Original Research Article

Evaluating digital well-being among generation Z college students: Index construction and method design

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Abstract: For Generation Z college students—Digital natives—Their digital well-being is a critical contemporary issue. This study conceptualizes digital well-being for this cohort and proposes a five-dimension evaluation framework encompassing usage experience, autonomy and control, growth efficacy, social relationships, and security perception. This framework comprises 20 secondary indicators and 61 observation points. An evaluation approach, integrating the entropy weight method with fuzzy comprehensive evaluation, is then designed and applied to a sample of ten students. This research provides a theoretical foundation and an objective assessment tool to support future quantitative investigations in this domain.

Keywords: generation Z college students; digital well-being; evaluation index system; entropy weight method; fuzzy comprehensive evaluation

1. Introduction

Generation Z (born 1995–2009) are digital natives, immersed in technology-saturated environments. The impact of digital technology on this group is dual-faceted: while facilitating information access, enriching experiences, and broadening social connections, its excessive use can precipitate digital addiction, information overload, and social anxiety (Huang & Yu, 2024)[1].

"Digital well-being" provides a lens to understand Generation Z's relationship with technology. Existing conceptualizations of digital well-being generally adopt one of three perspectives: satisfaction, mental health, or balance (Wang & Liu, 2025)[2]. Drawing on foundational theories like self-determination theory, scholars have developed various measurement instruments (Arslankara et al., 2022; Kara, 2023; Prakash, 2023; Mathew et al., 2023; Rosič et al., 2024; Deng et al., 2025)[3-8]. However, two key research gaps persist. First, the conceptual boundaries of digital well-being remain ambiguous, with existing tools focusing on specific platforms or online interactions, thereby lacking an integrated framework tailored to Generation Z college students. Second, methodologically, most studies employ correlational analyses, with a notable scarcity of research adopting systematic, multi-indicator comprehensive evaluations.

To address these gaps, this study pursues two objectives: (1) constructing a multidimensional evaluation index system for digital well-being, and (2) designing a corresponding evaluation method by combining entropy weighting with fuzzy comprehensive evaluation, thus providing a robust methodological pathway for quantitative research.

2. Constructing the evaluation index system

2.1. Dimensional construction

Generation Z college students are quintessential digital natives, for whom technology is deeply embedded in daily life. They occupy a transitional life phase where identity formation and social expansion are inextricably intertwined with the digital environment. Furthermore, higher education settings themselves are highly digitized, making students' digital experiences a blend of individual choice and institutional constraints.

Synthesizing existing research with these characteristics, we define digital well-being for this population as a dynamic psychological state wherein students, through technology use, achieve self-growth and a healthy coexistence with technology, characterized by positive emotions, autonomous control, meaningful developmental efficacy, healthy social relationships, and adequate security perception.

Drawing on Triadic Reciprocal Determinism (Deng et al., 2025)[8], Self-Determination Theory (Ma et al., 2025)[9], and the Dynamic System Model of Digital Well-being (Vanden Abeele, 2021)[10], we propose a five-

dimensional structure, as shown in **Table 1**.

Table 1. Five-dimensional structure of digital well-being.

Dimension	Core Connotation	Theoretical Basis	Source Literature
Digital Usage Experience	Positive emotions and satisfactory experiences during digital use	Triadic Reciprocal Determinism	Kara (2023)[4]; Deng et al. (2025)[8]
Digital Autonomy and Control	Autonomy and sense of control in digital usage	Self-Determination Theory (Need for Autonomy)	Prakash (2023)[5]; Zhang (2026)[11]
Digital Growth Efficacy	Role of digital technology in fostering self-development	Self-Determination Theory (Need for Competence)	Mathew et al. (2023)[6]; Deng et al. (2025)[8]
Digital Social Relationships	Relationship quality and sense of belonging in digital social interactions	Self-Determination Theory (Need for Relatedness)	Rosič et al. (2024)[7]; Li & You (2025)[12]
Digital Security Perception	Sense of security and trust in the digital environment	Dynamic System Model	Huang & Yu (2024)[1]; Arslankara et al. (2022)[3]

2.2.Evaluation index system framework

Building on this structure, we develop an evaluation index system comprising 5 primary indicators, 20 secondary indicators, and 61 observation points, as shown in **Table 2**.

Table 2. Evaluation index system for digital well-being.

