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RESEARCH ARTICLE

College Students Online Education Evaluation Through SWOT Analysis During COVID-19

HAIYUN WANG[1], JIAHUI WU[1], MULADI MUHEDANER[2], AND SANIYE MAIHEMUTI[1]
[1]College of Electrical Engineering, Xinjiang University, Ürümqi 830017, China
[2]Student Affairs Department (Division), Changsha University of Technology, Changsha, Hunan 410114, China

Corresponding author: Haiyun Wang (why@xju.edu.cn)

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ABSTRACT The COVID-19 epidemic has disrupted the normal teaching and learning in universities, which poses significant challenges to college education. The traditional face-to-face learning mode has been switched to online (distance) learning, causing various influences on students' academic performance. As higher education plays a central role in technology innovation and society development, it is of great importance to investigate and improve online education in the context of COVID-19. This study distributed online questionnaires to college students from 30 provinces or municipalities in China to evaluates the SWOT (Strengths, Weaknesses, Opportunities, and Threats) factors of shifting from traditional learning to online learning during COVID-19 Pandemic. The SWOT analysis has been employed to construct 16 kind of internal and external evaluation factors and 4 kind of improvement strategies for assess online education. The basic data of subjective weight method — AHP comes from the questionnaire survey, and the weight value of SWOT factors are determined through the questionnaire survey results. The fuzzy MARCOS approach is used to select the most suitable strategies for its effective implementation. Several coping strategies are suggested to improve the online education in post-pandemic era, which is essential for higher education and promoting a civilized and sustainable society. ''By reforming and innovating the teacher led teaching mode, stimulate students' interest in learning, get rid of the boring learning state, create a good learning atmosphere and improve the teaching quality'' is the most effective strategy to enhance the online learning experience and increase students' satisfaction. This methodology is applicable with a case study concerning the students' online education in pandemic and the validity of this approach is presented through comparative analysis and sensitivity analysis. Through example verification, it is found that SWOT method is suitable for online education evaluation research no matter how the research object changes.

INDEX TERMS COVID-19 pandemic, online education, SWOT analysis, fuzzy AHP, fuzzy MARCOS.

I. INTRODUCTION

The corona virus disease 2019 (COVID-19) pandemic is a highly infectious disease that spreads via direct contact and air droplets, affecting millions of people worldwide and disrupting global economic, social, and educational activities [1], [2]. Over 507.5 million confirmed cases and 6.2 million deaths have been documented to date (April 25, 2022), with a large percentage of individuals receiving medical treatment [3], [4]. Since June 2022, recurring COVID-19 outbreaks have occurred in multiple places/regions in China. As a result, the government is forced to adopt a humiliating policy of blockage or isolation to contain the spread of infection, which has proven to be the most effective technique to date [5], [6]. Social distance can be maintained through blockage or isolation, preventing direct human contact or aerosol pollution,

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and therefore containing the pandemic [7]. However, this method has certain negative consequences, such as limiting social activities [8], [9].

In this century, humanity has faced the most severe epidemic of infectious illnesses [10]. In the context of regular epidemic prevention and control, the study and living environment, psychological condition, social environment and life support of college students have changed dramatically [11], [15]. However, pupils are also forced to miss school and participate in an unprecedented large-scale online education practice at home without having the option of successfully responding to the epidemic situation [16]. Many universities have switched to online education accordingly to react to the COVID-19 epidemic since 2020 in order to ensure the continuity of instruction, but schools and teachers have not properly planned and prepared for this variation, resulting in significant changes in the field of education [17]. This in turn has an impact on college students' behavioral, psychological and academic performance, such as high frequency use of social media (e.g., Wei xin, QQ, Sina Weibo or Twitter), inattention and anxiety. Compared to face-to-face learning, online (distance) learning has different characteristics such as physical distance [18], technology dependency [18], network requirements [19], low practicability [20], high hardware requirements [15], and lack of teaching experience [20], which has an immediate and long-term impact on students' physiology, psychology and life [20], [21]. Besides, an important difference of online learning that distinguishes from face-to-face learning is the difficulty of prompting learning communities that helps to enhance teacher-student empathy and social interactions between students [22]. Learning communities in turn can benefit students' academic performance, physical and mental health. These difference or factors could bring profound changes and challenge to higher education which is critical for technology innovation and shaping civilized society for sustainable development [23], [24]. Although, throughout the last two years, the online education model has been gradually enhanced and modified. Educational institutions used different online learning platforms with different capabilities and strategies to facilitate learning [25]. Universities adopted different teaching techniques such as direct online lectures, audio and video recorded lectures, shared online materials, and blended learning [26]. Additionally, they used online assessments methods, such as online quizzes, exams, and assignments [27]. So far, there are 32000 online Mu classrooms, 490 million learners, and 140 million students obtaining Mu credits [28]. The shifting to online education by universities during COVID-19 Pandemic impacted learners, educators and learning performance [29]. Unfortunately, many educational institutions, educators, and students were not ready for this new experience.

The epidemic is both a challenge and an opportunity for education [17]. In terms of education, this abrupt shift ''increases instructors' burden significantly because they must not only transfer teaching content and resources to cyberspace, but also be adept in using the essential education tools''. Students, too, confront difficulties and hurdles in adapting to online learning's rapid and unforeseen transition, but there are also opportunities [30]. Students' participation in online education is voluntary and arranged before the advent of the pandemic, despite the fact that it is ubiquitous in today's culture. If the school's high-intensity teaching approach shifts to online learning, kids may suffer severe consequences, such as high frequency use of social media, inattention and anxiety [31]. We want to look at how these changes influence students, what benefits they provide, how the benefits and drawbacks of online education effect students' learning, and what remedies are available [32].

Students also valued the fact that online learning could give them with a convenient, cost-free, and relaxing learning environment [33]. It will enhance time, space, and schedule flexibility while reducing commuting time and textbook prices. Despite the fact that students with varied skills and motives have different ''real-time learning'', they statistically have the same instruction time. However, it is important to note that we are unable to assess how engaged kids are in real time during this period. Students are the only ones who choose their ''real-time learning'' based on their own intellect. Teachers and parents are unable to effectively monitor their students' learning activities. Aside from that, students had technical difficulties. Students can participate in online learning at any time and from any location as long as they have access to a network. However, the network's volatility is also an online education's fatal flaw. Both professors and students encounter internet connection issues, particularly the availability of electronic platform servers and the fear of network instability, which resulted in image reception delays and voice and image asynchronization. When family members were all required to use the internet for business, internet connectivity deteriorated. It causes students' passion and patience for learning to gradually erode [34]. Under COVID-19, many students expressed stress, poorer learning satisfaction, and interest in their online learning as a result of these issues. Table 1 lists some of the studies on online education during the COVID-19 epidemic.

Many scholars are currently studying online education from the perspectives of students, teachers, schools, and parents. It mostly consists of student pressure and difficulties, student happiness, teacher and school management efforts and deficiencies, parental and social supervision and cooperation, and so on. However, most of the previous articles were about overviews and statistics. As a result, this paper proposes a combination of the SWOT method and the Multi-Criteria Decision-Making (MCDM) method, comprehensively evaluates the Strengths, Weaknesses, Opportunities, and Threats brought by online education to students at the student level, and proposes several improvement strategies for student's online education in the future, based on summarizing the previous experience.

The term ''complete evaluation'' refers to a thorough, objective, and reasonable examination of all aspects of

TABLE 1. Some of the studies about online education during the COVID-19 Pandemic.

