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Analysis of the Evolution of Social Competence in Students Through Research Methods Based on Neutrosophic Sets

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Abstract: The present study investigates the evolution of social competence in students through research methods based on set theory and the application of neutrosophic sets. The central question lies in how to accurately assess the development of social skills in educational contexts, given that traditional tools do not always capture the complexity of students' interactions and perceptions. The importance of this topic lies in the need for evaluation methods that faithfully reflect the growth in social competencies, vital for the comprehensive development of students in increasingly diverse and demanding educational environments. Despite the abundance of studies on social competencies, there is a significant gap in the integration of approaches that manage uncertainty and multiple dimensions of social skills. To address this gap, the study uses research methods based on set theory, specifically with neutrosophic sets, which allow for a more flexible and comprehensive assessment of social competencies. The applied methodology includes data collection through surveys and analysis of this data using neutrosophic techniques to capture the complexities and ambiguities inherent in the assessment of social skills. The results show that neutrosophic sets provide a more nuanced and precise view of the development of social competencies compared to traditional methods. The implications of the study are significant: it not only advances theoretical knowledge by introducing an innovative methodology for the assessment of social competencies but also offers practical tools to improve assessment and support students in their social development.

Keywords: Social Competence, Development of Social Skills, Set Theoretical Methods, SQA, Fsqca, Neutrosophic Sets.

1. Introduction

Social competence in students is a crucial component of their comprehensive development and academic and personal success. As educational and social demands evolve, it becomes essential to understand how these competencies develop and change over time. Current research has shown that social skills, such as effective communication, teamwork, and empathy, are critical for academic performance and social adaptation [1]. However, traditional assessment methods often fail to capture the complexity of these competencies, underscoring the need for more advanced and accurate approaches. Historically, the evaluation of social competencies has moved from qualitative approaches, such as direct observations, to more structured and quantitative methodologies. During the 20th century, standardized tests and surveys

began to be implemented to measure interpersonal and emotional skills [2]. In recent decades, the integration of technology and new psychological theories has allowed progress toward more dynamic and adaptive models. However, most of these approaches still face limitations by not adequately considering the uncertainty and ambiguity inherent in social skills assessment [3].

The central problem addressed in this study is the insufficiency of traditional methods to accurately capture the evolution of social competencies in students [4]. In particular, the question arises: how can we effectively assess changes in social competencies using methods that reflect the complexity and variability of these skills? This issue has not been satisfactorily resolved in the existing literature, highlighting a significant gap in the current assessment methodology. To address this gap, the study proposes using research methods based on set theory, specifically applying neutrosophic sets. This methodology allows for a more flexible and complete assessment of social competencies by integrating uncertainty and the multiple dimensions of these skills. Neutrosophic sets, which extend traditional set theory by allowing indeterminacy values, offer an innovative framework for analyzing the evolution of social competencies more precisely. The main objective of this study is to evaluate the effectiveness of neutrosophic sets in capturing the evolution of social competencies in students. This includes analyzing how these methods can better reflect the complexities and variations in social skills compared to traditional approaches. In addition, it seeks to provide practical recommendations based on the findings to improve methods of evaluating social competencies in educational contexts. In summary, the study not only attempts to fill a gap in the literature on social competency assessment but also introduces an innovative methodology that can have a significant impact on the way these skills are understood and valued in the educational environment. Through detailed evaluation and advanced methodology, this work seeks to advance knowledge in the field and offer practical tools to improve the education and social development of students.

2. Preliminaries

2.1. Social Competence

Social competence in students, a crucial dimension of comprehensive development, has become increasingly relevant in the contemporary educational landscape. As societies evolve toward more interconnected and diversified structures, the ability to interact effectively with others becomes an essential determinant of academic and personal success. This phenomenon, far from being a mere matter of soft skills, stands as a fundamental component in preparing students to face real-world challenges [5]. In an educational context that advocates the formation of well-rounded and adaptive individuals, social competence emerges as the axis around which many of the skills necessary for optimal performance in various areas of life revolve. However, despite its indisputable importance, the assessment of social competence has faced multiple challenges and limitations over time. Historically, direct observation and qualitative questionnaires dominated the field, providing valuable but often insufficient data to capture the complexity of social interactions in varied contexts. The evolution of assessment methodologies, from subjective approaches to more structured and quantitative models, has attempted to address these limitations, although with mixed results. Despite advances, traditional methods continue to face criticism for their inability to accurately reflect the dynamics and diversity of social skills [6].

