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Research article

Practical teaching method innovation decisions related to labor and reading at agricultural colleges based on entropy-fuzzy AHP combination weights

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Abstract: Due to the rapid development of the economy, science, and technology, we have noticed a trend where less and less attention is being paid to the modernization and development of labor and reading concerning agricultural teaching methods. Using the entropy weight method and the analytic hierarchy process, this paper empirically evaluates the practical aspects of interdisciplinary farming at agricultural colleges. In addition, it analyzes problems with current practical teaching methods from the perspectives of curriculum materials, practical education, educational platforms, and teachers. We also put forward corresponding ideas and suggestions for practical teaching methods related to interdisciplinary farming. The results show the following: i) A student's sense of responsibility to develop agriculture should be cultivated by integrating the cultural elements of agriculture with science curricula. ii) Faculties with knowledge of interdisciplinary practices should be set up to improve students' abilities regarding practical activities. iii) A practical teaching platform should be established to provide conditions for interdisciplinary integration. iv) The previous conclusion requires schools to cultivate high-level teachers to maximize their leading role; only in this way can the process of agricultural education be comprehensively promoted. In this paper, by studying practical farming teaching methods at agricultural colleges and universities, we found that farming culture can be enhanced by educational culture. The cultivation of agricultural talents in the new era can be aided by helping students understand and appreciate agriculture, and by disseminating farming culture, agricultural talent can be cultivated among these students. Furthermore, this study focuses on cultivating excellent talent in terms of technical agriculture and

rural management, thus combining theory and practice, which will promote the spirit of labor among students, as well as professional quality. This will ensure the constant innovation of agricultural and nonagricultural professional services for agriculture, rural areas, and farmers.

Keywords: entropy-fuzzy AHP; interdisciplinarity; labor and study; practical teaching; agricultural colleges
Mathematics Subject Classification: 62B86, 97M70

1. Introduction

Recently, the development of science and technology has greatly progressed due to interdisciplinary research and its applications in the international community, as well as among domestic scholars. With the rise and application of interdisciplinarity, much progress has been made in many current hot-topic issues and difficult problems. The universal recognition and wide application of interdisciplinarity have proved its role in understanding and transforming the world [1]. However, the academic benefits, vitality, and sustainable development of interdisciplinarity are not widely understood, and some scholars even hold a skeptical attitude toward it. In his book *How to Do Interdisciplinary Research*, Repko (2020), a professor at the University of Texas, said that the failure of university management to implement interdisciplinarity into the entire education system is the fundamental reason why universities do not pay attention to interdisciplinary research. Universities tend to see interdisciplinarity as a trend rather than a real revolution, resulting in a piecemeal, disorganized, patchwork approach to interdisciplinary work rather than comprehensive and radical reform [2]. Furthermore, unlike well-known universities abroad, Chinese universities have come late to the field of interdisciplinarity, and the cross-disciplinary work in our country is still at the primary stage. As such, there are many problems worth discussing and studying [3]. However, conventional mathematics is not always feasible for this purpose because of the ambiguities and uncertainties that plague many everyday problems. Different approaches—such as the probability theory hypothesis, the rough set hypothesis, and the fuzzy set hypothesis—have been proposed as alternative approaches to address these challenges.

Multicriteria decision-making (MCDM) is a method of choosing the best possible alternative from a large number of candidates based on a set of criteria or attributes [4]. In recent years, interest in the challenges of MCDM studies has increased, notably in the field of operations research [5]. There are three main steps in multi-attribute decision-making (MADM). The MADM process begins with the structure of the decision model by first formulating information about the data from each alternative based on criteria defined by each decision expert. According to the defined criteria, the information about the data from all alternatives is then represented by a decision expert's decision matrix. The final step in the decision-making process is determining the best option [6]. Due to a lack of information about the situation, the existence of many criteria with variable degrees of significance, and the difficulty of determining whether one criterion is more important than another, these decisions are complicated [7]. MCDM techniques employ structured procedures and algorithms to determine the optimal response to a diverse set of facts, values, and stakeholder views [8]. These tactics, in general, seek to eliminate ambiguity in decision-making. Thus, uncertainty is considered in relation to MCDM and its numerous applications. It is uncommon to make comprehensive examinations of multiple sources of uncertainty in environmental choices impacting MCDM outcomes [9].

MCDM is a decision-making process used to choose between a finite or infinite set of conflicting and unreconcilable alternatives [10]. It is one of the most important parts of analytical decision theory. The decision scheme is either finite or infinite, and it can be divided into two categories: MADM and multi-objective decision-making (MODM). MADM, also known as finite-scheme MODM, refers to the problem of choosing the best alternative scheme or making scheme rankings under conditions where there are multiple attributes. It is an important part of modern decision science. Its theories and methods are widely used in engineering, technology, economics, management, and military fields. Multi-objective decisions are decisions that require the consideration of two or more objectives at the same time [11]. Unlike conventional evaluation methods, multicriteria decision evaluations can evaluate, queue, and select multiple items. When studying a project, each impact factor should be considered in terms of the main judgment criterion of that project; information processing and the extraction of each factor's value should be carried out to assign weight to each factor. With the help of modern computer technology, MCDM can be used to quickly complete information processing, reflect the opinions of decision participants, and facilitate the formation of a consistent view.

Throughout the thousand years of Chinese civilization, agriculture and reading have complemented each other. This combination is an important tradition in Chinese culture. It not only shows that ancient people valued settling down and working hard but also shows the unique educational wisdom of the Chinese people [12]. It is the ideological inheritance of a particular development road, one that has Chinese characteristics. This means that rural civilization is a primary component of national civilization. However, due to the rapid development of the economy, science, and technology, we have noticed a trend where less and less attention is being paid to the modernization and development of labor and reading education. This trend is reflected in higher agricultural and forestry education; it can be seen that training alone cannot provide support for production practices. Indeed, talented students are unwilling to work in agriculture. This requires a new era of agricultural colleges and universities to reform teaching modalities and promote agricultural education [13]. In February 2021, the General Offices of the CPC Central Committee and the State Council issued Opinions on Accelerating the Revitalization of Rural Talents. The Opinions call for improving the higher education teaching system, comprehensively strengthening agricultural education in colleges and universities, and making agricultural courses compulsory for students majoring in agriculture [14]. Regarding China's goal of building a modern socialist country, the concept of agricultural education has been highlighted, and its development should be clarified. This shows that the Party and the state attach great importance to the cultivation of practical education, agricultural development, and cultural inheritance. This shows the value of cultivating high-quality talent. Furthermore, it opens up space for agricultural colleges and universities to explore their educational modes and personnel training systems according to their own characteristics.