Sources	Aim of the study
Elham Hussein et al. (2020) [35]	Students' attitudes towards emergency online learning
Mahmoud Maqableh et al. (2021) [36]	Online learning experience and students' satisfaction
Avijit Saha et al. (2021) [37]	Emergency online learning at undergraduate level
Sigalit Warshawski (2022) [38]	Academic self-efficacy, resilience and social support of online learning
Alice Hoi Ying Yau et al. (2022) [39]	A co-orientation analysis of teachers' and students' perceptions of online teaching and learning
Timothy G. Ford (2021) [17]	Challenges and opportunities of online learning
Yue Zhang et al. (2021) [40]	Online education of graduating students in a high school
David John Lemay et al. (2021) [41]	Students about their perceptions of online learning before and after the transition to online learning
Gazi Mahabubul Alam et al. (2021) [42]	Comparison of academic success and job-readiness before and after online learning
Maya Usher et al. (2021) [43]	Online vs. on-campus higher education
María del Carmen Gallego Sa´nchez et al. (2021) [44]	Impact on the quality of education online with a structural equations model
Jørgen Melgaard et al. (2022) [45]	Academic Procrastination and Online Learning
Julia Yu-Fong Chang et al. (2021) [46]	Comparison of learning effectiveness between physical classroom and online learning for dental

the examined object. Its core consists of the evaluation object's index system and the thorough evaluation method chosen [47]. The MCDM method is currently a powerful tool for comprehensive evaluation, such as Analytic Hierarchy Process (AHP) [48], Entropy Weight (EW) [49], Cloud Method (CM) [50], Grey Relation Analysis (GRA) [51], Analytic Network Process (ANP) [52], Decision Making Trialand Evaluation Laboratory (DEMETEL) [53], Više-Kriterijumska Optimizacija I Kompromisno Rešenje (VIKOR) [54], Technique for Order Performance by Similarity to Ideal Solution (TOPSIS) [55] evaluation method based on evidence theory. There are several applications for the MCDM evaluation methods currently in use, including the ranking of indices, the identification and evaluation of risk and the comparison of sustainable development between nations as well as economic, social, environmental, and technical assessments. However, in recent years, it has been largely abandoned in the evaluation of online education. As a result of Albert Humphrey's 1960 explanation of the SWOT analysis, decision-makers and participants can now better understand their organization's strengths and weaknesses, as well as potential opportunities and threats. A strong tool for selecting the optimal management strategies for a business is also available [56]. As a result, a SWOT analysis may not be sufficient in identifying the importance of SWOT criteria and feasible alternative tactics. Such an inadequacy can be eliminated using MCDM procedures. Because of this, MCDM approach is typically used in conjunction with SWOT analysis to reduce the weakness of SWOT analysis, even if there is uncertainty in SWOT analysis [57], [58], [59], [60]. A pair-wise comparison matrix is used to establish the numerical weight or priority of each technique [59]. Accordingly, MCDM is applied to modify SWOT analysis for this research. As far as we are aware, this is the first study on online education to use AHP-MARCOS methodology along with SWOT analysis in order to organize and rank the SWOT aspects for online education and to pick out the best online education development approach.

On a case study at the Xinjiang University in China, the suggested SWOT-based fuzzy AHP-MARCOS technique is used to evaluate and investigate the strategic advantages of online education from the perspective of students. Electronic questionnaires (considering the diversity of subjects' location, major, grade, gender, and influencing factors) and quantitative assessment tools are used to analyze strengths and weaknesses performance and encountered opportunities and threats of Chinses college students in online learning. Then, improvement strategies are suggested, which provides decision support for effectively enhancing online learning experience and performance of college students. It can also provide guidance and suggestions for online education and sustainable social development in China and the world. For the purpose of validating the proposed integrated SWOT-fuzzy AHP-MARCOS approach, the results are compared to those of the fuzzy VIKOR and TOPSIS methodologies [56], [63].

As a result of the SWOT analysis, new plans for Xinjiang University and its online education development in the future have been identified. The following sections are included in the research: Using SWOT analysis and the proposed approach, Section II discusses these concepts. Section III explains in depth the research approach and computational technique. It is explained in Section IV how the proposed methodology might be applied, and the results of comparison and sensitivity analyses are provided. Ending thoughts for future research are included in the concluding paragraphs.

II. THE PROPOSED METHOD

The SWOT approach, its components, and how it has been used in the literature are explained in this section. That is followed by a description of the proposed methodology.

A. SWOT ANALYSIS

The SWOT analysis is a common strategic analytical tool that helps to identify an organization's strengths and weaknesses, as well as its potential opportunities and threats. Nonetheless, the SWOT analysis approach does not statistically analyze the components, nor can it objectively compare the relative importance of the various factors. A SWOT matrix can also include multiple tactics based on its dimensions and elements, such as strength-opportunity (SO), weakness-opportunity

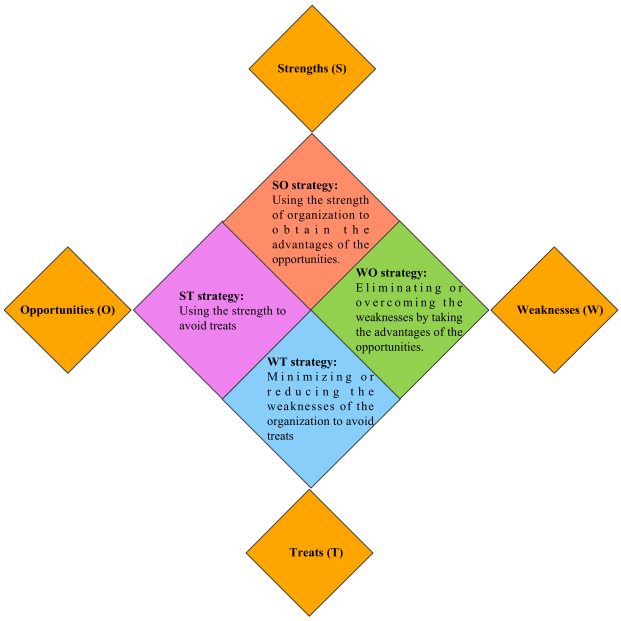


FIGURE 1. SWOT matrix and the strategies.

(WO), strength-threat (ST) and weakness-threat (WT) strategies are given in Fig. 1.

The advantages of SWOT analysis are as follows:

- It allows focusing on the positive and negative aspects of the external and internal environments of the system;
- It helps reveal opportunities to take advantage and eliminate or threats by understanding weaknesses;
- It prepares the basis for strategic decisions and supports through group discussion to determine SWOT factors about the research object;
- It is useable in a variety of contexts, including research.

We will see an example of how SWOT-fuzzy AHP-MARCOS might be used in this way in the next section. Following that, we will take a look at the actual strategies being used and the benefits they provide.

B. THE SWOT-FUZZY AHP-MARCOS METHODOLOGY

There are numerous MCDM strategies that have been used to tackle various decision-making problems in the literature. In addition, MCDM approaches are frequently employed in studies assessing the security of the electrical system.

C. THE AHP METHOD

American operations research scientists in the 1970s promoted AHP as a popular MCDM technology as part of a broader thorough evaluation study [48]. It is an excellent tool for environmental and natural resource planning. While still being practical and easy to use, this approach calls for significantly less quantitative information. In order to quantify the usefulness of the SWOT model, it must be incorporated into a hierarchical framework using the AHP method. Because of this, the AHP approach is perfectly appropriate for this investigation.

D. THE MARCOS METHOD

A revolutionary MCDM method developed by Stevi'c *et al.* [63], MARCOS evaluates several choice criteria based on ideal and anti-ideal solutions and delivers utility degrees for both options. Using the recently proposed MARCOS approach [61], which has been combined with the AHP method in the references, with its ability to analyze expert preferences without regard for scale, it is more adaptable than other methods. Notwithstanding the large diversity of standards and alternatives, it remains stable. In comparison to traditional multi-criteria techniques, they demonstrated the advantages of the MARCOS methodology: Multi-Attributive Border Approximation area Comparison (MABAC) [57], Više-Kriterijumska Optimizacija I Kompromisno Rešenje (VIKOR) [54], and Technique for order of Preference by Similarity to Ideal Solution (TOPSIS) [55]. The examples from the literature above show that MARCOS has been successfully used in a wide variety of settings. But the use of MARCOS for strategy selection highlights the contributions and novelty of this study. TOPSIS, MABAC, COPRAS, and VIKOR are just a few of the numerous selection strategies that have been studied. A balance between ideal and anti-ideal methods ensures a suitable performance in the fuzzy environment, as well.

