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Plithogenic-Neutrosophic Rough Number for Reimagining Rural Education: Quality Evaluation of Early Childhood Programs

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Abstract: Early childhood education (ECE) is crucial to rural rehabilitation because it promotes sustainable and equitable development in underprivileged areas. Using an evaluation approach, this study provides a thorough assessment of the caliber of early development programs in rural regions. Four primary characteristics are the focus of the assessment: community and family participation, curriculum relevance and delivery, teacher qualification and training, and infrastructure quality. To ascertain their efficacy and contextual fit, six different rural ECE program models, from mobile units to cooperative-funded schools, were examined using both qualitative and quantitative methods. To develop a comparison framework, the study used field observations, stakeholder comments, and performance indicators. This study uses the Plithogenic-Neutrosophic Rough Number to overcome uncertainty information. The findings show notable differences in program quality and emphasize the role that community integration, instructor readiness, and localized design play in fostering successful educational outcomes. In line with national rural regeneration aims, this study aids in the planning, policy-making, and strategic development of rural early learning environments.

Keywords: Plithogenic-Neutrosophic Rough Number; Reimagining Rural Education; Early Childhood Programs; Evaluation.

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1. Introduction

As a result, several effective methods for obtaining the assessment data of DMs with unclear consideration have surfaced. However, the uncertainty can only be described using these techniques based on the membership degree and non-membership degree sets. Because of this, Smarandache [1], [2]proposed the neutrosophic set, which is based on the extension of the sets mentioned above and clearly quantifies indeterminacy while taking truth-membership and falsity-membership into account[3], [4]. Neutrosophic set logic may pre-digest ambiguous,

conflicting, and unclear information from real-world issues and be used to express mathematical models of uncertainty, ambiguity, and imprecision[5], [6].

Smarandache [7], [8] created the Plithogenic set based on the neutrosophic set to extract the inherent information characteristics among criteria. When incorporating criteria evaluation information, he also considered the degree of appurtenance and contradiction, which is crucial for enhancing the subjective judgments of DMs and lowering ambiguity[9], [10].

1.1 Literature Review

The educational system has come under fire recently for not living up to the promises made to fulfill children's dreams and futures. This significant gap in the system, which is based on ideological and epistemological traditions, is exemplified by an expanding corpus of study. The merits and validity of indigenous metaphysics have been acknowledged in response to these worries, highlighting the necessity of reevaluating the educational system. However, it is still unclear how education may be rethought in an indigenous setting to better reflect children's future dreams. Indigenous perspectives on the future and how they relate to children's goals have not been fully explored in studies to yet.

Kassa et al. [11] looked at this by examining it from the perspective of Ethiopia's sociopolitical and intellectual ecologies. I use ethnographic study that was done in Ethiopia (students) between the ages of 9 and 15, their parents, and other stakeholders. Indigenous methods of knowing were used to gather data, paying close attention to the positionality and reflexivity of the researcher.

To inform future local and state action involving public pre-kindergarten (pre-K) and kindergarten (K) provision, Liz Nigro et al. [12] aimed to investigate and elevate the perspectives of historically marginalized families from an understudied rural community, given opportunities for early childhood education (ECE) expansion in the US. They held two culturally responsive focus groups in collaboration with a local district and the state Department of Education (DOE) to learn more about how these caregivers view early childhood education (ECE) and school readiness, identify problems with the current system, and identify potential solutions to enhance public pre-K and K. Eight female caregivers were among the participants; three classified as Black, two as Hispanic, and three as White.

The DOE's qualifying standards for public preschool attendance were satisfied by every family. For two 90-minute focus groups, we discovered that families saw ECE as a period for experiential learning and humanizing activities. They challenged the idea of school preparedness and promoted strategies for schools to be prepared for their students. Additionally, families noted that accountability culture, which includes testing, curriculum uniformity, a restricted focus on core academic subject, etc.—was an issue, especially when kindergarteners first entered. More fair financing, representative curriculum, and chances for cooperation amongst education interest-holders (teachers, families, administration, etc.) at the school, district, and state levels were some of the solutions to enhance pre-K and K.