Recently, the Ministry of Education asked colleges and universities to strengthen and improve their agricultural labor reading education plans. This proposal was put forward to achieve the following: to help schools better understand labor and reading education processes; to build a labor and reading education curriculum; to expand practical teaching methods through various channels; to build a contingent of full-time and part-time teachers; to strengthen labor; and to study cultural inheritance in relation to the creation of campus culture, for example, as it relates to the five tasks. The purpose of this program is to improve agricultural colleges and universities so they can pay attention to agricultural education and make in-depth studies of agricultural education teaching practices. The government's intends to make sure that students do not fear the countryside; that they will be willing to approach farmers; and that they will come to love agriculture. This will cultivate students' agricultural literacy and professional abilities; take them out of the classroom and put them into the mountains, fields, and seas; cultivate the spirit of thrift and hard work; and challenge them to innovate and dedicate themselves to agriculture. This will also improve students' practical labor abilities by placing them directly in the countryside. Only in this way can we train outstanding workers to serve the drive for socialist modernization. Agricultural colleges and universities are the core of agricultural education. However, the curricula of many colleges and universities mostly follow traditional engineering teaching methods, and they have not reformed or innovated these methods. As a result, the professional talent cultivated at agricultural colleges and universities cannot match the demands of the severe agricultural problems in China. Only by studying and exploring reasonable teaching methods can we cultivate outstanding talent in line with the development of a new era.

Therefore, this research breaks down traditional education ideas and teaching methods using multidisciplinary techniques. We examine the construction of teaching materials for curricula; the practice of platform building; and teacher-level explorations and innovations to provide knowledge regarding systematic discipline theories, new ideas, and new perspectives. This will enhance the innovative consciousness and practical abilities of students. This paper also discusses the current problems affecting agricultural practices and reading at agricultural colleges and universities against a cross-disciplinary background. As such, we have also constructed a reasonable interdisciplinary system and put forward teaching methods from a cross-disciplinary perspective. This has important theoretical and practical significance for the sustainable development of agricultural colleges and universities.

Fuentes-Bargues et al. (2015) [15] pointed out that the use of multicriteria techniques in environmental decision-making, including choices between various alternatives, is important in complex decisions in several subject areas. The most widely used technique is the analytic hierarchy process (AHP). Ouyang and Guo (2018) [16] argued that MCDM is the study of methods and procedures through which concerns about multiple, conflicting criteria can be formally incorporated into the management planning process. AHP is a multi-objective decision analysis method that combines qualitative and quantitative analysis methods [17]. This method's main idea is to decompose complex problems into several levels and factors, compare and judge the importance degree between the two indicators, and establish a judgment matrix. By calculating the maximum eigenvalue and corresponding eigenvector of a judgment matrix, the weight of the importance degree of different schemes can be obtained, providing the basis to choose the best scheme. Because AHP has the advantage of showing the relationship between each layer, each criterion, and each element, and because it simplifies the evaluation procedure [18], this study adopts this method to study the model.

Various academic circles have conducted their own multidimensional studies on interdisciplinarity, multidisciplinary integration and cultivation, and reading education. However, few studies have combined the concept of interdisciplinarity with the cultural aspects of agriculture. On this basis, through the use of the scientific analysis method and the establishment of an analysis model, we established an interdisciplinary and practical teaching model for in-depth research.

The contents of this paper are as follows. Section 2 describes and defines interdisciplinarity and agriculture–reading education by combing the literature on interdisciplinary agricultural teaching methods. Section 3 uses the entropy weight method and AHP to determine the comprehensive weight of the data. Section 4 carries on the empirical research according to the relevant data. Section 5 discusses the existing problems via data analysis. Section 6 is the conclusion.

2. Theoretical mechanism

2.1. Interdisciplinary subjects

Interdisciplinarity is a new type of discipline. It refers to situations involving two or more interdisciplinary cross-disciplines, mutual integration, and mutual penetration. A cross-discipline can not only be a cross-fusion of multiple discipline categories but also a cross-fusion of different branches of discipline categories, thus forming a new discipline. For example, the natural sciences and the humanities and social sciences can be integrated to form new disciplines. Other disciplines within the natural sciences and humanities and social sciences can also be integrated across disciplines to form new disciplines. The controversial issues of modern scientific development and major social issues related to people's livelihood cannot be solved with a single discipline; instead, they require the integration and crossover of multiple disciplines. In August 2020, interdisciplinarity was listed as the 14^{th} discipline group in the current academic discipline group. According to a column on the official website of the National Natural Science Foundation of China, in addition to the other eight traditional academic departments, a ninth academic department, the Interdisciplinary Department, has been set up.

2.2. Labor and reading education

Ancient China was an agricultural society. Thus, Chinese culture has a strong tradition of agriculture, and it includes many rural areas and farmers. Ancient Chinese agriculture involved the extensive participation of intellectuals, as most intellectuals were born in rural areas or were farmers themselves. The essence of this cultural feature is a unique combination of agriculture and reading. At first, farming education was just a way of life for scholars in ancient times, but this has slowly changed into a broader educational concept, a family discipline, a set of rules, and a way to cultivate the pillars of the country. Labor and study combine work with reading and fulfill both the body and the spirit. Farming on a sunny day and reading during rainy days or farming during the day and reading at night are ancient Chinese traditions. These practices, combined with the surrounding environment, formed a unique way of life. This not only reveals the material and spiritual self-sufficiency of ancient Chinese lifestyles but also influences statecraft [19]. Cultivated reading cultures, unlike other cultures, have disappeared over time. However, despite a millennium of cultural waves—which have been a powerful force on the character of the Chinese nation—Chinese culture has endured; it is still thriving, and it is one of the oldest ancient civilizations in the world.

