NSS
Neutrosophic Sets and Systems, Vol. 79, 2025
University of New Mexico

The PAMSSEM Approach for Multi-Attribute Group Decision-Making Using Single-Valued Neutrosophic Sets: Applications to Evaluating the Effectiveness of College Students' Psychological Education

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Abstract: The evaluation of the effectiveness of college students' psychological education involves using scientific approaches and tools to assess the actual impact of psychological education on improving students' mental health, fostering personality development, and enhancing psychological adjustment abilities. The evaluation covers aspects such as students' mental health status, the achievement of educational goals, the effectiveness of interventions, and student satisfaction. Through such evaluations, psychological education programs can be optimized to improve quality, help students better cope with psychological challenges in academics, life, and relationships, and promote their holistic development and healthy growth. The results also provide a scientific basis for continuous improvement of psychological education. The effectiveness evaluation of college students' psychological education is MADM. In this paper, the single-valued neutrosophic sets (SVNSs) and the average are employed to determine the attribute weights within decision-making processes. To address multi-attribute group decision-making (MADM) problems under SVNSs, the single-valued neutrosophic numbers PAMSSEM (SVNN-PAMSSEM) approach is proposed and systematically structured. This approach integrates the advantages of SVNSs, which effectively handle uncertainty, imprecision, and inconsistency in decision-making scenarios, with the PAMSSEM approach, known for its robustness in evaluating alternatives based on multiple attributes. To demonstrate the practicality and effectiveness of the proposed SVNN- PAMSSEM approach, a case study on the effectiveness evaluation of college students' psychological education is presented. This example illustrates how the approach can be applied to assess the outcomes of psychological education programs, highlighting its applicability in real-world scenarios. Additionally, comparative decision analyses with other existing approaches are conducted to validate the SVNN- PAMSSEM approach further. The results confirm its superior performance in handling complex decision-making problems involving linguistic and fuzzy information, proving its value as a robust tool for MADM under SVNSs.

Keywords: MADM; single-valued neutrosophic sets (SVNSs); PAMSSEM approach; effectiveness evaluation; college students' psychological education.

1. Introduction

The evaluation of the effectiveness of psychological education for college students is aimed at scientifically assessing the impact of psychological education on students' mental health and overall quality development. As social pressures increase and mental health issues among college students become more

prominent, psychological education plays a critical role as an intervention and support measure. Effectiveness evaluation helps educators understand the outcomes of psychological education, identify its strengths and weaknesses, and provide a scientific basis for subsequent improvements. This evaluation process not only focuses on the role of psychological education in addressing mental health problems but also examines its impact on students' emotional regulation, stress-coping skills, and personality development. Through systematic and comprehensive analysis, the evaluation reveals the actual effects of psychological education among college students, helping to optimize educational content and methods while enhancing its relevance and effectiveness. Furthermore, effectiveness evaluation is a vital part of ensuring educational quality, offering directions for continuous improvement in psychological education. In addition, evaluating the effectiveness of psychological education for college students carries significant social value. As college students are the future backbone of society, their mental health directly influences social stability and development. Scientific evaluation not only supports students' healthy growth during their academic years but also lays a solid foundation for their psychological adaptation after entering society. A well-conducted evaluation enables psychological education to better meet students' needs and promotes their comprehensive development. In summary, the evaluation of psychological education effectiveness is a process that integrates systematic, scientific, and practical approaches. It is not merely a summary of educational efforts but also a crucial tool for driving the continuous advancement of psychological education. Effective evaluation can greatly improve the quality of psychological education, safeguard the mental health of college students, and contribute to societal harmony and progress. Research on the psychological education of college students has deepened over the past two decades, expanding its focus and improving the educational framework. The following is a chronological summary of the research content in nine papers. The earliest study by Yuan [1] analyzed the characteristics of psychological education and the factors affecting its effectiveness. He emphasized that psychological education differs significantly from other forms of education and highlighted the importance of addressing specific issues based on its unique characteristics to improve its outcomes. This research underlined the theoretical understanding of psychological education. Later, Jing et al. [2, 3] conducted a two-year longitudinal study on the mental health education of Henan Polytechnic University's 2008 cohort. They found that students who received psychological education showed significant improvements in their mental health, with psychological lectures being particularly effective. The study also emphasized that psychological education is critical for

