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Research Article

A Novel Online Education Reform Model Based on Risky Decision-Making under the Situation of Internet Plus

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In the new situation of Internet plus, information technology has been widely applied in education, and hence online education has attracted wide attention from all walks of life. Today's society is a risk society, and risk is everywhere. Online education reform is also risky, which is determined by many reasons. Some risks will cause certain losses to the online education reform, so based on risky decision-making, it is necessary to carry out online education reform under the new situation of Internet plus. At first, the risky decision-making in online education reform is analyzed, which is the risk of online education reform in risk society and the allocation logic of online education reform. Then, taking interval type-2 fuzzy logic (IT2FL) as the information environment, this study proposes the optimal risky decision-making method based on IT2FL utility functions, IT2FL entropy, and risk preference factor of online education reform to solve the multipath risky decision-making problem of online education reform. Finally, the experimental results show that, in the risky decision-making model, the decision-maker's risk preference has an impact on the path weight and the ranking of the scheme, and the idea has a certain reference role for risky decision-making. Compared with the three benchmarks, the proposed method has the fewest ranking time with the same ranking results.

1. Introduction

Society today is a risk society, from Ulrich Beck, a recognizable German author in environmental sociology [1]. At the same time, he argues that a risk society is a disaster society [2]. There is a danger that the anomaly will become the norm. In this way, the risk is universal and objective in today's society, which is a fact we should face squarely. On the other hand, as risks may cause disasters to human society, they should be prevented and avoided. As an artificial social practice, online education reform also has inevitable risks. Facing the risks in online education reform, what kind of attitude should we hold and what kind of actions should we take? A clear understanding of the risks in education reform is helpful to reduce the errors caused by the risks and enhance the effectiveness of online education reform, so the research on the risks in online education reform has a certain theoretical and practical significance [3–5]. Education reform in a risky social environment is risky decision-making. The logic of risk distribution is equalization, but the vulnerable groups in the current society will bear more risks. Therefore, we must consider the online education reform within the perspective of risk, call for decision-making ethics, strengthen institutional prevention, and establish the decision-making system of online education reform with multiple participation.

The new situation of Internet plus drives the reform of online education. Internet plus emphasizes the integration of the Internet and traditional industries [6, 7]. With the continuous promotion and progress of Internet plus, Internet plus education has become one of the new development directions in education [8, 9]. The common feature of Internet plus education is to make up for the deficiency of teaching by relying on online courses and making use of the advantages of convenient access to resources and flexible teaching methods. However, the disadvantage is that schools or colleges generally do not have a clear position on the role of online education. In addition, the variety of online education courses increases the difficulty for teachers to choose. In particular, each course has obvious differences in content and the proportion of practice, leading to the independent setting of education based on Internet plus according to the characteristics of the course, so as to better meet the needs of teachers and students.

The online education reform has brought an unprecedented impact on education, including the following four aspects: (i) Educational resources are transformed from segmentation to sharing. The idea of sharing educational resources arises from the rise of massive open online courses (MOOC) [10]. Apart from MOOC, as another important phenomenon, Open Educational Resources (OER) is another important trend of education development in recent years [11, 12]. No matter MOOC or OER, the revolutionary change it brings is that education breaks through the traditional time and spatial limitation and solves the unbalanced distribution of educational resources. (ii) The shift in the form of learning from linear to nonlinear: linear learning is planned and purposeful learning based on the logic and sequence of subject knowledge within a certain time range. Linear learning is the most important form of student learning. However, the disadvantages of this model are also obvious. Its prominent disadvantage is that the learning process is step-by-step, which cannot take into account the personalized and diversified learning needs of students. Different from linear learning, nonlinear learning is not in accordance with the unified learning plan. But according to the students' personalized learning differences, students choose the learning content, learning process, and learning way [13–15]. (iii) The course reform changes from structured course to unstructured course. (iv) Educational technology changes from auxiliary means to deep integration with education. Given the above, it is necessary to reform online education based on risky decision-making under the new situation of Internet plus.

Accordingly, the main contributions of this paper are summarized as follows: (i) the risky decision-making in online education reform is studied, which is the risk of online education reform in risk society and the allocation logic of online education reform. (ii) The optimal risky decision-making method based on interval type-2 fuzzy logic (IT2FL) utility functions, IT2FL entropy, and risk preference factor of online education reform is proposed to solve the multipath risky decision-making problem of online education reform.

The rest of this paper is organized as follows. Section 2 reviews the related work. In Section 3, risky decision-making in online education reform is studied. In Section 4, the risky decision-making of IT2FL and entropy in novel online education reform mode is proposed, and the risk preference factor is introduced. The experimental results are shown in Section 5. Section 6 concludes this paper.

2. Related Work

The research on risky decision-making has put forward different views in people's rational judgment and choice. There are some risky decision-making strategies have been proposed. In [16], the authors explored the effects of optimism on self-framing and risky decision-making. In [17], a normal distribution-based interval number risky decision-making method was proposed to rank schemes. In [18], the author determined whether the risky decision-making of medicine users was increased. In [19], the authors examined the effects of physiological and combined mental stress on decision-making under risk and whether risk-taking differed between women and men.

