



# Student financial support and sustainable recovery based on fuzzy-analytic hierarchy process comprehensive method

Hua Wei<sup>1</sup> · Lingling Yang<sup>1</sup>

Received: 25 November 2022 / Accepted: 4 April 2023 / Published online: 15 April 2023

© The Author(s), under exclusive licence to Springer Science+Business Media, LLC, part of Springer Nature 2023

## Abstract

In the post-COVID-19 era, many university students face financial distress due to macroeconomic downturns. Helping college students overcome financial difficulties is an important aspect of sustainable recovery. Based on the theory of student satisfaction and the perspective of new financial support systems, this study constructs a performance evaluation system for financial support for financially distressed students in colleges and universities. To comprehensively evaluate financially distressed students for financial support from the perspective of satisfaction, an empirical study is conducted by taking the authors' college as an example according to the fuzzy Analytic Hierarchy Process analysis and evaluation model. The results show that, according to the characteristics of students, the students' families' characteristics should be considered and carefully sorted, and on this basis, the appropriate selection criteria for financially distressed students are selected.

**Keywords** Student financial support · Fuzzy- Analytic Hierarchy Process · Sustainable recovery · Post pandemic era

## 1 Introduction

Owing to the economic crisis, many university students are struggling financially in the post-Covid-19 era. A crucial component of a nation's sustainable recovery is helping college students who are facing financial challenges. Financial support for university students is crucial in improving people's livelihoods and eradicating poverty on a nationwide scale (Doyle et al. 2009; Raza et al. 2019; Qayyum et al. 2019; Ngo and Astudillo 2019; Zhang 2021), and becomes increasingly detailed in recent years due to the thorough improvement and implementation of the state funding policy, especially the effect of financial support on targeted poverty alleviation,

---

✉ Lingling Yang  
yll@htc.edu.cn

<sup>1</sup> Department of Biotechnology, Hefei Technology College, Hefei 238000, China

which has been greatly enhanced (Wei 2021). The efficient completion of financial support work is related to the functional realization of university financial assistance and education, personal growth of students in financial need, and a nation's sustainable recovery.

However, according to the feedback information from various aspects, there are still many problems in the financial support for the financially distressed students in universities and colleges, and there are still many deficiencies in the practical work, especially in the "financial support" and "educational" two aspects appear disjointed phenomenon. The education function is often ignored in the financial support, and the actual financial support effect is far from the expected effect because it only focuses on the funding and does not pay attention to the integration of the education function (see Xue and Li 2022, Angrist 2022). Therefore, a reasonable assessment and evaluation of the performance of student financial support work is an effective way to improve the working mode of financial support and improve the effectiveness of educational aid work.

The contributions to the existing literature are twofold. First, different from the above literature, we consider the issue of student financial support from various aspects, especially from the aspects of student financial aid satisfaction. Second, we comprehensively consider various characteristics of college students with financial difficulties in the perspective of sustainable recovery, construct the performance evaluation system of financial support for financially distressed students in colleges and universities based on the theory of student satisfaction and the perspective of new financial support system, comprehensively evaluates the financial support for financially distressed students from the perspective of satisfaction. From these perspectives, this paper is clearly innovative.

In this paper, a total of 980 questionnaires were collected in the form of on-site distribution, individual interviews and thematic discussions with a recovery rate of 98% and an effective rate of 95.2%, the fuzzy mathematical statistics method is applied to explore the student satisfaction-oriented performance evaluation model of financial support work for comprehensive evaluation, and corresponding countermeasures and suggestions are put forward, so as to provide solutions for the practical problems existing in the financial support work of the colleges.

## 2 Literature review

Scholars looked at the sustainable recovery from various perspectives in the post pandemic era. Zhao et al (2022) analyzed the opportunities and challenges China faces for sustainable recovery on the basis of a comparative study of green economic recovery policy practices across the globe. It then offers solutions and recommendations for how to advance China's sustainable development in the post-epidemic era. Rasoulinezhad et al. (2022) examined how green finance affects the growth of the green economy. The economic recovery of small and medium-sized enterprises (SMEs) following the COVID-19 pandemic was studied by Taghizadeh-Hesary et al. (2022), and the connection between foreign direct investment and the green

recovery of Southeast Asian economies was examined by Phung et al. (2022). For more on sustainable recovery, please refer to Rasoulinezhad (2020), Yoshino et al. (2021), Peng et al (2022) and their references.

In the global sustainable recovery stage after the pandemic, the topic of financial support for financially distressed students has received wide attention from both academic and management fields (see eg. Murra-Anton 2022). Anderson et al (2020) conducted the first long-term experimental evaluation for financially distressed students and found that, related to the reforms of the Wisconsin Scholar Grant, decisionmakers should consider the relative allocation of resources between two-year and four-year institutions. Adarkwah and Agyemang (2022)'s results pointed to a policy change by college administrators that resulted in the implementation of a multi-track year-round education (MT-YRE) system to encourage social estrangement. To guarantee post-COVID-19 economic, health, and educational recovery, policymakers in the field of education should offer clear instructions, resources, funding, and recognition to school stakeholders as they work together to combat the virus. Minaya et al (2022) aimed to assess the causal effects of tightening academic requirements, as reflected in the academic performance of needy students, and found that stringent grade requirements had a statistically significant positive effect on performance across all aspects of "average" recipients. In the study of Yang and Wei (2017), the performance appraisal system of university's financially distressed students' support work is set up based on student satisfaction by employing fuzzy analysis evaluation. Recently, most universities focused on financial support for financially distressed students, such as the timeliness of fund distribution and the fairness of fund evaluation, while they do not pay enough attention to other aspects such as psychology and ability of financially distressed students. In addition, when examining the effectiveness of financial support, only the goal of financial support is met, and the self-development process of the funded students is ignored. Most of the university assessment indicators are too one-sided, and do not reflect the assessment indicators from the perspective of students.