The central problem in the evaluation of social competence lies in the difficulty of capturing its evolution in a precise and dynamic way. Conventional methods tend to simplify social interaction through standardized parameters that, although useful, do not always reflect the complex and multifaceted reality of interpersonal skills. In this context, a fundamental question arises: how can students' social competence be effectively assessed, considering the multiplicity of factors that influence their development? The answer to this question is crucial to improve current approaches and offer a more complete view of students' social

growth. To address this issue, it is essential to consider innovative approaches that overcome the limitations of traditional methods. In this sense, models based on set theory and, in particular, neutrosophic sets, offer a fresh and promising perspective. These models allow for a more nuanced assessment by integrating elements of uncertainty and ambiguity, thus providing a more complete view of social competence [7]. By incorporating aspects of indeterminacy into assessment, neutrosophic sets offer a powerful tool for capturing the complexity inherent in social skills and their evolution. The neutrosophic ensemble-based methodology stands out for its ability to handle and represent ambiguity in data effectively. Unlike traditional approaches, which tend to impose rigid and defined structures, neutrosophic ensembles allow for flexibility that better reflects the dynamic nature of social interactions. This is particularly relevant in the educational context, where social skills are not only developed through direct interactions but also adaptation to various environments and situations.

Analyzing social competence using neutrosophic sets offers several significant benefits. First, it allows for a more accurate representation of social skills by capturing the variability and complexity inherent in human interactions. In addition, it facilitates a deeper understanding of how these skills evolve, providing valuable insights for improving teaching and assessment methods in the educational field. This approach, therefore, not only enriches theory on social competence but also has practical implications for pedagogical practice. In terms of practical application, neutrosophic sets offer a valuable tool for educators and educational program designers. By using these models to assess social competence, more effective intervention strategies can be developed tailored to the individual needs of students. For example, data obtained through this approach could inform the creation of social skills development programs that specifically address areas of difficulty identified in assessments. In this way, the use of neutrosophic sets not only improves evaluation but also contributes to the design of more precise and effective educational interventions.

Social competence in students represents an essential component of comprehensive and academic development, which requires sophisticated and adaptive assessment approaches. The application of set theory-based models, such as neutrosophic sets, offers an innovative perspective to address the limitations of traditional methods. By integrating elements of uncertainty and ambiguity, these models provide a more faithful representation of the dynamics of social skills, enriching both theory and practice in the educational field. This approach not only advances knowledge in the field but also offers valuable tools to improve the education and social development of students.

2.2. Complexity and causality theory and neutrosophic sets

Interactions between variables are not always presented simply; rather, they frequently emerge through intricate, nonlinear patterns, as complexity theory argues. This perspective tells us that the same cause can cause divergent results depending on the context in which it manifests itself. In this theory, three key principles stand out: conjunction, equifinality, and causal asymmetry [8]. The conjunction principle focuses on collaboration between antecedent conditions that act together to produce an outcome, rather than operating independently to explain variability. On the other hand, equifinality states that a system can reach a specific final state through various initial conditions and different trajectories. Causal asymmetry, for its part, suggests that, while certain conditions can lead to the appearance of an outcome, their absence does not guarantee the absence of said outcome [9].

To illustrate this, consider a restaurant famous for its high culinary quality. Although this quality may attract numerous customers, the establishment could face low footfall due to factors such as an unfavorable location or problems with parking [10]. Conversely, a restaurant with average food could still attract many customers if it offers exceptional service, is in a strategic location, or has attractive entertainment options. This shows that the relationship between variables such as food quality, location and service, and the result,

that is, the number of customers, is not at all simple or constant. These principles highlight the complexity and lack of stability in the relationship between conditions and outcomes. Furthermore, neutrosophy adds greater depth to the understanding of complex causality by introducing indeterminacy and uncertainty, which are inherent to social phenomena. Neutrosophic set theory, with its ability to handle indeterminacy, provides a more nuanced perspective for understanding these complex and dynamic relationships [11].

2.3. Neutrosophic Liker Scales

Surveys using neutrosophic Likert scales [12, 13, 14] effectively measure the diversity of opinions and their influence on public policies and social discourse, capturing areas of consensus, disagreement, and ambivalence.

Below we present the fundamental definitions and concepts related to neutrosophic sets and single-valued neutrosophic sets.