Primary Indicator	Secondary Indicator	Observation Point	Attribute
A. Digital Usage Experience	A1 Perceived Usefulness	A1-1 Digital technology supports my learning	Positive
		A1-2 Digital technology makes my life more convenient	Positive
		A1-3 Digital technology helps me expand my social network	Positive
	A2 Perceived Ease of Use	A2-1 The digital devices I use are easy to operate	Positive
		A2-2 Commonly used digital software is user-friendly	Positive
		A2-3 I can quickly master new digital features	Positive
	A3 Positive Emotions	A3-1 I feel pleasure when using digital devices	Positive
		A3-2 I experience enjoyment in digital activities	Positive
		A3-3 I feel relaxed when using digital technology	Positive
		A3-4 I can immerse myself in digital content I enjoy	Positive
	A4 Negative Emotion management	A4-1 I can avoid feeling anxious due to information overload	Positive
		A4-2 I do not feel troubled by missing online information	Positive
		A4-3 I do not feel empty after using digital devices	Positive
B. Digital Autonomy and Control	B1 Technology Mastery	B1-1 I can proactively select digital tools that suit my needs	Positive
		B1-2 I can adjust digital technology settings as needed	Positive
		B1-3 I can identify and resist excessive technological inducements	Positive
	B2 Self-Control	B2-1 I can control how long I use digital devices each time	Positive
		B2-2 I can resist unnecessary urges to use digital devices	Positive
		B2-3 I complete important tasks before using digital devices	Positive
	B3 Disconnection Freedom	B3-1 I can actively schedule time away from digital devices	Positive
		B3-2 I do not feel anxious during periods of disconnection	Positive
		B3-3 I can enjoy real life when disconnected	Positive
	B4 Choice Freedom	B4-1 I can independently choose the digital content I view	Positive
		B4-2 I am not led by algorithmic recommendations	Positive
		B4-3 I can break free from algorithmically constructed "information cocoons"	Positive
C. Digital Growth Efficacy	C1 Knowledge Acquisition	C1-1 I can acquire professional knowledge through digital platforms	Positive
		C1-2 Digital resources help me understand interdisciplinary knowledge	Positive
		C1-3 I can track cutting-edge developments through digital tools	Positive
	C2 Skill Enhancement	C2-1 Digital practice has improved my operational skills	Positive
		C2-2 Digital creation allows me to exercise my innovative abilities	Positive
		C2-3 Digital collaboration has strengthened my cooperation skills	Positive
	C3 Self-Awareness	C3-1 Digital activities help me better understand my interests	Positive
		C3-2 Digital expression clarifies my own views	Positive
		C3-3 Digital interactions make my values clearer to me	Positive
	C4 Value Realization	C4-1 My digital creations give me a sense of achievement	Positive
		C4-2 My digital contributions make me feel valued	Positive
		C4-3 My digital works receive recognition from others	Positive

Continuation Table 2

Primary Indicator	Secondary Indicator	Observation Point	Attribute
D. Digital Social Relationships	D1 Emotional Connection	D1-1 I receive emotional support through digital social interactions	Positive
		D1-2 I can obtain help through digital channels when facing difficulties	Positive
		D1-3 Digital interactions strengthen my relationships with family and friends	Positive
	D2 Social Identity	D2-1 I find a sense of belonging in digital communities	Positive
		D2-2 My digital identity is recognized by the group	Positive
		D2-3 I gain social recognition through digital participation	Positive
	D3 Relationship Quality	D3-1 Digital social interactions enhance my real-life relationships	Positive
		D3-2 Digital interactions help me understand others better	Positive
		D3-3 Digital communication reduces interpersonal misunderstandings	Positive
	D4 Social Balance	D4-1 I maintain balance between online and offline social time	Positive
		D4-2 Digital social interactions have not weakened my face-to-face communication skills	Positive
		D4-3 My social circles have not become insular barriers	Positive
E. Digital Security Perception	E1 Information Security	E1-1 My personal privacy is protected in the digital environment	Positive
		E1-2 My personal information is not misused	Positive
		E1-3 I possess basic information security protection capabilities	Positive
	E2 Psychological Safety	E2-1 I have not encountered cyberbullying or online violence	Positive
		E2-2 I can cope with psychological stress arising from online conflicts	Positive
		E2-3 The online environment does not negatively affect my mental health	Positive
	E3 Consumer Safety	E3-1 I can identify pitfalls in online consumption	Positive
		E3-2 I can avoid impulsive and irrational consumption	Positive
		E3-3 Digital consumption has not created financial burden for me	Positive
	E4 Content Safety	E4-1 I can discern false and harmful information	Positive
		E4-2 I can resist the influence of questionable values	Positive
		E4-3 Digital content has not caused me value confusion	Positive

3. Designing the evaluation method

Evaluating digital well-being involves multiple indicators and inherent fuzziness. To overcome the subjectivity of methods like the Analytic Hierarchy Process (AHP), we employ the entropy weight method for objective weighting and fuzzy comprehensive evaluation for the overall assessment.