The fuzzy comprehensive evaluation method and the analytic hierarchy process (AHP) method are two methods which are widely applied in evaluation situations. The fuzzy evaluation method was created by Zadeh (Zadeh 1965) to capture the system-specific uncertainties. It is built on fuzzy set theory. The processes involved in satisfaction assessment naturally involve information that is fuzzy, uncertain, dynamic, and changing. As a "fuzzy" thing, the satisfaction evaluation can adopt the fuzzy comprehensive evaluation method, which is an analytical evaluation method that uses the fuzzy mathematics principle to transform the qualitative evaluation into the quantitative evaluation (see e.g., Zhang and Feng 2018; Cai et al. 2022). The analytic hierarchy process method is used to judge the relationship between the indexes and evaluate the selection objects comprehensively (see e.g., Peng et al. 2021; Zhou and Chan 2017). This method objectively determines the attribution relationship of each index factor, avoids subjective arbitrariness, and is more reasonable in the process of establishing the index hierarchy. The fact that the AHP method offers both an elicitation technique and a solid theoretical foundation that permits exact quantitative computations is one of its benefits.

Based on the theory of student satisfaction and the perspective of new financial support system, this paper constructs the performance evaluation system of financial support for financially distressed students in colleges and universities. To comprehensively evaluate the financial support for financially distressed students from the perspective of satisfaction, an empirical study is conducted by taking the authors' college as an example according to the fuzzy- Analytic Hierarchy Process (fuzzy-AHP) analysis and evaluation model.

### 3 Construction of student satisfaction index system

According to Kotler's theory of customer satisfaction (see Kotler 1994), satisfaction is a function of perceived performance and expected performance, which can be expressed by the formula:  $S$  (user satisfaction) =  $P$  (perceived service effect) -  $E$  (expected value of service). When  $P > E$ , users show high satisfaction; When  $P = E$ , users show satisfaction; When  $P < E$ , users show dissatisfaction.

From the perspective of the university, the so-called "customer" is actually student, from the perspective of satisfaction, they are the same mechanism. The student satisfaction of colleges and universities refers to the comparative evaluation results between the expectations of college students and the actual effects of the service quality of colleges and universities. Based on the above theories, student satisfaction was evaluated from the perspective of the financial support work system. Supported by the construction of three aspects, namely financial support, ideological education and management services, which were used as three first-level indicators; Financially distressed students identification, the allocation of resources, mental health, inspiring education, ability training, the counselor service ability and service capacity of seven as the second-level indexes, and 15 measures for the third-level indexes (see Table 1 for detailed). This paper builds university finance work performance evaluation based on student satisfaction evaluation index system, adopts expert questionnaire.

## 4 Empirical analysis of student satisfaction measurement

### 4.1 Data sources

The empirical study of this paper selects 1000 students from Hefei Technology College with different majors (see Yang and Wei 2017). A total of 980 questionnaires were collected in the form of on-site distribution, individual interviews and thematic discussions, with a recovery rate of 98%, among which 952 were valid, with an effective rate of 95.2%. The questionnaire consists of two parts: the first part is the specific content of the student satisfaction survey, mainly to understand the students' satisfaction with the financial support, ideological education and

**Table 1** Weight table of performance evaluation index system of university financial support based on student satisfaction *Source:* Authors

First tier index	Second tier index	Third tier index
Financial support $U_1$	Financially distressed students identification $U_{11}$	Financially distressed students to identify the implementation of the procedure $U_{111}$ The implementation effect of the financially distressed student's identification procedure $U_{112}$
	Resource allocation $U_{12}$	The grants are in the form of class allocations $U_{121}$ The implementation results of the financial support $U_{122}$
	Mental health $U_{21}$	Implementation effects of diversified funding forms $U_{123}$ Forms of care for financially distressed students $U_{211}$ The effect of caring for financially distressed students $U_{212}$
Ideological education $U_2$	Inspiration education $U_{22}$	The educational effect of campus thanksgiving inspirational education routine activities $U_{221}$ The development form of inspirational education activities $U_{222}$
	Ability training $U_{23}$	Inspirational typical educational effect $U_{223}$ The activity form that financially distressed student ability cultivates $U_{231}$
	Counselor service ability $U_{31}$	Implementation effect of ability training platform construction for financially distressed students $U_{232}$ How often counselors care about financially distressed students $U_{311}$
Management service $U_3$	Service capacity $U_{32}$	The way counselors care about financially distressed students $U_{312}$ Satisfaction with the service attitude of the financial support $U_{313}$

management services of the college, a total of 15 questions; The second part is to collect students' problems and good suggestions on. All the

## 4.2 The main content of the financial support work system

From the perspective of students to evaluate the financial support work, through the students' satisfaction with the financial support work and their own benefit degree, to obtain the final degree of recognition of students, so as to achieve the goal of education.