The Opinions of the CPC Central Committee and the State Council on the Implementation of the Rural Revitalization Strategy require that China's agricultural heritage should be effectively protected and that this heritage should be rationally and moderately utilized and promoted. In the new era, labor and reading education has been endowed with several different factors: (1) Self-reliance and self-improvement, which involve progressing labor and reading education. Cultivating education involves utilizing ambitious people; even in the process of hard physical labor in agriculture, they still study hard and make progress. In long-term labor, the principles of thrift and spiritual self-improvement will gradually form among such people. In today's era of rapid development, farming education should not be abandoned. On the contrary, we should continue to advocate and promote the spirit of self-respect. Wealth and rank should not be corrupted, poverty and unhappiness should not be removed, and power and force should not be subdued. (2) Service dedication, which is a challenge that asks people to participate in labor education. By developing agricultural and reading education, we can see that this factor covers the overall concept of self-cultivation, as well as methods for governing a country. This has become an important spiritual force in encouraging the Chinese nation to move forward. In the new era, students' ideas should be strengthened to cultivate correct concepts of labor, and they should be instilled with a spirit of labor so they are not afraid of suffering; this will further the development goals of the Chinese nation. (3) Knowledge of farming and practical agricultural education. Farming education not only involves traditional agricultural production knowledge but is also related to agricultural technology, which forms a practical concept that unifies knowledge and action. Agricultural education should not only focus on imparting knowledge of agricultural production and cultivating students' interest in agriculture, but also cultivate students' practical abilities regarding agricultural production. This will improve students' professional qualities and help them actively participate in agricultural practices based on agricultural education. In the new era, agricultural education can serve not only as an important way of purifying people's minds—guiding students to be healthy and improve their moral literacy—but it can also stimulate the sustainable development of rural society and promote rural revitalization.

3. Materials and methods

The American school of decision support is based on the functional approach, that is, utilization value or availability. These strategies often do not take into account data inconsistencies, ambiguities, or decisionmaker preferences. These technologies are closely related to operating methods based on a single comprehensive standard. AHP, ANP, and TOPSIS are important methods used in the American school. In most cases, real-life problem-solving involves several competing viewpoints that must be considered to make a sound decision. A decision can be defined as a choice. This choice is made based on the available information or a method of action aimed at solving a particular decision-related problem. Basilio et al. (2022) [20] stated that, in practice, multicriteria decision analysis (MCDA) evaluates possible courses of action or options by selecting a preferred option or ranking options from best to worst. In everyday practice, the use of MCDA is essential to signal the best rational choice to decisionmakers so that they can allocate limited resources between competing and alternative interests [21].

The TOPSIS method (Technique for Order Preference by Similarity to an Ideal Solution) was first proposed by Wang and Yoon in 1981 [22]. The TOPSIS method is a way to rank a limited number of evaluation objects according to their proximity to an idealized target, which is to evaluate the relative advantages and disadvantages of existing objects. The TOPSIS method is a sort of ranking method that is close to an ideal solution, and it only requires each utility function to monotonously increase (or decrease) [23]. The TOPSIS method is a commonly used and effective method of multi-objective decision analysis, also known as the superior and inferior distance solution method [24]. ANP is a practical decision-making method proposed in 1996 by Professor Suaty of the University of Pittsburgh based on AHP. It aims at the internal dependence and feedback relationship between evaluation indicators [25]. It is suitable for evaluating interactions between multiple indicators in large systems, such as command information systems. The complex ANP model includes two parts: the control layer and the network layer [26]. AHP is a simple method to make decisions in more complex and fuzzy problems, and it is especially suitable for problems that are difficult to complete with quantitative analysis. According to the basic principle of information theory, the entropy weight method takes entropy is a measure of the degree of disorder in a system. Therefore, the entropy value can be used to judge the dispersion degree of the evaluation indicators, fully excavate the information contained in the original data, and determine the weight of each index according to the variation degree of the index values. Since the model constructed in this study is relatively simple, and it is difficult to conduct a complete quantitative analysis of the indicators, this paper adopts the AHP—entropy weight method to study the practical teaching methods of interdisciplinary farming at agricultural colleges.

3.1. Determination of index weight

3.1.1. Entropy weight method

The entropy weight method is an objective method of determining weight. It is essential to the entropy weight method to determine the weight of each index. The concept of entropy was first used in information theory. At present, the concept of entropy is widely used in many fields, including engineering technology, social economy, and so on. Calculating index variability is the basis of the entropy weight method. Generally speaking, entropy is inversely proportional to the amount of information. When the index variability value is large, the entropy value is smaller, and the larger the weight, the smaller the comprehensive evaluation. Given m evaluation objects and n evaluation indicators, the original data matrix, X, is defined as follows:

$$X = \begin{pmatrix} x_{11} & \cdots & x_{1n} \\ \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{mn} \end{pmatrix}_{m\times n}. \tag{1}$$

Where x_{ij} is the value of the evaluation object's original data, i, under index j.

Evaluation indicators map different assessment dimensions, and their application scenarios, reference standards, value ranges, dimensions, and other differences cannot be directly compared. Therefore, it is necessary to process the evaluation data and establish a unified reference system.

Dimensionless processing is performed on the original data to obtain the standardized matrix, V as shown in the following formula:

$$V = \begin{pmatrix} v_{11} & \cdots & v_{1n} \\ \vdots & \ddots & \vdots \\ v_{m1} & \cdots & v_{mn} \end{pmatrix}_{m\times n}. \tag{2}$$

In the formula, v_{ij} is the standardized value of the evaluation object, i, under item j.