fostering student growth and cultivating innovative talents. Zhan and Lian [4] focused on students in agricultural disciplines at Fujian Agriculture and Forestry University. Through experimental comparisons using the SCL-90 scale, they found significant differences in students' mental health levels before and after receiving education. They proposed building a systematic education framework and implementing need-oriented education strategies. He et al. [5] investigated the effects of crisis education on college students. Their study revealed that crisis education significantly improved students' knowledge of psychological crises, enabling them to adopt effective coping strategies and seek help proactively, thus supporting crisis prevention. Yang and Ouyang [6] tracked college students with abnormal psychological survey results from 2016 to 2018. They found that psychological education effectively improved students' mental health and reduced SCL-90 scores. The study highlighted the importance of addressing specific psychological issues among college students to support their development. Xie and Yao [7] examined the impact of mental health on the effectiveness of online education among agricultural students. They found that mental health significantly influenced students' performance in online learning, particularly in interpersonal relationships and emotional aspects. Qiu et al. [8] explored the application of diary-based psychological education for students with bipolar disorder. Their results showed that the intervention significantly improved mental states, increased positive emotions, reduced negative emotions, optimized stress coping strategies, and enhanced satisfaction with psychological interventions. Pei [9] analyzed the current state of psychological education in art colleges and proposed innovative methods that integrate professional characteristics. She emphasized a student-centered approach to fully realize the educational potential of psychological education and contribute to the cultivation of artistic talents. In conclusion, research on college students' psychological education has shifted from theoretical explorations and general studies to more specific intervention methods and educational practices in recent years. These studies provide valuable theoretical foundations and practical references for improving the effectiveness of psychological education.

The effectiveness evaluation of college students' psychological education is a MADM problem under an SVNN environment. However, there are three main shortcomings in addressing such MADM problems, which form the motivations for this study:

- Complexity of Existing Decision Approaches: Current decision-making approaches often involve complex computational processes [10-21]. Simplifying these approaches while maintaining their

effectiveness is a critical and emerging research focus. Therefore, the first motivation of this study is to develop new decision-making approaches with relatively simpler computational requirements, ensuring they are practical and accessible for real-world applications.

- Limitations of Existing Weighting Approaches: Most existing weighting approaches assume completely known weight information [22-27]. However, in many practical scenarios, such as the evaluation of psychological education, the weight information may be completely unknown. Exploring approaches to handle this uncertainty is both challenging and significant. Thus, the second motivation of this paper is to propose a novel weight determination approach that can effectively address situations with completely unknown weight information.
- Lack of Research on Psychological Education Evaluation: The effectiveness evaluation of college students' psychological education in China remains largely unexplored. This gap highlights the need for exploratory research to advance the understanding of this field and enrich its theoretical and practical content. Recognizing the importance of psychological education in fostering students' mental well-being, this study aims to address the lack of systematic decision-making frameworks for its evaluation. Therefore, the third motivation is to design new MADM approaches tailored specifically for the effective evaluation of college students' psychological education, contributing to both theory and practice in this domain.

By addressing these three challenges, this study seeks to contribute innovative approaches to the field of MADM, particularly in the context of evaluating the effectiveness of college students' psychological education, which holds significant theoretical and practical importance.

On this basis, combined with the specific characteristics of the effectiveness evaluation of college students' psychological education, a new MADM approach in the SVNNs environment is proposed. The specific research contributions are summarized as follows:

- Development of the SVNN-PAMSSEM Approach: This paper introduces the SVNN-PAMSSEM approach, which is constructed by integrating the PAMSSEM [28] with SVNNs under conditions of completely unknown weight information. The SVNN-PAMSSEM approach incorporates distance-based measures to improve decision-making processes.
- Weight Determination Using the Average Approach: To derive the completely unknown attribute weights, an optimization model is established using the average method This model determines the

attribute weights. By combining the traditional PAMSSEM model with SVNN information, the SVNN- PAMSSEM approach is established, and a systematic computational process for MADM is provided.

- Advantages of the SVNN- PAMSSEM Approach: The SVNN- PAMSSEM approach offers several benefits: it provides stable computational results, utilizes simple calculation equations, accounts for the latent values of gains and losses, and can be flexibly combined with other decision-making approaches. As a result, the SVNN-PAMSSEM approach is a robust and effective tool for obtaining reasonable decision-making outcomes.
- Application to Psychological Education Evaluation: A numerical example is presented to demonstrate the practical application of the SVNN- PAMSSEM approach in the effective evaluation of college students' psychological education. Comparative analyses are conducted to highlight the advantages of the proposed approach. This paper primarily offers approach logical guidance and technical support for applying the SVNN- PAMSSEM approach.

This research provides significant insights into decision-making in the context of college students' psychological education. It also has broader implications for public-sector decision-making, infrastructure development, and the promotion of national security and stability. The proposed approach contributes to the theoretical and technical advancements in MADM under SVNN environments.

2. Preliminaries

This section introduces the fundamental concepts and definitions necessary for understanding the proposed methodology, including an overview of single-valued neutrosophic sets (SVNSs) and their role in multi-attribute decision-making.