With the continuous development of information technology, vigorously promoting "Internet plus education" and sharing high-quality education and teaching resources can be regarded as an effective means to solve the current problems of basic education. In [20], the mode of ideological and political education under the Internet plus environment was proposed to ensure the effectiveness of education. In [21], the Internet plus education-based innovative personnel training mode was studied. In [22], a novel smart learning-based education paradigm was proposed to enhance the teaching effects. In [23], the authors analyzed the transformation of film education mode in Internet plus. In [24], innovative methods were proposed for improving the talent cultivation of software engineering under the perspective of Internet plus.

IT2FL has become a hot issue in current academic research. In [25], the IT2FL controller design was proposed to control chaos and associated instability in a nonlinear dynamical power system. In [26], a novel calculation-effective IT2FL controller was designed. In [27], an IT2FL mutual subset fuzzy neural inference system was proposed. In [28], the IT2FL method was used for the route planning problem. In [29], an integrated ranking algorithm GRAP is proposed to solve decision-making problems by combining grey relational analysis, rank-sum, and preference ranking organization method enrichment evaluation methods. In [30], a rough set-based ranking algorithm is proposed to deal with the decision-making problem. In [31], a possibility degree-based decision-making method is proposed.

3. Risky Decision-Making in Online Education Reform

3.1. *Risk of Online Education Reform in Risk Society.*

The risks of modern society are the results of the increasing extremes of modernization and economization. The online education reform may be risky in any social context. The reform is an attempt to replace the old paradigm with a new one, but the new paradigm is not superior to the old model in all respects, and this "replacing the old with the new" often comes at the expense of what is good in the old model. Due to the existence of social differences and different interest groups, a reform may harm the interests of another group while benefiting one group, leading to contradictions and conflicts. The reform is also risky due to the deficiency and error of people's subjective understanding. In addition, online education reform is an exploratory activity, and the implementation of reform is a dynamic process, which means that uncertainty and risk are inherent dimensions of education reform. Particularly in the risk society, the risks of online education reform are even greater.

3.1.1. *Excessive Trust and Reliance on Education Experts.*

Beck, Giddens, and other scholars believe that risk in modern society is different from that in traditional society. The source of risk is no longer ignorance but knowledge, which is mainly brought by decision-making. Because modern society is a society ruled by science and technology, experts of all walks of life have gained people's trust, and the decisions made by these experts with professional knowledge make people feel safe. However, social risks come out when science and technology develop uncontrollably and are used irrationally.

The current online education reform in China is also facing a similar situation. Important education reforms are planned and implemented by some experts whose views influence education policy. On the other hand, due to the special knowledge on an educational part by education experts, officials in education departments, teachers, and people all believe in the views of education experts, and the views of experts have been become an important standard to measure the fact.

Although education experts are people who have more research on education, their understanding is not always correct and comprehensive. At first, the consequences of reform cannot be fully predicted. The uncertainty, concealment, lag, and sudden characteristics of risks make it impossible for education experts to predict when formulating reform plans. Then, due to the limitation of knowledge, experts may have wrong understanding and judgment. Many experts who participate in online education reform are scholars who study advanced knowledge in colleges or scientific research institutions. Their alienation from the front-line educational practice makes them underestimate the complexity of practice. Finally, experts' understanding of "what is ideal education" may be different from teachers' understanding, so online education reform may be planned against the will of the general public. In addition, experts may carry out sensationalist reforms for their own purposes (e.g., seeking prestige, political achievements, and economic benefits) regardless of facts. In this case, people's trust and reliance on experts and their expertise to some extent breed the risk of online education reform.

3.1.2. Risk Transmission and Intensified Diffusion. The development of communication tools, especially the popularization of the Internet, and the accelerated flow of information around the world have led to the alienation of the social structure into a network virtual society in a certain sense, which makes the spread and diffusion of risk present an overwhelming trend. Giddens pointed out that one of the characteristics of modernity is that the far-reaching events and actions continue to affect our lives, and this impact is still increasing. In Giddens's view, the high extension of modern society in the space-time structure makes people can only rely on the symbolic system and expert system to obtain information and reach a consensus. However, if there are problems in the symbolic system and expert system for providing and interpreting information, the society may fall into high tension and risk brought by emergencies.

At present, China has also entered a globalized and information-based society. We can see that a local online education reform step will spread to the whole country and even the world in an instant. In the process of information transmission, people's different understanding, processing, and even misinformation, coupled with the rendering of the media, may expand tension and risks. The spread of a large amount of information is actually creating and expanding risks to some extent because people who lack professional knowledge do not know the truth, and uncontrolled and excessive information will only bring them more confusion and panic.