For an indicator of a larger and better type (positive indicator), v is calculated as follows:

$$v_{ij} = \frac{x_{ij}-min(x_j)}{max(x_j)-mi\ \ (x_j)}, \tag{3}$$

where $max(x_j)$ and $min(x_j)$, respectively, represent the maximum and minimum values of all evaluation objects under item j. It should be noted that when the 2 are equal, they will be 0/0, and there will be other uncertainties. In this case, v_{ij} can be set to 1.

For a smaller, better type indicator (negative indicator), the calculation method of v_{ij} is as follows:

$$v_{ij} = \frac{max(x_j)-x_{ij}}{max(x_j)-min(x_j)}. \tag{4}$$

Similar to the index of the bigger and better type, when $max(x_j)$ and $min(x_j)$ are equal, v_{ij} can be set to 1.

After further processing the standardized matrix, the characteristic specific gravity matrix, P can be obtained, as shown below:

$$P = \begin{pmatrix} p_{11} & \cdots & p_{1n} \\ \vdots & \ddots & \vdots \\ p_{m1} & \cdots & p_{mn} \end{pmatrix}_{m\times n} \tag{5}$$

where p_{ij} is the characteristic proportion of the i evaluation object under item j, and the calculation method is as follows:

$$p_{ij} = \frac{v_{ij}}{\sum_{i=1}^{m} v_{ij}}. \tag{6}$$

We can calculate the entropy matrix, E, as shown below:

$$E = (e_1 \quad e_2 \cdots \quad e_n) \tag{7}$$

where e_j is the entropy value of item j, and the calculation method is as follows:

$$e_j = -\frac{1}{ln(m)} \sum_{i=1}^{m} p_{ij} \, ln \, p_{ij}. \tag{8}$$

In the above formula, to avoid the occurrence of $ln(0)$, the overall data of p can be translated, and a smaller number can be added, such as 0.0001.

We can calculate the weight matrix as follows:

$$W_{(e)} = (w_{(e)1} \quad w_{(e)2} \cdots \quad w_{(e)n}) \tag{9}$$

where $w_{(e)j}$ is the weight of the j index, and the calculation method is as follows:

$$w_{(e)ij} = \frac{(1-e_j)}{\sum_{j=1}^{n}(1-e_j)}. \tag{10}$$

3.1.2. AHP

AHP is a kind of hierarchical weight analysis method proposed by the American operational research scientist Sati, a professor at the University of Pittsburgh in the early 1970s. Its core idea is to decompose the target and calculate the ranking to determine the weight of each index [27]. The ranking includes the single ranking and the total ranking, and its calculation method adopts qualitative index fuzzy quantization.

The following analysis is of the principle of hierarchical single sorting. Assume that there are n indicators at a certain level related to an element at the upper level, and define the judgment matrix A as follows:

$$A = \begin{pmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{n1} & \cdots & a_{nn} \end{pmatrix}_{n\times n} \tag{11}$$

where a_{ij} is the comparison value of index i relative to index j, which satisfies the following relationship:

$$\begin{cases} a_{ij} > 1 \\ a_{ii} = 1 \\ a_{ji} = \frac{1}{a_{ij}} \end{cases}. \tag{12}$$

There are various calibration methods for comparison value a_{ij}, such as the 1–9 scale methods and the 0.618 scale method, as shown in Tables 1 and 2.

Table 1. The 1–9 scale methods for judging matrix elements.

Scale	Implication
1	Important
3	A little important
5	More important
7	Highly important
9	Extremely important
2, 4, 6, 8	The median of the two adjacent judgments above
Reciprocal of the scale	The comparison value of index i relative to j is the reciprocal of the comparison value of j relative to i

The root method is used to solve the weight matrix, as shown below:

$$w_{(a)} = (w_{(a)1} \quad w_{(a)2} \quad \cdots \quad w_{(a)n}) \tag{13}$$

where $w_{(a)i}$ is the weight of item i, and the calculation method is as follows:

$$w_{(a)i} = \frac{\sqrt[n]{\prod_{j=1}^{n} a_{ij}}}{\sum_{i=1}^{n} \sqrt[n]{\prod_{j=1}^{n} a_{ij}}}. \tag{14}$$

The ideal case of the judgment matrix is the uniform matrix, i.e.,

$$a_{ij} = a_{ik} \bullet a_{kj} \tag{15}$$

In practical applications, the calibration of the judgment matrix is often compared in two ways, and the nonuniform matrix situation often appears. To avoid calculation errors and logical contradictions, a consistency test is necessary.

Consistency indicator CI is defined and calculated as follows:

$$CI = \frac{\lambda - n}{n - 1} \tag{16}$$

where λ is the maximum characteristic root of the judgment matrix, as shown below:

$$\lambda = \frac{1}{n} \sum_{i=1}^{n} \frac{(AW)_i}{w_i}. \tag{17}$$

We can define the evaluation random consistency index, RI, as shown in Table 2.

The consistency ratio, CR, is thus defined, and its calculation method is as follows:

$$CR = \frac{CI}{RI}. \tag{18}$$

When CR is less than 0.1, the consistency of the judgment matrix is acceptable. Otherwise, it needs to be fixed.

Table 2. List of indicators for evaluating random consistency.

n	1	2	3	4	5	6	7	8	9	10	11
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49	1.51

3.2. Comprehensive weight

After the weight matrices $W_{(e)}$ and $W_{(a)}$ are calculated using the entropy weight method and AHP, respectively, the comprehensive weight matrix can be further solved as follows:

$$W = (w_1 \quad w_2 \quad \cdots \quad w_n) \tag{19}$$

where w_i is the weight of item i, and the calculation method is as follows:

$$w_i = w_{(e)i} \bullet (1 - e_i) + w_{(a)i} \bullet e_i. \tag{20}$$

The objective factors of the entropy weight method and the subjective factors of AHP are integrated into the comprehensive weight. This shows the close connection and complementary advantages of the two. It also reduces the deviation caused by the single method of entropy weight method and AHP, and it makes the analysis result more comprehensive, fair, and objective.

3.3. Methodological framework

In this study, an integrated approach based on entropy-fuzzy AHP combination weight was proposed. The running logic of this method is shown in Figure 1.