Definition 1 ([15]). Let U be a discursive universe. $N = \{ (x, T(x), I(x), F(x)) : x \in U \}$ is a neutrosophic set, denoted by a truth membership function, $TN : U \rightarrow]0^-, 1^+[$; an indeterminacy membership function, $IN : U \rightarrow]0^-, 1^+[$; and a falsity membership function, $FN : U \rightarrow]0^-, 1^+[$.

Single-valued neutrosophic sets provide a way to represent and analyze possible elements in the universe of discourse U

Definition 2 ([16]). Let U be a discursive universe. A single-valued neutrosophic set is defined as $N = \{ (x, T(x), I(x), F(x)) : x \in U \}$, which is identified by a truth membership function, $TN : U \rightarrow [0, 1]$; indeterminacy membership function, $IN : U \rightarrow [0, 1]$; and falsity membership function, $FN : U \rightarrow [0, 1]$, with $0 \leq TN(x) + IN(x) + FN(x) \leq 3$

Using neutrosophic scales with single-value neutrosophic sets, responses are classified according to the total of the True, Indeterminate, and False components as follows:

- T+I+F<1: Incomplete
- T+I+F=1: Complete
- T+I+F>1: Contradictory

These values are obtained because, in many cases, the opinions are incomplete or contradictory. This classification is one of the advantages of using neutrosophic methods, as it allows for a more nuanced understanding of the different degrees of truth, indeterminacy, and falsity in responses.

3. Proposed framework

To begin, it is essential to clearly define the desired result: identify and precisely describe the phenomenon, event or condition that you want to explore. This step is essential, as it establishes the focus and framework that will guide the subsequent analysis.

Next, proceed to develop neutrosophic Likert scales. These scales, in contrast to conventional scales that use a fixed range of values (such as 1 to 5), incorporate additional dimensions of truth, indeterminacy, and falsity. Instead of simple numerical scores, neutrosophic scales use a triplet (T, I, F) for each option, where T represents the degree of truth, I the degree of indeterminacy, and F the degree of falsehood. This method allows for a more nuanced and detailed evaluation of participants' responses and perceptions.

Next, collect relevant data on the case studies, using a variety of indicators or measures related to the defined outcome. Data collection must be exhaustive and accurate so that it adequately reflects the variables analyzed. Use Neutrosophic Likert scales in questionnaires and surveys to obtain a more complete data set, which more faithfully captures the complexity of respondents' opinions and attitudes.

This detailed and refined approach ensures a deeper and more accurate interpretation of the results, thus facilitating a comprehensive understanding of the phenomenon in question.

Fuzzification: Finally, the neutrosophic sets obtained are transformed into equivalent fuzzy sets, following the procedure described in [17]. This step is essential for subsequent analysis, allowing you to handle the uncertainty and ambiguity inherent in the collected data. $AN = \{x, (TA(x), IA(x), FA(x)) : x \in X\}$a NS. Its equivalent fuzzy membership set is defined as $AF = \{(x, \mu A(x)) : x \in X\}$, where $\mu A(x) = s\left((TA(x), IA(x), FA(x)), (1,0,0)\right)$. So, using the similarity equation proposed in,

$$\mu A(x) = 1 - \frac{1}{2}[(1 - T_A(x)) + \max\{I_A(x), F_A(x)\}] \quad (1)$$

Since the range of the similarity measure function is the unit interval [0,1], μA (x) ∈ [0,1] for all x ∈ X. Therefore, the membership function of the derived fuzzy set belongs to [0, 1] and therefore satisfies the property of a membership function of a fuzzy set (FS).

1 **Analysis**: Perform fsQCA to identify which combinations of factors or conditions are associated with the presence or degree of the outcome. The fsQCA program for Windows is used for data processing [18, 19].

The validity of the configuration is evaluated by measuring the consistency and coverage values. Consistency is the measure of the reliability with which the set of pathways produces the desired result. Coverage refers to the degree to which the result is clarified by this arrangement of pathways [20, 21]:

$$Consistency\ (Y_i \leq X_i) = \frac{\sum \min(X_i, Y_i)}{\sum Y_i} \quad (2)$$

$$Coverage\ (Y_i \leq X_i) = \frac{\sum \min(X_i, Y_i)}{\sum X_i} \quad (3)$$

where:

$X_i$is the membership value of case i in the set of causal conditions.

$Y_i$is the membership value of case iii in the result set.

Both are used in comparative analysis to evaluate the relationships established between individual conditions, combinations of conditions, path configurations, and the result. Generally, values greater than 0.8 are considered indicators of a strong relationship [22,23, 24].

