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A topological finding Equipping Gen Z with Resilience Skills for Leadership in Dynamic Environments

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Abstract
The contemporary world is marked by technological shifts, environmental crisis, instability, inequality and ethical issues concerning digital media. Generation Z or digital natives can become active agents to address these challenges as they are well-versed in technology, socially conscious, highly connected, and globally engaged. Gen Z is the truly first digital natives who are formed by technology, social media and internet. The traditional leadership skills and attitudes are not sufficient to this generation. Resilience is now a core leadership competency that will help them to become a good citizen and great leader. For Gen Z, resilience must blend emotional intelligence, adaptability, and purpose-driven action. This article leads the predominance resilience skills of Gen Z for Leadership in Dynamic Environments.
Keywords: *Rough sets, Resilience, nano topology.*

1. Introduction
Rough set theory [1] was designed as a tool for conceptualising, organising, and analysing various types of data, particularly when dealing with imprecise, uncertain, or ambiguous knowledge in artificial intelligence applications. Rough set theory overlaps with many other theories, such as fuzzy sets, evidence theory, and statistics. It is an excellent data analysis tool in practise. The primary goal of rough set analysis is to create concept approximations from acquired data. In this study we are analysing the fact that in which factor plays predominant role to help to earn the resilience skills via a rough topology.

2. Preliminaries
Let us review some fundamental definitions that we will use in the following chapter.

Definition 2.1[1] Let $\tilde{U}$ be a non-empty finite set of objects called the Universe and $\ddot{R}$ be an equivalence relation on $\tilde{U}$ named as the indiscernibility relation. Then $\tilde{U}$ is divided into disjoint equivalence classes. Elements belonging to the same equivalence class are said to be indiscernible with one another. The pair $(\tilde{U}, \ddot{R})$ is said to be the approximation space. Let $X \subseteq \tilde{U}$.

- The lower approximation of X with respect to $\ddot{R}$ is the set of all objects, which can be for certain classified as X with respect to $\ddot{R}$ and it is denoted by $L\ddot{R}(X)$. $L\ddot{R}(X) = \{x \in \tilde{U} \{\ddot{R}(x) : \ddot{R}(x) \subseteq X\}$, where $\ddot{R}(x)$ denotes the equivalence class determined by x.
- The $\tilde{U}$pper approximation of X with respect to $\ddot{R}$ is the set of all objects, which can be possibly classified as X with with respect to $\ddot{R}$ and it is denoted by $\tilde{U}\ddot{R}(X)$. $\tilde{U}\ddot{R}(X) = \{ x \in \tilde{U} \{\ddot{R}(x) : \ddot{R}(x) \cap X \neq \varphi\}$.
- The boundary region of X with respect to R is the set of all objects, which can be classified neither as X nor as not X with respect to $\ddot{R}$ and it is denoted by $B\ddot{R}(X)$. That is, $B\ddot{R}(X) = \tilde{U}\ddot{R}(X) - L\ddot{R}(X)$.

Definition 2.2 [1] An information system is of the form $(\tilde{U}, A, \{Va\}, fa)$ where $\tilde{U}$ is a non-empty finite set of objects, called the Universe, A is a finite non-empty set of attributes, Va is the attribute value set of an attribute $a \in A$ and $fa : \tilde{U} \rightarrow Va$ is called the information function. If fa(x) is equal to a missing

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value for some x ∈ Ũ and a ∈ A, then the information system is called an incomplete information system (IIS) Otherwise it is a complete information system(CIS) [2-6].

Definition 2.3[15] Let Ũ be an Universe and R̈ be an equivalence relation on Ũ and τR(X) = {φ, Ũ, BR̈(X)}, where X ⊆ Ũ. Then τR̈(X) is called the rough topology on Ũ and it satisfies conditions:

- φ, Ũ ∈ τR(X)
- The Ũnion of the elements of any sub collection of τR̈(X) is in τR̈(X)

The intersection of the elements of any finite sub collection of τR̈(X) is in τR̈(X). In this case, (Ũ, τR̈(X)) is called the rough topological space on Ũ with respect to X. It is obvious that τR̈(X) for a topology on Ũ with respect to the equivalence relation R̈.

Definition 2.4 [15] Let (Ũ, A) be an information system. Where Ũ is a Universe, A is the set of attributes is divided into a set of C of condition attributes and a set of D of decision attribute. A sŨbset B of C is said to be a CORE if τR(B)(X) = τR̈(C)(X) and τR̈(B)(X) ≠ τR̈(B−{r}) (X) for all r ∈ B where X ⊆ Ũ, τR̈(B)(X) is the rough topology corresponding to B ⊆ C. It is not necessary that all condition attributes in an information system depict the decision attribute. That is the decision attribute depends not on the whole set of condition attributes but on a subset of it is called the CORE. Attributes of Equipping Gen Z with Resilience Skills for Youth Leadership

2.1.Adaptability in Uncertain Environments

Youth leaders learn to navigate rapid change—academic pressure, social shifts, digital disruption, and global challenges—without losing direction or motivation.