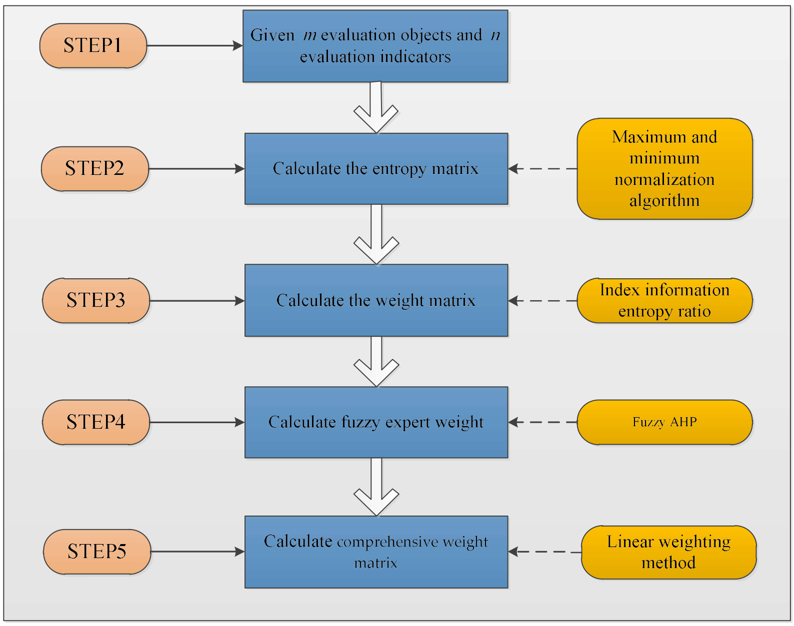

Figure 1. Methodological framework of practical teaching method innovation decisions.

4. Application and results

4.1. Application

This research mainly adopted the questionnaire method to better understand the practical teaching methods of interdisciplinary farming at agricultural colleges and universities.

This study integrated the evaluation theory and index model system established by scholars and research institutions. Based on the current policies, regulations, and implementation status of interdisciplinary farming education at domestic agricultural colleges and universities, a satisfaction questionnaire was compiled. The questionnaire design follows the principles of scientificity, authenticity, and operability, and it uses the measurement scale issued by the policy authority, which is used frequently and is highly reliable. Based on the above research, factors such as system and mechanism innovations, the construction of course materials, the construction of practice platforms, the cultivation of high-level teachers, and the construction of campus culture were selected as the core indicators for the satisfaction survey we used to evaluate interdisciplinary farmland education in domestic agricultural universities.

To fully understand satisfaction with interdisciplinary education at agricultural colleges and universities, the questionnaire adopted two forms of objective questions and subjective questions. The first part of the questionnaire's design comprises basic information about the enterprise, such as the name and scale of the university. The second part comprises objective questions about the factors affecting satisfaction with interdisciplinary education in agricultural colleges and universities. The third part is open; enterprises can put forward opinions and suggestions for the construction of interdisciplinary farmland education at agricultural colleges and universities.

The questionnaire was distributed to agricultural colleges and universities all over the country. The respondents were of high quality and had rich experience, and they were middle- and high-level curriculum builders at colleges and universities. The survey was conducted via questionnaires. In total, 200 questionnaires were sent out through the Julexing website, and 192 effective questionnaires were recovered (a recovery rate of 96%).

4.2. Empirical results

This paper evaluates teaching methods related to interdisciplinary agricultural and reading practices at agricultural colleges and universities. It formulates 5 first-level indexes and refines 15 second-level indexes. At the same time, to simplify the evaluation process, five grades were set: very satisfied, satisfied, general, not satisfied, and very dissatisfied. The evaluation feedback of each group was obtained in the form of a questionnaire, as shown in Table 3.

Taking indicator C1 (implementation plan of interdisciplinary farming and reading education) as an example, according to the questionnaire statistics, 31% of the respondents were very satisfied, 28% were satisfied, 24% were average, 14% were dissatisfied, and 3% were very dissatisfied. By analogy, this constitutes the original data of the evaluation indicators.

Table 3. Index and comment collection relating to interdisciplinary teaching methods at agricultural colleges and universities.

Primary indicators	Secondary indicators	Comment collection				
		Very satisfied	Satisfied	General	Dissatisfied	Very dissatisfied
System and mechanism innovations (B1)	Implementation plan of interdisciplinary farming and reading education (C1)	0.31	0.28	0.24	0.14	0.03
	The carrier function of interdisciplinary labor education (C2)	0.21	0.26	0.31	0.16	0.06
	Interdisciplinary farming and reading education evaluation system (C3)	0.27	0.32	0.21	0.15	0.05
Curriculum and textbook construction (B2)	Interdisciplinary farming education series general courses (C4)	0.29	0.26	0.24	0.12	0.09
	Interdisciplinary cultivation and reading elements of professional education (C5)	0.23	0.33	0.19	0.23	0.02
	Interdisciplinary farming and reading teaching resource database (C6)	0.24	0.29	0.32	0.11	0.04
Construction of practice platform (B3)	Interdisciplinary cultivation and reading education practice base (C7)	0.42	0.27	0.19	0.09	0.03
	Interdisciplinary cultivation and reading education brand activity project (C8)	0.35	0.26	0.18	0.09	0.12
	Interdisciplinary cultivation and reading education platform level (C9)	0.38	0.26	0.19	0.06	0.11

Continued on next page

Primary indicators	Secondary indicators	Comment collection				
		Very satisfied	Satisfied	General	Dissatisfied	Very dissatisfied
Cultivation of high-level teachers (B4)	The leading role of interdisciplinary cultivation and reading education teachers (C10)	0.33	0.27	0.28	0.07	0.05
	Double-qualified teachers (C11)	0.37	0.33	0.15	0.11	0.04
	Parttime teachers of interdisciplinary farming and reading education (C12)	0.21	0.26	0.27	0.11	0.15
Campus culture construction (B5)	Integrating farming civilization into campus culture (C13)	0.43	0.27	0.23	0.04	0.03
	Publicity and promotion of interdisciplinary farming and reading education (C14)	0.46	0.27	0.11	0.09	0.07
	Interdisciplinary agricultural culture education with regional characteristics (C15)	0.29	0.36	0.26	0.11	0.03