At every educational level, including high-quality early childhood education, systems guarantee the achievement of objectives. While several studies highlight the advantages and elements of high-quality early childhood education, none highlight the mechanisms that will help early childhood development (ECD) centers provide high-quality instruction. Adebunmi Y. Aina et al. [13]looked at the structures in place that help ECD centers give young children high-quality education. Using qualitative research methodology, the study gathered information from eight participants who were specifically chosen from four ECD centers in Pretoria through document analysis and in-person interviews.

A thematic analysis of the data was conducted. The results showed that the participating centers are supported in providing high-quality education by national laws, domestically developed policies, and finance mechanisms. Nonetheless, many participants were unaware of the current national policy. According to the findings, ECD centers in the township area lack the financial resources necessary to deliver high-quality instruction. To raise awareness and ensure that government rules are strictly followed at ECD centers, the study suggests efficient implementation measures. They promoted awareness and adherence to high-quality early childhood education by recommending that teachers, principals, and ECD centers receive pertinent and useful training on how to set up systems from the national education policies that are currently in place to enable them to provide high-quality instruction.

1.2 Motivation

The aggregation of information in certain studies is entirely dependent on the subjective preferences of DMs, ignoring the objective relationship between criterion information in the alternative, even though fuzzy theory has been widely used as an effective tool to describe evaluation information with uncertainty.

Therefore, to address the growing gap between objective assessments and an uncertain subjective environment, it is vital to incorporate the benefits of many researched theories of uncertainty.

To create a P-NRN for aggregating assessment data, Plithogenic sets and NRNs must be combined, considering their respective advantages in handling imprecision and uncertainty.

1.3 Aims

This paper proposes an NRN model that uses the benefits of Plithogenic set operators, NRN for Reimagining Rural Education: Quality Evaluation of Early Childhood Programs. This will close existing research gaps, improve the representation of uncertainty, and remove the negative effects of subjectivity.

1.4 Contributions

The following is a summary of this paper's contributions:

(1) To provide an impartial and thorough assessment result, a unique integrated Plithogenic-Neutrosophic Rough Number (P-NRN) is presented to represent and aggregate the evaluation data of DMs.

(2) Four criteria and six alternatives are used for Reimagining Rural Education: Quality Evaluation of Early Childhood Programs.

(3) To rank the options and choose the best one, a P-NRN is used to select the best alternative.

(4) A real-world case study pertaining Reimagining Rural Education: Quality Evaluation of Early Childhood Programs.

2. Preliminaries

Plithogenic Set[14]

Smarandache [7], [8]introduced the Plithogenic set, which is a generalization of the crisp set, fuzzy set, intuitionistic fuzzy set, and neutrosophic set. It is commonly written as (p, a, V, d, c). One or more criteria define the components of the plithogenic set. Each criterion can have four or more values, with $A = \{\alpha_1, \alpha_2, \dots, \alpha_m\}\ and\ V = \{v_1, v_2, \dots, v_n\}$ (membership for fuzzy and crisp sets; membership and non-membership for intuitionistic fuzzy sets; membership, non-membership, and indeterminacy for neutrosophic sets).

Let two Plithogenic set such as:

$$x = (x_1, x_2, x_3)\ and\ y = (y_1, y_2, y_3)$$

Intersection of Plithogenic set is defined as:

$$(x_1, x_2, x_3) \bigwedge P\ (y_1, y_2, y_3) =$$

$$\left(\left(x_{i1} \bigwedge F\ b_{i1}, 0.5 * \left(x_{i2} \bigwedge F\ b_{i2}\right)\right) + 0.5 * \left(x_{i2} \bigvee F\ b_{i2}\right), x_{i3} \bigvee F\ b_{i3}\right)$$

Union of Plithogenic set is defined as:

$$(x_1, x_2, x_3) \bigvee P\ (y_1, y_2, y_3) =$$

$$\left(\left(x_{i1} \bigvee F\ b_{i1}, 0.5 * \left(x_{i2} \bigwedge F\ b_{i2}\right)\right) + 0.5 * \left(x_{i2} \bigvee F\ b_{i2}\right), x_{i3} \bigwedge F\ b_{i3}\right)$$

