
**A COMPARATIVE STUDY USING NEUTROSOPHIC COGNITIVE MAP AND
TRIANGULAR FUZZY COGNITIVE MAP FOR ANALYZING THE FACTORS
FOR QUALITY TRAINING OF ELEMENTARY EDUCATION STUDENT-
TEACHERS IN TAMILNADU**

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ABSTRACT. Education is an instrument that measures the growth and development of the country. To ensure transformative learning in the process of teaching, preparation of teachers is a main role of education involving teacher and learner as co- constructors of knowledge. Teacher education moulds the teacher educators, policy makers and the public instructing what to teach and how to teach effectively in terms of knowledge and needed skills as well as the contexts needed are created in order that teachers develop and use it. Teacher and his/her education plays significant role in teacher education. The focus of this paper is to compare the extension of FCM tools Neutrosophic Cognitive Map, Triangular Fuzzy Cognitive Map. In order to find the effectiveness of the study, the factors which will enhance the quality training in teacher education especially in Elementary Education training along with the aptitude of the student-teachers, the causes of the low academic results in the diploma elementary education final examinations, the solid ways of upgrading the students' academic skills, techno-pedagogic skills and teaching competencies are considered and analyzed.

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1. INTRODUCTION

Education is the treasure which can be preserved without fear or loss, Education is God incarnate (10). In India like countries education is given much emphasis and the government launches many new schemes for quality, compulsory education of the people. Swami Vivekananda says education is not the amount of information that is put into the brain rather it is the achievement of life building, man making, character making and assimilation of ideas. For learning to be active for the highest achievement, the quality of teachers is expected to be high. Teacher education plays a key role in training quality teachers because teachers are human-making (). So this study is undertaken to scrutinize the factors upholding holistic training for the student teachers according to the changes and developments in the evolving society. In this paper, after evaluating the course programs, the academic results and competencies of the students of primary teacher training students, study of the causes of setback in the course and the need for updating the content are studied and discussed with the experts and factors are derived for analyzing the influencing factor through Comparative study of Neutrosophic Cognitive map and Triangular FCM.

2. BRIEF REVIEW OF FUZZY COGNITIVE MAP

Dynamic and complex systems with the presence of uncertainty and incomplete information is represented and simulated with a suitable tool called Fuzzy Cognitive Maps. In 1965, Cognitive Map was introduced by L.A.Zadeh.. Kosko (1986) introduced FCMs as an extension of Cognitive Maps. It is a combination of fuzzy logic and cognitive mapping. When the data is unsupervised FCMs are suitable. FCMs are used widely because of its capability of dealing with uncertainty and vagueness, incomplete information, simplicity and adoptability. The relationship between any two nodes or concepts is denoted as positive, negative or nonexistence, represented as 1,-1 and 0 respectively. But FCM cannot handle indeterminacy.

2.1. Method. The advancement of FCM considers the importance of change in the primary teacher training program in this paper. Based on the choice of expert educators the relationship between the factors are discussed.

- Step 1: The factors are framed after the study of the background issues that persists and discussion with the experts along with the suggested remedies from published papers on the challenges of teacher education.
- Step 2: The relation between factors is determined using panel of experts.
- Step 3: The obtained cognitive map is extended to a Neutrosophic Cognitive Map by establishing the concept of Positive, Negative and Indeterminacy.

2.2. Neutrosophic Logic. Neutrosophic logic is introduced as an indefinite statistics and as an extension of FCM by Samarandache and W.B.Vasantha Kandasamy. It is a combination of the fuzzy cognitive maps which includes indeterminacy. The grade of membership and the nonexistence of a membership is measured by FCM revolutionarily but not attributing when the relationship between concepts are indeterminate. Neutrosophic logic is the ideal tool to deal with indeterminacy.

Definition 2.1. *A Neutrosophic Cognitive Map (NCM) is a neutrosophic directed graph with concepts like policies, events etc. as nodes and causalities or indeterminate as edges. It represents the causal relationship between concepts.*

Let C_i and C_j denote the two nodes of the NCM. The directed edge from C_i to C_j denotes the causality of C_i on C_j called connections. Every edge in the NCM is weighted with a number in the set $\{-1, 0, 1, I\}$. Let e_{ij} be the weight of the directed edge $C_i C_j$, $e_{ij} \in \{-1, 0, 1, I\}$ $e_{ij} = 0$ if C_i does not have any effect on C_j , $e_{ij} = 1$ if increase (or decrease) in C_i causes increase (or decreases) in C_j , $e_{ij} = -1$ if increase (decrease) in C_i causes decrease (or increase) in C_j , $e_{ij} = I$ if the relation or effect of C_i on C_j is an indeterminate.