The growth of students from poor families should include the following basic factors: First, financial support. We should help them get economic help through reasonable student aid procedures and improve the efficiency of targeted poverty alleviation through appropriate resource allocation. Second, ideological education. Through the inspirational form of education to guide the correct values, through the quality of the development platform to improve the future employment ability. Third, management services. Through the love management of the counselors to gain the education effect, through the professional management of the service window to simplify the procedures.

On the basis of giving full consideration to the economic assistance and self-development, the aid to financially distressed students and the encouragement to become talents, combined with the specific work of student aid, this paper makes a preliminary exploration from the three aspects of financial support, ideological education and management services, and establishes a new assessment and evaluation system of financial support. To evaluate the service quality of school financial support work through student satisfaction, so as to improve the service ability of all levels of funding.

## 4.3 Student satisfaction evaluation methods

With consideration of the theoretical basis of fuzzy comprehensive evaluation, a three-layer comprehensive evaluation index is established. After the membership functions are determined by experts scoring, the evaluation appraisals are calculated by using the fuzzy comprehensive evaluation model to characterize students' satisfaction. Then with the use of AHP, the weights of students'

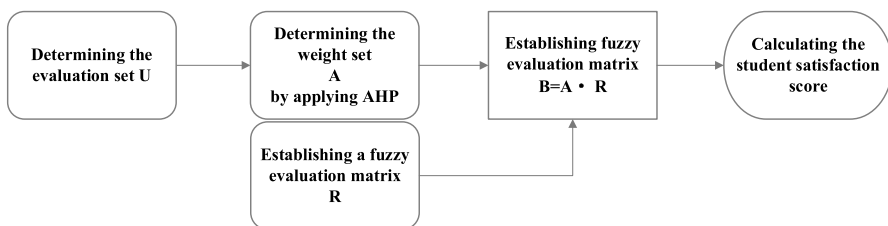


Fig. 1 Framework of the methodological procedure. *Source:* Authors

satisfaction components are elicited from these experts. The analysis steps are shown in Fig. 1 and listed as follows.

- (1) Determining factor set  $U = \{U_1, U_2, \dots, U_n\}$ , where  $U_i$  ( $i = 1, 2, \dots, n$ ) refers to the  $i$ -th influencing factor of student satisfaction assessment. Through this step, the corresponding index system is established, which includes the specific goals of all levels, and the goals of different levels affect each other. Through the construction of the three-tiers fuzzy comprehensive evaluation model, this paper considers the evaluation factors more comprehensively, makes the satisfaction evaluation system more reasonable, fair and objective, and improves the accuracy of the fuzzy comprehensive evaluation results.
- (2) Determining the weight of each factor  $A = \{A_1, A_2, \dots, A_n\}$ , the importance of each factor in the set will affect the rationality of the evaluation result. This paper uses analytic hierarchy process (AHP) to determine the weight, and the weight of each index can be calculated according to the analytic hierarchy process method. Ten experts engaged in student work in the college were selected and evaluated by five grades, namely  $M =$  (very important, important, general, unimportant, very unimportant), and their scores were given as (5, 4, 3, 2, 1) in turn.
- (3) Establishing a fuzzy evaluation matrix  $R$ .
- (4) Establishing three-tiers fuzzy comprehensive evaluation level by level B.
- (5) Calculating the student satisfaction score: the degree of student satisfaction can be graded by 5 levels, namely {very satisfied, satisfied, general, dissatisfied, very dissatisfied}, so the score set  $H = [h_1, h_2, h_3, h_4, h_5] = \{100, 80, 60, 40, 20\}$ .

#### 4.4 Hierarchical fuzzy comprehensive evaluation

(1) Calculate the  $A_i$  of the third tier and the evaluation results of students. The three-tiers index weights are obtained through expert scoring, as shown in Table 8 in the Appendix. At the same time, a questionnaire was designed based on the specific contents of the three-tiers indicators, and a comprehensive survey table of student satisfaction was obtained, as shown in Table 9 in the Appendix.

(2) As can be seen from the above Tables 2 and 3, in terms of the financially distressed students to identify the implementation of the procedure, the implementation effect of the financially distressed student's identification procedure totaled 2 items. A two-order judgment matrix  $R$  was constructed for the AHP hierarchical method research (calculation method: sum-product method), and the eigenvalue vector obtained by analysis was (0.909, 1.091), and the corresponding weight values of the two items were as follows: 45.455%, 54.545%. In addition, the maximum eigenvalue root (2.000) can be calculated by combining the feature vector, and then the maximum characteristic root value can be used to calculate the Consistency Index (CI) value (0.000).