2.1 SVNSs and Their Role in Multi-Attribute Decision-Making

Single-Valued Neutrosophic Sets (SVNSs) are an advanced mathematical tool used to handle uncertainty, vagueness, and imprecision in decision-making processes. Unlike traditional methods that rely on precise values, SVNSs provide a flexible framework by representing information through three independent membership functions: truth (T), indeterminacy (I), and falsity (F). Each function takes a value between 0 and 1, allowing for a nuanced representation of uncertainty.

In multi-attribute decision-making (MADM), where alternatives are evaluated based on multiple criteria, SVNSs offer a powerful way to incorporate imprecise and inconsistent data. Decision-makers can use SVNSs to express their preferences and judgments in situations where exact values are difficult to obtain, such as subjective evaluations or linguistic assessments. By capturing the complexity of real-world scenarios, SVNSs improve the accuracy and reliability of decision-making outcomes.

Overall, SVNSs enhance the ability to analyze and prioritize alternatives in MADM, making them a valuable tool for tackling complex problems with uncertain or incomplete information.

2.1 Definitions

This subsection provides key definitions related to SVNSs, including their structure, operations, and core concepts, which form the foundation for their application in multi-attribute decision-making. These definitions are essential for understanding how SVNSs handle uncertainty and imprecision effectively.

Definition 1 [29]. The SVNSs are articulated:

$$PA=\left\{\left(y,PT\left(y\right),PI\left(y\right),PF\left(y\right)\right)\middle|y\in Y\right\} \tag{1}$$

with truth-membership $PT\left(y\right)$, indeterminacy-membership $PI\left(y\right)$ and falsity-membership $PF\left(y\right)$, $PT\left(y\right),PI\left(y\right),PF\left(y\right)\in\left[0,1\right],\ 0\le PT\left(y\right)+PI\left(y\right)+PF\left(y\right)\le 3.$

The SVNN is articulated as $PA=\left(PT_A,PI_A,PF_A\right)$, $PT_A,PI_A,PF_A\in\left[0,1\right]$, $0\le PT_A+PI_A+PF_A\le 3.$

Definition 2 [30]. Let $PA=\left(PT_A,PI_A,PF_A\right)$ be SVNN, the score value is articulated:

$$SV\left(PA\right)=\frac{\left(2+PT_A-PI_A-PF_A\right)}{3},\ SV\left(PA\right)\in\left[0,1\right]. \tag{2}$$

Definition 3 [30]**.** Let $PA=\left(PT_A,PI_A,PF_A\right)$ be the SVNN, the accuracy value is articulated:

$$HV\left(PA\right)=PT_A-PF_A,\ HV\left(PA\right)\in\left[-1,1\right]. \tag{3}$$

Peng et al. [30] suggested an order relation for SVNNs to facilitate their comparison in decision-making scenarios. This order relation evaluates SVNNs based on their truth, indeterminacy, and falsity memberships, providing a systematic way to rank alternatives even under uncertain or imprecise conditions.

Definition 4 [30]**.** Let $PA=\left(PT_A,PI_A,PF_A\right)$ and $PB=\left(PT_B,PI_B,PF_B\right)$ be SVNNs, let $SV\left(PA\right)=\frac{\left(2+PT_A-PI_A-PF_A\right)}{3}$ and $SV\left(PB\right)=\frac{\left(2+PT_B-PI_B-PF_B\right)}{3}$, and let $HV\left(PA\right)=PT_A-PF_A$ and $HV\left(PB\right)=PT_B-PF_B$, if $SV\left(PA\right)<SV\left(PB\right)$, $PA<PB$; if $SV\left(PA\right)=SV\left(PB\right)$, then (1)if $HV\left(PA\right)=HV\left(PB\right)$, $PA=PB$; (2) if $HV\left(PA\right)<HV\left(PB\right)$, $PA<PB$.

Definition 5 [31]**.** Let $PA=\left(PT_A,PI_A,PF_A\right)$ and $PB=\left(PT_B,PI_B,PF_B\right)$ be SVNNs, the basic operations are articulated:

(1) $PA\oplus PB=\left(PT_A+PT_B-PT_A\cdot PT_B,PI_A\cdot PI_B,PF_A\cdot PF_B\right)$;

(2) $PA\otimes PB=\left(PT_A\cdot PT_B,PI_A+PI_B-PI_A\cdot PI_B,PF_A+PF_B-PF_A\cdot PF_B\right)$;

(3) $\lambda PA=\left(1-\left(1-PT_A\right)^{\lambda},\left(PI_A\right)^{\lambda},\left(PF_A\right)^{\lambda}\right),\lambda>0$;

(4) $\left(PA\right)^{\lambda}=\left(\left(PT_A\right)^{\lambda},\left(PI_A\right)^{\lambda},1-\left(1-PF_A\right)^{\lambda}\right),\lambda>0.$

