Innovative Model of Tourism on Educational Engineering: Transformation Learning from Experiential to Interactive

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***Abstract*—This study explores the interactive relationship between tourism education and industry development by applying a coupled coordination model and proposing an innovative framework that shifts learning from traditional experiential approaches to interactive teaching. The research establishes comprehensive evaluation indicators for both tourism industry performance and educational engineering, and quantitatively analyzes their coupling degree. Results reveal that although tourism education and industrial development are closely linked, mismatches in resource allocation and talent demand reduce coordination effectiveness. The innovative model, based on educational engineering, demonstrates significant advantages by integrating digital technologies such as VR, AR, and big data analytics into teaching. These tools enhance student engagement, improve knowledge construction, and provide real-time feedback, thereby optimizing both educational outcomes and industrial benefits. The findings indicate that interactive teaching strengthens students' practical competencies, increases efficiency in resource distribution, and contributes to the sustainable growth of the tourism sector. Furthermore, the degree of coupling coordination has gradually shifted from an initial to a moderate level, suggesting that interactive teaching promotes a more resilient and adaptive education–industry system. However, the transformation requires stronger institutional support, improved teacher training in technological applications, and regional balance in resource allocation. The study concludes that fostering an interactive mechanism between education and industry is essential for achieving synergy, cultivating high-quality professionals, and advancing the long-term competitiveness of tourism. Future research should refine indicator systems, integrate diverse modeling methods, and address regional disparities to strengthen the innovation pathway for tourism education.**

***Keywords*—Tourism education; educational engineering; coupling coordination model; industry–education integration**

I. Introduction

As an important branch of contemporary education, tourism education carries the function of cultivating students' specialized knowledge and skills in tourism, as well as the mission of spreading culture and promoting social and economic development [1]. However, with the rapid development of the tourism industry and the rapid progress of educational technology, the traditional tourism education model is facing serious challenges [2]. For a long time, experiential learning has been widely used in tourism education, which helps students establish intuitive knowledge of the tourism industry by simulating real tourism scenes and organizing on-site internships [3]. However, there are obvious limitations of traditional experiential learning, including the problems of large resource investment, limited scene expansion, uneven student participation, etc., which lead to localization and fragmentation of the teaching effect [4]. How to break through these limitations and build a more efficient, open, and dynamic teaching mode has become an important issue in the current tourism education research.

In this context, educational engineering, as a cross-discipline integrating pedagogy, engineering, and information technology, provides brand-new ideas and tools for the innovation of tourism education [5]. By integrating educational theory, technical support, and teaching practice, educational engineering aims to solve complex problems in education and optimize the teaching process and learning effect. In recent years, the rapid development of educational engineering technology, especially the application of artificial intelligence, virtual reality (VR), augmented reality (AR), big data, and other technologies, has made it possible for tourism education to realize the transformation from experiential learning to interactive teaching [6]. This transformation is not only the upgrading of teaching methods but also a fundamental innovation of educational concepts, the core of which lies in placing the learner at the center of teaching and learning and enhancing the interactive experience and knowledge construction ability of students through technological means, to realize a significant improvement in the teaching effect [7]. As a modern teaching mode emphasizing teacher-student interaction, student-student interaction, and human-computer interaction, interactive teaching fully embodies the educational concept of taking students as the main body [8]. In tourism education, interactive teaching can not only enhance students' immersion by simulating the real tourism environment but also provide real-time feedback on students' learning with the help of intelligent technology to provide teachers with accurate teaching support [9]. For example, the virtual tour system allows students to visit world-famous attractions without leaving home, and actively participate in the learning process through interactive questions and answers, task guidance, etc.; big data technology can record students' learning trajectories. The application of these technical means can not only solve the problem of limited resources in

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traditional experiential learning but also greatly enhance the enthusiasm and initiative of students' learning, injecting new vitality into tourism education.