Using the entropy weight method, the original data matrix of index B1 can be obtained, as shown below:

$$X_{B1} = \begin{pmatrix} 0.31 & 0.21 & 0.27 \\ 0.28 & 0.26 & 0.32 \\ 0.24 & 0.31 & 0.21 \\ 0.14 & 0.16 & 0.15 \\ 0.03 & 0.06 & 0.05 \end{pmatrix}. \tag{21}$$

Then, the weight matrix, based on the entropy weight method, can be obtained as follows:

$$W_{(e)B1} = (0.333 \quad 0.335 \quad 0.332). \tag{22}$$

Using AHP, combined with expert opinions and group feedback, the three indicators C1–C3 can be compared. Then, the weight matrix, based on AHP, can be obtained as follows:

$$W_{(a)B1} = (0.584 \quad 0.184 \quad 0.232). \tag{23}$$

When comparing the weights of $W_{(e)B1}$, $W_{(a)B1}$, $C1$, $C2$, and $C3$, the results are similar. From Equation (20), the comprehensive weight can be obtained as follows:

$$W_{B1} = (0.459 \quad 0.259 \quad 0.282). \tag{24}$$

Then, the comprehensive evaluation results of index B_1 are as follows:

$$Y_{B1} = X_{B1} \bullet {W_{B1}}^{\mathrm{T}} = (0.273 \quad 0.286 \quad 0.250 \quad 0.148 \quad 0.043)^{\mathrm{T}}, \tag{25}$$

where the symbol T represents the matrix transpose. After comprehensive analysis, for indicator B_1, 27.3% of respondents were very satisfied, 28.6% were satisfied, 25.0% were average, 14.8% ere dissatisfied, and 4.3% were very dissatisfied.

Similarly, the comprehensive evaluation results of B2, B3, and B4 can be calculated as follows:

$$\begin{cases} Y_{B2} = (0.261 \quad 0.285 \quad 0.254 \quad 0.142 \quad 0.053)^{\mathrm{T}} \\ Y_{B3} = (0.392 \quad 0.266 \quad 0.186 \quad 0.088 \quad 0.069)^{\mathrm{T}} \\ Y_{B4} = (0.318 \quad 0.294 \quad 0.220 \quad 0.098 \quad 0.070)^{\mathrm{T}} \\ Y_{B5} = (0.421 \quad 0.286 \quad 0.166 \quad 0.077 \quad 0.050)^{\mathrm{T}} \end{cases}. \tag{26}$$

The final original data matrix is

$$X_{\mathrm{all}} = \begin{pmatrix} 0.273 & 0.261 & 0.392 & 0.318 & 0.421 \\ 0.286 & 0.285 & 0.266 & 0.294 & 0.286 \\ 0.250 & 0.254 & 0.186 & 0.220 & 0.166 \\ 0.148 & 0.142 & 0.088 & 0.098 & 0.077 \\ 0.043 & 0.053 & 0.069 & 0.070 & 0.050 \end{pmatrix}. \tag{27}$$

Via the calculations of the entropy weight method and AHP, the comprehensive weight matrix is

$$W_{all} = (0.285 \quad 0.111 \quad 0.246 \quad 0.171 \quad 0.187). \tag{28}$$

The final evaluation of interdisciplinary teaching methods for agricultural and reading education at agricultural universities is as follows:

$$Y_{all} = X_{all} \bullet {W_{all}}^{\mathrm{T}} = (0.336 \quad 0.282 \quad 0.214 \quad 0.111 \quad 0.057). \tag{29}$$

That is, combined with the first- and second-level indicators, 33.6% of respondents were very satisfied, 28.2% were satisfied, 21.4% were average, 11.1% were dissatisfied, and 5.7% were very dissatisfied.

5. **Discussion**

5.1. Discussion results

Based on the above analysis, it can be seen that the construction of curriculum materials accounts for the smallest proportion in the index relating to the process of teaching method reform. In recent years, most agricultural colleges have paid more attention to cultivating scientific research strength in terms of their agricultural disciplines and students' scientific research abilities, which means these schools not only neglect the cultivation of practical teaching but also weaken students' practical abilities. As for the system and mechanism innovation index, the implementation of cross-disciplinary farming education accounted for 45.9%. It can be seen that agricultural colleges pay too much attention to the implementation plan of cross-disciplinary farming education in the process of exploring interdisciplinary farming practice teaching methods. As for the index of practice platform building, the cross-disciplinary farmland education platform level accounts for the smallest proportion. It can be seen that at the present stage, Chinese agricultural colleges and universities do not pay enough attention to their cross-disciplinary farming practice education platforms. In the training system for teachers at most agricultural colleges and universities, the sources of teachers' curricula lack richness, and some teachers lack practical experience and practical abilities.

In the comprehensive weight comparison, we can see that the proportion related to the construction of teaching material is the smallest. In recent years, a series of related problems have appeared in most agricultural colleges and universities due to the wave of research universities being constructed in China. As noted above, we found that most agricultural universities pay more attention to cultivating scientific research strength and students' scientific research abilities, which leads to practical teaching being neglected and students' practical abilities declining. The practical teaching methods at colleges and universities mainly include verification and demonstration experiments, and there are few comprehensive practical experiments. Most students' internship tasks are perfunctory and cursory, without real hands-on experience; graduation project topics lack innovation. They cannot advance with the times and only consider old topics.

In the system and mechanism innovation evaluation index, the implementation plan of interdisciplinary education accounted for 45.9%, much higher than other secondary indicators. This study shows that the implementation plan for interdisciplinary agricultural and reading education has been overemphasized in the teaching methods at in agricultural colleges. This leads to a weakening of student participation in practical teaching activities. Because the instructor does not actively guide and fully explain relevant practical activities before carrying them out with students, the majority of students only know the location and the special requirements of practical activities, and they cannot clearly define the goal of these activities.