Definition 6 [32]. Let $PA=\left(PT_A,PI_A,PF_A\right)$ and $PB=\left(PT_B,PI_B,PF_B\right)$, the Hamming distance between $PA=\left(PT_A,PI_A,PF_A\right)$ and $PB=\left(PT_B,PI_B,PF_B\right)$ is articulated:

$$HD\left(PA,PB\right)=\frac{\left|PT_A-PT_B\right|+\left|PI_A-PI_B\right|+\left|PF_A-PF_B\right|}{3} \tag{4}$$

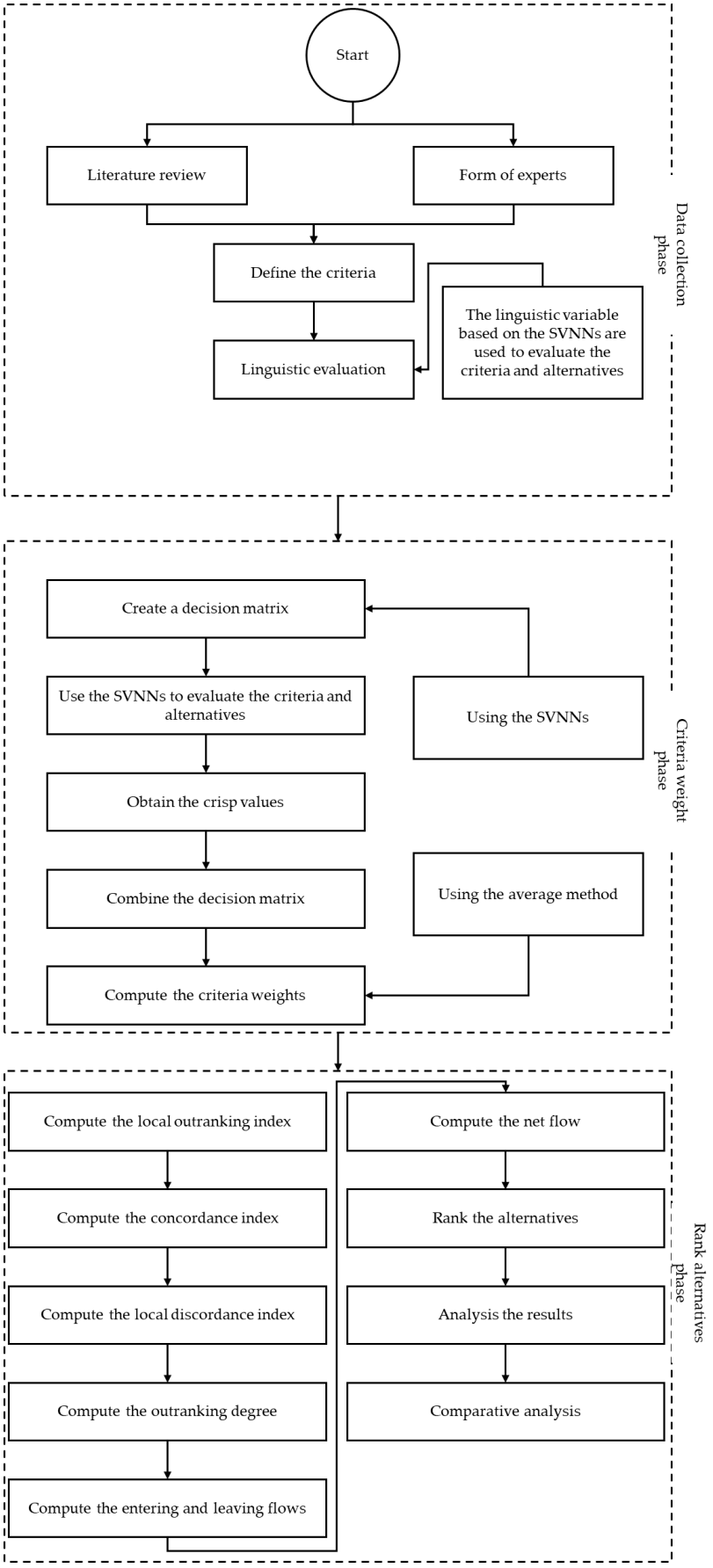

Figure 1. The flowchart of the proposed method.

3. Methodology

3.1 Research Basis

The research framework of this study is presented in Figure 1 which shows the steps of the proposed methodology under the neutrosophic sets.

3.2 Phase 1 Data Collection

Data collection is a process of gathering different data on criteria and alternatives to answer various questions, test hypotheses, and evaluate results. A survey was conducted to gather data on the criteria and alternatives and analysis of different criteria. Experts are decision-making and are required to obtain their opinions to evaluate the criteria and alternatives. The collected data is primary data. The decision-makers create the decision matrix based on the criteria and alternatives. We replaced their opinions by using single-valued neutrosophic numbers (SVNNs).

3.3. Phase 2 Data Evaluation

This phase refers to applying the proposed methodology to evaluate the data by obtaining the criteria weights and ranking the alternatives.