The entropy weight method assigns weights based on the degree of variation in each indicator's data. A lower information entropy signifies more information and, consequently, a larger weight. This approach derives weights purely objectively from the data; fuzzy comprehensive evaluation, grounded in membership degree theory, then transforms qualitative assessments into quantitative ones, effectively managing the inherent fuzziness of such evaluations. The combination of these two methods thus achieves complementary advantages.

3.1. Determining indicator weights using entropy weight method

(1) Data Standardization.

For positive indicators:

$$k_{ij}=\frac{x_{ij}-\min(x_j)}{\max(x_j)-\min(x_j)} \tag{1}$$

(2) Calculating Information Entropy.

Calculate the proportion of the i-th student's value on the j-th indicator:

$$p_{ij}=\frac{k_{ij}}{\sum_{i=1}^{m} k_{ij}} \tag{2}$$

Calculate the information entropy of the j-th indicator:

$$e_j=-\frac{1}{\ln m}\sum_{i=1}^{m} p_{ij}\ln\left(p_{ij}\right) \tag{3}$$

(3) Calculating Indicator Weights.

The coefficient of variation is $g_j=1-e_j$. The weight of the j-th indicator is:

$$w_j=\frac{g_j}{\sum_{j=1}^{n} g_j} \tag{4}$$

For multi-level indicator systems, bottom-level indicator weights can be calculated first, and then top-level indicator weights can be obtained through weighted summation.

3.2. Calculating comprehensive scores using fuzzy comprehensive evaluation

(1) Determining the Evaluation Factor Set and Comment Set.

The factor set U comprises all indicators. The comment set V has five levels: V={Very Low, Low, Moderate, High, Very High}, assigned values V={1,2,3,4,5}.

(2) Determining Membership Functions.

We use trapezoidal distributions for membership functions (**Table 3**).

Table 3. Five-level trapezoidal distribution membership functions.

Level 1 (Very Low)	Level 2 (Low)	Level 3 (Moderate)	Level 4 (High)	Level 5 (Very High)
$\mu_1(x)=\begin{cases}1, x\le 1\\ 2-x, 1<x<2\\ 0, x\ge 2\end{cases}$	$\mu_2(x)=\begin{cases}0, x\le 1\\ x-1, 1<x<2\\ 3-x, 2<x<3\\ 0, x\ge 3\end{cases}$	$\mu_3(x)=\begin{cases}0, x\le 2\\ x-2, 2<x<3\\ 4-x, 3<x<4\\ 0, x\ge 4\end{cases}$	$\mu_4(x)=\begin{cases}0, x\le 3\\ x-3, 3<x<4\\ 5-x, 4<x<5\\ 0, x\ge 5\end{cases}$	$\mu_5(x)=\begin{cases}0, x\le 4\\ x-4, 4<x<5\\ 1, x\ge 5\end{cases}$

(3) Multi-level Fuzzy Comprehensive Evaluation.

First-level evaluation: For secondary indicator with weight vectorand the membership matrix (composed of membership degree vectors for each observation point), the result vector is:

$$B_i=W_i \circ R_i=\{b_{i1},b_{i2},b_{i3},b_{i4},b_{i5}\} \tag{5}$$

Here, " ∘ " is the fuzzy composition operator. We employ the weighted average operator M(·,⊕) to account for each indicator's contribution and fully utilize the information.

Second-level evaluation: For the overall objective with weight vector and membership matrix , the result vector is:

$$B=W\circ R=\{b_1,b_2,b_3,b_4,b_5\} \tag{6}$$

(4) Calculating Comprehensive Scores.

The comprehensive score is calculated by combining the result vector with the comment set values:

$$F=B\times V=\sum_{k=1}^{5} b_k\times k \tag{7}$$

F ranges from 1 to 5, with higher scores indicating higher well-being. Levels: Very Low (1.0-1.8), Low (1.8-2.6), Moderate (2.6-3.4), High (3.4-4.2), Very High (4.2-5.0).

4. Case analysis

4.1. Data calculation

To validate the proposed model, data were collected from ten Generation Z college students. Each of the 45 observation points was rated on a 5-point Likert scale (1 = Completely Disagree, 5 = Completely Agree). Due to space limitations, **Table 4** presents raw data for selected key indicators only.

Table 4. Raw data of selected observation points for ten students.