Neutrosophic Rough Number (NRN)

Rough number (RN) is capable of processing subjective choice information well and is based on Pawlak's rough set theory. Approximations are the most important techniques in the philosophy of rough sets to address the ambiguity and uncertainty of object identification brought on by incomplete information. A rough boundary interval is defined to represent imprecise and hazy

information by an RN, which is also made up of lower and upper bounds. This method extends the single representation of a crisp number and equivalency relation to an approximation with higher and lower values. Since the RN acquisition procedure only uses the actual evaluation data and no preexisting information, it can accurately capture DMs' true perceptions based on expectations and experience and combine them into a consistent and objective group judgment.

The lower and upper approximation of NRN is defined as:

$$\underline{G}(z) = \left(\left(z, T_{\underline{G}(z)}(x), I_{\underline{G}(z)}(x), F_{\underline{G}(z)}(x)\right) | X \in [x]_R, x \in X\right)$$

$$\overline{G}(z) = \left(\left(z, T_{\overline{G}(z)}(x), I_{\overline{G}(z)}(x), F_{\underline{\overline{G}}(z)}(x)\right) | X \in [x]_R, x \in X\right)$$

$$T_{\underline{G}(z)}(x) = \bigwedge X \in [x]_R T_G(x)$$

$$I_{\underline{G}(z)}(x) = \bigwedge X \in [x]_R I_G(x)$$

$$F_{\underline{G}(z)}(x) = \bigwedge X \in [x]_R F_G(x)$$

$$T_{\overline{G}(z)}(x) = \bigvee X \in [x]_R T_G(x)$$

$$I_{\overline{G}(z)}(x) = \bigvee X \in [x]_R I_G(x)$$

$$F_{\overline{G}(z)}(x) = \bigvee X \in [x]_R F_G(x)$$

The lower limit NRN and lower limit NRN is defined as:

$$\underline{NRN}(G_{iT}) = \frac{1}{N_{LT}} \sum_{i=1}^{N_{LT}} X \in \underline{G}(C_{iT})$$

$$\underline{NRN}(G_{iI}) = \frac{1}{N_{LI}} \sum_{i=1}^{N_{LI}} X \in \underline{G}(C_{iF})$$

$$\underline{NRN}(G_{iF}) = \frac{1}{N_{LF}} \sum_{i=1}^{N_{LF}} X \in \underline{G}(C_{iF})$$

$$\overline{NRN}(G_{iT}) = \frac{1}{N_{LT}} \sum_{i=1}^{N_{LT}} X \in \overline{G}(C_{iT})$$

$$\overline{NRN}(G_{iI}) = \frac{1}{N_{LI}} \sum_{i=1}^{N_{LI}} X \in \overline{G}(C_{iF})$$

$$\overline{NRN}(G_{iF}) = \frac{1}{N_{LF}} \sum_{i=1}^{N_{LF}} X \in \overline{G}(C_{iF})$$

Let two NRN such as:

$$[x_1] = \left[\underline{x}_1, \overline{x}_1\right] and\ [x_2] = \left[\underline{x}_2, \overline{x}_2\right]$$

$$x \times [x_1] = \begin{bmatrix} x \times \underline{x}_1, \\ x \times \overline{x}_1 \end{bmatrix}, \frac{[x_1]}{[x_2]} = \frac{\underline{x}_1}{\overline{x}_2}, \frac{\overline{x}_1}{\underline{x}_2}$$

$$[x_1] + [x_2] = \begin{bmatrix} \underline{x}_1 + \underline{x}_2, \\ \overline{x}_1 + \overline{x}_2 \end{bmatrix}, [x_1] \times [x_2] = \begin{bmatrix} \underline{x}_1 \times \underline{x}_2 \\ , \overline{x}_1 \times \overline{x}_2 \end{bmatrix}$$

3. Methodology

This section shows the steps of the proposed approach to rank the alternatives. Different alternatives such as $PNRA = \{PNRA_1, PNRA_2, PNRA_3, \dots, PNRA_m\}$, m refers to the number of alternatives. These alternatives are ranked based on a set of criteria such as $PNRC = \{PNRC_1, PNRC_2, PNRC_3, \dots, PNRC_n\}$, n refers to the number of criteria. The criteria and alternatives are ranked based on a set of decision makers $D = \{DM_1, DM_2, DM_3, \dots, DM_t\}$, t refers to the number of decision makers and experts. Experts and decision makers use the triangular neutrosophic numbers (TNNs) to evaluate the criteria and alternatives.