2.3. Adaptation of Neutrosophic Cognitive Maps. The various factors are analyzed to imparting the efficiency of student teachers considering the current status of the elementary teacher education with its pros and cons. The factors are framed after the study of the background issues that persists and discussion with the experts along with the suggested remedies from published papers on the challenges of teacher education. The factors are as follows:

- C1- Living competencies and techno pedagogic competencies has to be correlated
- C2- Preparing human professional teacher educators in order to integrate life skills, emotional competencies and social sensitivity and social management skills.
- C3- Need to train quality teachers through skilled and competent Teacher Education Professionals based on the curriculum.
- C4- Self-learning techniques are to be adopted.
- C5- Basic knowledge of the school subjects is to be acquired in depth.
- C6- Acquiring the skills of second language English.
- C7- Integration of technology for smart classroom and digital lesson designs.
- C8- For the future effective competent teachers, bridging of teacher education curriculum and school curriculum is vital.
- C9- Change in the syllabus like duration and mode of internship could be brought to reduce the stress of student teachers and Teacher Educators.
- C10- Minimum pass percentage could be modified in the final examinations according to the minimum eligibility of various categories of students for admission.
- C11- Minimum marks for the admission could be increased for all categories of students.
- C12- Integration of human climate development through trust, risk taking, openness, reward, responsibilities, feedback, team spirit and collaboration.
- C13- Integration of spiritual intelligence dimensions such as spirituality, self-awareness, quest for life values, interpersonal relations, acceptance and empathy, leadership, love and compassion, flexibility, commitment and character in order to be more self-confident and assertive.

The table on the next page is obtained from the experts' opinion which is Neutrosophic FCM table.

This paper analyses the various reasons for the low academic achievement of the elementary teacher education students in the recent past. The results of the examination is very low percentage and their expected achievement is questioned in comparison with the precision.

$$M = \begin{matrix} c_1 \\ c_2 \\ c_3 \\ c_4 \\ c_5 \\ c_6 \\ c_7 \\ c_8 \\ c_9 \\ c_{10} \\ c_{11} \\ c_{12} \\ c_{13} \end{matrix} \begin{pmatrix} 0 & 1 & 1 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 1 & 1 \\ 1 & 0 & 1 & 0 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 1 & 1 & 0 & 1 & 0 & 1 & 0 & 0 & 1 & 1 \\ 1 & 0 & 1 & 0 & 1 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 0 & 1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 1 & 1 & 0 & 1 & 0 & 1 & 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 0 & 1 & 0 & 0 & 1 & 0 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 1 & 1 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 \\ 1 & 1 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 1 \\ 1 & 1 & 1 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 1 & 0 \end{pmatrix}$$

(1) Consider the state vector $A1$ which is in ON position
 Let the initial input vector be

$$\begin{aligned} X1 &= (1\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0) \\ X1 \times M1 &= (0\ 1\ 1\ 0\ 0\ 0\ 1\ 1\ 0\ 0\ 0\ 1\ 1) \\ \implies &(1\ 1\ 1\ 0\ 0\ 0\ 1\ 1\ 0\ 0\ 0\ 1\ 1) = A1 \\ A1 \times M1 &= (6\ 6\ 5\ 2 + i\ 3 + i\ 2\ 4 + i\ 4\ 4\ 0\ 1\ 4\ 4 + i) \\ \implies &(1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 0\ 1\ 1\ 1\ 0) = A2 \\ A2 \times M1 &= (7\ 6\ 9\ 4 + i\ 5 + 2i\ 3\ 6 + i\ 6 + i\ 5 + i\ 1 + i\ 2\ 4\ 4 + i) \\ \implies &(1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1) = A3 \\ A3 \times M1 &= (7\ 6\ 9\ 4 + i\ 5 + 2i\ 3\ 6 + i\ 6 + i\ 5 + i\ 1 + i\ 2\ 4\ 4 + i) \\ \implies &(1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1) = A4 \\ A3 &= A4 \end{aligned}$$

The state vector $X1 = (1\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0)$ gives the fixed point as $(1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1)$.