(3) According to the weight values in Table 8 ( $A = (A_{ij})$ ) and Table 9 ( $R = (R_{ij})$ ), the fuzzy comprehensive evaluation operation formula  $B_{ij} = A_{ij} \cdot R_{ij}$  is used to carry out the first-level fuzzy comprehensive evaluation, and the fuzzy evaluation set of

**Table 2** AHP data of  $U_{111}$  and  $U_{112}$ . *Source:* Authors

	Financially distressed students to identify the implementation of the procedure ( $U_{111}$ )	The implementation effect of the financially distressed student's identification procedure ( $U_{112}$ )
Financially distressed students to identify the implementation of the procedure ( $U_{111}$ )	1.000	4.3/4.8 = 0.833
The implementation effect of the financially distressed student's identification procedure ( $U_{112}$ )	4.8/4.3 = 1.200	1.000



**Table 3** AHP results of  $U_{111}$  and  $U_{112}$  *Source:* Authors

	Eigenvalue vector	Weight (%)	Maximum Eigenvalue root	CI
Financially distressed students to identify the implementation of the procedure ( $U_{111}$ )	0.909	45.455	2.000	0.000
The implementation effect of the financially distressed student’s identification procedure ( $U_{112}$ )	1.091	54.545		

CI: Consistency Index.

each factor in the second level is obtained. For example, the fuzzy comprehensive evaluation set of factors  $B_{11}$ :

$$\begin{aligned}
 B_{11} &= (0.4545, 0.5455) \begin{bmatrix} 0.0579 & 0.4558 & 0.3168 & 0.1221 & 0.0474 \\ 0.0242 & 0.5295 & 0.3411 & 0.0821 & 0.0232 \end{bmatrix} \\
 &= (0.0395, 0.4960, 0.3301, 0.1003, 0.0342), \\
 B_{12} &= (0.2998, 0.3421, 0.3581) \begin{bmatrix} 0.0705 & 0.5179 & 0.3642 & 0.5263 & 0.0053 \\ 0.0589 & 0.6126 & 0.2705 & 0.0579 & 0 \\ 0.0821 & 0.6116 & 0.2116 & 0.0579 & 0.0368 \end{bmatrix} \\
 &= (0.0707, 0.5839, 0.2775, 0.1983, 0.0148)
 \end{aligned}$$

As can be seen from Tables 4 and 5 above, for the identification of financially distressed students, a total of two items of resource allocation are constructed two-order judgment matrix for AHP hierarchical method research (calculation method: sum product method), and the analysis results show that the feature vector is (0.935,1.065), and the corresponding weight values of the two items are 46.729% and 53.271%, respectively. In addition, the maximum characteristic root (2.000) can

**Table 4** AHP data of  $U_{11}$  and  $U_{12}$  *Source:* Authors

	Financially distressed students identification ( $U_{11}$ )	Resource allocation ( $U_{12}$ )
Financially distressed students identification ( $U_{11}$ )	1.000	4.3/4.9=0.877
Resource allocation ( $U_{12}$ )	4.9/4.3=1.140	1.000

**Table 5** AHP results of  $U_{11}$  and  $U_{12}$

	Eigenvalue vector	Weight (%)	Maximum Eigenvalue root	CI
Financially distressed students identification ( $U_{11}$ )	0.935	46.729	2.000	0.000
Resource allocation ( $U_{12}$ )	1.065	53.271		

Source: Authors

**Table 6** AHP data of  $U_1$  and  $U_2$ 

	$U_1$	$U_2$	$U_3$
$U_1$	1.000	$4.1/4.6=0.891$	$4.1/4.0=1.025$
$U_2$	$4.6/4.1=1.122$	1.000	$4.6/4.0=1.150$
$U_3$	$4.0/4.1=0.976$	$4.0/4.6=0.870$	1.000

Source: Authors

**Table 7** AHP results of  $U_1$  and  $U_2$ 

	Eigenvalue vector	Weight	Maximum Eigenvalue root	CI
$U_1$	0.968	32.283%	3.000	0.000
$U_2$	1.087	36.222%		
$U_3$	0.945	31.495%		

Source: Authors

be calculated by combining the feature vector, and then the maximum characteristic root value can be used to calculate the CI value (0.000).

(4) Fuzzy comprehensive evaluation of the second level index. Firstly, the weight set A of the second factor set is determined. By referring to the above method of weight calculation, the expert evaluation score weight of the second-level index is similarly obtained, as shown in Table 10 in the Appendix.

The formula  $B_i=A_i \cdot R_i$  ( $R_i$  is fuzzy comprehensive evaluation matrix) is used to calculate the fuzzy comprehensive evaluation set of each factor in the second tier.

From Tables 6 and 7 above, it can be seen that a three-order judgment matrix is constructed for the total three items of index 1, index 2 and index 3 to conduct the AHP hierarchical method research (calculation method: sum-product method), and the analysis results show that the eigenvalue vector is (0.968,1.087,0.945), and the corresponding weight values of the three items are: 32.283%, 36.222%, 31.495%. In addition, the maximum eigenvalue root (3.000) can be calculated by combining the eigenvalue vector, and then the CI value (0.000) can be calculated by using the maximum characteristic root value.