Convert the decision matrix into NRNs using the operations and definitions of NRNs.

Apply the score function to obtain crisp values such as:

$$S(X) = \begin{pmatrix} \frac{1}{8}\left(T_X(Z) + I_X(Z) + F_X(Z)\right) \times \\ \left(2 + T_X^*(Z) - I_X^*(Z) - F_X^*(Z)\right) \end{pmatrix}$$

In the last step the alternatives are ranked.

4. Case Study

This study shows the case study for Reimagining Rural Education: Quality Evaluation of Early Childhood Programs. This study invited three experts and decision makers to evaluate the criteria and alternatives. We collect four criteria and six alternatives such as: Infrastructure Quality, Teacher Qualification and Training, Curriculum Relevance and Delivery, Community and Parental Engagement. The alternatives are: Early Childhood Program Description, Village-based public kindergarten with local government support, Mobile preschool unit serving remote and nomadic communities, NGO-run early learning center with community volunteers, Faith-based preschool with traditional values and cultural emphasis, Privately-owned rural kindergarten with digital learning integration, Agricultural cooperative-funded preschool with integrated nutrition and health services.

Three experts evaluate the criteria and alternatives using the TNNs as shown in Table 1. Convert the decision matrix into NRNs using the operations and definitions of NRNs as shown in Table 2.

Apply the score function to obtain crisp values as shown in Table 3.

In the last step the alternatives are ranked as shown in Table 4

Table 1. TNNs.