According to the calculation, when the factors $A1$ and $A5$ are in ON position, $A3$, $B3$ and $C3$ is the fixed point which reveals that the above two factors are influencing all the factors. The above results in this research reveals that the teacher education would go through changes in the pedagogical competencies adapting the technology available and attractive to the learning and they need

to equip themselves through self-learning techniques and acquiring deep knowledge of the school subjects and mastering the applications in daily life with the command of second language skills.

3. TRIANGULAR FUZZY COGNITIVE MAP

Fuzzy set theory deals with the extraction of primary outcome from an expressed multiplicity of first-hand information expressed in vague and imprecise terms. The Triangular FCM tool is used to predict the system's future state. Triangular FCM tool is used to predict the system's future state. It is used to handle practical uncertainties expressed as linguistic values with flexibility (2).

3.1. Triangular Fuzzy Number. A fuzzy number is a fuzzy set possessing the properties of convex and normalized fuzzy set. There are many fuzzy numbers namely Triangular (TFN), Trapezoidal Fuzzy number, Gaussian Fuzzy number etc. Triangular fuzzy number is a fuzzy number represented with three points $A = (a_1, a_2, a_3)$.

The membership function is defined as

$$\mu_A(x) = \begin{cases} 0, & \text{for } x < a_1 \\ \frac{x - a_1}{a_2 - a_1}, & \text{for } a_1 \leq x \leq a_2 \\ \frac{a_3 - x}{a_3 - a_2}, & \text{for } a_2 \leq x \leq a_3 \\ 0, & \text{for } x > a_3 \end{cases}$$

Degrees of triangular fuzzy Number The linguistic variable was introduced by Lofti Zadeh in 1975 to compute with words in the place of numbers. They are used as values to get Triangular Fuzzy Cognitive Map from experts. The linguistic values of the triangular fuzzy numbers are as follows:

| | |
|-----------|-----------------|
| Very High | (0.75,1,1) |
| High | (0.50,0.75,1) |
| Medium | (0.25,0.5,0.75) |
| Low | (0,0.25,0.50) |
| Very low | (0,0,0.25) |

3.2. Method of determining the hidden pattern of Triangular Fuzzy Cognitive maps.

Step 1: $TrC_1, TrC_2, \dots, TrC_n$ are the nodes of a Triangular FCM, with feedback $Tr(M)$ be the associated adjacency matrix.

Step 2: To find the hidden pattern TrC_1 is switched ON. Let $A_1 = (1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0)$ be the input vector which passes through the relation matrix M which is denoted as $A_i(M)$ that is multiplying A_i by the triangular matrix M .

Step 3: Consider $A_iTr(M) = (a_1, a_2 \dots a_n)$ be a triangular vector. $A_1Tr(M) = (1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0)$ gives the triangular weight of the attributes called as $A_iTr(M)$ weight

Step 4: Add the corresponding node of the opinion of three experts and get as $A_iTr(M)_{Sum}$

Step 5: Threshold (\rightarrow) the obtained triangular vector and denote as $A_iTr(M)_{Maxweight}$ replacing a_i by 1 a_i is maximum weight of the triangular node or a_i by 0 otherwise.

Step 6: Suppose the input vector is A_2 then $A_2Tr(M)$ weight is obtained by adding weightage of the ON attribute with $A_1Tr(M)$ weight

Step 7: Then $A_2Tr(M)$ Sum is obtained.

Step 8: The threshold (\rightarrow) of the ON attribute is found and denoted as $A_2Tr(M)_{Maxweight}$ by replacing a_i by 1 if it is maximum otherwise a_i by 0

Step 9: The dynamical system is ended when $A_1Tr(M)_{Maxweight} = A_2Tr(M)_{Maxweight}$.
Otherwise the procedure is repeated.

Step 10: The above steps are repeated till a limit cycle or a fixed point is obtained

Concept of the problem.

The connection matrix related with the FCM is given on the next page.

Calculation.