3.2. The Allocation Logic of Online Education Reform. Beck emphasizes that the transformation of risk society means the transformation of new contradiction and distribution mode. In a risk society, the allocation logic of risk is different from that of wealth. The original hierarchical allocation logic of wealth will be disrupted, and finally, the situation of risk equalization will emerge; that is, "poverty is hierarchical, but smog is democratic." On the other hand, Beck states that the risk is still allocated by the hierarchy in fact. We are in an era of overlapping industrial society and risk society, and the two allocation logics play a powerful role in it. Wealth accumulates mainly at the top, while risk accumulates at the bottom. Poverty absorbs a lot of risks, and wealth obtains security and avoids risk. That is to say, in current society, the risk does not eliminate the hierarchy but depends on it, and social stratification plays a filtering or enlarging effect of risk.

In China, the ability and potential of people of different professions and education classes to deal with the risks of online education reform are obviously quite different. In view of the unemployment risk caused by the expansion of higher education and the financial crisis, families with strong economic capital, cultural capital, and social capital will obviously have a greater ability to avoid the unemployment risk for their children. The online education reform is planned by the powerful groups in society, but the risks are more shouldered by the vulnerable groups in society, which is obviously unreasonable and contrary to our goal of building a harmonious society. Moreover, the harm of risk will eventually spread to the whole society. Therefore, actions must be taken to prevent and reduce the risks brought by online education reform.

4. The Risky Decision-Making of Interval Type-2 Fuzzy Logic and Entropy in Novel Online Education Reform Mode

To sum up, online education reform presents fuzziness and uncertainty, so risky decision-making in a fuzzy environment is attracting more and more attention from experts and scholars. This section takes interval type-2 fuzzy logic (IT2FL) as the information environment and proposes two IT2FL utility functions based on the cut set. These two utility functions effectively extract all information of IT2FL, which is conducive to reducing the decision-making error of online education reform. The risky decision-making model of IT2FL and entropy in novel online education reform mode based on utility function, entropy, and risk preference factor is constructed to observe the influence of decision-makers' risk preference on attribute weight and decision scheme ordering by solving the model.

4.1. Two IT2FL Utility Functions. Based on the idea of the cut set, this section proposes two utility functions of IT2FL to measure the advantages and disadvantages of IT2FL. The larger the utility function $U(P)$ is, the better P is.

Definition 1. (T2FS). P is a type-2 fuzzy set (T2FS) in domain X; if for any $x \in X$ and $u \in J_X$, there is $\mu_P(x,u) \in X\,(\forall x \in X,\ u \in J_X \in [0,1])$.

Assume that $P = (P^U, P^L)$ is an IT2FL, where P^U and P^L are the upper bound and lower bound of IT2FL, respectively. Then, P can be defined as follows:

$$P = \begin{pmatrix} (p_1^U),(p_2^U),(p_3^U),(p_4^U);H(P^U) \\ (p_1^L),(p_2^L),(p_3^L),(p_4^L);H(P^L) \end{pmatrix}, \quad (1)$$

where $0 \le p_1^* \le p_2^* \le p_3^* \le p_4^* \le 1$ and $0 \le H(P^L) \le H(P^U) \le 1$. $*$ represents L or U, and P^U and P^L are the Interval Type-1 Fuzzy Set (IT1FS), respectively. The membership of p_2^* and p_3^* is equal to $H(P^*)$. Particularly, when $p_2^* = p_3^*$, the IT2FL degenerates into an interval type-2 triangular fuzzy set and meets the relation $p_1^U \le p_1^L \le p_4^L \le p_4^U$.

Let $\overline{\mu_P}(x)$ and $\underline{\mu_P}(x)$ denote the upper membership function and α cut set-based IT2FL P. Two IT2FL utility functions $U_1(P)$ and $U_2(P)$ based on cut set can be defined as follows:

$$U_1(P) = \begin{pmatrix} \dfrac{1}{p_4^U - p_1^U}\displaystyle\int_0^{h+}\int_{p_1^U}^{p_4^U}\left(\dfrac{P^U_{(\alpha)l} + P^U_{(\alpha)r}}{2} + \log\dfrac{x}{2}\left(P^U_{(\alpha)l} + P^U_{(\alpha)r}\right)\right)\overline{\mu_P}(x)\mathrm{d}x\mathrm{d}\alpha + \\ \dfrac{1}{p_4^L - p_1^L}\displaystyle\int_0^{h+}\int_{p_1^L}^{p_4^L}\left(\dfrac{P^L_{(\beta)l} + P^L_{(\beta)r}}{2} + \log\dfrac{y}{2}\left(P^L_{(\beta)l} + P^L_{(\beta)r}\right)\right)\underline{\mu_P}(y)\mathrm{d}y\mathrm{d}\beta \end{pmatrix}, \quad (2)$$

$$U_2(P) = \begin{pmatrix} \dfrac{1}{p_4^U - p_1^U}\displaystyle\int_0^{h+}\int_{p_1^U}^{p_4^U}\left(\dfrac{P^U_{(\alpha)l} + P^U_{(\alpha)r}}{2} + \dfrac{x}{2}\left(1 - \log\left(P^U_{(\alpha)l} + P^U_{(\alpha)r}\right)\right)\right)\overline{\mu_P}(x)\mathrm{d}x\mathrm{d}\alpha + \\ \dfrac{1}{p_4^L - p_1^L}\displaystyle\int_0^{h+}\int_{p_1^L}^{p_4^L}\left(\dfrac{P^L_{(\beta)l} + P^L_{(\beta)r}}{2} + \dfrac{y}{2}\left(1 - \log\left(P^L_{(\beta)l} + P^L_{(\beta)r}\right)\right)\right)\underline{\mu_P}(y)\mathrm{d}y\mathrm{d}\beta \end{pmatrix}, \quad (3)$$

where $h^+ = H(P^U)$ and $h^- = H(P^L)$ represent the membership values of the middle two parameters in the upper membership and lower membership, respectively. l and r represent the left cut point and right cut point under the cut set, respectively.