	$PNRC_1$	$PNRC_2$	$PNRC_3$	$PNRC_4$
$PNRA_1$	((0.1,0.3,0.35),0.1,0.2,0.15)	((0.15,0.25,0.1),0.6,0.2,0.3)	((0.4,0.35,0.5),0.6,0.1,0.2)	((0.65,0.6,0.7),0.8,0.1,0.1)
$PNRA_2$	((0.1,0.3,0.35),0.1,0.2,0.15)	((0.95,0.9,0.95),0.9,0.1,0.1)	((0.9,0.85,0.9),0.8,0.2,0.2)	((0.7,0.65,0.8),0.9,0.2,0.1)
$PNRA_3$	((0.15,0.25,0.1),0.6,0.2,0.3)	((0.4,0.35,0.5),0.6,0.1,0.2)	((0.65,0.6,0.7),0.8,0.1,0.1)	((0.7,0.65,0.8),0.9,0.2,0.1)
$PNRA_4$	((0.65,0.6,0.7),0.8,0.1,0.1)	((0.4,0.35,0.5),0.6,0.1,0.2)	((0.15,0.25,0.1),0.6,0.2,0.3)	((0.1,0.3,0.35),0.1,0.2,0.15)
$PNRA_5$	((0.7,0.65,0.8),0.9,0.2,0.1)	((0.65,0.6,0.7),0.8,0.1,0.1)	((0.4,0.35,0.5),0.6,0.1,0.2)	((0.15,0.25,0.1),0.6,0.2,0.3)
$PNRA_6$	((0.7,0.65,0.8),0.9,0.2,0.1)	((0.7,0.65,0.8),0.9,0.2,0.1)	((0.65,0.6,0.7),0.8,0.1,0.1)	((0.7,0.65,0.8),0.9,0.2,0.1)
	$PNRC_1$	$PNRC_2$	$PNRC_3$	$PNRC_4$
$PNRA_1$	((0.65,0.6,0.7),0.8,0.1,0.1)	((0.15,0.25,0.1),0.6,0.2,0.3)	((0.4,0.35,0.5),0.6,0.1,0.2)	((0.65,0.6,0.7),0.8,0.1,0.1)
$PNRA_2$	((0.4,0.35,0.5),0.6,0.1,0.2)	((0.95,0.9,0.95),0.9,0.1,0.1)	((0.9,0.85,0.9),0.8,0.2,0.2)	((0.65,0.6,0.7),0.8,0.1,0.1)
$PNRA_3$	((0.15,0.25,0.1),0.6,0.2,0.3)	((0.4,0.35,0.5),0.6,0.1,0.2)	((0.65,0.6,0.7),0.8,0.1,0.1)	((0.4,0.35,0.5),0.6,0.1,0.2)
$PNRA_4$	((0.1,0.3,0.35),0.1,0.2,0.15)	((0.4,0.35,0.5),0.6,0.1,0.2)	((0.15,0.25,0.1),0.6,0.2,0.3)	((0.15,0.25,0.1),0.6,0.2,0.3)
$PNRA_5$	((0.95,0.9,0.95),0.9,0.1,0.1)	((0.65,0.6,0.7),0.8,0.1,0.1)	((0.4,0.35,0.5),0.6,0.1,0.2)	((0.1,0.3,0.35),0.1,0.2,0.15)
$PNRA_6$	((0.65,0.6,0.7),0.8,0.1,0.1)	((0.65,0.6,0.7),0.8,0.1,0.1)	((0.65,0.6,0.7),0.8,0.1,0.1)	((0.95,0.9,0.95),0.9,0.1,0.1)
	$PNRC_1$	$PNRC_2$	$PNRC_3$	$PNRC_4$
$PNRA_1$	((0.1,0.3,0.35),0.1,0.2,0.15)	((0.15,0.25,0.1),0.6,0.2,0.3)	((0.4,0.35,0.5),0.6,0.1,0.2)	((0.65,0.6,0.7),0.8,0.1,0.1)
$PNRA_2$	((0.95,0.9,0.95),0.9,0.1,0.1)	((0.95,0.9,0.95),0.9,0.1,0.1)	((0.9,0.85,0.9),0.8,0.2,0.2)	((0.7,0.65,0.8),0.9,0.2,0.1)
$PNRA_3$	((0.9,0.85,0.9),0.8,0.2,0.2)	((0.1,0.3,0.35),0.1,0.2,0.15)	((0.65,0.6,0.7),0.8,0.1,0.1)	((0.7,0.65,0.8),0.9,0.2,0.1)
$PNRA_4$	((0.7,0.65,0.8),0.9,0.2,0.1)	((0.95,0.9,0.95),0.9,0.1,0.1)	((0.1,0.3,0.35),0.1,0.2,0.15)	((0.1,0.3,0.35),0.1,0.2,0.15)
$PNRA_5$	((0.65,0.6,0.7),0.8,0.1,0.1)	((0.9,0.85,0.9),0.8,0.2,0.2)	((0.95,0.9,0.95),0.9,0.1,0.1)	((0.1,0.3,0.35),0.1,0.2,0.15)
$PNRA_6$	((0.4,0.35,0.5),0.6,0.1,0.2)	((0.7,0.65,0.8),0.9,0.2,0.1)	((0.9,0.85,0.9),0.8,0.2,0.2)	((0.95,0.9,0.95),0.9,0.1,0.1)

Table 2. NRNs.