(i) Attribute TrC_1 is ON:

$$A^{(1)} = (1 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0)$$

$$A^1 Tr(M)_{weight} = [0, (0.5, 0.75, 1), (0.5, 0.75, 1) (0.25, 0.5, 0.75) (0, 0.25, 0.5), (0.25, 0.5, 0.75) (0.75, 1, 1) (0.25, 0.5, 0.75), (0, 0, 0.25) (0,$$

TABLE 1. Initial triangular fuzzy values

| | | | | | | | | | | | | | |
|----|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 1 | - | (0.5,0.75,1) | (0.5,0.75,1) | (0.25,0.5,0.75) | (0,0.25,0.5) | (0.25,0.5,0.75) | (0.75,1,1) | (0.25,0.5,0.75) | (0,0,0.25) | (0,0,0.25) | (0,0,0.25) | (0.5,0.75,1) | (0.25,0.5,0.75) |
| 2 | (0.75,1,1) | - | (0.5,0.75,1) | (0.5,0.75,1) | (0,0,0.25) | (0.25,0.5,0.75) | (0.75,1,1) | (0,0.25,0.5) | (0,0.25,0.5) | (0,0,0.25) | (0,0,0.25) | (0.75,1,1) | (0.5,0.75,1) |
| 3 | (0.75,1,1) | (0.75,1,1) | - | (0.75,1,1) | (0.5,0.75,1) | (0.5,0.75,1) | (0.75,1,1) | (0.25,0.5,0.75) | (0.25,0.5,0.75) | (0.25,0.5,0.75) | (0.25,0.5,0.75) | (0.75,1,1) | (0.25,0.5,0.75) |
| 4 | (0.25,0.5,0.75) | (0.25,0.5,0.75) | (0.25,0.5,0.75) | - | (0.5,0.75,1) | (0.5,0.75,1) | (0.25,0.5,0.75) | (0,0.25,0.5) | (0.5,0.75,1) | (0.25,0.5,0.75) | (0.5,0.75,1) | (0.25,0.5,0.75) | (0.25,0.5,0.75) |
| 5 | (0.25,0.5,0.75) | (0.25,0.5,0.75) | (0.25,0.5,0.75) | (0.25,0.5,0.75) | - | (0.5,0.75,1) | (0.25,0.5,0.75) | (0,0,0.25) | (0,0,0.25) | (0,0,0.25) | (0,0,0.25) | (0.25,0.5,0.75) | (0,0,0.25) |
| 6 | (0.5,0.75,1) | (0.5,0.75,1) | (0.5,0.75,1) | (0.5,0.75,1) | (0.75,1,1) | - | (0.5,0.75,1) | (0.25,0.5,0.75) | (0.25,0.5,0.75) | (0.25,0.5,0.75) | (0.25,0.5,0.75) | (0.25,0.5,0.75) | (0,0.25,0.5) |
| 7 | (0.75,1,1) | (0,0.25,0.5) | (0.75,1,1) | (0.5,0.75,1) | (0.25,0.5,0.75) | (0.25,0.5,0.75) | - | (0.25,0.5,0.75) | (0,0.25,0.5) | (0,0.25,0.5) | (0,0,0.25) | (0.25,0.5,0.75) | (0,0.25,0.5) |
| 8 | (0.5,0.75,1) | (0,0,0.25) | (0.5,0.75,1) | (0.25,0.5,0.75) | (0.5,0.75,1) | (0.5,0.75,1) | (0,0.25,0.5) | - | (0,0.25,0.5) | (0,0,0.25) | (0,0.25,0.5) | (0,0,0.25) | (0,0,0.25) |
| 9 | (0,0,0.25) | (0,0.25,0.5) | (0,0.25,0.5) | (0,0,0.25) | (0,0.25,0.5) | (0,0.25,0.5) | (0,0,0.25) | (0,0.25,0.5) | - | (0,0.25,0.5) | (0,0,0.25) | (0,0.25,0.5) | (0,0,0.25) |
| 10 | (0,0,0.25) | (0.25,0.5,0.75) | (0,0,0.25) | (0,0.25,0.5) | (0,0,0.25) | (0.25,0.5,0.75) | (0,0,0.25) | (0,0.25,0.5) | (0.25,0.5,0.75) | - | (0,0.25,0.5) | (0,0,0.25) | (0,0,0.25) |
| 11 | (0.25,0.5,0.75) | (0,0.25,0.5) | (0.25,0.5,0.75) | (0.25,0.5,0.75) | (0.25,0.5,0.75) | (0.25,0.5,0.75) | (0,0.25,0.5) | (0,0,0.25) | (0,0.25,0.5) | (0.25,0.5,0.75) | - | (0,0,0.25) | (0,0,0.25) |
| 12 | (0,0.25,0.5) | (0.25,0.5,0.75) | (0.5,0.75,1) | (0.25,0.5,0.75) | (0.25,0.5,0.75) | (0,0.25,0.5) | (0,0.25,0.5) | (0,0,0.25) | (0,0.25,0.5) | (0,0.25,0.5) | (0,0.25,0.5) | (0,0,0.25) | (0,0,0.25) |
| 13 | (0,0.25,0.5) | (0.25,0.5,0.75) | (0.5,0.75,1) | (0.5,0.75,1) | (0.5,0.75,1) | (0,0.25,0.5) | (0.25,0.5,0.75) | (0.25,0.5,0.75) | (0,0,0.25) | (0,0.25,0.5) | (0,0.25,0.5) | (0.5,0.75,1) | - |