Both utility functions meet the following two properties:

(1) For any fuzzy set P IT2FL, $U_i(P) \in [0,4]$ $(i = 1,2)$

(2) $U_i(P^+) = 4$ and $U_i(P^-) = 0$, where $P^+ = ((1,1,1,1;1),(1,1,1,1;1))$ and $P^- = ((0,0,0,0;0),(0,0,0,0;0))$

For any fuzzy set P and Q of IT2FL, the utility functions of P and Q have three partial order relations, which are listed as follows:

(1) If $U_i(P) < U_i(Q)$, then P is inferior to Q, which can be expressed as $P < Q$

(2) If $U_i(P) > U_i(Q)$, then P is better than Q, which can be expressed as $P > Q$

(3) If $U_i(P) = U_i(Q)$, then P is equal to Q, which can be expressed as $P \cong Q$

4.2. IT2FL Entropy. Entropy is a measure of the uncertainty of things. In this section, the IT2FL entropy is proposed to measure the uncertainty of IT2FL. Furthermore, the three new uncertainty measures of IT2FL are proposed to describe the uncertainty of IT2FL, which are fuzziness measure (ζ), hesitation measure (θ), and interval measure (δ).

$$\zeta_P = \sqrt{\frac{\left(\zeta_P^U\right)^2 + \left(\zeta_P^L\right)^2}{2}}, \quad (4)$$

$$\theta_P = \sqrt{\frac{\left(\theta_P^U\right)^2 + \left(\theta_P^L\right)^2}{2}}. \quad (5)$$

The interval measure (δ) of IT2FL can be defined as follows:

$$\delta_P = \delta_P^U - \delta_P^L = \int_{p_1^U}^{p_4^U}\overline{\mu_P}(x)\mathrm{d}x - \int_{p_1^U}^{p_4^U}\underline{\mu_P}(x)\mathrm{d}x, \quad (6)$$

where $\delta_P^U = \int_{p_1^U}^{p_4^U}\overline{\mu_P}(x)\mathrm{d}x$ and $\delta_P^L = \int_{p_1^U}^{p_4^U}\underline{\mu_P}(x)\mathrm{d}x$ represent the areas of upper membership and lower membership, respectively. The larger the area difference between the two is, the larger the interval measure will be. It is easy to prove that $\zeta_P = \zeta_P^C \in [0,(1/2)]$, $\theta_P = \theta_P^C \in [0,(1/2)]$, and $\delta_P = \delta_P^C \in [0,1]$.

Supposing that $P = (P^U, P^L)$ is a fuzzy set of IT2FL, the entropy $E(P)$ of the fuzzy set P of IT2FL based on the above three uncertain measures is defined as follows:

$$E(P) = -\frac{2}{3\ln 2}\begin{pmatrix} \zeta_P \ln \zeta_P + (1-\zeta_P)\ln(1-\zeta_P) + \\ \theta_P \ln \theta_P + (1-\theta_P)\ln(1-\theta_P) + \\ \frac{\delta_P}{2}\ln\frac{\delta_P}{2} + \left(1-\frac{\delta_P}{2}\right)\ln\left(1-\frac{\delta_P}{2}\right) \end{pmatrix}. \quad (7)$$

For any fuzzy set P of IT2FL, $E(P)$ meets the following four properties:

(1) If and only if P is a definable set, then $E(P) = 0$; that is, $\zeta_P = \theta_P = \delta_P = 0$
(2) $E(P) = f(\zeta_P, \theta_P, \delta_P)$ is a continuous real-valued function, which increases at larger ζ_P, θ_P, and δ_P
(3) For any fuzzy set P of IT2FL, $0 \le E(P) \le 1$
(4) $E(P) = E(P^C)$

The uncertainty measure of IT2FL is analyzed from three aspects, and the entropy of IT2FL is proposed based on the uncertainty measure, which makes the entropy equation more scientific and reasonable.