In the practical platform construction evaluation index, the level of the interdisciplinary education platform accounts for the smallest proportion. We found that agricultural universities have not paid enough attention to interdisciplinary agricultural and reading educational platforms. At present, most agricultural colleges and universities are in a relatively backward stage in the construction of practical teaching platforms. The process of interdisciplinary cultivation and the construction of practical education platforms for reading at agricultural universities lags behind other teaching software. Therefore, strengthening the construction of practical education teaching platforms plays a crucial role in the study of practical teaching methods at agricultural colleges and universities from a cross-disciplinary perspective.

Out of all the evaluation results, 7.0% of the respondents considered the high-level teacher training index very unsatisfactory, which was higher than other indicators. Research shows that, in most colleges and universities, the faculty's discipline structure typically comes from a single source, and some teachers lack practical abilities or experience, meaning there are few double-qualified teachers, the presence of whom we advocate for. Most of the teachers on the faculty study one particular field and only desire to learn within this field; they lack awareness of interdisciplinary integration. In agricultural colleges and universities, some teachers do not have a strong awareness of cultivation, lack awareness of ways to strengthen students' practical abilities, and do not pay attention to the implementation of cultivation education.

In the construction of quality course material systems in most agricultural colleges in China, the lack of educational labor and agricultural materials does not play an important role in personnel training. Multiple colleges and universities should, by combining regional characteristics, jointly establish an agricultural education resource base and create openness and sharing policies so that students can better absorb agricultural culture. Schools should rework and refine the training and educational elements in the professional curriculum, and they should scientifically and objectively combine training and cultural elements in the curriculum. In this way, academic and professional education complement and promote each other, cultivating the student's sense of responsibility for strengthening and developing agriculture. In terms of building a model of practical learning for agriculture and reading, we should highlight the value of labor, enhance practical abilities, cultivate the spirit of practice, broaden our horizons, and enhance our sense of social responsibility. This will help cultivate students' unity of knowledge and action in the practice of farming and reading, and it will transform their positive feelings and knowledge of farmers into practical actions, in that they will learn from and serve these farmers. Schools can build practical educational platforms, combining the virtual and the real by independently developing virtual simulation projects; make full use of the online practical teaching experience provided by the state and enterprises; and build a combined online-offline practical teaching method. Students would be able to simulate practical work online, stimulate their interest in practical activities, and enhance their thirst for knowledge, improve their practical abilities.

Labor learning is the foothold of this kind of education; therefore, a basis for practical training and reading education is particularly important. Schools should make full use of campuses, fields, and society; expand education to the frontline of agricultural production; and enrich students' experiences in labor practices. With existing social resources, such as agricultural science and educational resources, as well as national modern agricultural parks, we can build a basis for agricultural education and labor education brands. We should establish practical teaching platforms on campus. The establishment of open-practice resources in colleges and universities encourages teachers to teach courses practically and students to participate in practical activities, which provides conditions for interdisciplinary integration [28]. We should establish an interdisciplinary competition platform and encourage the cross-disciplinary integration of open platforms. Interdisciplinary competitions train students in a variety of abilities, including theoretical analysis and problem-solving [29].

Teachers are the facilitators of practical teaching, and the quality of practical teaching is directly influenced by their teaching methods and practical abilities. Therefore, the key to building high-quality education lies in high-level teachers. In the creation of high-level teachers, we should not only make use of agricultural policy but also find ways to implement incentives. We should strengthen both incentives and policies and build agricultural and reading education faculties comprising teachers who specialize in work both inside and outside of school. In this way, teachers can be motivated to participate in practical education and maximize their leading roles in promoting labor and reading education. To achieve more service in rural areas and facilitate agricultural production, this paper was written in the motherland [30].

5.2. Discussion of methods

AHP is a powerful systematic analysis method, and it is quite effective for comprehensive evaluations and the prediction of trends regarding multi-factors, multicriteria, and multi-schemes. The biggest advantage of AHP is that it can deal with problems that combine qualitative and quantitative methods, and it can introduce decisionmakers' subjective judgment and policy experience into the model for quantitative processing. In essence, AHP is a scientific way of thinking. Used in research on practical teaching methods related to interdisciplinary farming at agricultural colleges, the AHP method can decompose this subject layer by layer and break it down into multiple, single-criterion evaluation problems for the purpose of overall comprehensive evaluation. This method takes an “importance” (mathematically expressed as weight) comparison as a unified processing format and quantifies the results on a scale of 1 to 9 in terms of importance. At the same time, AHP uses the linear algebraic theory and method to process information and make models to find deep, substantial, and comprehensive information. However, in the study of practical teaching methods related to interdisciplinary farming at agricultural colleges, AHP can only select the best strategies among those given; it cannot provide new strategies. Moreover, the AHP method needs to make consistent comparisons when it makes multilayer comparisons. If it does not meet the requirements of the consistency index, the AHP method will not function. In dealing with relatively complex problems, the AHP method is not applicable. Therefore, more appropriate approaches will need to be considered when dealing with more complex information and models in the future [31].

6. Conclusions and enlightenment

6.1. Conclusions

Interdisciplinary integration is an important way for universities to improve the quality of teaching and the level of scientific research, as well as an embodiment of contemporary university system innovations. Promoting farming–reading education is an important way to strengthen labor education in colleges and universities and guide students to participate in agriculture and engage with rural areas and farmers, and it is an important starting point to hand down the traditional culture of families who farm and read. Farming education should be involved with the inheritance and creative transformation of farming culture to promote innovation and development in rural areas. Agricultural education and agricultural culture have a spiritual relationship, and only a combination of the material and spiritual agricultural traditions have long-term vitality. Therefore, farming–reading education should also involve the innovation and development of farming-reading culture in the new era, and cultural inheritance and innovations should be integrated into educational practices. In this context, the focus of academic circles in recent years has been on how to develop and benefit from cross-disciplines, as well as from the singular perspective of agricultural education. This study integrates emerging interdisciplinary education methods with farming-reading education, and it describes the optimal way to select practical teaching methods based on those factors. Based on the above theoretical analysis, variables such as system and mechanism innovation, curriculum construction, practice platform construction, high-level teacher training, and campus culture construction are introduced. In this study, many experts were invited to consult in the form of attributed questionnaires. Based on the survey data, this paper draws the following conclusions.