2.2.Emotional Intelligence & Self-Awareness

Understanding emotions, managing reactions, and empathizing with peers from diverse backgrounds strengthens trust and peer leadership.

2.3.Growth Mindset & Learning Orientation

Encouraging young leaders to see mistakes as part of growth builds confidence and long-term resilience.

2.4.Mental Well-Being & Stress Regulation

Youth leaders develop healthy coping strategies, balance responsibilities, and avoid burnout while staying engaged.

2.5.Confidence & Self-Efficacy

Belief in their voice, ideas, and ability to lead—even without formal authority—empowers youth to step up.

2.6.Ethical Awareness & Values-Based Leadership

Strong moral grounding helps youth leaders make fair decisions and advocate for inclusivity and social justice.

2.7.Communication & Peer Collaboration

Clear expression, active listening, and teamwork across cultures and identities are central to youth-led initiatives.

2.8.Digital Leadership & Media Literacy

Using digital platforms responsibly for advocacy, organizing, and influence while navigating misinformation and online pressure.

2.9.Problem-Solving & Initiative

Youth leaders identify community issues, co-create solutions, and take action despite limited resources.

2.10. Resilience to Feedback, Failure & Criticism

Learning to accept feedback, handle peer judgment, and persist after setbacks strengthens leadership maturity

3. Application

In this information table, we take Adaptability in Uncertain Environments, Emotional Intelligence, Growth Mindset & Learning Orientation, Ethical Awareness, Resilience to Feedback, Failure & Criticism are the conditional attributes and Raising Resilience skills is the decision attribute. Let us a universal set U = {SG1, SG2, SG3……, SG10}as the set of all student groups those who involved in the survey.

SG	EI	GL	RF	EA	UE	RRK
SG1	Yes	Yes	Yes	Yes	No	H
SG2	Yes	No	No	Yes	Yes	L
SG3	Yes	No	Yes	No	Yes	H

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SG4	Yes	Yes	No	Yes	No	H
SG5	No	Yes	Yes	Yes	Yes	H
SG6	No	Yes	Yes	No	No	L
SG7	No	No	Yes	No	Yes	L
SG8	Yes	Yes	No	Yes	No	H
SG9	No	No	Yes	No	Yes	L
SG10	Yes	Yes	Yes	Yes	No	L

SG	EI	GL	RF	EA	UE	Factors
SG1	Yes	Yes	Yes	Yes	No	H
SG2	Yes	No	No	Yes	Yes	L
SG3	Yes	No	Yes	No	Yes	H
SG4	Yes	Yes	No	Yes	No	H
SG5	No	Yes	Yes	Yes	Yes	H
SG6	No	Yes	Yes	No	No	L
SG7	No	No	Yes	No	Yes	L
SG8	Yes	Yes	No	Yes	No	H
SG9	No	No	Yes	No	Yes	L
SG10	Yes	Yes	Yes	Yes	No	L

Based on the decision variable we have the following similarity table

Case 1

Consider X1 to be the group of students who recognised the significance of Resilience Skills acquired [7-11].

Here X1= {SG1, SG3, SG4, SG5, SG8}.

SG	EI	GL	RF	EA	UE	Factors
SG1	Yes	Yes	Yes	Yes	No	H
SG2	Yes	No	No	Yes	Yes	L
SG3	Yes	No	Yes	No	Yes	H
SG4	Yes	Yes	No	Yes	No	H
SG5	No	Yes	Yes	Yes	Yes	H
SG6	No	Yes	Yes	No	No	L
SG7	No	No	Yes	No	Yes	L
SG8	Yes	Yes	No	Yes	No	H
SG9	No	No	Yes	No	Yes	L
SG10	Yes	Yes	Yes	Yes	No	L

Let R represent the equivalence relation on U with respect to the condition attributes C = {Adaptability in Uncertain Environments, Emotional Intelligence, Growth Mindset & Learning Orientation, Ethical Awareness, Resilience to Feedback, Failure & Criticism} = {UE, EI, GL, EA, RF}. The equivalence classes determined by R corresponding to C are given by U/R(C) = {{SG1, SG10}, {SG2}, {SG3}, {SG4, SG8}, {SG5}, {SG6}, {SG7, SG9}}.

For case 1, we have the following table,

The Upper Approximation, Lower Approximation Spaces and Boundary region are as follows,

UC(X1) = {SG1, SG10, SG3, SG4, SG8, SG5}, LC(X1) = {SG3, SG4, SG5, SG8}, BC(X1) = {SG1, SG10}.

Then the rough topology with respect R is given by τR(C) = {Φ, U, {SG1, SG10}}

Attributes Reduction in Case 1

We can reduce the conditional attributes one by one to identify the attributes which influence on decision attribute predominantly [12-15].