(5) Fuzzy comprehensive evaluation of the first-tier index. Firstly, the weight set A of the factor set in the first layer is determined. Similarly, the expert evaluation score weight of first-tier indicators is obtained, as shown in Table 11 in the Appendix.

Using the three-tiers fuzzy comprehensive evaluation, the fuzzy comprehensive evaluation set of students' overall satisfaction with college financial support justice is obtained. The fuzzy comprehensive evaluation matrix R is formed by the fuzzy comprehensive evaluation set of three first-level indicators, namely economic aid, ideological education and management service. The final fuzzy comprehensive evaluation set is obtained by  $B=A \cdot R$  calculation, and the comprehensive evaluation is carried out.

#### 4.5 Analysis of student satisfaction evaluation results

From the analysis of student satisfaction evaluation results (see Fig. 1 as well as Table 12 in Appendix), we have three observations.

First, the satisfaction evaluation score of the student financial support assessment system from high to low is: financial support 73.74; ideological education 70.63; management services 69.32. It shows that the students' satisfaction in ideological education, financial support and management service is only at the normal level, and the management service level is the lowest. This indicates that, comparing with financial support and ideological education, the management service level is the one that needs to improve the most.

Second, for the corresponding second-tier students' satisfaction evaluation scores, the scores of financially distressed students' identification, mental health and counselor's service ability are low. As can be seen from Fig. 2, the implementation of the identification procedure for financially distressed students and the way counselors care about financially distressed students are the key factors leading to low student satisfaction.

Third, for the third-tier students' satisfaction evaluation scores, the implementation mode of financially distressed students' identification, the forms of care for financially distressed students of mental health and the way counselors care about financially distressed students, are with the lowest three indices of students satisfaction. The colleges should pay more attention to these three indices improvement.

### 5 Conclusion and policy recommendations

Based on the analysis of the above comprehensive results, combined with the sorting of existing problems, this study proposes some countermeasures and suggestions to improve financial support for financially distressed students in the global sustainable recovery stage following the pandemic.

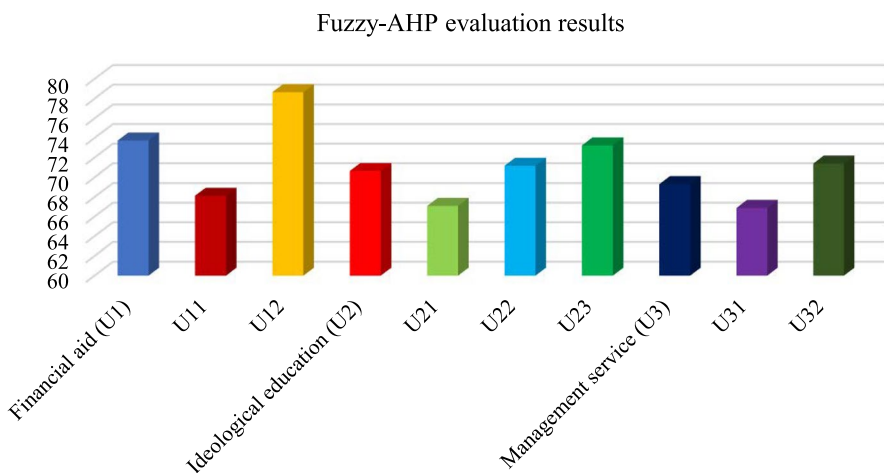


Fig. 2 Fuzzy-AHP evaluation results. Source: According to Table 12 in Appendix

First, the financially distressed students should be reasonably defined, the information base should be well established, and the financial support work should be scientific. While implementing financial support, students reported significant problems in the identification of financially distressed students. The identification and operation methods are extremely simple. Students often only need a single declaration form or certificate when they enroll in school, apply for loans, and work-study, which leads to high arbitrariness and low transparency of the financial assistance process, resulting in considerable deviation in its implementation.

From the perspective of sustainable recovery, the appropriate selection scheme for financially distressed students should be determined based on the student's democratic evaluation rather than relying on the guidance counselor to decide the selection criteria and process. According to the characteristics of the students in this major, the students' families are carefully sorted and classified to select the appropriate selection criteria for financially distressed students and to widen the gap for enrollment. In guarantee under the premise of open, fair, at the same time through various family situation to verify the candidate for financial distress students, as far as possible eliminate family situation has improved students and students with other invisible income or funding sources, as far as possible on the selection standards of financial distress students work done a bit more detailed, as far as possible for professional for more assistance from poor areas. Thus, we can ensure that financial support is rewarded to students who really need it, and no students lose the opportunity for financial support.

Second, increase a variety of incentive mechanisms. Implement psychological care, enrich campus culture, and realize the integration of funding education. As a special group, financially distressed college students bear much more psychological pressure than ordinary students. Therefore, we should adhere to the "economic poverty" and "psychological poverty" in both hands, while helping financially distressed students to relieve economic difficulties, we should focus on cultivating their self-confidence, self-reliance, self-improvement, self-esteem consciousness. Financially distressed students hope that the school should pay attention to strengthen the overall cultural construction of classes and dormitories, give full play to the role of financially distressed students' associations, actively carry out peer psychological assistance activities, and create a good environment for them.

