

Assessing The Impact Factors of Mental Well-Being of Students Relying on Digital Density and Usage Through Nano Topology.**Dr.R. Maheswari¹, Ms.S. Sarumathi²**

¹ Assistant Professor, Department of Mathematics, Shrimati Indira Gandhi College, Affiliated to Bharathidasan University, Trichy-620 002, Tamil Nadu.

² PG Scholar, Department of Mathematics, Shrimati Indira Gandhi College, Affiliated to Bharathidasan University, Trichy-620 002, Tamil Nadu.

Abstract:

This study investigates the complex relationship between digital device use and student mental health. We apply nano-topology as a novel framework to map and analyse the effects of factors like screen time, social media usage, gaming hours, sleep disturbance, physical activity, offline hobbies and family interaction. The model identifies hidden patterns and risk clusters within the data, revealing previously unrecognized connections. This innovative approach provides a deeper understanding of how digital habits impact mental well-being. Our findings offer a new, data-driven perspective for developing targeted interventions. The nano-topological model visualizes these intricate relationships, making them more accessible for analysis. Ultimately, this research aims to improve student's digital habits.

Keywords: Upper Approximation, Lower Approximation, Boundary Region, Nano Topological space, Mental well being.

1.Introduction:

Lellis Thivagar and Carmel Richard proposed new a new topology known as Nano topology [1]. Multiple authors have examined the applications of Nano topology in various fields [2-9]. This study proposes the application of Nano Topology as a powerful mathematical framework to assess the impact factors of digital density and usage on student mental well-being. By moving beyond traditional statistical methods, which may oversimplify these complex interactions, Nano Topology offers a unique lens to model the "closeness" and "neighbourhoods" of different digital behaviours and their corresponding mental health outcomes. This introduction will lay the groundwork for a multidisciplinary investigation, bridging computer science, psychology, and pure mathematics, to provide a more nuanced

understanding of how our increasingly digital world is shaping the minds of the next generation.

2. Preliminaries:

Definition: 2.1[1]

The lower approximation of X with respect to $\mathfrak{R}$ is the set of all objects which can for certain classified as X with respect to $\mathfrak{R}$ and it is denoted by $LR_{\mathfrak{R}}(X)$.

$$(i.e.) LR_{\mathfrak{R}}(X) = \bigcup_{x \in U} \{\mathfrak{R}(X) : \mathfrak{R}(X) \subseteq X\}$$

The upper approximation of X with respect to $\mathfrak{R}$ is the set of all objects which can be possibly classified as x with respect to $\mathfrak{R}$ and it is denoted by $UR_{\mathfrak{R}}(X)$.

$$(i.e.) UR_{\mathfrak{R}}(X) = \bigcup_{x \in U} \{\mathfrak{R}(X) : \mathfrak{R}(X) \cap X \neq \emptyset\}$$

The boundary region of X with respect to $\mathfrak{R}$ is the set of all objects which can classified neither as x nor as not x with respect to $\mathfrak{R}$ and it is denoted by $BR_{\mathfrak{R}}(X)$.

$$(i.e.) BR_{\mathfrak{R}}(X) = UR_{\mathfrak{R}}(X) - LR_{\mathfrak{R}}(X)$$

Definition: 2.2[1]

Let U be a non-empty, finite universe of objects and $\mathfrak{R}$ be an equivalence relation U . Let $X \subseteq U$ and $\tau_{\mathfrak{R}}(X) = \{U, \emptyset, LR_{\mathfrak{R}}(X), UR_{\mathfrak{R}}(X), BR_{\mathfrak{R}}(X)\}$. Then $\tau_{\mathfrak{R}}(X)$ is a topology on U , called as the Nano topology on U with respect to X .

Elements of the Nano topology are known as the Nano open sets in U and $(U, \tau_{\mathfrak{R}}(X))$ are called the Nano topological spaces. Let U be a finite set and $X \subseteq U$ then the basis of Nano topology $\tau(X)$ is given by, $\beta_{\mathfrak{R}}(X) = \{U, LR_{\mathfrak{R}}(X), BR_{\mathfrak{R}}(X)\}$.

3. Applications of Nano topology

Proposed Methodology

Step:1 For a limited universe U , a limited set of attributes K which is partitioned in to two class S and I and an equivalence relation $\mathfrak{R}$ on U corresponding to S .