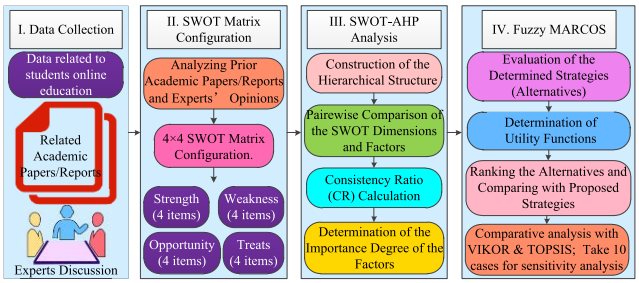


FIGURE 2. Research procedure.

E. THE INTEGRATED METHODOLOGY

AHP and MARCOS are employed in the suggested technique to derive criteria weights with SWOT and to analyze the options and to select the best alternative to take advantage of their strengths in the process of selection. Fig. 2 provides an overview of the suggested integrated technique, which will be discussed in the following section.

III. PROPOSED METHODOLOGY

This section illustrates how the integrated SWOT-fuzzy AHP-MARCOS methodology is used to the problem at hand.

Step 1: Build the SWOT matrix to get the experts' SWOT aspects and strategies [62].

Step 2: Use the language phrases in Table 2 to help the experts establish the criteria's order of importance. At this point, the triangular fuzzy numbers (TFN) are used to build a

TABLE 2. TFN fuzzy scale.

Intensity of importance	Fuzzy number	Definition	Membership function
1	1	Equal importance (EI)	(1, 1, 2)
3	3	Moderate importance (MI)	(2, 3, 4)
5	5	Strong importance (SI)	(4, 5, 6)
7	7	Absolutely importance (AI)	(6, 7, 8)
9	9	Extremely more importance (EMI)	(8, 9, 10)

comparison matrix $\tilde{A}$.

$$\tilde{A} = \begin{bmatrix} 1 & \tilde{a}_{12} & \cdots & \tilde{a}_{1n} \\ \tilde{a}_{21} & 1 & \cdots & \tilde{a}_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{a}_{n1} & \tilde{a}_{n2} & \cdots & 1 \end{bmatrix} \tag{1}$$

where $\tilde{a}_{ij} = 1$, if $i = j$ and $\tilde{a}_{ij} = \tilde{1}, \tilde{3}, \tilde{5}, \tilde{7}, \tilde{9}$ or $\tilde{a}_{ij} = \tilde{1}^{-1}, \tilde{3}^{-1}, \tilde{5}^{-1}, \tilde{7}^{-1}, \tilde{9}^{-1}$ where $i \neq j$.

The weights of fuzzy AHP are calculated using the AHP method and a MATLAB application that constructs a fuzzy comparison matrix.

TABLE 3. Evaluation scale for alternatives.

Linguistic term	Triangular fuzzy numbers
Extremely poor (EP)	(0.1, 0.1, 0.1)
Very poor (VP)	(0.1, 0.1, 0.3)
Poor (P)	(0.1, 0.3, 0.3)
Medium poor (MP)	(0.3, 0.3, 0.5)
Medium (M)	(0.3, 0.5, 0.5)
Medium good (MG)	(0.5, 0.5, 0.7)
Good (G)	(0.5, 0.7, 0.7)
Very good (VG)	(0.7, 0.7, 0.9)
Extremely good (EG)	(0.7, 0.9, 0.9)

Step 3: Table 3 can be used to construct the group decision matrix $\tilde{X}$, where $\tilde{A}(AI)$ and $\tilde{A}(ID)$ are the ideal solution and the anti-ideal solution, based on the opinions of experts.

$$\tilde{X} = \begin{array}{c} ext. \\ \tilde{A}(AI) \\ \tilde{A}_1 \\ \tilde{A}_2 \\ \vdots \\ \tilde{A}_m \\ \tilde{A}(ID) \end{array} \begin{array}{c} \begin{array}{cccc} \tilde{C}_1 & \tilde{C}_2 & \cdots & \tilde{C}_n \end{array} \\ \begin{bmatrix} \tilde{X}_{ai1} & \tilde{X}_{ai2} & \cdots & \tilde{X}_{ain} \\ \tilde{X}_{11} & \tilde{X}_{12} & \cdots & \tilde{X}_{1n} \\ \tilde{X}_{21} & \tilde{X}_{22} & \cdots & \tilde{X}_{ai1} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{X}_{m1} & \tilde{X}_{m2} & \cdots & \tilde{X}_{mn} \\ \tilde{X}_{id1} & \tilde{X}_{id2} & \cdots & \tilde{X}_{idn} \end{bmatrix} \end{array} \tag{2}$$

$$\tilde{A}(AI) = \min_i \tilde{x}_{ij} \ \ if \ \ j \in B \ \ \ and \ \ \ \max_i \tilde{x}_{ij} \ \ if \ \ j \in C \tag{3}$$

$$\tilde{A}(DI) = \max_i \tilde{x}_{ij} \ \ if \ \ j \in B \ \ \ and \ \ \ \min_i \tilde{x}_{ij} \ \ if \ \ j \in C \tag{4}$$

Step 4: Normalize the $\tilde{X}$ to obtain $\tilde{N} = \left[\tilde{n}_{ij}\right]_{m\times n}$:

$$\tilde{n}_{ij} = \left(n_{ij}^l, n_{ij}^m, n_{ij}^u\right) = \left(\frac{x_{id}^l}{x_{ij}^u}, \frac{x_{id}^l}{x_{ij}^m}, \frac{x_{id}^l}{x_{ij}^l}\right) ifj \in C \tag{5}$$

$$\tilde{n}_{ij} = \left(n_{ij}^l, n_{ij}^m, n_{ij}^u\right) = \left(\frac{x_{ij}^l}{x_{id}^u}, \frac{x_{ij}^m}{x_{id}^u}, \frac{x_{ij}^u}{x_{id}^u}\right) ifj \in B \tag{6}$$

Step 5: Using the fuzzy-AHP approach, compute the weight coefficients of the criterion $\tilde{\omega}_j = \left(\omega_j^l, \omega_j^m, \omega_j^u\right)$ and obtain the weighted fuzzy matrix $\tilde{V}$:

$$\begin{aligned} \tilde{v}_{ij} &= \left(v_{ij}^l, v_{ij}^m, v_{ij}^u\right) = \tilde{n}_{ij} \otimes \tilde{\omega}_j \\ &= \left(n_{ij}^l \times \omega_j^l, n_{ij}^m \times \omega_j^m, n_{ij}^u \times \omega_j^u\right) \end{aligned} \tag{7}$$

Step 6: Calculate the utility degree $\tilde{K}_i$ of alternatives:

$$\tilde{K}_i^- = \frac{\tilde{S}_i}{\tilde{S}_{ai}} = \left(\frac{s_i^l}{s_{ai}^u}, \frac{s_i^m}{s_{ai}^m}, \frac{s_i^u}{s_{ai}^l}\right) \tag{8}$$

$$\tilde{K}_i^+ = \frac{\tilde{S}_i}{\tilde{S}_{id}} = \left(\frac{s_i^l}{s_{id}^u}, \frac{s_i^m}{s_{id}^m}, \frac{s_i^u}{s_{id}^l}\right) \tag{9}$$

where $\tilde{S}_i = (s_i^l, s_i^m, s_i^u)$ indicates the sum of the elements of $\tilde{V}$.

$$\tilde{S}_i = \sum_{i=1}^{n} \tilde{v}_{ij} \tag{10}$$

Step 7: Determine the utility functions for the ideal $f(\tilde{K}_i^+)$ and anti-ideal$f(\tilde{K}_i^-)$ solutions.

$$f\left(\tilde{K}_i^+\right) = \frac{\tilde{K}_i^-}{df_{crisp}} = \left(\frac{k_i^{-l}}{df_{crisp}}, \frac{k_i^{-m}}{df_{crisp}}, \frac{k_i^{-u}}{df_{crisp}}\right) \tag{11}$$

$$f\left(\tilde{K}_i^-\right) = \frac{\tilde{K}_i^+}{df_{crisp}} = \left(\frac{k_i^{+l}}{df_{crisp}}, \frac{k_i^{+m}}{df_{crisp}}, \frac{k_i^{+u}}{df_{crisp}}\right) \tag{12}$$

Step 8: Calculate the utility functions$f\ (K_i)$ to determine the rank of alternatives:

$$f\ (K_i) = \frac{K_i^+ + K_i^-}{1 + \frac{1-f(K_i^+)}{f(K_i^+)} + \frac{1-f(K_i^-)}{f(K_i^-)}} \tag{13}$$

Fig. 3 shows the detailed steps of the methods:

IV. APPLICATION OF THE PROPOSED METHODOLOGY

Xinjiang University in China and its online education have a significant impact on students, as this section explains. Case studies are then discussed.