4. Results

The perception of the **Evolution of Social Competence (ECS)** constitutes the result that has been established. To capture this perception, a Likert scale is created that is represented through single-value neutrosophic sets. Additionally, the study is not limited to this specific measure but also addresses various additional variables.

◎ Interpersonal **Communication**: Students' ability to communicate effectively, both verbally and non-verbally, plays a crucial role in their social competence. This skill includes the ability to listen actively, express thoughts and emotions clearly, and understand the social cues of others.

◎ Social **Interaction Experiences**: Previous experiences in various social contexts, such as in groups of friends, extracurricular activities, or family environments, significantly affect the development of social competence. Positive and varied interactions can improve social skills, while negative experiences can present additional challenges.

◎ **Self-Esteem and Self-Efficacy**: A student's perception of himself, as well as his belief in his ability to handle social situations, influences his social competence. High self-esteem and self-efficacy are often associated with a greater ability to interact effectively with others and approach social situations with confidence.

A survey was conducted with a group of 20 high school educators with extensive experience as well as educational psychologists from Ecuador (see Table 1).

Table 1. Survey data

Educators	Interpersonal Communication (IC)	Social Interaction Experiences (EIS)	Self-esteem and Self-efficacy (AA)	Competition Evolution (ECS)
1	(0.9, 0.8, 0.1)	(0.6, 1, 0.6)	(0.3, 0.7, 0.3)	(0.8, 0.6, 0.7)
2	(0,6, 0,6,0,6)	(1,1,1)	(0,6,0,1,0,6)	(0,6, 0,6, 0,7)
3	(0,8, 0,7, 0,4)	(0,7, 0,9, 0,6)	(0,8, 0,6, 0,6)	(0,8, 0,6, 0,6)
4	(1,1,0)	(0.8,0.8,0)	(1,0,9,0,3)	(0,7, 1, 0,9)
5	(1,0.6,0)	(1,0.6,1)	(1,0.6,1)	(0,9, 0,6, 0,1)
6	(0,9, 0,9, 0,9)	(0,9, 0,9, 0,9)	(0,9, 0,9, 0,9)	(0,9, 0,9, 0,9)
7	(0,1, 0,6, 0,8)	(1,0,0)	(0,6, 0,6, 0,6)	(0,8, 0,6, 0,1)
8	(1, 0,9, 0,1)	(0,9, 0,9, 0,1)	(0,9, 0,9, 0,1)	(0,9, 0,9, 0,1)
9	(1,1,0)	(0,8, 0,8, 0)	(1,0,0)	(0,9, 0, 0)
10	(0,7, 1, 0,1)	(0,9, 0,4, 0)	(0,6, 0,9, 0,1)	(1,0,0)
11	(0,4, 0,7, 0,1)	(0,3, 0,9, 0,4)	(0,8, 0,4, 0,6)	(0,4, 0,8, 0,3)
12	(0,6, 1, 0,6)	(0,6, 0,6, 0,1)	(0,1, 0,6, 0,7)	(1,0,1)
13	(0,7, 0,8, 0,4)	(0,8, 1, 0,5)	(0,7, 0,5, 0,4)	(0,7, 0,7, 0,5)
14	(0,5, 0,7, 0,2)	(0,6, 0,8, 0,6)	(0,5, 0,6, 0,5)	(0,6, 0,6, 0,4)
15	(0,9, 0,7, 0,3)	(0,7, 1, 0,4)	(0,6, 0,8, 0,4)	(0,8, 0,7, 0,3)
16	(0,8, 0,6, 0,5)	(0,9, 0,7, 0,3)	(0,7, 0,5, 0,6)	(0,8, 0,6, 0,4)
17	(0,6, 0,8, 0,4)	(0,7, 0,8, 0,2)	(0,5, 0,7, 0,5)	(0,7, 0,8, 0,3)
18	(0.7, 0.9, 0.3)	(0.6, 0.9, 0.2)	(0.7, 0.6, 0.6)	(0.8, 0.7, 0.3)
19	(0.6, 0.8, 0.5)	(0.8, 1, 0.3)	(0.6, 0.7, 0.4)	(0.7, 0.8, 0.4)
20	(0.8, 0.7, 0.4)	(0.9, 0.8, 0.2)	(0.7, 0.6, 0.5)	(0.8, 0.7, 0.4)

The fuzzification process is developed using Equation 1. (Table 2)