Emotional Intelligence:

C1 = {UE, GL, EA, RF}

U/R(C1) = {{SG1, SG10}, {SG2}, {SG3, SG7, SG9}, {SG4, SG8}, {SG5}, {SG6}}.

BR(C1) (X) = {SG1, SG3, SG7, SG9, SG10} and τR(C)(X) ≠ τR(C1) (X).

Therefore, VE is indispensable.

Growth Mindset & Learning Orientation:

C2 = {UE, EI, EA, RF}

U/R(C2) = {{SG1, SG10}, {SG2}, {SG3}, {SG4, SG8}, {SG5}, {SG6}, {SG7, SG9}}.

BR(C2) (X) = {SG1, SG10} and τR(C)(X) ≠ τR(C1) (X).

Therefore, ECD is dispensable.

Resilience to Feedback, Failure & Criticism:

C2 = {UE, GL, EA, EI}

U/R(C2) = {{SG1, SG4, SG8 SG10}, {SG2}, {SG3}, {SG5}, {SG6}, {SG7, SG9}}.

BR(C2) (X) = {SG1, SG4, SG8, SG10} and τR(C)(X) ≠ τR(C2) (X).

Therefore, NW is indispensable

Ethical Awareness:

C3 = {UE, GL, EI, RF}

U/R(C3) = {{SG1, SG10}, {SG2}, {SG3}, {SG4, SG8}, {SG5}, {SG6}, {SG7, SG9}}.

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BR(C3) (X) = {SG1, SG10} and τR(C)(X) = τR(C3) (X).
Therefore, IAT is dispensable.

Adaptability in Uncertain Environments:

C4 = {RF, GL, EA, EI}

U/R(C4) = {{SG1, SG10}, {SG2}, {SG3}, {SG4, SG8}, {SG5}, {SG6}, {SG7, SG9}}.
BR(C4) (X) = {SG1, SG10} and τR(C)(X) = τR(C1) (X).
Therefore, VE is dispensable.

CORE = {EI, GL, RF, UE} ∩ {EI, GL, RF, EA} = {EI, GL, RF}

CASE :2

Consider X2 to be the group of students who are not much interest toward the significance of Resilience Skills acquired. Here X2 = {SG2, SG6, SG7, SG9, SG10}. Let R represent the equivalence relation on U with respect to the condition attributes C = {Adaptability in Uncertain Environments, Emotional Intelligence, Growth Mindset & Learning Orientation, Ethical Awareness, Resilience to Feedback, Failure & Criticism} = {UE, EI, GL, EA, RF}. The equivalence classes determined by R corresponding to C are given by U/R(C) = {{SG1, SG10}, {SG2}, {SG3}, {SG4, SG8}, {SG5}, {SG6}, {SG7, SG9}}.

For case 2,

UC(X2) = {SG1, SG2, SG6, SG7, SG9, SG10},
LC(X2) = {SG2, SG6, SG7, SG9},
BC(X2) = {SG1, SG10}.
Then the rough topology with respect R is given by τR(C) = {Φ, U, {SG1, SG10}}
Attributes Reduction in Case 2:

Emotional Intelligence:

C1 = {UE, GL, EA, RF}

U/R(C1) = {{SG1, SG10}, {SG2}, {SG3, SG7, SG9}, {SG4, SG8}, {SG5}, {SG6}}.
BR(C1) (X) = {SG1, SG3, SG7, SG9, SG10} and τR(C)(X) ≠ τR(C1) (X).
Therefore, EI is indispensable.

Growth Mindset & Learning Orientation:

C2 = {UE, EI, EA, RF}

U/R(C2) = {{SG1, SG10}, {SG2}, {SG3}, {SG4, SG8}, {SG5}, {SG6}, {SG7, SG9}}.
BR(C2) (X) = {SG1, SG10} and τR(C) (X) = τR(C1) (X).
Therefore, GL is dispensable.

Resilience to Feedback, Failure & Criticism:

C2 = {UE, GL, EA, EI}

U/R(C2) = {{SG1, SG4, SG8 SG10}, {SG2}, {SG3}, {SG5}, {SG6}, {SG7, SG9}}.
BR(C2) (X) = {SG1, SG4, SG8, SG10} and τR(C)(X) ≠ τR(C2)(X).
Therefore, RF is indispensable.

Ethical Awareness:

C3 = {UE, GL, EI, RF}

U/R(C3) U/C = {{SG1, SG10}, {SG2}, {SG3}, {SG4, SG8}, {SG5}, {SG6}, {SG7, SG9}}.

Conclusion

Based on both cases, it has been discovered that the Emotional Intelligence, Growth Mindset & Learning Orientation & Resilience to Feedback, Failure & Criticism are the factors involving in Equipping Gen Z with Resilience Skills for Leadership in Dynamic Environments.

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