4.3. Risk Preference Factor of Online Education Reform. This section introduces the risk preference factor to reflect the different risk attitudes of decision-makers during the risky decision-making of online education reform. Risk preference is the degree of the decision-maker's preference for risk, and its uncertainty is difficult to measure. Therefore, for this uncertainty, the decision-maker's risk attitude and tendency are the concrete embodiment of risk preference. According to the different risk preference of online education reform, it can be divided into online education reform risk aversion type, online education reform relative risk aversion type, online education reform risk-neutral type, online education reform relative risk preference type, and online education reform risk preference type. Therefore, according to different risk attitudes of decision-makers, the risk preference factors are set as follows:

$$\Phi(x) = \begin{cases} 1, & \text{online education reform risk preference type,} \\ \Phi_1, & \text{online education reform relative risk preference type } \Phi_1 \in (0,1), \\ 0, & \text{online education reform risk neutral type,} \\ \Phi_2, & \text{online education reform relative risk aversion type } \Phi_2 \in (-1,0), \\ -1, & \text{online education reform risk aversion type.} \end{cases} \quad (8)$$

4.4. Online Education Reform Optimal Decision-Making Method. Taking IT2FL as the information environment, this section proposes the optimal risky decision-making method based on IT2FL utility functions, IT2FL entropy, and risk preference factor of online education reform to solve the multipath risky decision-making problem of online education reform. Suppose that there are m paths Path_j $(1 \le j \le m)$ and n online education scheme sets x_i $(1 \le i \le n)$. The weight of the path $\omega = (\omega_1, \omega_2, \ldots, \omega_m)$, $\omega_j \ge 0$, and $\sum_{j=1}^{m} \omega_j = 1$. Let $P = (p_{ij})_{n\times m}$ be the risky decision-making matrix of online education reform. Each of p_{ij} is the fuzzy set of IT2FL, which represents the decision value of decision-maker for online education reform scheme x_i under path Path_j. Path types are generally divided into benefit-type and cost-type. When the path types are different, $P = (p_{ij})_{n\times m}$ needs to be normalized to obtain the normalized risky decision-making matrix $R = (r_{ij})_{n\times m}$, where r_{ij} is the normalized form of p_{ij}. To be specific, the online education reform optimal decision-making process can be summarized as follows:

(i) *Step 1.* Normalize the original decision-making matrix.

$$r_{ij} = \begin{cases} p_{ij}, & j \text{ is the benefit} - \text{type path,} \\ p_{ij}^{C}, & j \text{ is the cost} - \text{type path.} \end{cases} \quad (9)$$

(ii) *Step 2.* Calculate the utility functions $U_1 = (r_{ij})_{n\times m}$, $U_2 = (r_{ij})_{n\times m}$ and IT2FL entropy $E = (r_{ij})_{n\times m}$ of the normalized risky decision-making matrix of online education reform.
(iii) *Step 3.* An optimal linear programming model based on IT2FL utility functions, IT2FL entropy, and risk preference factor of online education reform is constructed to solve the optimal path weight. There are two cases of path weight, which are fully unknown and partially known.
(iv) *Step 4.* The ordered weighted averaging (OWA) operator [32] is used to aggregate the path weight and utility function of each scheme to obtain the comprehensive utility value $U(x_i)$, and the maximum value is the optimal scheme of online education reform.

5. Experiment and Result Analysis

5.1. Setup. The experiment is running on a computer with Intel i9-10850K, CPU 3.6 GHz, and 32 GB RAM 3333 MHz. The decision-maker selects one from the following five ways to reform online education, including live steaming interaction (x_1), online-merge-offline (x_2), modular reconstruction of course resources (x_3), MOOC (x_4), and home-school linkage (x_5). The teaching quality (Path_1), online platform supervision (Path_2), strategic positioning (Path_3), and development path (Path_4) are used to evaluate the risky decision-making of online education reform. The evaluation results are scaled by very low

(VL), low (L), relatively low (RL), medium (M), relatively high (RH), high (H), and very high (VH). As seen from Table 1, each scale corresponds to a fuzzy set of IT2FL, and the evaluation results are listed in Table 2.

Table 1: Scale and the corresponding fuzzy set of IT2FL.

Scale	The corresponding fuzzy set of IT2FL
VL	{(0, 0.05, 0.05, 0.1; 1), (0, 0, 0.05, 0.05; 0.9)}
L	{(0, 0.05, 0.1, 0.2; 1), (0, 0.1, 0.1, 0.2; 0.9)}
RL	{(0.2, 0.3, 0.3, 0.5; 1), (0.2, 0.3, 0.3, 0.4; 0.9)}
M	{(0.4, 0.5, 0.5, 0.7; 1), (0.4, 0.5, 0.5, 0.6; 0.9)}
RH	{(0.6, 0.7, 0.7, 0.9; 1), (0.6, 0.7, 0.7, 0.8; 0.9)}
H	{(0.8, 0.9, 0.9, 1; 1), (0.9, 0.9, 0.9, 1; 0.9)}
VH	{(0.9, 1, 1, 1; 1), (0.95, 1, 1, 1; 0.9)}

5.2. Multipath Risky Decision-Making of Online Education Reform. The specific steps of multipath risky decision-making of online education reform are summarized as follows:

(i) *Step 1.* Let $P = (p_{ij})_{5\times4} = R = (r_{ij})_{5\times4}$.