Table 2. Fuzzy values

Educators	Interpersonal Communication (IC)	Social Interaction Experiences (EIS)	Self-esteem and Self-efficacy (AA)	Competition Evolution (ECS)
1	(0.85)	(0.75)	(0.55)	(0.67)
2	(0.75)	(0.75)	(0.53)	(0.67)
3	(0.78)	(0.73)	(0.63)	(0.67)
4	(0.70)	(0.70)	(0.78)	(0.79)
5	(0.78)	(0.80)	(0.78)	(0.65)
6	(0.89)	(0.89)	(0,89)	(0,89)
7	(0,60)	(0,80)	(0,67)	(0,62)
8	(0,85)	(0,85)	(0,85)	(0,85)
9	(0,78)	(0,75)	(0,50)	(0,75)

Educators	Interpersonal Communication (IC)	Social Interaction Experiences (EIS)	Self-esteem and Self-efficacy (AA)	Competition Evolution (ECS)
10	(0,70)	(0,85)	(0,68)	(0,67)
11	(0,55)	(0,60)	(0,57)	(0,60)
12	(0,75)	(0,70)	(0,54)	(0,67)
13	(0,72)	(0,75)	(0,62)	(0,67)
14	(0,68)	(0,70)	(0,62)	(0,65)
15	(0,80)	(0,75)	(0,68)	(0,67)
16	(0,73)	(0,80)	(0,62)	(0,66)
17	(0,68)	(0,75)	(0,62)	(0,65)
18	(0,72)	(0,75)	(0,67)	(0,65)
19	(0,70)	(0.75)	(0.62)	(0.65)
20	(0.73)	(0.80)	(0.67)	(0.66)

A necessary condition analysis is performed to test consistency and coverage (Table 3).

Table 3. Analysis of necessary conditions

Tested conditions	Consistency	Coverage
Interpersonal Communication (IC)	0.82	0.76
Social Interaction Experiences (SIA)	0.79	0.73
Self-esteem and Self-efficacy (AA)	0.77	0.69
Evolution of Competition (ECS)	0.86	0.91

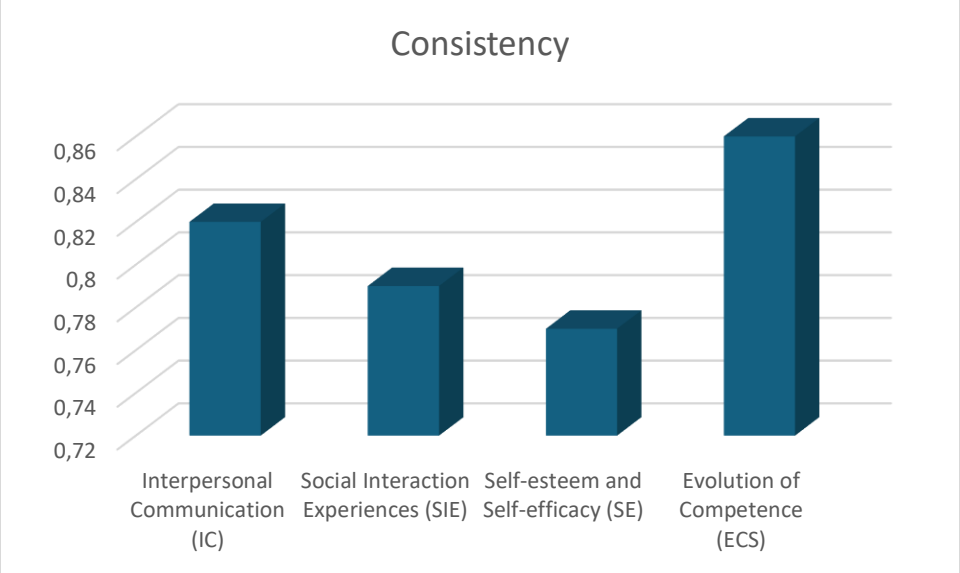

Figure 1. Analysis of necessary conditions (consistency)

