominant values for each attribute are D2 and D7. When dimensions D2 and D7 are activated, other related aspects are also activated, suggesting that classroom relationships and management, along with the development of systemic competencies, directly influence student academic performance and the quality of blended teaching. To propose effective solutions, it is crucial to identify the intersection of these key attributes within the plithogenic set. The relative importance of Dimension D2 (Classroom Relationships and Management)

and Dimension D7 (Systemic Competencies), as well as their impact on educational effectiveness, should be evaluated. Therefore, the intersection between these dimensions is assessed using the following formula:

- $(a1, a2, a3) \wedge p(b1, b2, b3) = (0.84, 0.08, 0.04)$

An evaluation for this intersection shows a level just above Very High (MA) and closer to Very Very High (VVH). This result reflects a strong connection between classroom management and the development of systemic competencies, surpassing the influence of other dimensions on teaching performance. Consequently, it is suggested that solutions focus on addressing the plithogenic areas that converge in dimensions D2 and D7, as they significantly affect academic performance and educational effectiveness in blended learning environments.

To maximize the impact on teaching performance and student competency achievement, it is recommended to implement training programs that enhance classroom management skills and improve relationships with students in blended learning environments. Additionally, it is essential to promote practical activities that allow students to apply their competencies in real or simulated situations, reinforcing systemic skills. Finally, continuous evaluations should be conducted to adjust teaching strategies and ensure the effective development and application of student competencies. This integration significantly enhances both teaching performance and competency achievement by creating a positive feedback loop.

Conclusion

The student perception of teaching performance in blended learning environments has shown a predominantly positive evaluation regarding classroom management and reflective practice. Results indicated that students highly value the ability of teachers to manage the classroom effectively and foster a reflective learning environment, highlighting the importance of these competencies for educational success. This positive assessment underscores the effectiveness of the pedagogical approaches used but also suggests potential areas for improvement, particularly in collaboration and participation within the educational community.

The achievement of student competencies has revealed that interpersonal and technical skills need strengthening. Despite a generally positive appreciation of systemic competencies, instrumental and interpersonal skills are perceived in a range suggesting significant opportunities for improvement. This points to the need to review and adjust teaching strategies and educational resources to ensure a comprehensive development of students' technical and communicative skills.

The intersection between classroom management (D2) and the development of systemic competencies (D7) demonstrated notable synergy. The plithogenic analysis revealed that this intersection achieved a neutrosophic level close to Very Very High (VVH), indicating a strong relationship between the quality of classroom management and student's ability to apply knowledge across various contexts. This result emphasizes the need to optimize both dimensions to improve academic performance and practical application of knowledge. Additionally, it is recommended to develop continuous training programs for teachers, including specific modules on the use of educational technologies and fostering interpersonal skills. Updating the curriculum to more effectively address students' needs in blended learning environments is also suggested.

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