Step 1. Define the criteria of this study based on the literature.

Step 2. Define a set of alternatives

Step 3. Create a decision matrix

Step 4. Obtain the crisp values.

Step 5. Combined the decision matrix.

Step 6. Compute the criteria weights.

The criteria weights are computed using the average method.

Step 7. Compute the local outranking index.

$$R(A_i, A_{i'}) = \sum_{A_{i'}} \left(\sum_{A_i} R_j^-(A_i, A_{i'}) f_j(A_i) \right) f_j(A_{i'}) \tag{5}$$

Where $f_j(A_i)\ and\ f_j(A_{i'})$ refers to the probability density function and is assumed to be equal to one

$$R_j^-(A_i, A_{i'}) = \begin{cases} 0 & if\ \Delta_j < -p_j \\ \dfrac{\Delta_j - p_j}{p_j - q_j} & if - p_j < \Delta_j - q_j \\ 1 & if\ \Delta_j \geq -q_j \end{cases} \tag{6}$$

$$\Delta_j = k_j(A_i) - k_j(A_{i'}) \tag{7}$$

For the cardinal criteria

$$R_j(A_i, A_{i'}) = \begin{cases} 0 & if\ \Delta_j < -1 \\ 0.5 & if - 1 < \Delta_j \leq 0 \\ 1 & if\ \Delta_j \geq 0 \end{cases} \tag{8}$$

Step 8. Compute the concordance index.

$$C(A_i, A_{i'}) = \sum_{j=1}^{n} R_j(A_i, A_{i'}) w_j \tag{9}$$

Step 9. Compute the local discordance index.

$$D(A_i, A_{i'}) = \sum_{A_i} \left(\sum_{A_{i'}} D_j^-(A_i, A_{i'})\ f_j(A_i) \right) f_j(A_{i'}) \tag{10}$$

$$D_j^-(A_i, A_{i'}) = \begin{cases} 0 \quad if\ \Delta_j < -v_j \\ -\left(\dfrac{\Delta_j + p_j}{p_j - p_j}\right) \quad if - v_j < \Delta_j - p_j \\ 1 \quad if\ \Delta_j \geq -p_j \end{cases} \tag{11}$$

For the cardinal criteria

$$R_j(A_i, A_{i'}) = \begin{cases} \min\left\{1, t(w_j)\Delta_j + \dfrac{e_j + 1}{2}\right\} \quad if\ \Delta_j < -\left[\dfrac{e_j + 1}{2}\right] \\ 0 \quad if \Delta_j \geq -\left[\dfrac{e_j + 1}{2}\right] \end{cases} \tag{12}$$

.

Where $e_j > 3$ and

$$t(w_j) = 0.2\left(1 + \frac{w_j}{2}\right) \tag{13}$$

Step 9. Compute the outranking degree

$$N(A_i, A_{i'}) = C(A_i, A_{i'}) \prod_{j=1}^{n} \left[1 - D_j^3(A_i, A_{i'})\right] \tag{14}$$

Step 10. Compute the entering and leaving flows.

$$N^+(A_i) = \sum_{A_i \in A} N(A_i, A_{i'}) \tag{15}$$

$$N^-(A_i) = \sum_{A_i \in A} N(A_{i'}, A_i) \tag{16}$$

Step 11. Compute the net flow

$$N(A_i) = N^+(A_i) - N^-(A_i) \tag{17}$$

Step 12. Rank the alternatives.

Step 13. End

4. Case Study

4.1 Criteria weights.

The effective evaluation of college students' psychological education is the MADM. Five local colleges are evaluated with 8 attributes. We define eight criteria in this study and five alternatives.

a. Awareness and Literacy

Assesses the extent to which students are informed about mental health concepts, psychological well-being, and coping strategies. Programs should aim to destigmatize mental health issues and improve overall mental health literacy.

b. Accessibility of Psychological Counseling Services

Evaluates the availability and accessibility of counseling centers, mental health professionals, and helplines for students. This includes factors like the number of counselors, ease of appointments, and online/remote options.

c. Effectiveness of Intervention Programs

Measures the success of targeted intervention programs such as stress management workshops, cognitive-behavioral therapy sessions, and resilience training. The effectiveness is determined through feedback, outcomes, and measurable improvements.

d. Early Detection and Prevention Mechanisms

Assesses systems for identifying students at risk of mental health issues early. This includes tools like screenings, peer monitoring, faculty training for early warning signs, and prevention programs.

e. Student Engagement in Psychological Programs

Analyzes how actively students participate in mental health education activities such as workshops, seminars, and awareness campaigns. Higher engagement indicates greater program success.

f. Integration with Academic Curriculum

Examines whether psychological education is incorporated into the broader curriculum. For example, life skills courses, well-being seminars, and topics in personal development enhance students' mental resilience.

g. Faculty and Staff Training for Psychological Support

Evaluate whether teachers, mentors, and non-teaching staff are trained to support students' psychological well-being. This includes their ability to identify concerns and refer students for professional help.

h. Peer Support Systems

Measures the effectiveness of peer counseling and mentoring programs where students support each other under the guidance of professionals. Peer networks create trust and reduce stigma.