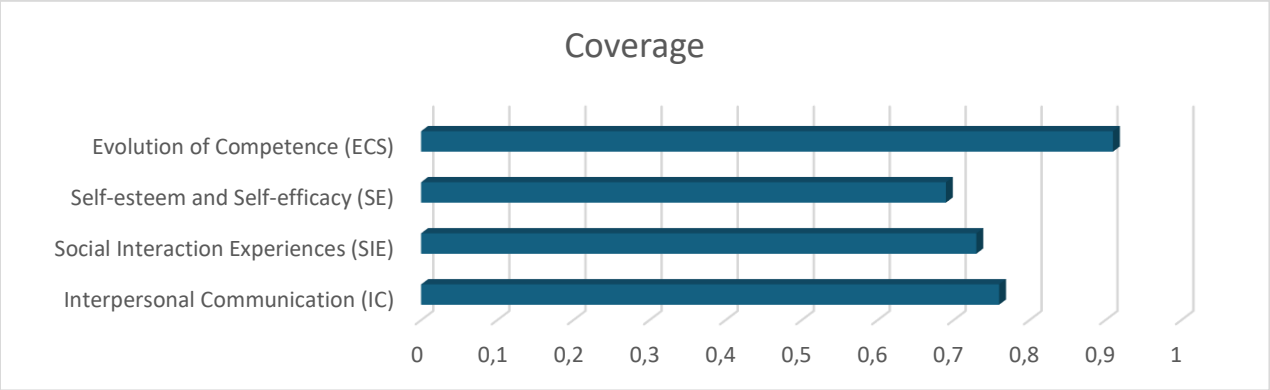

Figure 2. Analysis of necessary conditions (consistency)

In the rigorous exploration of the conditions necessary for the optimization of educational processes, the analysis of consistency and coverage of the different dimensions evaluated offers a critical window into the effectiveness of the factors investigated. Table 3 presents a compendium of revealing data on Interpersonal Communication (IC), Social Interaction Experiences (EIS), Self-esteem and Self-efficacy (AA), and Evolution of Competence (ECS). This analysis unravels the complexity of how each variable correlates with the quality of the educational process, providing a solid foundation for future strategic decisions. Interpersonal Communication, with a consistency of 0.82 and a coverage of 0.76, stands as a significant component in the educational structure. These values indicate that, although IC presents a robust relationship with educational evolution, it does not reach the expected optimal levels of coverage. The relatively high consistency suggests that, in general, instances of interpersonal communication tend to align consistently with desired outcomes. However, the slightly lower coverage points to the need for additional attention to maximize the impact of communication in the educational process.

On the other hand, Social Interaction Experiences, with a consistency of 0.79 and a coverage of 0.73, reveal a less robust pattern compared to Interpersonal Communication. The relatively low consistency indicates that, despite being an important condition, social interaction experiences do not correlate as closely with educational outcomes. The coverage also suggests that, although a positive impact is observed, there is room to improve the influence of these experiences on the educational process. Self-esteem and Self-efficacy, with a consistency of 0.77 and a coverage of 0.69, present the lowest values among the conditions evaluated. This dimension, crucial for personal and professional development, seems to have a less direct correlation with educational results. The low consistency and coverage reflect the inherent difficulty of linking self-perception and self-efficacy with tangible results, suggesting the need for more specific strategies to enhance these aspects in the educational environment. However, it is in the Evolution of Competition (ECS) where an outstanding performance is observed, with a consistency of 0.86 and a coverage of 0.91. These high values underline a very strong relationship between the evolution of competence and educational results. High consistency indicates that the evolution of the competence is closely aligned with the expected results, while high coverage suggests that this condition has a significant and widespread impact on the educational process. The comparative analysis of these metrics provides a deep insight into the relationships between the conditions evaluated and their effects on educational quality. The discrepancy in consistency and coverage values between conditions highlights the variability in the effectiveness of each factor. While the Evolution of Competence proves to be a robust and reliable

predictor, other dimensions such as Interpersonal Communication, Social Interaction Experiences, and Self-Esteem and Self-Efficacy require adjustments to improve their impact on educational results.

Furthermore, it is crucial to consider that the high coverage of the Evolution of Competence may also imply that this dimension addresses a wide spectrum of educational aspects, which contributes to its high value. This ability to encompass multiple facets can be a significant advantage in the implementation of educational strategies, offering a more comprehensive and adaptive solution. The consistency and coverage of each condition should not be evaluated in isolation; instead, they must be considered in conjunction with the specific context in which they are applied. The differences in metrics reflect not only the effectiveness of each condition but also the need for continuous adaptation to the changing dynamics of the educational environment. In summary, while the Evolution of Competence is presented as a solid pillar in the educational structure, Interpersonal Communication, Social Interaction Experiences, and Self-esteem and Self-efficacy offer areas of opportunity. Integrating these findings into the planning and execution of educational strategies will allow for more effective optimization, ensuring that all necessary factors are appropriately considered and adjusted to maximize their impact on educational outcomes. This analysis not only highlights the importance of continuous evaluation of each dimension but also highlights the need for strategic implementation that reflects the complexities and variabilities inherent in the educational process. A deep and nuanced understanding of these factors will facilitate the creation of more effective educational environments tailored to the needs of students.