	PNR
$PNRA_1$	(0.1485,0.2475,0.099),0.4485,0.1495,0.22425)(0.225,0.375,0.15),0.594,0.198,0.297)
$PNRA_2$	(0.9405,0.891,0.9405),0.67275,0.07475,0.07475)(1.425,1.35,1.425),0.891,0.099,0.099)
$PNRA_3$	(0.297,0.33,0.4455),0.28225,0.108,0.132875)(0.45,0.5,0.675),0.429,0.132,0.1815)
$PNRA_4$	(0.5775,0.528,0.6435),0.54825,0.07475,0.11625)(0.875,0.8,0.975),0.693,0.099,0.165)
$PNRA_5$	(0.726,0.6765,0.759),0.598,0.108,0.108)(1.1,1.025,1.15),0.792,0.132,0.132)
$PNRA_6$	(0.6765,0.627,0.759),0.6395,0.11625,0.07475)(1.025,0.95,1.15),0.858,0.165,0.099)
	PNR
$PNRA_1$	(0.396,0.3465,0.495),0.4485,0.07475,0.1495)(0.6,0.525,0.75),0.594,0.099,0.198)
$PNRA_2$	(0.891,0.8415,0.891),0.598,0.1495,0.1495)(1.35,1.275,1.35),0.792,0.198,0.198)
$PNRA_3$	(0.6435,0.594,0.693),0.598,0.07475,0.07475)(0.975,0.9,1.05),0.792,0.099,0.099)
$PNRA_4$	(0.132,0.264,0.1815),0.28225,0.1495,0.174375)(0.2,0.4,0.275),0.429,0.198,0.2475)
$PNRA_5$	(0.5775,0.528,0.6435),0.54825,0.07475,0.11625)(0.875,0.8,0.975),0.693,0.099,0.165)
$PNRA_6$	(0.726,0.6765,0.759),0.598,0.108,0.108)(1.1,1.025,1.15),0.792,0.132,0.132)
	PNR
$PNRA_1$	(0.6435,0.594,0.693),0.598,0.07475,0.07475)(0.975,0.9,1.05),0.792,0.099,0.099)

$PNRA_2$	(0.6765,0.627,0.759),0.6395,0.11625,0.07475)(1.025,0.95,1.15),0.858,0.165,0.099)
$PNRA_3$	(0.594,0.5445,0.693),0.573,0.11625,0.108)(0.9,0.825,1.05),0.792,0.165,0.132)
$PNRA_4$	(0.1155,0.2805,0.264),0.241,0.1495,0.162)(0.175,0.425,0.4),0.264,0.198,0.198)
$PNRA_5$	(0.1155,0.2805,0.264),0.116,0.1495,0.1245)(0.175,0.425,0.4),0.264,0.198,0.198)
$PNRA_6$	(0.858,0.8085,0.891),0.67275,0.083,0.07475)(1.3,1.225,1.35),0.891,0.132,0.099)
	PNR
$PNRA_1$	(0.2805,0.396,0.462),0.3075,0.11625,0.0955)(0.425,0.6,0.7),0.33,0.165,0.132)
$PNRA_2$	(0.4785,0.5115,0.594),0.507,0.083,0.112125)(0.725,0.775,0.9),0.528,0.132,0.1485)
$PNRA_3$	(0.396,0.4455,0.363),0.515,0.1495,0.191)(0.6,0.675,0.55),0.66,0.198,0.264)
$PNRA_4$	(0.4785,0.5115,0.6105),0.3985,0.14125,0.091375)(0.725,0.775,0.925),0.594,0.165,0.1155)
$PNRA_5$	(0.759,0.7095,0.8085),0.6395,0.083,0.07475)(1.15,1.075,1.225),0.858,0.132,0.099)
$PNRA_6$	(0.5775,0.528,0.66),0.53975,0.083,0.108)(0.875,0.8,1),0.759,0.132,0.132)

Table 3. Crisp values.

	$PNRC_1$	$PNRC_2$	$PNRC_3$	$PNRC_4$
$PNRA_1$	0.368309	0.166973	0.211509	0.578375
$PNRA_2$	0.566001	0.322507	0.400999	0.640393
$PNRA_3$	0.414408	0.185827	0.354157	0.566122
$PNRA_4$	0.567295	0.46379	0.207093	0.233699
$PNRA_5$	0.919631	0.389408	0.469419	0.21972
$PNRA_6$	0.676303	0.345123	0.274947	0.738153

Table 4. Ranks of alternatives.