(ii) *Step 2.* Equations (2) to (6) are used to calculate utility function $U_t(r_{ij})_{5\times4}$ and IT2FL entropy $E_t(r_{ij})_{5\times4}$, which are expressed as follows:

$$U_1(r_{ij})_{5\times4} = \begin{bmatrix} 1.5995 & 1.1432 & 1.4995 & 0.3561 \\ 1.4124 & 0.7152 & 1.4995 & 1.4995 \\ 1.8829 & 0.3561 & 1.4995 & 0.7152 \\ 1.4995 & 0.0717 & 1.8872 & 0.7152 \\ 1.4995 & 1.1314 & 0.7152 & 1.1314 \end{bmatrix},$$

$$U_2(r_{ij})_{5\times4} = \begin{bmatrix} 1.6056 & 1.2735 & 1.6056 & 0.5737 \\ 1.2735 & 0.8599 & 1.6056 & 1.6056 \\ 1.6480 & 0.5737 & 1.6056 & 0.8599 \\ 1.6056 & 0.2046 & 1.8460 & 0.8599 \\ 1.6056 & 1.2735 & 0.8599 & 0.8599 \end{bmatrix}, \quad (10)$$

$$E(r_{ij})_{5\times4} = \begin{bmatrix} 0.6722 & 0.6242 & 0.6722 & 0.6242 \\ 0.6242 & 0.6276 & 0.6722 & 0.6722 \\ 0.5479 & 0.6242 & 0.6722 & 0.6276 \\ 0.6722 & 0.6722 & 0.5479 & 0.6276 \\ 0.6722 & 0.6242 & 0.6276 & 0.6242 \end{bmatrix}.$$

(iii) *Step 3.* When the path weight is fully unknown and the utility function is $U_1(r_{ij})_{5\times4}$, the path weight values and changing images under different risks are shown in Table 3 and Figure 1, respectively.

(iv) When the path weight is fully unknown and the utility function is $U_2(r_{ij})_{5\times4}$, the path weight values and changing images under different risks are shown in Table 4 and Figure 2, respectively.

(v) As can be seen from Figures 1 and 2, when the decision-maker's risk preference Φ changes from −1 to 1, ω_1 and ω_3 gradually decrease, while ω_2 and ω_4 gradually increase.

(vi) *Step 4.* The OWA operator is used to aggregate the path weights and utility functions under different paths in each scheme to obtain the comprehensive utility values $U_1(x_i)$ and $U_2(x_i)$, as shown in Tables 5 and 6.

As can be seen from Tables 3–6, as Φ of decision-makers' risk preference changes from −1 to 1, when the utility function is $U_1(r_{ij})_{5\times4}$ and $U_2(r_{ij})_{5\times4}$, respectively, the weights ω_1 and ω_3 gradually decrease, while the ω_2 and ω_4 gradually increase. When the utility function is $U_1(r_{ij})_{5\times4}$ and the decision-maker's risk preference Φ changes from 1 to 0, the ranking is $x_2 \succ x_5 \succ x_1 \succ x_3 \succ x_4$. When the risk preference Φ changes from 0.5 to 1, the ranking changes to $x_2 \succ x_1 \succ x_5 \succ x_3 \succ x_4$. When the utility function is $U_1(r_{ij})_{5\times4}$ and the risk preference changes from −1 to 1, the ranking changes to $x_2 \succ x_5 \succ x_1 \succ x_3 \succ x_4$.

When the path weight is partially known and the utility function is $U_1(r_{ij})_{5\times4}$ and $U_2(r_{ij})_{5\times4}$, the path weight obtained under different risk preferences of decision-makers is the same; that is, $\omega = (0.3, 0.1, 0.4, 0.2)$. Therefore, when the utility function is $U_1(r_{ij})_{5\times4}$ and $U_2(r_{ij})_{5\times4}$, respectively, the utility value and ranking result of the scheme can be obtained by using the OWA operator, as shown in Table 7.

5.3. Comparison Analysis

5.3.1. Ranking Results. In order to explore the validity of the proposed method in this paper, the ranking results of the proposed method are compared with those of the existing methods. Suppose that the path weight is set as $\omega = (0.3, 0.1, 0.4, 0.2)$.

(1) In [29], an integrated ranking algorithm GRAP is proposed to solve decision-making problems by combining grey relational analysis, rank-sum, and preference ranking organization method enrichment evaluation methods. $R(x_1) = 1.6425$, $R(x_2) = 1.8726$, $R(x_3) = 1.6893$, $R(x_4) = 1.4192$, and $R(x_5) = 1.7368$. So the ranking of the scheme is $x_2 \succ x_5 \succ x_1 \succ x_3 \succ x_4$.

(2) In [30], a rough set-based ranking algorithm is proposed to deal with the decision-making problem. Based on this, the ranking is summarized as follows: $R(x_1) = 4.1216$, $R(x_2) = 4.6738$, $R(x_3) = 3.5724$, $R(x_4) = 2.9980$, and $R(x_5) = 4.2907$. So the ranking of the scheme is $x_2 \succ x_5 \succ x_1 \succ x_3 \succ x_4$.