First, agricultural universities cultivate their scientific research strength and students' scientific research abilities, but they neglect practical teaching, which leads to a decline in students' practical abilities. The curriculum system can be effectively integrated into professional education and teaching curricula, which will provide a high-level, diversified, and comprehensive knowledge system suitable for agricultural and reading education. To combine regional characteristics, a series of teaching materials related to farming education should be published, and a resource database of farming education should be built and shared so that the farming culture can be better absorbed by students. Second, agricultural colleges overemphasize the implementation of interdisciplinary labor and reading education, which weakens students’ enthusiasm for participating in practical teaching activities. It is very important to unify students’ knowledge and actions. This will help them understand and appreciate agriculture, which will translate into practical actions. This will also help students broaden their horizons, enhance their sense of social responsibility, and carry forward traditional culture regarding reading. Third, agricultural universities do not pay enough attention to interdisciplinary practical teaching platforms. The construction of practical teaching platforms at most agricultural colleges is backward and lags behind other teaching software. They should establish practice teaching platforms, establish open-practice resources, promote practical training for teachers, and encourage students to participate in practical activities. With interdisciplinarity, practical teaching resources on important subjects can be used to enhance practical teaching platforms and cultivate their characteristic practical abilities. Fourth, at most colleges and universities, the disciplinary structure of the teaching faculty comes from a single source; some teachers lack practical abilities and experience, and they lack knowledge of interdisciplinary integration. We should encourage teachers to participate in practical education and maximize their leading role in promoting agricultural education. We should cultivate high-level, double-qualified teachers, encourage and guide teachers to recognize the importance of cultivation and reading education, and stimulate their enthusiasm and positive feelings for education.

6.2. Theoretical contribution

The theoretical contribution of this study is mainly reflected in the following two aspects: First, the authors made an in-depth study of practical farming–reading teaching methods based on an interdisciplinary perspective using the scientific analysis method. This reveals some problems relating to the current agricultural education methods. Based on these problems, corresponding countermeasures and suggestions are provided for the optimization of practical agricultural and reading education methods. This provides a new perspective for empirical research on teaching methods for practical interdisciplinary education. Second, this study provides a new theoretical interpretation perspective and empirical evidence for teaching methods related to practical agricultural and reading education, which have been seldom studied in the past. In this study, multidisciplinary practices were combined with agricultural education. The entropy weight method and AHP method were combined, and the optimized selection of teaching methods based on practical, interdisciplinary agricultural education was clarified through empirical analysis.

6.3. Practical contribution

China is constructing a modern socialist country. However, it faces restrictions due to certain key technologies, which are problems that can be found in both China and western countries. Domestic rural revitalization and other major strategic tasks require a lot of effort, and patriotic feelings are required among young people to aid the socialist modernization drive, as well as reform and development related to various problems. History has proved that paying attention to agricultural education, reading, and self-improvement is important for cultivating knowledge, whether private or public. Loyalty and filial piety to one’s family and country are linked to personal growth, and the fates of families and their countries are linked. Cultivating these feelings is an effective way of encouraging people to participate in the farming experience, establish emotional connections with land, and identify with rural sentiments. Farming education in the new era should foster values and emotions among young students so they will advocate for the interests of their families and their country. This will allow them to view the world as their responsibility, and they will pursue careers in rural areas. This will pool strong driving forces for the comprehensive revitalization of rural areas and contribute wisdom to the modernization of agriculture and rural areas. The research results show the following: (1) Open, compulsory courses for freshmen are necessary, and schools should set up practical weeks for agricultural education based on practical teaching resources, thus combining theory with practice. New curriculum systems and training programs for education can be effectively integrated into professional education and teaching curricula, which will encourage students to understand the Chinese model of agricultural and rural development, thus helping students solve complex problems in agriculture and develop comprehensive rural abilities. (2) We should create learning atmospheres in which teachers and students can learn from each other and make progress together; build comprehensive educational and teaching platforms combining agriculture and reading; and unify students' knowledge and action regarding the practice of farming and reading, and helping them understand and appreciate farmers and thus encouraging them to learn from and serve farmers in practical ways. (3) Schools should make full use of campuses, fields, and social resources, and they should take existing social resources—such as agricultural science and education resources, agricultural heritage sites, and national modern agricultural parks—as the main resources for building the basis for a culture of education in agriculture and reading. The interdisciplinary integration of open platforms can effectively train students to use theoretical analysis and problem-solving skills. (4) Colleges and universities should rely on teacher development and teacher evaluation centers to carry out special training for farming education; select relevant teachers to study at domestic and foreign colleges and universities; and encourage teachers to live in the countryside and participate in agriculture. Agricultural colleges and universities can require relevant young teachers to work in the field, conduct research in the countryside, and use their outstanding talents, which are needed in the current agricultural education system. This will keep them on the surface and help them aim at the target.

Through the in-depth implementation of farming education, students will have a profound understanding of the spirit and strength of China's 5,000-year agricultural civilization and traditional farming culture, as well as a profound understanding of China's national and agricultural conditions. At the same time, the implementation of labor and reading education can improve students' sense of responsibility to modernize agriculture and rural areas, which is the only way to implement rural revitalization. It is also an important step in cultivating students' patriotic feelings toward agriculture, and the rural values of hard work and simplicity. This will improve students' ability to work in rural areas. The reason agricultural colleges and universities attach importance to farming education is that it is not only an important way to promote the intelligence, physiques, aesthetics, work-ethics, and all-around moral development of students but also an important way to carry forward traditional Chinese farming culture. Therefore, from the perspective of interdisciplinarity, agricultural and forestry colleges must comprehensively promote the process of agricultural and reading education, and they must speed up the implementation of practical education curricula, with agricultural and reading education as the core principle.

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Conflicts of interest

The authors declare no conflicts of interest.

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