A. INTRODUCTION OF XINJIANG UNIVERSITY IN CHINA

University of Xinjiang was established in 1924 and is located in the capital of the Xinjiang Uygur Autonomous Region, Urumqi. World-class engineering and construction education are available at this university (category B). The three campuses of Xinjiang University are Honghu, Youhao, and Boda. 27 colleges, one Graduate School and two teaching and research departments make up the institution, as well as 39 affiliated departments that provide teaching and research help. 34400 students, comprising 22070 undergraduates, 11270 graduate students, 880 postdoctoral researchers and 163 international visitors are enrolled.

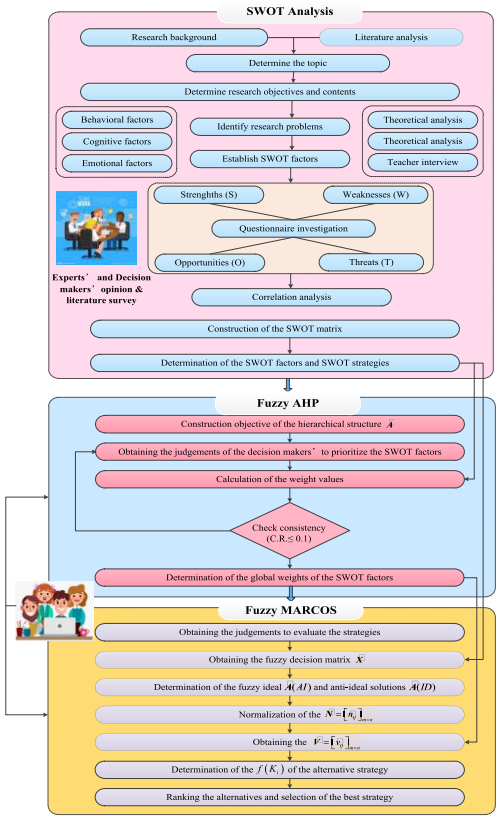


FIGURE 3. The computational steps of the proposed methodology.

For the purposes of this research, we used a questionnaire survey to gather information about the strengths, weaknesses, opportunities, and threats of online education at the Xinjiang University School of Electrical Engineering. Full-time professors and associate professors make up the majority of the 78 faculty members at the college. There are 1321 first-year students, 875 second-year students, and 29 doctorate students enrolled. The questionnaires were distributed online through ''Questionnaire Star'' to university students. In order to make the results more general, the questionnaire was distributed to subjects with/in different cities, genders, grades, and majors. According to statistics, the regions covered by the questionnaire include: Beijing, Shanghai, Jiangsu, Guangdong, Hainan, Xinjiang and other 30 provinces or municipalities. A total of 292 questionnaires were received, of which 265 were valid and 27 were invalid. The invalid questionnaires were eliminated based on response time, and the abnormal questionnaires with response time lower than 60s (too fast) or longer than 600s (unreasonably long) were eliminated based on pretest of the questionnaire completion. At the same time, we receive 126 suggestions from questionnaire. The contents of the questionnaire are shown in the Appendix. The questionnaire results are shown in Fig 4.

For this study, we recruited teachers and students representing various demographics within our school to collect data on online education's advantages and disadvantages during the epidemic. We created a SWOT matrix using 16 indicators, discussed our findings with an advisory panel, and then proposed four ways to improve the system.

B. SWOT FACTORS

Experts, related studies, and industry reports are used to compile the SWOT analysis. Table 4 provides a breakdown of these elements.

C. CASE STUDY

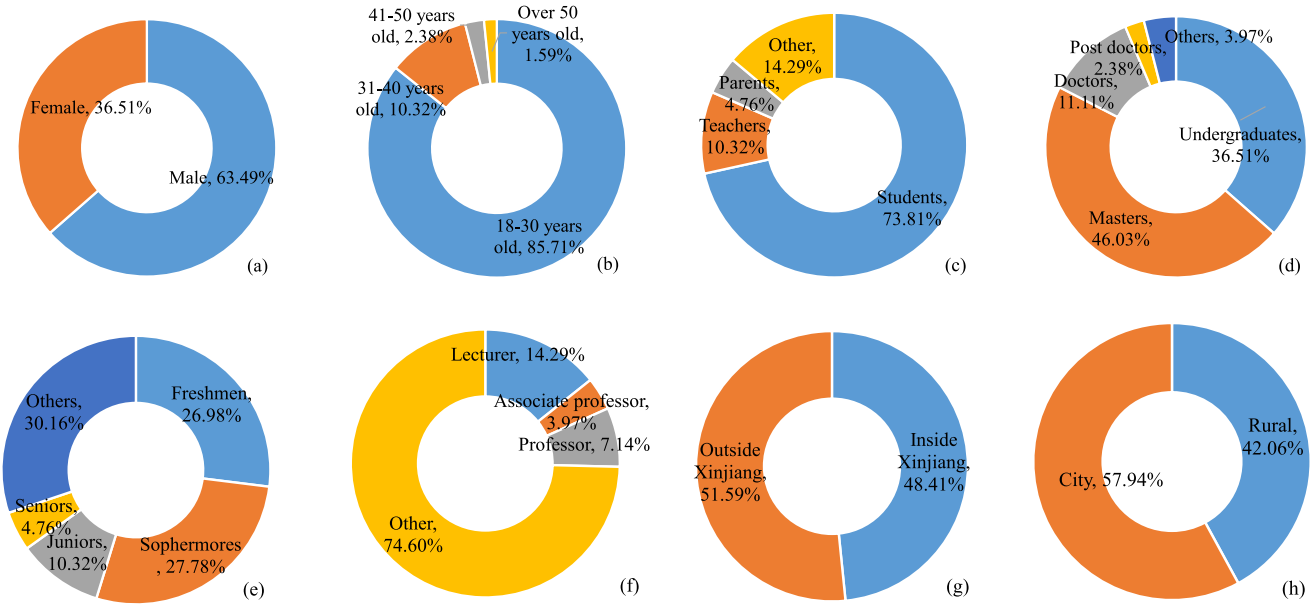
Organizations typically utilize multi-criteria decision-making methodologies such as the AHP to quantify the priority order of strategies after learning about the elements in the SWOT model. The SWOT analysis was used to identify the evaluation factors, and the AHP approach was used to calculate the weights of the factors.

Table 4 shows the SWOT matrix and its hierarchical structure based on 16 elements and four improvement strategies. Table 2 is used by a group of experts to prioritize the SWOT dimensions and elements. Tables 5-9 present the estimated weights and the resulting data. (C.R. $\leq$ 0.1).

The Fig. 5 shows how the weights of the SWOT dimensions and components are distributed according to their global weights.