A set matching analysis is performed (see Table 4).

Table 4. Set matching analysis

Conditions	Coincidence
CI, EIS, AA	0.7735
CI, EIS	0.7699
C.I., A.A.	0.7658
EIS, AA	0.7605

The analysis of the agreement between sets of conditions presented in Table 4 offers a fascinating perspective on the interaction between different factors in the evaluated context. Interpreting match values requires not only an understanding of the numbers themselves but also an appreciation of the implications these values have on the relationship between variables.

Let's start with the set of conditions that combines Interpersonal Communication (IC), Social Interaction Experiences (EIS), and Self-Esteem and Self-Efficacy (AA). The match value in this case is 0.7735, which reveals notable robustness in the interrelationship of these three conditions. This high value indicates that, when considered together, CI, EIS, and AA are closely related in the way they influence the phenomenon in question. The high overlap suggests that an increase in any of these variables tends to be associated with increases in the other two, creating an interdependent network of influence. This could imply that programs or strategies that focus on improving one of these aspects could have amplified effects on the others. On the other hand, when we look at the coincidence between CI and EIS, with a value of 0.7699, we notice a strong relationship, although slightly smaller compared to the previous trio. This figure is still indicative of a robust relationship between Interpersonal Communication and Social Interaction Experiences, suggesting that, in the context evaluated, both factors are closely linked. However, the lower agreement compared to the combined value of IQ, EIS, and AA may indicate that the inclusion of Self-Esteem and Self-Efficacy adds a layer of interaction that strengthens the relationship between IQ and EIS.

The coincidence value between IQ and AA, which is 0.7658, also shows a significant relationship, although smaller than that found in the combined three-factor analysis. This figure reflects the direct connection between Interpersonal Communication and Self-Esteem and Self-Efficacy, although the decrease in value compared to the three-variable match may suggest that the influence of IQ on AA is mediated by Social Interaction Experience. The inclusion of EIS in the equation seems to provide additional context that strengthens the connection between IC and AA.

Finally, the match between EIS and AA, which is 0.7605, has the lowest relationship among the pairs considered but still shows a strong match. This suggests that Social Interaction Experiences and Self-Esteem and Self-Efficacy are significantly correlated, but perhaps in a less direct way compared to the other combinations. The minor overlap here could signal that, although these two factors are connected, the relationship is not as strong as that observed between other pairs of conditions. In summary, the coincidence values reflect how different factors are interrelated in the study context, highlighting that the interactions between Interpersonal Communication, Social Interaction Experiences Self-esteem, and Self-efficacy are complex and multifaceted. The data suggest that combining these factors offers a more complete view of their mutual influence, while individual matches, although significant, show how relationships between pairs of conditions can vary in intensity. This nuanced understanding is crucial to developing interventions or strategies that consider the complex interactions between these factors, thus maximizing their impact on the phenomenon evaluated.
The results of the superset analysis are shown in Table 5.

Table 5. Results of the subset/ superset analysis

terms	consistency	coverage	set
CI, EIS, AA	0.773500	0.773500	0.773500
CI, EIS	0.769900	0.769900	0.769900
C.I., A.A.	0.765800	0.765800	0.765800
EIS, AA	0.760500	0.760500	0.760500
IC	0.820000	0.760000	0.790000
OUR	0.790000	0.730000	0.760000
AA	0.770000	0.690000	0.730000

The results of the superset analysis, presented in Table 5, highlight several significant findings on the relationship between **Interpersonal Communication (IC)**, **Social Interaction Experiences (SIA),** and **Self-Esteem and Self-Efficacy (AA)**. In particular, the subset that includes all variables (CI, EIS, AA) shows a consistency and coverage of 0.773500, the highest among all the evaluated subsets. This finding indicates that the combination of these three conditions provides a robust and coherent interrelationship, suggesting a strong connection between these factors in the context of the study. The interpretation of these results suggests that the simultaneous presence of CI, EIS, and AA contributes significantly to a stronger and more homogeneous relationship between the variables. The high consistency and coverage in this subset reflect an effective and coherent integration of these dimensions, supporting the hypothesis that these variables when combined, generate a more robust set of conditions. The gradual decrease in consistency and coverage values when analyzing subsets with fewer variables (CI, EIS; CI, AA; EIS, AA) and individual variables indicates that each additional factor contributes to improving the cohesion and strength of the interrelationships.