From the perspective of sustainable recovery, we should actively carry out career guidance for impoverished students, and establish a full-coverage, whole-process and development-oriented career guidance mechanism. In addition to financial support, the ultimate goal of financial support is to pay attention to financially distressed students' study and psychology (similar results can be found in Yang and Wei 2017 and Anderson et al 2020). Carry out a variety of activities and competitions to increase the incentive effect among financially distressed students. By concretizing the indicators of the financially distressed students in various activities, the performance of the financially distressed students in various activities and competitions is investigated and converted into quantifiable standards. And on this basis, set up a variety of forms of awards for financially distressed students, not only play an incentive role in the financially distressed group, but also easy to set up inspirational examples, play a good inspirational education effect.

Third, make clear the evaluation system of counselors in the financial support work. There are two ways to evaluate the performance of counselors' financial support work: one is through students' online evaluation of counselors; the other is to establish various assessment standards: (a) The average score of the comprehensive quality assessment of the financially distressed students in the class; (b) Help records to solve specific problems of financially distressed students; (c) Record of heart-to-heart talk with financially distressed students. A clear assessment and evaluation system can improve counselors' sense of responsibility and strengthen counselors' awareness of paying more attention to students.

## Appendix

In this Appendix, we first present some data tables which can be used in our main context, and then make the robust check for our main results.

### Data tables

See Tables 8, 9, 10, 11, 12.

**Table 8** Weight table of expert evaluation score of three-tiers indicators *Source*: Experts scoring, see Yang and Wei (2017)

	Score ( $S$ )	Average score ( $F=S/10$ )	Weight
$U_{111}$	48	4.8	0.4545
$U_{112}$	43	4.3	0.5455
$U_{121}$	45	4.5	0.2998
$U_{122}$	41	4.1	0.3421
$U_{123}$	36	3.6	0.3581
$U_{211}$	43	4.3	0.5058
$U_{212}$	44	4.4	0.4942
$U_{221}$	39	3.9	0.3290
$U_{222}$	38	3.8	0.3355
$U_{223}$	38	3.8	0.3355
$U_{231}$	39	3.9	0.5247
$U_{232}$	43	4.3	0.4753
$U_{311}$	41	4.1	0.5181
$U_{312}$	44	4.4	0.4819
$U_{321}$	35	3.5	1.0000

**Table 9** Comprehensive table of student satisfaction survey data *Source:* Questionnaire for students, see Yang and Wei (2017)

	Very satisfied		Satisfied		Normal		Not satisfied		Very dissatisfied	
	Volume	Ratio (%)	Volume	Ratio (%)	Volume	Ratio (%)	Volume	Ratio (%)	Volume	Ratio (%)
<i>U</i> <sub>111</sub>	55	5.79	433	45.58	301	31.68	116	12.21	45	4.74
<i>U</i> <sub>112</sub>	23	2.42	503	52.95	324	34.11	78	8.21	22	2.32
<i>U</i> <sub>121</sub>	67	7.05	492	51.79	346	36.42	50	52.63	5	0.53
<i>U</i> <sub>122</sub>	56	5.89	582	61.26	257	27.05	55	5.79	0	0
<i>U</i> <sub>123</sub>	78	8.21	581	61.16	201	21.16	55	5.79	35	3.68
<i>U</i> <sub>211</sub>	44	4.63	397	41.79	361	38.00	134	14.11	14	1.47
<i>U</i> <sub>212</sub>	55	5.79	393	41.37	359	37.79	135	14.21	8	0.84
<i>U</i> <sub>221</sub>	66	6.95	552	58.10	309	32.53	12	1.26	11	1.16
<i>U</i> <sub>222</sub>	77	8.11	530	55.79	265	27.89	66	6.95	12	1.26
<i>U</i> <sub>223</sub>	50	5.26	406	42.74	359	37.79	114	12.00	21	2.21
<i>U</i> <sub>231</sub>	99	10.42	508	53.47	288	30.32	44	4.63	11	1.16
<i>U</i> <sub>232</sub>	110	11.58	486	51.16	272	28.63	76	8.00	6	0.63
<i>U</i> <sub>311</sub>	149	15.68	335	35.26	314	28.63	130	13.68	22	2.32
<i>U</i> <sub>312</sub>	77	8.11	389	40.95	318	33.47	111	11.68	55	5.79
<i>U</i> <sub>321</sub>	66	6.95	453	47.68	398	41.89	22	2.32	11	1.16

**Table 10** Weight table of second-level index expert evaluation score *Source:* Authors

	Score (S)	Average score (F = S/10)	Weight
$U_{11}$	49	4.9	0.46729
$U_{12}$	43	4.3	0.53271
$U_{21}$	46	4.6	0.3079
$U_{22}$	39	3.9	0.3517
$U_{23}$	43	4.3	0.3404
$U_{31}$	46	4.6	0.4587
$U_{32}$	39	3.9	0.5413