There are four dimensions and 16 factors in SWOT, which are shown in Fig. 5. The more the weight, the more significant it is. The SWOT is ranked in the order of S > O > T > W. It is possible to overcome the weaknesses of online education by focusing on its virtues and taking use of more chances. The strength factors are ranked in the order of S4 > S2 > S1 > S3. One of the most popular advantages of online education for college students is the wide variety of information and forms, as well as the intelligence and endless playback options. In addition, online education has a huge impact. Second, there are no restrictions on where, when, or how long people can spend learning online. The weakness factors are ranked in that order: W3 > W4 > W2 > W1. Teachers and students are unable to make face-to-face communication, so the efficiency of humanized communication and emotional interchange between teachers and students is reduced by online learning. The opportunity factors are ranked in this order: O2 > O3 > O4 > O1. It is possible for students to develop their critical thinking skills in an online education environment, cultivate their enthusiasm for active learning, and thus encourage students to be more independent. The threat factors are graded in the following order: T2 > T1 > T3 > T4. Students face many obstacles in online education. Among them, online learning students need strong self-control ability to withstand various temptations in cyberspace, as professors and parents cannot properly supervise students' learning. Another major issue in online education is network instability. Teachers and students alike will be unable to attend class if the network fails. This is an unavoidable and uncontrollable issue. Rural students are its primary victims.

In Table 10, experts use the linguistic concepts in Table 3 to evaluate the SWOT criteria in Table 4 and come up with a group decision matrix.



(a) Subjects' gender distribution; (b) Subjects' age distribution; (c) Subjects' occupational distribution; (d) Subjects' educational background distribution; (e) Subjects' educational grade distribution; (f) Subjects' professional title distribution; (g) Subjects' location distribution; (h) Subjects' living distribution;

FIGURE 4. The questionnaire results.

TABLE 4. Constructed hierarchical model of swot matrix.

SWOT	Factors	Strategies
Strangths (S)	Fully respect students' personality and stimulate their learning motivation (S1) Not limited by time, place and space (S2) High learning freedom (S3) Diversified contents and forms, intelligent and unlimited playback (S4)	**SO**——By reforming and innovating the teacher led teaching mode, stimulate students' interest in learning, get rid of the boring learning state, create a good learning atmosphere and improve the teaching quality (A1)
Weakness (W)	Reduce vision (W1) Lack of humanized communication and passion(W2) Weak practical function (W3) Low efficiency and effectiveness of communication (W4)	**WO**——Promote the reform of student-centered teaching methods, give full play to students' enthusiasm, cultivate students' teamwork ability, writing ability and expression ability through group discussion and thematic discussion, and stimulate students' imagination and learning enthusiasm (A2)
Opportunities (O)	Multi-directional information exchange activity (O1) Under the network background, students have strong independent thinking ability, do not superstitious teachers, and can learn critically(O2) Diversity of students' learning motivation (O3) Beneficial to realize the autonomy of education (O4)	**ST**——Study the online and offline mixed teaching mode, improve the supervision of teachers, and avoid the inconvenience caused by complex network environment and network instability (A3)
Threats (T)	Network instability (T1) Requires strong self-control (T2) Online resources are numerous and complex (T3) (T4)	**WT**——The teaching method of combining teaching and discussion allows students to give full play to themselves and guide students to improve their self-discipline ability (A4)

TABLE 5. Evaluation of swot dimensions concerning the goal.

Dimensions	Matrix in linguistic terms				Matrix in fuzzy terms				Weights
	S	W	O	T	S	W	O	T	
S	1	AI	EI	MI	1	[6,8]	[1,2]	[2,4]	0.4283
W		1			[1/8,1/6]	1	[1/6,1/4]	[1/4,1/2]	0.0567
O		SI	1	MI	[1/2,1]	[4,6]	1	[2,4]	0.3731
T		MI		1	[1/4,1/2]	[2,4]	[1/4,1/2]	1	0.1419

(C.R.=0.016)

The extended initial fuzzy matrix $\tilde{X}$ of MARCOS method is created, including fuzzy anti-ideal $\tilde{A}(AI)$ and fuzzy ideal $\tilde{A}(AI)$ solutions. Extended initial fuzzy matrix is normalized using Eq. (6) based on benefit criteria of the proposed SWOT

TABLE 6. Evaluation of swot dimensions concerning the strangths.

Dimensions	Matrix in linguistic terms				Matrix in fuzzy terms				Weights
	S1	S2	S3	S4	S1	S2	S3	S4	
S1	1		AI	EI	1	[1/4,1/2]	[6,8]	[1,2]	0.2760
S2	MI	1	SI		[2,4]	1	[4,6]	[1/4,1/2]	0.3099
S3			1		[1/8,1/6]	[1/6,1/4]	1	[1/4,1/2]	0.0537
S4		MI	MI	1	[1/2,1]	[2,4]	[2,4]	1	0.3604

(C.R.=0.085)

TABLE 7. Evaluation of swot dimensions concerning the weaknesses.

Dimensions	Matrix in linguistic terms				Matrix in fuzzy terms				Weights
	W1	W2	W3	W4	W1	W2	W3	W4	
W1	1				1	[1/4,1/2]	[1/8,1/6]	[1/6,1/4]	0.0639
W2	MI	1		EI	[2,4]	1	[1/4,1/2]	[1,2]	0.2291
W3	AI	MI	1	EI	[6,8]	[2,4]	1	[1,2]	0.3975
W4	SI		MI	1	[4,6]	[1/2,1]	[1/2,1]	1	0.3096

(C.R.=0.021)

TABLE 8. Evaluation of swot dimensions concerning the opportunities.

Dimensions	Matrix in linguistic terms				Matrix in fuzzy terms				Weights
	O1	O2	O3	O4	O1	O2	O3	O4	
O1	1				1	[1/10,1/8]	[1/8,1/6]	[1/6,1/4]	0.0453
O2	EMI	1	EI	MI	[8,10]	1	[1,2]	[2,4]	0.3971
O3	AI		1	EI	[6,8]	[1/2,1]	1	[1,2]	0.3146
O4	SI			1	[4,6]	[1/4,1/2]	[1/2,1]	1	0.2431

(C.R.=0.016)

TABLE 9. Evaluation of swot dimensions concerning the threats.

Dimensions	Matrix in linguistic terms				Matrix in fuzzy terms				Weights
	T1	T2	T3	T4	T1	T2	T3	T4	
T1	1		MI	EI	1	[1/4,1/2]	[2,4]	[1,2]	0.2683
T2	MI	1	SI	MI	[2,4]	1	[4,6]	[2,4]	0.4527
T3			1	MI	[1/4,1/2]	[1/6,1/4]	1	[2,4]	0.1661
T4				1	[1/2,1]	[1/4,1/2]	[1/4,1/2]	1	0.1129

TABLE 10. Evaluation of alternatives by the group of experts.

Strategies	S1	S2	S3	S4	W1	W2	W3	W4	O1	O2	O3	O4	T1	T2	T3	T4
A_1	G	EG	MG	M	VP	EP	P	MP	G	EG	VG	M	VP	MP	M	MP
A_2	M	MP	M	EG	MP	M	MG	M	VG	EG	G	MG	P	M	M	MP
A_3	MG	M	MP	M	MG	MG	G	VG	P	MG	G	VG	VG	G	M	M
A_4	P	MP	VP	MP	MG	MP	P	G	M	MG	EG	MP	M	EG	G	EG

model. All SWOT factors are benefit criteria. The weighted fuzzy matrix $\tilde{\boldsymbol{V}}$ created by using global weights of the SWOT factors given in Fig. 5. The utility degree $(\tilde{\boldsymbol{K}}_j), \tilde{\boldsymbol{A}}_j$ values, utility functions for the ideal $f(K_j^+)$ and anti-ideal $f(K_j^-)$ solutions, $\tilde{T}_j$ values of alternative strategies are calculated and shown in Table 11. The defuzzification of $\tilde{\boldsymbol{K}}_j^-$, $\tilde{\boldsymbol{K}}_j^+$, $f(K_j^+), f(K_j^-)$ values and utility functions $f(K_j)$ of alternative strategies are obtained and the results are given in Table 12. The ranked order of the alternative strategies is obtained as $A_1 > A_2 > A_3 > A_4$.