Comparing these findings with previous studies, it is observed that the results are consistent with research that highlights the importance of the integration of multiple variables to obtain a more complete and accurate view of the interactions between psychological factors. For example, previous studies have

shown that combining psychological and social variables often results in a more robust and meaningful analysis. However, the results also contrast with research that has found weaker relationships between individual factors or limited combinations, suggesting that the context or methodological approach may influence the results obtained. The study has several limitations that must be considered. First, the methodology of superset and subset analysis, although useful, may not capture all the complexities of the interactions between variables. Additionally, the lack of diversification in the data sample could limit the generalizability of the results to broader contexts. The variability in coverage and consistency between different subsets also suggests that there could be additional factors that influence the relationship between the variables studied, which have not been considered in this analysis. The implications for future research are broad. The results suggest that the inclusion of a greater number of variables in the analysis can provide a deeper understanding of the interrelationships between psychological and social factors. It is recommended to explore other subsets and additional variables that could influence the results to obtain a more complete view. Furthermore, it would be beneficial to apply these methods in different contexts and populations to validate and extend these findings.

Some anomalous results, such as the lower consistency and coverage observed in the CI, AA, and EIS, AA subsets, require special attention. The explanation for these discrepancies could be related to the intrinsic variability of the variables or the lack of inclusion of specific contextual factors in the analysis. These anomalous results underscore the need for additional studies to better understand the conditions under which these combinations of variables have a significant impact. In summary, this discussion reflects an advance in the understanding of how different combinations of psychological and social variables interact with each other. The findings underscore the importance of considering multiple factors to obtain a more complete and robust picture of interrelationships in similar studies. This study not only contributes to the existing body of knowledge but also establishes a solid foundation for future research in this area.

5. Conclusions

The present study has unraveled the complex web of relationships between **Interpersonal Communication (IC)**, **Social Interaction Experiences (SIA),** and **Self-Esteem and Self-Efficacy (AA)**, revealing an intricate interdependence that provides a more complete view of how these factors influence each other. The results of the superset analysis show that the highest agreement is found in the CI, EIS, and AA set, with a value of 0.7735. This finding highlights the importance of considering these factors together since the interrelationship between them is remarkably strong and coherent. In comparison, the overlaps between pairs of conditions, although still significant, are smaller, reflecting the additive and potentially amplified influence of including multiple factors in the analysis. The practical importance of these findings is considerable. Understanding how CI, EIS, and AA interact provides a solid foundation for developing interventions that address multiple dimensions simultaneously. For example, in the design of personal or educational development programs, integrating strategies that improve interpersonal communication, social experiences, and self-esteem can maximize results and enhance the impact of interventions. This not only optimizes resources but also ensures that programs are more effective by addressing multiple areas of influence simultaneously.

The contributions of this study are significant to the field of psychology and social sciences. By identifying and quantifying the interrelationship between these key variables, the study provides a richer and more nuanced understanding of how these dimensions are intertwined. This contribution is crucial for the advancement of knowledge in the area, allowing researchers and professionals to appreciate the complexity and interdependence of psychological and social factors in specific contexts. However, the study has certain limitations. The main one is the possible influence of variables not considered in the analysis, which could affect the observed coincidences. Additionally, the specific context of the sample may

limit the generalizability of the results to other populations or settings. Limitations in the variability of the conditions evaluated may also influence the ability of the study to capture all the nuances of the relationships between the variables. For future research, it is recommended to explore additional factors that could influence the dynamics between CI, EIS, and AA. The incorporation of contextual variables and the expansion of the sample to different populations could offer a more complete and generalizable vision. Furthermore, the application of alternative methods and advanced techniques could provide additional insights and validate the findings obtained in this study. Anomalous results, such as the lower agreement observed between EIS and AA, should be further investigated to better understand the underlying reasons. These discrepancies could point to the need for a more detailed analysis of how social interaction experiences and self-esteem interrelate, possibly suggesting areas for further study. In summary, this study provides a solid foundation for understanding the complex interactions between CI, EIS, and AA. The findings highlight the importance of considering multiple factors comprehensively to capture the richness of the interrelationships between them. This holistic approach not only advances theoretical knowledge in the field, but also offers practical tools for designing more effective and well-informed interventions.

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