We invited three experts to evaluate the criteria and alternatives. Then we obtain the crisp values. Then we combined these values into a single decision matrix. Then we compute the criteria weights as shown in Figure 2.

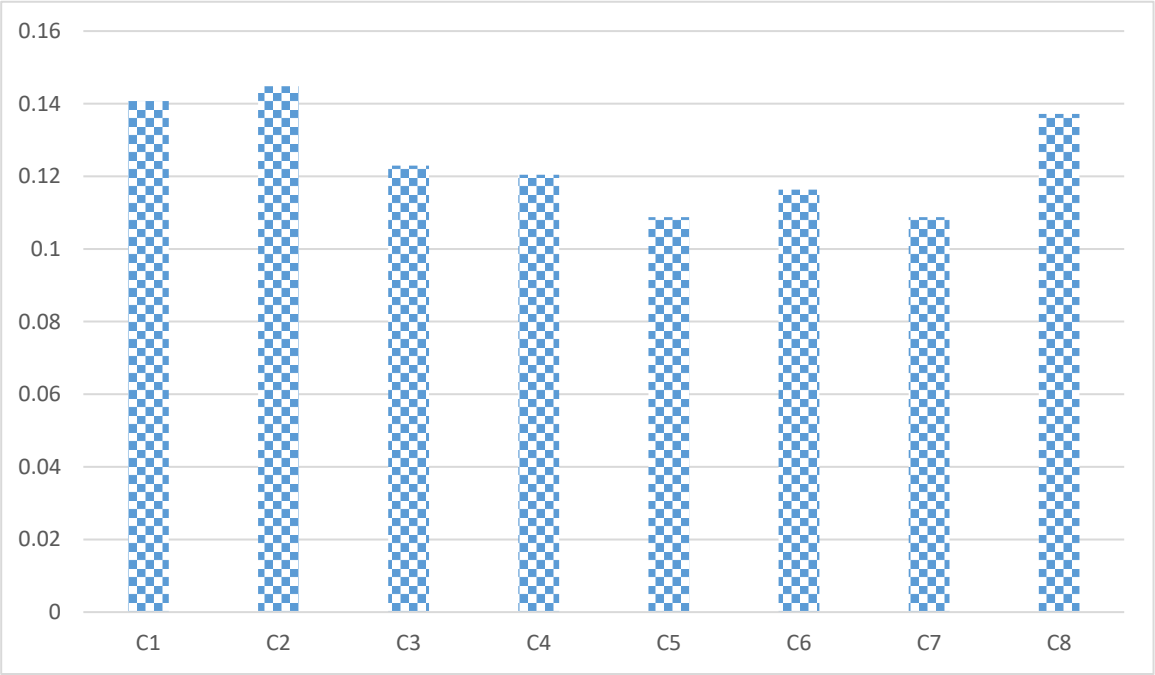

Figure 2. The criteria weights.

4.2 Rank of alternatives by the proposed method

In this part, we rank the alternatives by the proposed method.

Eq. (5) was used to compute the local outranking index. Eq. (9) was used to compute the concordance index. Eq. (10) was used to compute the local discordance index. Eq. (14) was used to compute the outranking degree Eqs. (15 and 16) were used to compute the entering and leaving flows. Then Eq. (17) was used to compute the net flow. Finally, we Ranked the alternatives.

A4>A2>A3>A1>A5

The results show alternative 4 is the best and alternative 5 is the worst.

The opinions of the first expert

(0.9,0.1,0.2) (0.8,0.2,0.3) (0.7,0.3,0.4) (0.6,0.4,0.5) (0.5,0.5,0.5) (0.3,0.6,0.7) (0.2,0.7,0.8) (0.1,0.8,0.9)

(0.3,0.6,0.7) (0.2,0.7,0.8) (0.1,0.8,0.9) (0.9,0.1,0.2) (0.8,0.2,0.3) (0.7,0.3,0.4) (0.6,0.4,0.5) (0.9,0.1,0.2)

(0.5,0.5,0.5) (0.6,0.4,0.5) (0.5,0.5,0.5) (0.2,0.7,0.8) (0.1,0.8,0.9) (0.9,0.1,0.2) (0.5,0.5,0.5) (0.8,0.2,0.3)

(0.6,0.4,0.5) (0.7,0.3,0.4) (0.8,0.2,0.3) (0.9,0.1,0.2) (0.1,0.8,0.9) (0.2,0.7,0.8) (0.3,0.6,0.7) (0.7,0.3,0.4)