According to the findings of the research, Xinjiang University should concentrate its efforts on internal and external aspects in online education that are nearly equal in importance. A_1— "by reforming and innovating the teacher-led teaching mode, stimulate students' interest in learning, get rid of the boring learning state, create a nice learning atmosphere and increase teaching quality"—is the most critical digital transformation method. At this point, China's education system urgently has to innovate and improve the teacher-led education model, whether it is done online or in school. A good learning environment can not only pique the students' interest in studying, but it can also increase the quality of instruction.

D. COMPARATIVE ANALYSIS

This section shows how the suggested approach is validated through a comparative analysis. The fuzzy VIKOR and TOPSIS approaches are used in this outcome comparison.

TABLE 11. Obtained $\tilde{A}_j$, $\tilde{K}_J(\tilde{K}_j^-, \tilde{K}_j^+)$ and $\tilde{T}_j$ values.

$\tilde{A}_j$	(A_j^l, A_j^m, A_j^u)			$\tilde{K}_j^-$	$(K_j^{-l}, K_j^{-m}, K_j^{-u})$			$\tilde{K}_j^+$	$(K_j^{+l}, K_j^{+m}, K_j^{+u})$			$\tilde{T}_j$	(t_j^l, t_j^m, t_j^u)		
$\tilde{A}_{aj}$	0.4288	0.4400	0.5822	$\tilde{K}_{aj}^-$				$\tilde{K}_{aj}^+$				$\tilde{T}_{aj}$			
$\tilde{A}_1$	0.7263	0.7504	0.7871	$\tilde{K}_1^-$	1.6937	1.7054	1.3519	$\tilde{K}_1^+$	0.7263	0.7504	0.9075	$\tilde{t}_1$	2.4200	2.4559	2.2595
$\tilde{A}_2$	0.7027	0.7439	0.7745	$\tilde{K}_2^-$	1.6387	1.6905	1.3302	$\tilde{K}_2^+$	0.7027	0.7439	0.8930	$\tilde{t}_2$	2.3414	2.4343	2.2232
$\tilde{A}_3$	0.6760	0.7014	0.7691	$\tilde{K}_3^-$	1.5764	1.5939	1.3210	$\tilde{K}_3^+$	0.6760	0.7014	0.8868	$\tilde{t}_3$	2.2524	2.2953	2.2078
$\tilde{A}_4$	0.5472	0.5712	0.6763	$\tilde{K}_4^-$	1.2760	1.2981	1.1615	$\tilde{K}_4^+$	0.5472	0.5712	0.7797	$\tilde{t}_4$	1.8232	1.8694	1.9413
$\tilde{A}_{jd}$	1.0000	1.0000	0.8673	$\tilde{K}_{jd}^-$				$\tilde{K}_{jd}^+$				$\tilde{T}_{jd}$			

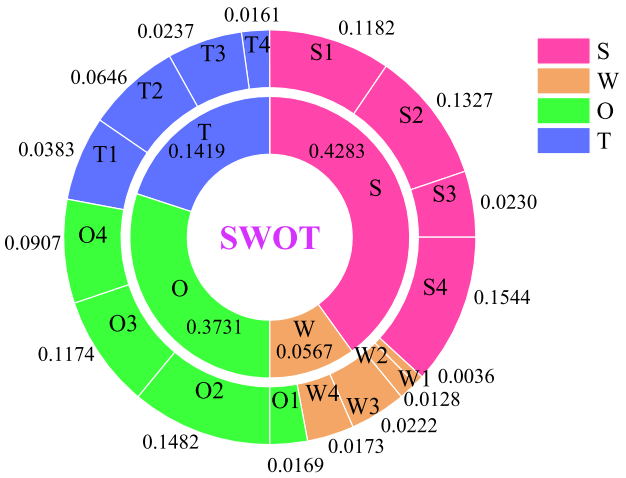


FIGURE 5. Weight distribution of the SWOT dimensions and factors.

TABLE 12. Results of fuzzy marcos method and ranked order of the strategies.

Strategies	$\tilde{K}_j^-$	$\tilde{K}_j^+$	$f(K_j^-)$	$f(K_j^+)$	$f(K_j)$	Order
A_1	1.6141	0.7837	0.3242	0.6678	0.6694	1
A_2	1.5875	0.7708	0.3189	0.6567	0.6446	2
A_3	1.5213	0.7414	0.3067	0.6294	0.5878	3
A_4	1.2585	0.6173	0.2554	0.5206	0.3879	4

TABLE 13. Results of fuzzy vikor method and ranked order of the strategies.

Strategies	S_j	Order	R_j	Order	Q_j	Order
A_1	1.3621	4	0.4635	4	0	1
A_2	1.5544	3	0.5351	3	0.2442	2
A_3	1.9052	2	0.6537	2	0.6679	3
A_4	2.1969	1	0.7411	1	1	4

Both fuzzy TOPSIS and fuzzy VIKOR [55] have been applied, with the results of the fuzzy TOPSIS and fuzzy VIKOR being presented in Table 13 and Table 14, respectively, as a result of these computations. Fig. 6 depicts a three-dimensional representation of the utility function distribution.

Fuzzy VIKOR, fuzzy TOPSIS, and fuzzy MARCOS algorithms are listed in Table 15 and Fig. 7, respectively, for

TABLE 14. Results of fuzzy topsis method and ranked order of the strategies.

Strategies	D_j^+	D_j^-	C_j	Order
A_1	0.0000	0.1565	1	1
A_2	0.0124	0.1442	0.9211	2
A_3	0.0237	0.1205	0.8356	3
A_4	0.1205	0.0000	0	4

TABLE 15. Compared ranked order of the strategies.

Strategies	Fuzzy VIKOR	Fuzzy TOPSIS	Fuzzy MARCOS
	Q_j	C_j	$F(K)$
A_1	1	1	1
A_2	2	2	2
A_3	3	3	3
A_4	4	4	4

comparison. It's clear from this comparison that the proposed strategy works and is right because the results acquired by comparing the three different approaches are all in sync.

Fuzzy MARCOS, fuzzy VIKOR, and fuzzy TOPSIS yielded the following ranked order for their alternative strategies: $A_1 > A_2 > A_3 > A_4$.

E. SENSITIVITY ANALYSIS

To determine the stability of the prioritizing of options, a sensitivity analysis is carried out in this section. This is necessary since a change in weight can lead to changes in the results. In addition, the sensitivity analysis can show how changes in priority weights of criteria affect the final prioritizing. Table 16's SWOT aspects are weighted differently in eight different instances. It is based on Table 17 case weights for each SWOT dimension that determines the weights of SWOT components. Sensitivity analysis is performed using these values. The fuzzy MARCOS approach is then applied to the weights of each example. These weights influence the utility function $F(K)$ values. Table 18 shows the utility function values of the strategies that were tested. The updated utility function values are used to determine the ranked order of the strategy choices. Table 19 shows the new rated positions of the tactics in various situations.

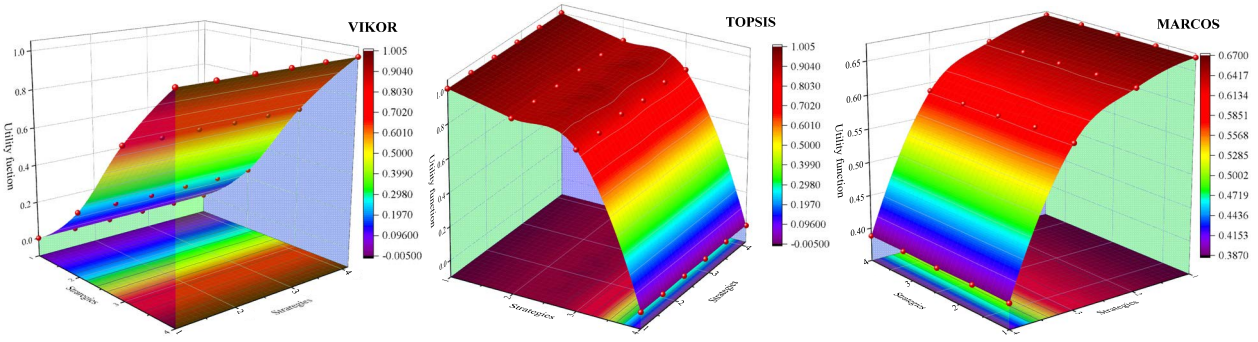


FIGURE 6. Three dimensional distribution of Utility function values of three methods.