**Table 11** Weight table of expert evaluation score of first-tier indicators *Source:* Authors

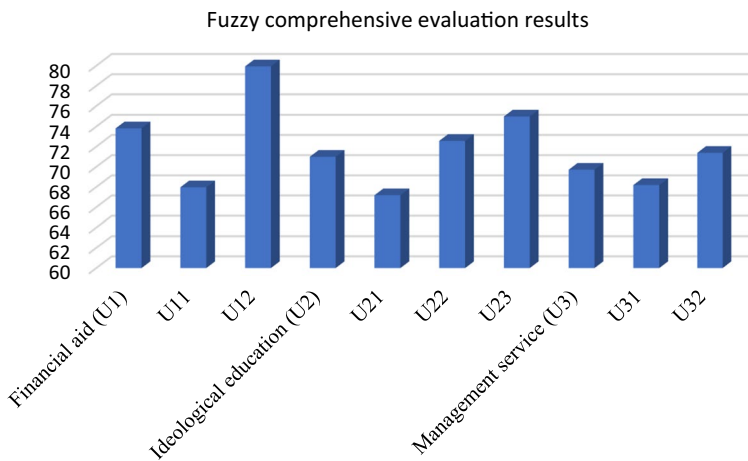
	Score (S)	Average score (F = S/10)	Weight
$U_1$	41	4.1	0.32283
$U_2$	46	4.6	0.36222
$U_3$	40	4.0	0.31495

**Table 12** Fuzzy-AHP evaluation results *Source:* Authors

Factor	Weight	Satisfaction (%)	Score
Financial support	0.3228	(5.61,54.28,30.21,15.25,2.38)	73.74
<i>Financially distressed students' identification</i>	0.46729	(3.95,49.60,33.01,10.03,3.42)	68.13
Implementation mode	0.45455	(5.79,45.58,31.68,12.21,4.74)	67.09
Implementation effect	0.54545	(2.42,52.95,34.11,8.21,2.32)	71.08
<i>Resource allocation</i>	0.53271	(7.07,58.38,27.75,19.83,1.47)	78.65
The grants are in the form of class allocations	0.29986	(7.05,51.79,36.42,52.63,0.53)	91.49
The implementation results of the funding	0.34209	(5.89,61.26,27.05,5.79,0)	73.44
Implementation effects of diversified funding forms	0.35805	(8.21,61.16,21.16,5.79,3.68)	72.89
Ideological education	0.3622	(7.72,48.98,33.23,8.86,1.21)	70.63
<i>Mental health</i>	0.30793	(5.20,41.58,37.90,14.16,1.16)	67.10
Forms of care for financially distressed students	0.50582	(4.63,41.79,38.00,14.11,1.47)	66.80
The effect of caring for financially distressed students	0.49418	(5.79,41.37,37.79,14.21,0.84)	67.41
<i>Inspirational education</i>	0.35168	(6.77,52.17,32.74,6.77,1.55)	71.17
The educational effect of campus Thanksgiving inspirational education routine activities	0.32895	(6.95,58.10,32.53,1.26,1.16)	73.68
The development form of inspirational education activities	0.33553	(8.11,55.79,27.89,6.95,1.26)	75.51
Inspirational typical educational effect	0.33552	(5.26,42.74,37.79,12.00,2.21)	67.37
<i>Ability training</i>	0.34040	(10.97,52.37,29.52,6.23,0.91)	73.25
The activity form that financially distressed student ability cultivates	0.52466	(10.42,53.47,30.32,4.63,1.16)	73.53
Implementation effect of ability training platform construction for financially distressed students	0.47534	(11.58,64.00,19.79,4.00,0.63)	76.38

**Table 12** (continued)

Factor	Weight	Satisfaction (%)	Score
Management service	0.3150	(9.28,43.24,36.88,7.09,2.46)	69.32
<i>Counselor service ability</i>	0.45872	(12.03,38.00,30.96,12.72,3.99)	66.90
How often counselors care about financially distressed students	0.51813	(15.68,35.26,33.05,13.68,2.32)	69.65
The way counselors care about financially distressed students	0.48187	(8.11,40.95,33.47,11.68,5.79)	66.78
<i>The service capacity of the funding window of the department</i>	0.54128	(6.95,47.68,41.89,2.32,1.16)	71.39
Satisfaction with the service attitude of the funding window	1.00	(6.95,47.68,41.89,2.32,1.16)	71.39
Overall student satisfaction		(7.50,47.90,33.00,9.60,2.00)	69.86

**Fig. 3** Fuzzy comprehensive evaluation results



**Table 13** Fuzzy-AHP evaluation results versus fuzzy comprehensive evaluation results

Index	Score under fuzzy comprehensive evaluation model	Score under fuzzy-AHP model
Financial aid ( $U_1$ )	73.82	73.74
$U_{11}$	67.98	68.13
$U_{12}$	79.94	78.65
Ideological education ( $U_2$ )	71	70.63
$U_{21}$	67.18	67.1
$U_{22}$	72.57	71.17
$U_{23}$	75	73.25
Management service ( $U_3$ )	69.72	69.32
$U_{31}$	68.2	66.9
$U_{32}$	71.39	71.39
Overall student satisfaction	76.84	69.86

## Robust check

In this part, we compare the results by applying the fuzzy comprehensive evaluation method with the fuzzy-AHP method, with all other things being equal, including the origin data, the index matrix, etc. The main result under the fuzzy comprehensive evaluation method is shown in Fig. 3, and the comparison result is listed as follows Table 13.