	Ranks
$PNRA_1$	3
$PNRA_2$	6
$PNRA_3$	5
$PNRA_4$	2
$PNRA_5$	1
$PNRA_6$	4

5. Conclusions

This study emphasizes how critical it is to rethink early childhood education in rural areas using frameworks that are quality-focused and context-responsive. According to the review, certain models, like preschools managed by NGOs and cooperatives, are excellent at integrating the community and using specialized teaching methods, while others lack the necessary infrastructure or teacher training. A one-size-fits-all approach is ineffective for rural areas, as seen by the variation in program success. Rather, the key to improving quality is to engage in parental participation, infrastructure support, and training. This study used the Plithogenic-Neutrosophic

Rough Number to overcome vague information. We combine the rough number with neutrosophic and Plithogenic. We use triangular neutrosophic numbers to evaluate the criteria and alternatives. Collaborative policy efforts that put an emphasis on sustainability, local culture, and diversity are crucial going ahead. Rural ECE programs can act as catalysts for long-term educational fairness and rural development by using adaptable, community-integrated techniques.

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References

[1] F. Smarandache, “Introduction to Neutrosophy, Neutrosophic Set, Neutrosophic Probability, Neutrosophic Statistics and Their Applications to Decision Making,” in *Neutrosophic Paradigms: Advancements in Decision Making and Statistical Analysis: Neutrosophic Principles for Handling Uncertainty*, Springer, 2025, pp. 3–21.

[2] F. Smarandache, “Foundation of superhyperstructure & neutrosophic superhyperstructure,” *Neutrosophic Sets Syst.*, vol. 63, pp. 367–381, 2024.

[3] M. Akram, N. Ishfaq, S. Sayed, and F. Smarandache, “Decision-making approach based on neutrosophic rough information,” *Algorithms*, vol. 11, no. 5, p. 59, 2018.

[4] H.-L. Yang, C.-L. Zhang, Z.-L. Guo, Y.-L. Liu, and X. Liao, “A hybrid model of single valued neutrosophic sets and rough sets: single valued neutrosophic rough set model,” *Soft Comput.*, vol. 21, pp. 6253–6267, 2017.

[5] T. Fujita, “General plithogenic soft rough graphs and some related graph classes,” *Adv. Uncertain Comb. through Graph. Hyperization, Uncertainization Fuzzy, Neutrosophic, Soft, Rough, Beyond*, p. 437, 2024.

[6] A. Yolcu, A. Benek, and T. Y. Öztürk, “A new approach to neutrosophic soft rough sets,” *Knowl. Inf. Syst.*, vol. 65, no. 5, pp. 2043–2060, 2023.

[7] S. Sudha, N. Martin, and F. Smarandache, “State of art of plithogeny multi criteria decision making methods,” *Neutrosophic Sets Syst. vol. 56/2023 An Int. J. Inf. Sci. Eng.*, vol. 10, no. 10, p. 389, 2024.

[8] F. Smarandache, *Plithogeny, plithogenic set, logic, probability, and statistics*. Infinite Study, 2017.

[9] T. Fujita, "General plithogenic soft rough expert mixed graphs," *Algorithms*, vol. 55, pp. 63–105, 2024.

[10] T. Fujita, "Plithogenic rough sets," *Adv. Uncertain Comb. through Graph. Hyperization, Uncertainization Fuzzy, Neutrosophic, Soft, Rough, Beyond*, vol. 152, 2025.

[11] D. Kassa, "Reimagining Children's Aspirations and Futures Through Indigenous Education in Ethiopia," 2023, *NTNU*.

[12] L. Nigro and A. Ward-Seidel, "Reimagining early childhood education and school readiness through the perspectives of historically marginalized families living in a rural community," *Contemp. Issues Early Child.*, p. 14639491241293480, 2024.

[13] A. Y. Aina and K. Bipath, "Reimagining systems that support early childhood development centres in offering quality education," *J. Transdiscipl. Res. South. Africa*, vol. 18, no. 1, p. 1107, 2022.

[14] P. Wang, Y. Lin, and Z. Wang, "An integrated decision-making model based on plithogenic-neutrosophic rough number for sustainable financing enterprise selection," *Sustainability*, vol. 14, no. 19, p. 12473, 2022.

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