TABLE 16. Different weights of the swot dimensions in different cases.

SWOT Dimensions	Base	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8
S	0.4283	0.250	0.200	0.300	0.300	0.400	0.400	0.350	0.350
W	0.0558	0.250	0.200	0.300	0.200	0.400	0.100	0.350	0.150
O	0.3731	0.250	0.300	0.200	0.300	0.100	0.400	0.150	0.350
T	0.1428	0.250	0.300	0.200	0.200	0.100	0.100	0.150	0.150

TABLE 17. The weights of the swot factors in different cases.

SWOT Dimensions	Base	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8
S1	0.1182	0.0295	0.0236	0.0355	0.0355	0.0473	0.0473	0.0414	0.0414
S2	0.1327	0.0332	0.0265	0.0398	0.0398	0.0531	0.0531	0.0465	0.0465
S3	0.0230	0.0058	0.0046	0.0069	0.0069	0.0092	0.0092	0.0081	0.0081
S4	0.1544	0.0386	0.0309	0.0463	0.0463	0.0618	0.0618	0.0540	0.0540
W1	0.0000	0.0009	0.0007	0.0011	0.0007	0.0014	0.0004	0.0012	0.0005
W2	0.0036	0.0032	0.0026	0.0038	0.0026	0.0051	0.0013	0.0045	0.0019
W3	0.0128	0.0055	0.0044	0.0067	0.0044	0.0089	0.0022	0.0078	0.0033
W4	0.0222	0.0043	0.0035	0.0052	0.0035	0.0069	0.0017	0.0060	0.0026
O1	0.0173	0.0042	0.0051	0.0034	0.0051	0.0017	0.0068	0.0025	0.0059
O2	0.0000	0.0370	0.0444	0.0296	0.0444	0.0148	0.0593	0.0222	0.0519
O3	0.0169	0.0293	0.0352	0.0235	0.0352	0.0117	0.0469	0.0176	0.0411
O4	0.1482	0.0227	0.0272	0.0181	0.0272	0.0091	0.0363	0.0136	0.0317
T1	0.1174	0.0096	0.0115	0.0077	0.0077	0.0038	0.0038	0.0057	0.0057
T2	0.0907	0.0162	0.0194	0.0129	0.0129	0.0065	0.0065	0.0097	0.0097
T3	0.0000	0.0059	0.0071	0.0047	0.0047	0.0024	0.0024	0.0036	0.0036
T4	0.0383	0.0040	0.0048	0.0032	0.0032	0.0016	0.0016	0.0024	0.0024

TABLE 18. Different weights of the swot dimensions in different cases.

SWOT Dimensions	Base	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8
A_1	0.2924	0.2924	0.2809	0.3039	0.3106	0.3276	0.3369	0.3159	0.3254
A_2	0.2815	0.2815	0.2767	0.2863	0.2875	0.2955	0.2954	0.2909	0.2919
A_3	0.2567	0.2568	0.2567	0.2565	0.2450	0.2549	0.2278	0.2558	0.2353
A_4	0.1694	0.1694	0.1858	0.1533	0.1570	0.1220	0.1398	0.1374	0.1474

TABLE 19. The order of the swot dimensions in different cases.

SWOT Dimensions	Base	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8
A_1	1	1	1	1	1	1	1	1	1
A_2	2	2	2	2	2	2	2	2	2
A_3	3	3	3	3	3	3	3	3	3
A_4	4	4	4	4	4	4	4	4	4

The term ''Base'' refers to the study's first findings. For a more comprehensive view, Fig. 8 shows the distribution of the ranked orders of the various techniques. The study's findings, however, reveal that the changes are minor and do not impair the study's usefulness. Another effective strategy in Chinese education today is to ''reform and innovate the teacher-led

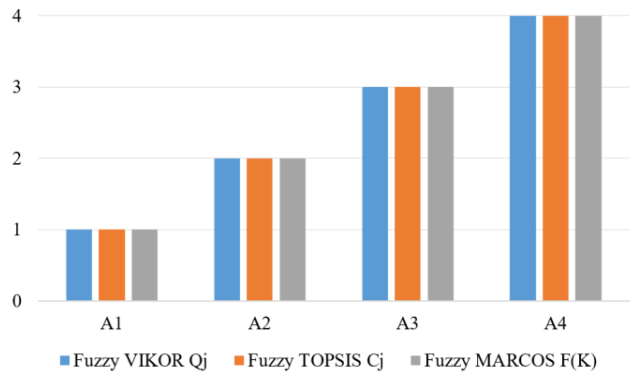


FIGURE 7. Compared ranked orders of the strategies.

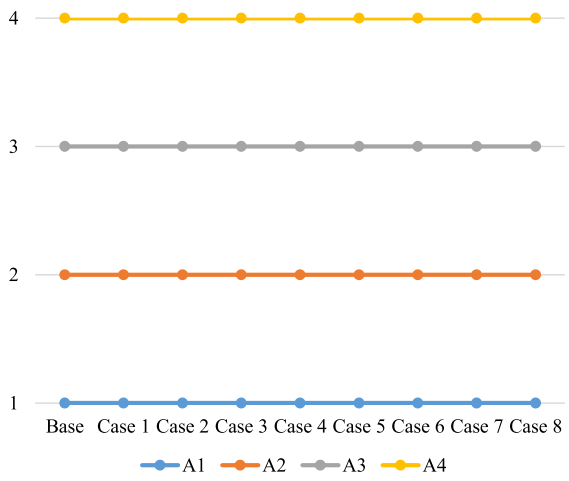


FIGURE 8. The comparison of the ranked orders of the strategies in different cases.

teaching mode, increase students' interest in learning, get rid of the boring learning state, create a positive learning atmosphere, and improve quality teaching''.

F. SUGGESTIONS FOR ONLINE LEARNING

Through the statistics of 126 opinions collected through the questionnaire survey, the following three aspects of opinions and measures to improve students' experience of ''online education'' are sorted out.

Firstly, a hierarchical arrangement of online learning programs is suggested for college students, considering the volume of study and research tasks at each stage. A flexible plan to increase exercise time and improve physical fitness can be designed. Regular exercise is particularly important during COVID-19 as it can enhance the human immune system. Suitable reduction of class time per session and an appropriate increase in the number of class sessions are recommended. Increasing the exercise time between classes can also be helpful, such as adding cervical spine relaxation exercises. Secondly, it is recommended that online interaction can be added based on requirements of different grades and the learning environment. In particular, lower-grade students (freshman and sophomore) who study at home or dormitory can be involved in more class discussions. The learning environment of home or dormitory could be inadequate and not suitable for online learning. Thus, improvement strategies of space design and renovation could be investigated in the future to create an online-learning-oriented environment. For instance, since the top two difficulties encountered in the online learning are ''Insufficient learning atmosphere'' and ''Inefficient learning'', a virtual learning community can be created through the efforts of teachers and students. Besides, psychological survey or one-on-one counseling could be conducted in a reasonable manner based on the grades, male and female students. More efforts should be invested in improving the mental health of students who are exposed to mental health risks, especially during the phase of regular epidemic prevention and control. To alleviate the psychological problems during online learning, it is recommended to add some interactive sessions in each online course to increase the interest of the class.