Step: 2 Find the lower boundary, upper boundary and boundary region with respect to $\mathfrak{R}$.

Step: 3 Generate the Nano topology $\tau_{\mathfrak{R}}(X)$ and its basis $\beta_{\mathfrak{R}}(X)$.

Step: 4 Eliminate an attribute C_1 from S and determine lower approximate, upper approximate and boundary region for $S-C_1$

Step: 5 Generate the Nano topology $\tau_{\mathfrak{R}-C_1}$ and its basis $\beta_{\mathfrak{R}-C_1}$

Step: 6 Repeat steps 4 and 5 for each attribute.

Step:7 If $\tau_{\mathfrak{R}-C_1}(X) \neq \tau_{\mathfrak{R}}(X)$ then C_1 will be an impact factors otherwise it does not belong to the core.

Step:8 Repeat process for $S - C_i$, $i=2$ to 7.

Step: 9 The attributes in core are the risk factors.

Table 1: INFORMATION TABLE

User	Screen time	Social media usage	Gaming hours	Sleep disturbance	Physical activities	Offline hobbies	Family interaction	Mental health
u_1	H	H	H	L	L	H	L	Healthy
u_2	H	L	L	H	L	H	H	Healthy
u_3	H	H	H	L	L	H	L	Unhealthy
u_4	H	L	L	L	H	H	L	Healthy
u_5	H	L	L	L	H	L	L	Unhealthy
u_6	H	L	H	H	H	H	H	Healthy
u_7	H	H	H	L	L	H	L	Unhealthy
u_8	H	L	L	L	H	H	L	Unhealthy
u_9	H	L	L	L	H	L	L	Unhealthy
u_{10}	H	L	H	H	H	H	H	Healthy
u_{11}	L	H	H	L	H	L	L	Unhealthy
u_{12}	L	H	H	L	L	H	L	Unhealthy
u_{13}	H	L	L	L	H	L	L	Unhealthy
u_{14}	L	H	H	L	H	L	L	Unhealthy
u_{15}	H	L	L	H	L	H	H	Healthy
u_{16}	H	L	L	L	H	H	L	Unhealthy
u_{17}	H	L	H	H	H	H	H	Healthy

u_{18}	H	H	H	L	L	H	L	Unhealthy
u_{19}	H	H	H	L	L	H	L	Unhealthy
u_{20}	L	H	H	L	H	L	L	Unhealthy

Let $U = \{U_1, U_2, U_3, U_4, U_5, U_6, U_7, U_8, U_9, U_{10}, U_{11}, U_{12}, U_{13}, U_{14}, U_{15}, U_{16}, U_{17}, U_{18}, U_{19}, U_{20}\}$ be the set of 20 students and $S = \{\text{screen time } (C_1), \text{Social media usage } (C_2), \text{Gaming hours } (C_3), \text{Sleep disturbance } (C_4), \text{Physical activities } (C_5), \text{Offline hobbies } (C_6) \text{ and Family interaction } (C_7)\}$ denote the symptom of stress.

Take S as $\{C_1, C_2, C_3, C_4, C_5, C_6, C_7\}$

Then,

$$U/\mathfrak{R}(X) = \{\{U_1, U_3, U_7, U_{18}, U_{19}\}, \{U_2, U_{15}\}, \{U_4, U_8, U_{16}\}, \{U_5, U_9, U_{13}\}, \{U_6, U_{10}, U_{17}, U_{19}\}, \\ \{U_{11}, U_{14}, U_{20}\}, \{U_{12}\}\}$$

Let the group of students who are mentally well as $X = \{U_1, U_2, U_4, U_{15}, U_6, U_{10}, U_{17}\}$

Then,

$$LR_{\mathfrak{R}}(X) = \{U_2, U_{15}, U_6, U_{10}, U_{17}\}$$

$$UR_{\mathfrak{R}}(X) = \{U_1, U_3, U_7, U_{18}, U_{19}, U_2, U_{15}, U_6, U_{10}, U_{17}, U_4, U_8, U_{16}\}$$

$$BR_{\mathfrak{R}}(X) = \{U_1, U_3, U_7, U_{18}, U_{19}, U_4, U_8, U_{16}\}$$

$$\tau_R(X) = \{\{U, \emptyset, \{U_2, U_{15}, U_6, U_{10}, U_{17}\}, \{U_1, U_3, U_7, U_{18}, U_{19}, U_2, U_{15}, U_6, U_{10}, U_{17}, U_4, U_8, U_{16}\}, \\ \{U_1, U_3, U_7, U_{18}, U_{19}, U_4, U_8, U_{16}\}\}$$