Student	A1-1	A1-2	A1-3	B1-1	B1-2	B1-3	C1-1	C1-2	C1-3	D1-1	D1-2	D1-3	E1-1	E1-2	E1-3
S01	5	4	4	4	3	3	5	4	4	4	4	5	3	3	4
S02	4	5	3	3	4	3	4	4	3	5	4	4	4	3	3
S03	3	4	5	2	3	4	3	5	4	3	5	3	2	4	3
S04	5	3	4	5	4	4	4	3	5	4	3	4	5	4	4
S05	2	3	2	3	2	2	2	3	2	3	2	2	3	2	2
S06	4	4	5	4	5	4	5	4	4	5	4	5	4	5	4
S07	3	2	3	2	3	3	3	2	3	2	3	3	2	3	3
S08	5	5	4	5	4	5	4	5	5	4	5	4	5	4	5
S09	4	3	3	3	3	4	3	3	4	3	3	4	3	3	3
S10	3	4	4	4	3	3	4	4	3	4	4	3	4	4	4

Following data standardization and the application of formulas (2) to (7), the calculated indicator weights are shown in Figure 1, and the comprehensive evaluation results for the ten students are presented in **Table 5**.

Figure 1. Weights of indicators at each level.

Table 5. Comprehensive results of digital well-being for ten students.

Student	Overall Objective Evaluation Result Vector	Comprehensive Score	Level	Ranking
S01	(0.0000, 0.0358, 0.2509, 0.3912, 0.3221)	4.00	High	3
S02	(0.0000, 0.0429, 0.2748, 0.3981, 0.2842)	3.92	High	5
S03	(0.0392, 0.1751, 0.3952, 0.2731, 0.1174)	3.26	Moderate	8
S04	(0.0000, 0.0321, 0.2641, 0.3982, 0.3056)	3.98	High	4
S05	(0.1052, 0.2481, 0.3971, 0.1712, 0.0784)	2.87	Moderate	10
S06	(0.0000, 0.0192, 0.2231, 0.3921, 0.3656)	4.11	High	2
S07	(0.0581, 0.2021, 0.4012, 0.2191, 0.1195)	3.14	Moderate	9
S08	(0.0000, 0.0061, 0.1862, 0.4001, 0.4076)	4.21	Very High	1
S09	(0.0000, 0.0872, 0.3911, 0.3571, 0.1646)	3.60	High	7
S10	(0.0000, 0.0581, 0.3132, 0.3911, 0.2376)	3.81	High	6

4.2. Results analysis

Overall Distribution Analysis: The comprehensive scores ranged from 2.87 to 4.21 (M = 3.69), placing the sample, on average, at the High level. Specifically, one student (10%) was classified as Very High, six (60%) as High, and three (30%) as Moderate. This olive-shaped distribution—Larger in the middle and tapered at the ends—Is commonly observed in psychological measurements. Notably, the 30% of students at the Moderate level represent a critical group for potential interventions, with student S05 (score 2.87) being of particular concern.

Typical Individual Differences Analysis: S08 (4.21), the sole student in the Very High category, demonstrated consistently high scores, predominantly between 4 and 5. Their performance in Dimension B (Digital Autonomy and Control) was exceptional, achieving a combined membership degree for Levels 4 and 5 of 0.84. This finding aligns with Zhang's (2026)[11] proposition that the essence of digital well-being is autonomous mastery over one's digital life. In contrast, S05 (2.87), the lowest scorer, predominantly recorded scores of 2 or 3. Their weaknesses were most pronounced in Dimension B, where the combined membership for low levels (1 and 2) was 0.39, compared to only 0.21 for high levels (4 and 5). This pattern corroborates Ma et al.'s (2025)[9] assertion that self-control is foundational to digital well-being.

Weight and Dimension Analysis: The primary indicator weights were ranked as follows: Digital Autonomy and Control (B, 0.2509) > Digital Usage Experience (A, 0.2248) > Digital Growth Efficacy (C, 0.2106) > Digital Social Relationships (D, 0.1985) > Digital Security Perception (E, 0.1152). The five most influential secondary indicators were Positive Emotions (A3), Technology Mastery (B1), Emotional Connection (D1), Self-Control (B2), and Skill Enhancement (C2). High-scoring students (S08, S06) excelled particularly in high-weight dimensions like Digital Autonomy and Control (B). Conversely, the deficits observed in low-scoring students (S05) were concentrated in these high-weight dimensions. Students in the middle range (S04, S02, S10, S09) demonstrated relatively balanced performance but exhibited localized weaknesses.

5. Conclusion

This study investigated digital well-being among Generation Z college students, yielding two main

outcomes. First, it established a five-dimension evaluation index system (Usage Experience, Autonomy/Control, Growth Efficacy, Social Relationships, Security Perception) with 20 secondary indicators and 61 observation points. Second, it developed an evaluation method combining entropy weighting for objective weighting with fuzzy comprehensive evaluation. By providing a robust theoretical framework and a practical assessment tool, this research lays a foundation for future studies and offers insights for interventions fostering student well-being in the digital age.

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