0, 0.25), (0, 0, 0. 25) (0.5, 0.75, 1), (0.25, 0.5, 0.75)

$$A^1 \text{ Tr}(M)_{Average} = (0, 0.75, 0.75, 0.5, 0.25, 0.5, 0.9167, 0.5, 0.0833, 0.0833, 0.75, 0.5)$$

$$A^{(1)} \text{ Tr}(M)_{Max(weight)} \rightarrow (0\ 0\ 0\ 0\ 0\ 0\ 1\ 0\ 0\ 0\ 0\ 0\ 0) = A_1^{(1)}$$

$$A_1^{(1)} \text{ Tr}(M)_{Average} = (0.9167, 0.25, 0.9167, 0.75, 0.5, 0.5, 0, 0.5, 0.25, 0.25, 0.0833, 0.25, 0.0833)$$

$$A_1^{(1)} \text{ Tr}(M)_{Maxweight} \rightarrow (1\ 0\ 1\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0) = A_2^{(1)}$$

$$A_2^{(1)} \text{ Tr}(M)_{Average} = (0.9167, 1.6667, 0.75, 1.4167, 1, 1.25, 1.8334, 1, 1, 0.5833, 1, 1.25, 1.25)$$

$$A_2^{(1)} \text{ Tr}(M)_{Maxweight} \rightarrow (0\ 1\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0) = A_3^{(1)}$$

$$A_3^{(1)} \text{ Tr}(M)_{Average} = (17.0005, 6.4167, 14.8334, 14.25, 6.833, 8, 15.0004, 4.0829, 5.9999, 6.5833, 4.3329, 14.0003, 11.5832)$$

$$A_3^{(1)} \text{ Tr}(M)_{Maxweight} \rightarrow (1\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0) = A_4^{(1)}$$

$$A_4^{(1)} \text{ Tr}(M)_{Average} = (7.9168, 6.9167, 7.4167, 7, 6.0833, 6.4167, 5.9167, 3.4999, 3.9999, 4.0833, 3.7499, 4.9166, 4.1665)$$

$$A_4^{(1)} \text{ Tr}(M)_{Maxweight} \rightarrow (1\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0) = A_5^{(1)}$$

$$A_4^{(1)} = A_5^{(1)}$$

The process is repeated for the remaining attributes.

Weightage of the attributes is given in the table on the next page.

4. CONCLUSION

Triangular FCM is more appropriate to reflect the practical vagueness and poor accuracy existed for using as decision support tool in real life situations. Triangular FCM modal gives the ranking for the factors enhancing the academic achievement and competencies of the student teachers. It is undeniable truth that FCM is a powerful tool and flexible to represent the relationships among concepts, which is not easy for the decision makers to quantify the edge weights

TABLE 2.