(3) In [31], a method for solving multicriteria decision-making problem is proposed to deal with evaluating and ranking alternatives from the best to the worst with respect to decision-maker's preferences, and the possibility degree matrix PE is defined as follows:

$$PE = \begin{bmatrix} 0.5001 & 0.4778 & 0.5087 & 0.5424 & 0.4926 \\ 0.5311 & 0.5001 & 0.5192 & 0.5453 & 0.5057 \\ 0.4933 & 0.4908 & 0.5001 & 0.5146 & 0.4890 \\ 0.4975 & 0.4626 & 0.4863 & 0.5001 & 0.4270 \\ 0.5083 & 0.4952 & 0.5192 & 0.5208 & 0.5001 \end{bmatrix}. \quad (11)$$

Table 2: Evaluation results.

	$Path_1$	$Path_2$	$Path_3$	$Path_4$
Live steaming interaction (x_1)	H	RH	H	RL
MOOC (x_2)	RH	M	H	H
Online-merge-offline (x_3)	VH	RL	H	M
Modular reconstruction of course resources (x_4)	H	L	VH	M
Home-school linkage (x_5)	H	RH	M	RH

Table 3: Path weights of different risk preferences under $U_1(r_{ij})_{5\times 4}$.

Φ	−1	−0.5	0	0.5	1
ω_1	0.4551	0.3707	0.3357	0.3171	0.3040
ω_2	0.0202	0.1080	0.1442	0.1701	0.1875
ω_3	0.4037	0.3446	0.3111	0.3023	0.2966
ω_4	0.1312	0.1727	0.1999	0.2046	0.2117

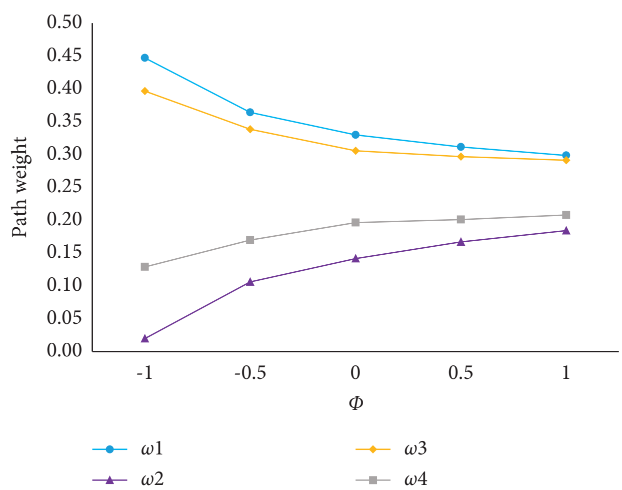

Figure 1: The changing of fully unknown path weight under different risk preferences with $U_1(r_{ij})_{5\times 4}$.

Table 4: Path weights of different risk preferences under $U_2(r_{ij})_{5\times 4}$.

Φ	−1	−0.5	0	0.5	1
ω_1	0.3999	0.3545	0.3149	0.3093	0.2937
ω_2	0.0785	0.1307	0.1696	0.1874	0.1960
ω_3	0.3676	0.3253	0.3050	0.2929	0.2851
ω_4	0.1568	0.1932	0.2087	0.2158	0.2250

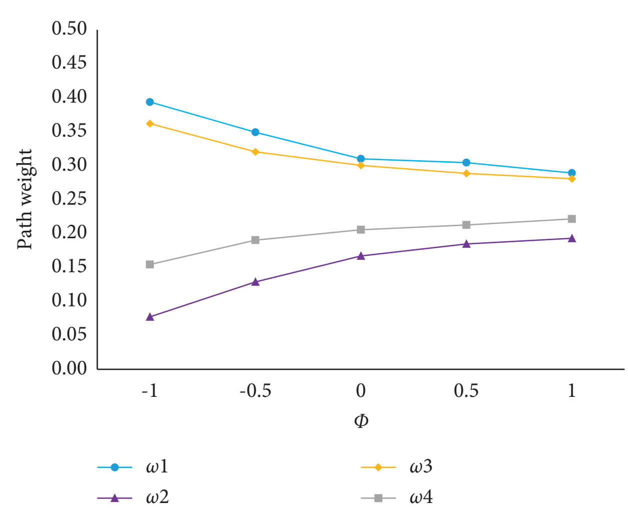

Figure 2: The changing of fully unknown path weight under different risk preferences with $U_2(r_{ij})_{5\times 4}$.

Based on the possibility degree matrix PE, the ranking vector $r = (0.1002, 0.1038, 0.0985, 0.0937, 0.1095)$ can be obtained. So the ranking of the scheme is $x_2 \succ x_5 \succ x_1 \succ x_3 \succ x_4$. Therefore, Table 8 shows the ranking results of all methods.

It can be seen from Table 8 that the ranking results of the four methods are basically the same, which indicates that the method proposed in this paper is scientific and effective.

5.3.2. Ranking Time. As can be seen from Figure 3, the proposed method has a lower ranking time with the increasing number of known path weights. This is because the risky decision-making ranking method proposed in this paper has some advantages. At first, based on the cut set, this paper proposes two IT2FL utility functions, which effectively extract all the information of IT2FL and comprehensively consider each parameter and membership, making the ranking of IT2FL more scientific, real, and effective. Then,

Table 5: The scheme ordering of different risk preferences under $U_1(r_{ij})_{5\times4}$.