(0.7,0.3,0.4) (0.8,0.2,0.3) (0.9,0.1,0.2) (0.1,0.8,0.9) (0.2,0.7,0.8) (0.3,0.6,0.7) (0.5,0.5,0.5) (0.6,0.4,0.5)

The opinions of the second expert

(0.7,0.3,0.4) (0.8,0.2,0.3) (0.7,0.3,0.4) (0.6,0.4,0.5) (0.7,0.3,0.4) (0.3,0.6,0.7) (0.2,0.7,0.8) (0.7,0.3,0.4)

(0.9,0.1,0.2) (0.7,0.3,0.4) (0.1,0.8,0.9) (0.7,0.3,0.4) (0.9,0.1,0.2) (0.7,0.3,0.4) (0.7,0.3,0.4) (0.9,0.1,0.2)

(0.2,0.7,0.8) (0.9,0.1,0.2) (0.7,0.3,0.4) (0.9,0.1,0.2) (0.2,0.7,0.8) (0.9,0.1,0.2) (0.9,0.1,0.2) (0.2,0.7,0.8)

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(0.7,0.3,0.4) (0.8,0.2,0.3) (0.2,0.7,0.8) (0.1,0.8,0.9) (0.2,0.7,0.8) (0.3,0.6,0.7) (0.5,0.5,0.5) (0.6,0.4,0.5)

The opinions of the third expert

(0.9,0.1,0.2) (0.1,0.8,0.9) (0.7,0.3,0.4) (0.1,0.8,0.9) (0.5,0.5,0.5) (0.3,0.6,0.7) (0.2,0.7,0.8) (0.1,0.8,0.9)

(0.1,0.8,0.9) (0.9,0.1,0.2) (0.1,0.8,0.9) (0.9,0.1,0.2) (0.1,0.8,0.9) (0.7,0.3,0.4) (0.1,0.8,0.9) (0.9,0.1,0.2)

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(0.8,0.2,0.3) (0.7,0.3,0.4) (0.9,0.1,0.2) (0.9,0.1,0.2) (0.8,0.2,0.3) (0.9,0.1,0.2) (0.8,0.2,0.3) (0.7,0.3,0.4)

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4.3 Results and Discussion

The evaluation of the effectiveness of college students' psychological education is a crucial process for assessing the actual impact of psychological education practices on university students. As society develops rapidly and the pressures of academic and everyday life increase, the mental health issues of college students have gradually become a focus of public concern. Psychological education, as an essential means of promoting the development of students' psychological quality and improving their mental health, directly affects their holistic development and the long-term interests of society. Therefore, a scientific evaluation of its effectiveness is particularly important. The core of psychological education effectiveness evaluation lies in assessing whether the educational activities have achieved their intended goals, improved students' mental health, enhanced their psychological adjustment abilities and facilitated their personal growth and social adaptability. Through evaluation, educators can understand the outcomes of psychological education, optimize its content and approaches, and improve its quality. Meanwhile, such evaluations can identify common psychological issues and potential crises among students, providing a scientific basis for subsequent interventions and improvements in education practices. This evaluation process typically involves monitoring the dynamic changes in students' psychological states and analyzing the impact of psychological education on their behaviors, cognition, and emotions. By conducting in-depth analyses of educational practices, it is possible to uncover strengths and weaknesses, clarify future directions for improvement, and guide more effective psychological education. The evaluation is not merely a summary of educational activities but also serves as a guiding tool, offering theoretical and practical references for continuous improvement in psychological education for college students.

Moreover, the evaluation of psychological education effectiveness holds significant social value. As college students are the backbone of society's future, their mental health directly affects social stability and development. Through scientific and rational evaluations, the psychological education system can be improved, ensuring the cultivation of healthier and more positive psychological qualities among students. This not only enhances their mental resilience during their time at university but also lays a solid psychological foundation for their future integration into society. In conclusion, the evaluation of the effectiveness of college students' psychological education is a process that integrates systematic, scientific, and practical approaches. It is not only a means of assessing psychological education practices but also an essential pathway for driving continuous advancements in psychological education. Effective evaluations can improve the relevance and efficacy of psychological education while contributing positively to the holistic development of students and the harmonious progress of society.

4.4 Compare analysis

The SVNN-PAMSSEM approach is compared with SVNN-CODAS approach and SVNN-EDAS approach, SVNN-TOPSIS, SVNN-VIKOR. The comparative results of different approaches are in Table 1.