Thirdly, some of the strategies used in traditional face-to-face education are suggested to be integrated into the online learning. For example, students can minimize the focus time of electronic screens and use paper- based courseware or writing for course interaction. In this case, smart wearable devices can be suggested to assist the health management of students engaged in online learning. Appropriate scheduling of outdoor activity courses is proposed to relax students' physical and mental well-being (when outdoor activity is available), thus in turn promoting online learning efficiency and academic performance.

G. LIMITATION AND FUTURE DIRECTION

This paper investigates the college students' strengths, weaknesses, opportunities, and threats of online education in China under the regular epidemic prevention and control. The limitations of this work are as follows. Future studies could increase the questionnaire sample involving more countries to provide more comprehensive analysis under different online learning modes. In this study, major influencing factors were discussed such as grade, gender, educational background, and professional title. However, the above factors could be limited, and other potential factors can be considered, such as prevention and control policies for COVID-19, time and spatial variation, etc. The prolonged online learning duration and focus on electronic display could be the key weakness factors affecting college students' physical and mental health, such as eye strain, which is more crucial for under-age students. In addition, adjusting the size of the electronic screen usually provides coping strategies for students' online education. Future research can investigate the strengths, weaknesses, opportunities, and threats that online education brings to teachers, schools, and parents. Since online education is a process involving multiple aspects (such as teachers, students, schools and parents), the efforts and coping strategies from different aspects should be integrated to obtain a more

comprehensive solution, which will be the research direction in the future.

V. CONCLUSION AND PERSPECTIVE

College education is essential for knowledge transmission, technology innovation and sustainable development of society. While COVID-19 has transformed the traditional face-to-face education to be online learning, higher education has faced with new challenges and opportunities, strengths and weaknesses. This study conducts an online questionnaire survey that covers the majority of Chinese provinces or municipalities. The SWOT matrix is based on a literature review and the opinions of experts, teachers, and students in this discipline. SWOT analysis is being used in this research, which identifies 16 different evaluation criteria in order to determine which implementation plan will be most effective for online teaching in pandemics. Through the analysis and the data summarized in the questionnaire survey, it is found that the most important strengths, weaknesses, opportunities and threats in online education are as follows:

Diversified contents and forms, intelligent and unlimited playback (S4), Weak practical function (W3), Under the network background, students have strong independent thinking ability, do not superstitious teachers, and can learn critically (O2), Requires strong self-control (T2);

Based on the above results, using the fuzzy AHP and fuzzy MARCOS methods, the weights of elements were calculated to prioritize SWOT factors and establish the optimum plan for online education, as shown in the following figure. Based on these findings, the ideal technique is "by reforming and innovating the teacher led teaching mode, excite students' interest in learning, get rid of the boring learning state, create a nice learning atmosphere, and increase the teaching quality (A_1)". A clear expectation against online education will be established as a result of this strategy.

The following are some of the paper's most important findings and recommendations:

- An evaluation of online education based on a combination of these two methodologies has never been done before to the best of the authors' knowledge.
- A novel evaluation methodology for online education improvement strategies has been developed in this study. Comparative and sensitivity analyses confirm the validity and efficacy of the provided method.

  In the future, the following aspects should be examined:
- It is possible to use Fuzzy MCDM approaches like ANP, DEA, ELECTRE, TOPSIS, and VIKOR to solve comparable decision problems.
- This paper's SWOT index system is primarily based on the perspective of students. Despite the fact that the index is very simple, it is impossible to thoroughly examine it. To better understand how teaching decisions interact with social and emotional dimensions and impact students' online learning, we plan to conduct future research that examines the strengths, and weaknesses, opportunities and threats from the perspective of teachers, schools and society. We will create a SWOT matrix and conduct in-depth analyses.

  COVID-19 has changed the way and pattern of learning and teaching in higher education. Meanwhile, new problems have emerged regarding the online education performance, physical and mental health of college students. It is suggested to pursue an effective and productive online education to promote the higher education in post-pandemic era for a civilized society and sustainable development.

ACKNOWLEDGMENT

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APPENDIX SAMPLE QUESTIONNAIRE

Questionnaire of online learning for college students during the epidemic

1, Gender:
- □ Male
- □ Female

2, Your occupation:
- □ Students
- □ Teacher
- □ Parent
- □ Other

3, Your age group:
- □ 18-30 years old
- □ 31-40 years old
- □ 41-50 years old
- □ over 50 years old

4, Your educational background:
- □ Undergraduates
- □ Masters
- □ Doctor
- □ Post doctor
- □ Other

5, Your current grade:
- □ Freshman
- □ Sophomore
- □ Junior
- □ Senior
- □ Other

6, If you are a teacher, your title:
- □ Lecture
- □ associate professor
- □ professor
- □ Other

7, In your opinion, the teaching process of online education mainly adopts:
- □ Mainly explained by teachers

- □ teachers present briefly and succinctly, and give consideration to students thinking
- □ Students are mainly self-taught and teachers solve problems
- □ Teacher's explanation and students group discussion
- □ Other

8, Strengths:
- □ Fully respect student's personality and stimulate their learning motivation
- □ Not limited by time, place and space
- □ High learning freedom
- □ Diversified contents and forms, intelligent and unlimited playback
- □ Other

9, Weakness:
- □ Reduce vision
- □ Lack of humanized communication and passion
- □ Weak practical function
- □ Low efficiency and effectiveness of communication
- □ Other

10, Opportunities:
- □ Multi-directional information exchange activity
- □ Under the network background, students have strong independent thinking ability, do not superstitious teachers, and can learn critically
- □ Diversity of students learning motivation
- □ Beneficial to realize the autonomy of education
- □ Other

11, Threats:
- □ Network instability
- □ Requires strong self-control
- □ Online resources are numerous and complex
- □ Rely too much on student's self-study
- □ Other

12, What is the participation of students in online education?
- □ Very positive
- □ Positive
- □ Commonly
- □ Not positive
- □ Other

13, Will there be discussions and exchanges between students in class?
- □ Basically will
- □ Occasionally will
- □ Rarely will
- □ No
- □ Other

14, Do you have enough time to discuss and communicate with each other in class?
- □ Basically will
- □ Occasionally will
- □ Class time is limited, rarely will
- □ No
- □ Other

15, You are from:
- □ Inside Xinjiang
- □ Outside Xinjiang

16, Your home is:
- □ Urban
- □ Rural

17, You are welcome to fill in your questions and suggestions:

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HAIYUN WANG received the B.E. degree from the Department of Electrical Engineering, University of Xinjiang, in 1995, and the M.E. degree in the field of electrical engineering from the Dalian University of Technology, China, in 1996. She is currently a Professor with the Department of Electrical Engineering, University of Xinjiang, and the Deputy Secretary of the New Energy Industry Innovation Alliance. Her research interests include the key components of large wind turbine, the detection technology of wind turbines, and power system security and stability and its control and protection.

JIAHUI WU received the B.E. degree in control engineering from the Beijing University of Chemical Technology, in 2011, and the M.E. and Ph.D. degrees in the field of electrical engineering from Xinjiang University, China, in 2015 and 2018, respectively. She is currently an Associate Professor with the Department of Electrical Engineering, University of Xinjiang, and the Deputy Secretary of the New Energy Industry Innovation Alliance. Her research interests include power system stability and integration of the renewable resources.

MULADI MUHEDANER received the B.E. degree from the College of Transportation Engineering, Changsha University of Technology, Hunan, China, in 2018. He is currently a full-time Counselor at the Changsha University of Technology.His research interest lies in education of ethnic minority students in China.

SANIYE MAIHEMUTI received the B.E. and M.E. degrees in electrical engineering from Xinjiang University, China, in 2016 and 2018, respectively. She is currently pursuing the Ph.D. degree in the field of comprehensive energy management and control with the School of Electrical Engineering, University of Xinjiang. Her research interests include integrated energy system planning, operation, and control with renewable energy resources.