| Attributes | C ₁ | C ₂ | C ₃ | C ₄ | C ₅ | C ₆ | C ₇ | C ₈ | C ₉ | C ₁₀ | C ₁₁ | C ₁₂ | C ₁₃ |
|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----------------|-----------------|-----------------|-----------------|
| (1 0 0 0 0 0 0 0 0 0 0 0 0 0) | 7.9168 | 6.9167 | 7.4167 | 7 | 6.0833 | 6.4167 | 5.9167 | 3.4999 | 3.9999 | 4.0833 | 3.7499 | 4.9166 | 4.1665 |
| (0 1 0 0 0 0 0 0 0 0 0 0 0 0) | 6.41 | 5.41 | 6.5834 | 6.1667 | 5.25 | 4.75 | 5.5 | 2.9166 | 3.24 | 2.9166 | 3.416 | 3.8333 | 3.9166 |
| (0 0 1 0 0 0 0 0 0 0 0 0 0 0) | 7.9168 | 6.9167 | 7.4167 | 7 | 6.0833 | 6.5834 | 6.4167 | 5.9167 | 3.4999 | 4.0833 | 3.7499 | 4.9166 | 4.1665 |
| (0 0 0 1 0 0 0 0 0 0 0 0 0 0) | 0 | 0.75 | 0.75 | 0.5 | 0.25 | 0.5 | 0.9167 | 0.5 | 0.5 | 0.0833 | 0.0833 | 0.75 | 0.5 |
| (0 0 0 0 1 0 0 0 0 0 0 0 0 0) | 0.5 | 0.5 | 0.5 | 0.5 | 0 | 0.9167 | 0.5 | 0.0833 | 0.0833 | 0.25 | 0.25 | 0.0833 | 0.0833 |
| (0 0 0 0 0 1 0 0 0 0 0 0 0 0) | 0.75 | 0.75 | 0.75 | 0.75 | 0.9167 | 0 | 0.75 | 0.5 | 0.5 | 0.5 | 0.5 | 0.25 | 0.25 |
| (0 0 0 0 0 0 1 0 0 0 0 0 0 0) | 7.9168 | 6.9167 | 7.4167 | 7 | 6.0833 | 6.4167 | 5.9167 | 3.4999 | 3.9999 | 4.0833 | 3.7489 | 4.9166 | 4.1665 |
| (0 0 0 0 0 0 0 1 0 0 0 0 0 0) | 7.9168 | 6.9167 | 7.4167 | 7 | 6.0833 | 6.4167 | 5.9167 | 3.4999 | 3.9999 | 4.0833 | 3.7489 | 4.9166 | 4.1665 |
| (0 0 0 0 0 0 0 0 1 0 0 0 0 0) | 7.9168 | 6.9167 | 7.4167 | 7 | 6.0833 | 6.4167 | 5.9167 | 3.4999 | 3.9999 | 4.0833 | 3.7489 | 4.9166 | 4.1665 |
| (0 0 0 0 0 0 0 0 0 1 0 0 0 0) | 0.5 | 0.5 | 0.5 | 0.5 | 0 | 0.9167 | 0.5 | 0.0833 | 0.0833 | 0.25 | 0.25 | 0.0833 | 0.0833 |
| (0 0 0 0 0 0 0 0 0 0 1 0 0 0) | 0.5 | 0.5 | 0.5 | 0.5 | 0 | 0.9167 | 0.5 | 0.0833 | 0.0833 | 0.25 | 0.25 | 0.0833 | 0.0833 |
| (0 0 0 0 0 0 0 0 0 0 0 0 1 0) | 7.9168 | 6.9167 | 7.4167 | 7 | 6.0833 | 6.4167 | 5.9167 | 3.4999 | 3.9999 | 4.0833 | 3.7489 | 4.9166 | 4.1665 |
| (0 0 0 0 0 0 0 0 0 0 0 0 0 1) | 7.9168 | 6.9167 | 7.4167 | 7 | 6.0833 | 6.4167 | 5.9167 | 3.4999 | 3.9999 | 4.0833 | 3.7489 | 4.9166 | 4.1665 |
| Total Weight | 64.0776 | 56.8269 | 61.5003 | 57.9167 | 48.9998 | 53.0837 | 50.5836 | 31.0826 | 31.9892 | 32.833 | 30.9936 | 39.4994 | 34.082 |
| Total Average weight | 4.9291 | 4.3713 | 4.7308 | 4.4551 | 3.7692 | 4.0834 | 3.8910 | 2.3910 | 2.4607 | 2.5256 | 2.3841 | 3.0384 | 2.6217 |

criteria with incomplete information, which is subjective, uncertain and vague. Hence using the Triangular fuzzy number, the ranking of the factors namely $TrC_1- 4.2921, TrC_4- 4.4551, TrC_2- 3713, TrC_6- 4.0834, TrC_5- 3.7692, TrC_{12}- 3.0384, TrC_{13}- 2.6217, TrC_{10}4, TrC_9- 2.4607, TrC_8- 2.3910$ and $TrC_{11}- 2.3841$. The research shows that application of NCM as well as Triangular FCM reveals the same result but Triangular FCM gives the accuracy with ranking.

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