Let the group of students who suffer from mental illness as $Y = \{U_3, U_7, U_5, U_9, U_{13}\}$

$$\text{then, } LR_{\mathfrak{R}}(Y) = \{U_5, U_9, U_{13}, U_{11}, U_{14}, U_{20}, U_{12}\}$$

$$UR_{\mathfrak{R}}(Y) = \{U_1, U_3, U_7, U_{18}, U_{19}, U_4, U_8, U_{16}, U_5, U_9, U_{13}, U_{14}, U_{11}, U_{20}, U_{12}\}$$

$$BR_{\mathfrak{R}}(Y) = \{U_1, U_3, U_7, U_{18}, U_{19}, U_4, U_8, U_{16}\}$$

$$\tau_R(Y) = \{U, \emptyset, \{U_5, U_9, U_{13}, U_{11}, U_{14}, U_{20}, U_{12}\}, \\ \{U_1, U_3, U_7, U_{18}, U_{19}, U_4, U_8, U_{16}, U_5, U_9, U_{13}, U_{14}, U_{11}, U_{20}, U_{12}\}\}$$

STEP I:

When the attribute “screen time (C_1)” is removed from S

$$\tau_{R-C_1}(X) = \{U, \emptyset, \{U_2, U_{15}, U_6, U_{10}, U_{17}\}, \{U_1, U_3, U_7, U_{18}, U_{19}, U_2, U_{15}, U_6, U_{10}, U_{17}, U_4, U_8, U_{16}, U_{12}\}\}$$

Here, $\tau_{R-C_1}(X) \neq \tau_R(X)$

$$\tau_{R-C_1}(Y) = \{U, \emptyset, \{U_1, U_3, U_7, U_{18}, U_{19}, U_4, U_8, U_{16}, U_5, U_9, U_{13}, U_{11}, U_{14}, U_{20}, U_{12}\}, \{U_5, U_9, U_{11}, U_{13}, U_{14}, U_{20}\}, \{U_1, U_3, U_7, U_{18}, U_{19}, U_4, U_8, U_{16}, U_{12}\}\}$$

Also, $\tau_{R-C_1}(Y) \neq \tau_R(Y)$

STEP II:

When the attribute “Social media usage (C_2)” is removed from S

$$\tau_{R-C_2}(X) = \tau_R(X)$$

$$\tau_{R-C_2}(Y) = \tau_R(Y)$$

STEP III:

When the attribute “Gaming hours (C_3)” is removed from S

$$\tau_{R-C_3}(X) = \tau_R(X)$$

$$\tau_{R-C_3}(Y) = \tau_R(Y)$$

STEP IV:

When the attribute “Sleep disturbance (C_4)” is removed from S

$$\tau_{R-C_4}(X) = \tau_R(X)$$

$$\tau_{R-C_4}(Y) = \tau_R(Y)$$

STEP V:

When the attribute “Physical activities (C_5)” is removed from S

$$\tau_{R-C_5}(X) = \tau_R(X)$$



$$\tau_{R-C5}(Y) = \tau_R(Y)$$

STEP VI:

When the attribute “Offline hobbies (C_6)” is removed from S

$$\tau_{R-C6}(X) \neq \tau_R(X)$$

$$\tau_{R-C6}(Y) \neq \tau_R(Y)$$

STEP VII:

When the attribute “Family interaction (C_7)” is removed from S

$$\tau_{R-C7}(X) = \tau_R(X)$$

$$\tau_{R-C7}(Y) = \tau_R(Y)$$

Therefore,

$$\text{CORE}(K) = \{\text{screen time, offline hobbies}\}$$

4. Conclusion:

We conclude that, “screen time, offline hobbies”, are the most impact factors for “**Mental Well-Being of Students Relying on Digital Density**” Also, The Concepts of Nano topology can be applied in various fields namely, medical field, Academic related field, Marketing fields, Business sectors and so on.

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