From the above result we can find that, our main conclusions still hold except for some minor differences in test values.

**Author contributions** All authors have read and agreed to the published version of the manuscript.

**Funding** Anhui Province Outstanding Young Talents Support Program (No. gxyq2021270), Key project of Natural Science Foundation of Universities in Anhui Province (KJ2021A1389).

**Data availability** The original contributions presented in the study are included in the article/supplementary material, and further inquiries can be directed to the corresponding author.

## Declarations

**Conflict of interest** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**Human and animal rights** This paper doesn't involve Human Participants and/or Animals.

## References

Adarkwah M, Agyemang E (2022) Forgotten frontline workers in higher education: aiding Ghana in the COVID-19 recovery process. *Phys Chem Earth, Parts a/b/c* 127:103202

- Anderson DM, Broton KM, Goldrick-Rab S, Kelchen R (2020) Experimental evidence on the impacts of need-based financial support: longitudinal assessment of the Wisconsin Scholars Grant. *J Policy Anal Manage* 39(3):720–739
- Angrist J, Autor D, Pallais A (2022) Marginal effects of merit aid for low-income students. *Q J Econ* 137(2):1039–1090
- Cai F, Yang L, Yuan Y, Taghizadeh-Hesary F (2022) The application of an improved fuzzy comprehensive evaluation in coal quality rating: the case study of China. *Front Energy Res* 9:934
- Doyle WR, Delaney JA, Naughton BA (2009) Does institutional aid compensate for or comply with state policy? *Res High Educ* 50(5):502–523
- Kotler P (1994) Reconceptualizing marketing: an interview with Philip Kotler. *Eur Manag J* 12(4):353–361. [https://doi.org/10.1016/0263-2373\(94\)90021-3](https://doi.org/10.1016/0263-2373(94)90021-3)
- Minaya V, Agasisti T, Bratti M (2022) When need meets merit: the effect of increasing merit requirements in need-based student aid. *Eur Econ Rev* 146:104164
- Murra-Anton Z (2022) Financial support and early admissions at selective need-blind colleges. *Econ Theor* 74(3):833–870
- Ngo F, Astudillo S (2019) California DREAM: the impact of financial support for undocumented community college students. *Educ Res* 48(1):5–18
- Peng G, Han L, Liu Z, Guo Y, Yan J, Jia X (2021) An application of fuzzy analytic hierarchy process in risk evaluation model. *Front Psychol* 12:715003
- Peng W, Lu S, Lu W (2022) Green financing for the establishment of renewable resources under carbon emission regulation. *Renew Energy* 199:1210–1225
- Phung TQ, Rasoulinezhad E, Luong Thi Thu H (2022) How are FDI and green recovery related in Southeast Asian economies?. *Econ Change Restruct* 1–21. <https://doi.org/10.1007/s10644-022-09398-0>
- Qayyum A, Zipf S, Gungor R et al (2019) Financial support and student persistence in online education in the United States. *Distance Educ* 40(1):20–31
- Rasoulinezhad E, Taghizadeh-Hesary F (2022) Role of green finance in improving energy efficiency and renewable energy development. *Energy Effic* 15(2):14
- Raza SS, Williams Z, Katsiaficas D et al (2019) Interrupting the cycle of worrying: financial implications of the California DREAM Act in the lives of undocumented college students. *Rev High Educ* 43(1):335–370
- Taghizadeh-Hesary F, Phoumin H, Rasoulinezhad E (2022) COVID-19 and regional solutions for mitigating the risk of SME finance in selected ASEAN member states. *Econ Anal Policy* 74:506–525
- Wei X (2021) Research on the identification system of students from Families with economic difficulties in higher vocational colleges. *Educ Vocat Educ* 20(10):105–108
- Xue E, Li J (2022) The student financial support in China's Vocational education. *China's Vocational Education Reform*. Springer, Singapore, pp 71–85
- Yang L, Wei H (2017) Research on the student satisfaction with financial assistance work based on fuzzy analysis method. *J Chaohu Coll* 19(6):151–156 ((in Chinese))
- Yoshino N, Rasoulinezhad E, Taghizadeh-Hesary F (2021) Economic impacts of carbon tax in a general equilibrium framework: empirical study of Japan. *J Environ Assess Policy Manag* 23(01):2250014
- Zadeh LA (1965) Fuzzy sets. *Inf Control* 8(3):338–353
- Zhang L (2021) Research on identification of disadvantaged students in colleges and universities under the new student financial support policy. *Educ Observ* 10(1):127–129
- Zhang P, Feng G (2018) Application of fuzzy comprehensive evaluation to evaluate the effect of water flooding development. *J Petroleum Explor Prod Technol* 8:1455–1463
- Zhao XX, Wen J, Zou XY, Wang QJ, Chang CP (2023) Strategies for the sustainable development of China in the post-epidemic era. *Sustain Dev* 31(1):426–438
- Zhou R, Chan A (2017) Using a fuzzy comprehensive evaluation method to determine product usability: a proposed theoretical framework. *Work* 56(1):9–19

**Publisher's Note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Springer Nature or its licensor (e.g. a society or other partner) holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.