	−1	−0.5	0	0.5	1
$U_1(x_1)$	1.2693	1.2268	1.2162	1.2053	1.1976
$U_1(x_2)$	1.3081	1.2858	1.2851	1.2674	1.2713
$U_1(x_3)$	1.2146	1.1815	1.1792	1.1682	1.1514
$U_1(x_4)$	1.1882	1.1354	1.1153	1.1002	1.0983
$U_1(x_5)$	1.2996	1.2319	1.2169	1.1986	1.1883
Ranking	$x_2 \succ x_5 \succ x_1 \succ x_3 \succ x_4$	$x_2 \succ x_5 \succ x_1 \succ x_3 \succ x_4$	$x_2 \succ x_5 \succ x_1 \succ x_3 \succ x_4$	$x_2 \succ x_5 \succ x_1 \succ x_3 \succ x_4$	$x_2 \succ x_5 \succ x_1 \succ x_3 \succ x_4$

Table 6: The scheme ordering of different risk preferences under $U_2(r_{ij})_{5\times4}$.

	−1	−0.5	0	0.5	1
$U_1(x_1)$	1.3067	1.2826	1.2775	1.2659	1.2645
$U_1(x_2)$	1.3644	1.3515	1.3505	1.3487	1.3406
$U_1(x_3)$	1.2970	1.2568	1.2478	1.2491	1.2398
$U_1(x_4)$	1.2286	1.1945	1.1802	1.1717	1.1694
$U_1(x_5)$	1.3367	1.3076	1.2961	1.2836	1.2776
Ranking	$x_2 \succ x_5 \succ x_1 \succ x_3 \succ x_4$	$x_2 \succ x_5 \succ x_1 \succ x_3 \succ x_4$	$x_2 \succ x_5 \succ x_1 \succ x_3 \succ x_4$	$x_2 \succ x_5 \succ x_1 \succ x_3 \succ x_4$	$x_2 \succ x_5 \succ x_1 \succ x_3 \succ x_4$

Table 7: The ranking of partially known path weight.

Online education reform scheme	$U_1(x_1)$	$U_1(x_2)$
x_1	1.1701	1.2551
x_2	1.2359	1.3223
x_3	1.0817	1.1856
x_4	1.0246	1.1198
x_5	1.1939	1.2897
Ranking	$x_2 \succ x_5 \succ x_1 \succ x_3 \succ x_4$	$x_2 \succ x_5 \succ x_1 \succ x_3 \succ x_4$

Table 8: The comparison of ranking results of four methods.

Method	Ranking
GRAP	$x_2 \succ x_5 \succ x_1 \succ x_3 \succ x_4$
Rough set-based ranking	$x_2 \succ x_5 \succ x_1 \succ x_3 \succ x_4$
Possibility degree	$x_2 \succ x_5 \succ x_1 \succ x_3 \succ x_4$
This paper	$x_2 \succ x_5 \succ x_1 \succ x_3 \succ x_4$

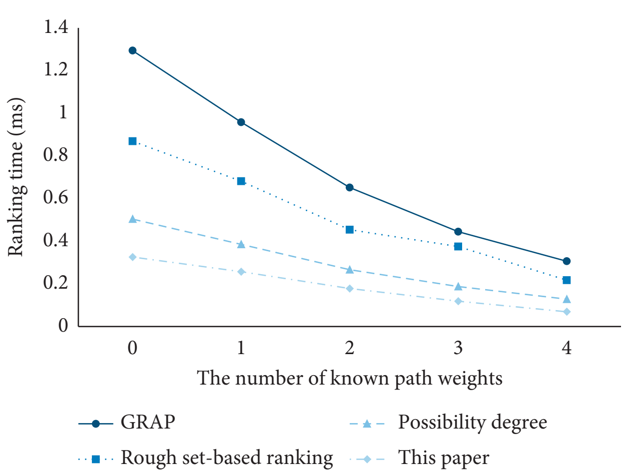

Figure 3: The comparison of ranking time.

the IT2FL entropy solves the problem of the different entropy values of complementary fuzzy sets. Finally, the risk preference factor of online education reform is introduced.

6. Conclusions

Online education reform has become an important direction of contemporary education development. In risk society, the reform process is also a continuous process, gradually transferring the teacher-centered teaching mode to the student-centered teaching mode. This study proposes two IT2FL utility functions based on the cut set. These two utility functions effectively extract all information of IT2FL, which is conducive to reducing the decision-making error of online education reform. In addition, the IT2FL entropy is proposed to measure the uncertainty of IT2FL. Furthermore, the risk preference factor is introduced to reflect the different risk attitudes of decision-makers during the risky decision-making of online education reform. The experimental results reveal that the proposed risky decision-making method has good validity in online education reform.

This paper selects five ways to reform online education, which has some limitations on risky decision-making, while there are many factors affecting the results of online education reform. In future, the joint multiattribute and multipath method will be used to reform online education reform on risky decision-making to obtain better results.

Data Availability

All data used to support the findings of the study are included within the article.

Conflicts of Interest

The author declares no conflicts of interest in this paper.

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