Table 1. Results for different given approaches

Approaches	Order
SVNN-CODAS approach	A4>A3>A2>A1>A5
SVNN-EDAS approach	A4>A2>A5>A1>A3
SVNN-TOPSIS approach	A4>A2>A3>A1>A5
SVNN-VIKOR approach	A4>A2>A3>A1>A5
SVNN-PAMSSEM approach	A4>A2>A3>A1>A5

From Table 1, the order of these approaches has a light difference and the best local college and the worst local college are the same. The five given models each have distinct advantages that make them valuable in different decision-making scenarios:

- SVNN-CODAS Approach: This approach evaluates the overall performance of alternatives using both Euclidean distance and Hamming distance from negative ideal points. The Euclidean distance serves as the primary measure for comparison. If the Euclidean distances between two alternatives are very close,

the Hamming distance is used as a secondary measure to differentiate between them. The threshold parameter is employed to determine the closeness of the Euclidean distance, enhancing the precision of the evaluation. This dual-measure approach ensures a robust and detailed assessment of alternatives.

- SVNN-EDAS Approach: A key advantage of this approach is its computational simplicity, requiring fewer calculations while achieving the same ranking of alternatives. Unlike methods such as TOPSIS and VIKOR, the EDAS approach evaluates alternatives based on their distance from average solutions for each criterion. This distinction makes EDAS a highly efficient and effective method for decision-making, particularly in contexts where computational resources or time are limited.
- SVNN- PAMSSEM Approach: This model offers several notable features, including stable computation results, simple calculating equations, and the ability to account for latent gains and losses. Additionally, it can be easily integrated with other decision-making models, increasing its flexibility and applicability. These characteristics make the SVNN-PAMSSEM approach an excellent tool for deriving reasonable and reliable decision-making outcomes.

In summary, each of these models has unique strengths tailored to specific decision-making needs. Whether emphasizing group or individual influences, offering computational efficiency, or providing robust evaluation measures, these approaches collectively address a wide range of decision-making challenges in multi-criteria environments.

5. Conclusion

The evaluation of the effectiveness of psychological education for college students is a crucial tool for assessing whether the intended goals of psychological education have been achieved. It aims to understand the actual impact of psychological education on students' mental health, psychological quality, and adaptability. As social competition intensifies and life pressures increase, the mental health issues of college students have become more prominent, making psychological education an essential solution to these challenges. Effectiveness evaluation helps educators grasp the current state of psychological education, identify its strengths and weaknesses, and provide a scientific basis for optimizing educational content and methods. Through systematic analysis of the outcomes of psychological education, the evaluation can assess its effectiveness in alleviating psychological problems, improving emotional regulation, and fostering personal growth. It serves not only as a summary of educational activities but also as guidance for the future development of psychological education, offering practical support and theoretical references for mental health education. The significance of this evaluation also lies in advancing the improvement of the psychological education system, helping students better cope with challenges in their studies and lives, and laying a solid psychological foundation for their future development. This process holds great value for both the personal growth of students and the harmonious

development of society. The effectiveness evaluation of college students' psychological education is a MADM problem. In this paper, the PAMSSEM approach is developed under the framework of SVNN-MADM. First, the average method is employed to determine the decision weights. Based on this, the SVNN- PAMSSEM approach is constructed to handle MADM problems under SVNSs. Finally, an example focused on evaluating the effectiveness of college students' psychological education is provided, along with comparative decision analyses to validate the proposed SVNN- PAMSSEM method.

The main contributions of this research are as follows:

- Attribute Weight Determination: The attribute weights are objectively derived using the average approach.
- Development of the SVNN- PAMSSEM Approach: This paper constructs a novel SVNN- PAMSSEM approach specifically tailored for evaluating the effectiveness of college students' psychological education.
- Case Study Application: The proposed approach is demonstrated through a practical case study, effectively showcasing its applicability and relevance in real-world scenarios.
- Comparative Analysis: Comparative decision-making analyses are conducted to verify the rationality and advantages of the SVNN- PAMSSEM method, highlighting its robustness and effectiveness in addressing MADM problems.

In summary, this work provides a systematic and innovative methodology for evaluating the effectiveness of psychological education for college students. Leveraging the SVNN-PAMSSEM approach, not only ensures a comprehensive evaluation process but also offers a reliable tool for decision-makers to assess and improve psychological education strategies. The findings confirm the practicality and superiority of the proposed method in tackling complex MADM problems.

Acknowledgment

The work was supported by the research project on the theory and practice of ideological and political education for college students in Guangxi in 2021 The research results of "Research on the Construction of a Positive Psychological Health Education System for College Students" (Project Number: 2021SZ065) and the research results of the Guangxi Education Science "14th Five Year Plan" 2021 Higher Education Innovation and Entrepreneurship Education, Higher Education Internationalization Special Project "Research on the Integration of Red Culture into College Students' Innovation and Entrepreneurship Spirit Cultivation from the Perspective of Positive Psychology" (Project Number: 2021ZJY1525).

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Received: Sep 22, 2024. Accepted: Dec 16, 2024