However, the transition from experiential learning to interactive teaching is not a quick fix, and the process faces many challenges [10]. First of all, the transition needs to be fully supported theoretically, clarifying the differences and connections between experiential learning and interactive teaching in terms of educational concepts, learning mechanisms, and instructional design, to provide a theoretical basis for practice. Secondly, the deep involvement of educational engineering technology requires teachers to have certain technical application abilities, which puts forward new requirements for teachers' professional development [11]. The existing body of research has primarily focused on the theoretical exploration of experiential learning models and the technological potential of interactive teaching, yet there remains a clear gap in systematically linking these approaches to measurable outcomes in tourism education and industry development. Most studies emphasize either pedagogical innovation or industrial application in isolation, but rarely investigate their dynamic interaction using quantitative models. Furthermore, limited attention has been paid to how educational engineering can act as a mediating mechanism to align tourism talent cultivation with evolving industry demands. This study addresses this gap by applying a coupled coordination model to examine the synergy between tourism education and industry performance, thereby offering both theoretical insights and practical implications for sustainable integration.

Section I of this study is an introduction, which describes the model of integration between tourism education and educational engineering and the importance of mutual integration, in addition to the importance and difficulties of the transition from experiential learning to interactive teaching. Section II is the research review, which reviews the development and application of educational engineering and the characteristics of tourism education. Section III is the research methodology, which introduces the theory of coupled coordination, describes the mechanism of coordinated development of educational engineering and tourism education, and also constructs a relevant index evaluation system. Section IV is the research results and discussion. Firstly, the coupling degree model is constructed, and secondly, the research results are discussed in depth. Section V is the conclusion, which introduces the main conclusions of this study and makes an objective evaluation of the shortcomings of the research, as well as organizes the future research direction.

II. Literature Review

A. Educational Engineering Literature Review

As a discipline combining pedagogy and engineering, educational engineering focuses on optimizing educational practices through scientific design, technical means, and systematic management [12]. Since the middle of the 20th century, educational engineering has gradually expanded from the pure development of educational technology to the holistic design and application of educational systems. Its core lies in the use of engineering thinking to solve complex problems in education, covering teaching design, resource allocation, technical support evaluation feedback, and other aspects [13]. With the development of artificial intelligence, big data, and virtual reality technology, the scope and depth of the application of educational engineering in education have been significantly improved.

Technological advancement is an important driving force in the development of educational engineering. From the early days of multimedia teaching to today's wide application of big data, artificial intelligence, and virtual reality technology, the continuous progress of technology enables educational engineering to better meet various needs [14]. For example, adaptive learning systems based on artificial intelligence can adjust teaching content in real-time according to learners' behavioral data to meet the individual needs of different students; virtual reality technology provides learners with a more realistic experience by constructing immersive learning scenarios, which is especially widely used in contexts such as medical, engineering and tourism education. Big data analytics can also predict learning outcomes and provide a basis for teaching improvement. There is a clear advantage in the development and innovative application of educational engineering technologies, especially in the United States, Europe, and other technological frontiers. Some studies focus more on the localized application of educational engineering technologies and the imbalance of educational resources [15]. The smart education strategy proposed in recent years promotes the in-depth integration of educational engineering technologies in vocational education, basic education, and higher education.

Despite the many achievements in educational engineering, the disconnection between theory and practice is still one of the main bottlenecks in current research [16]. Some technological applications lack an in-depth understanding of the laws of education, resulting in a low degree of match between teaching objectives and technological means. In addition, high technology costs and uneven distribution of resources have limited the popularization of educational engineering in less developed regions. In the future, the development of educational engineering needs to find a closer integration between theoretical research and technological practice, while focusing on technological universality and sustainability to promote the overall improvement of educational equity and quality.

B. Literature Review on Tourism Education

Tourism education is an interdisciplinary form of education that focuses on the cultivation of knowledge and practical ability in the tourism industry [17]. Since the mid-20th century, tourism education has gradually shifted from vocational education based on skills training to the comprehensive development of comprehensive quality and cultural awareness training. The research on tourism education involves multiple dimensions such as teaching mode, curriculum design, technology application, and industry docking, forming a rich theoretical and practical foundation [18]. In recent years, with the rapid development of the tourism industry and the wide application of educational engineering technology, tourism education has ushered in a profound paradigm change [19].

Early tourism education took experiential learning as its main form, helping students acquire practical experience and vocational skills through field trips, situational simulation, and

project-based learning [20]. This model emphasizes situational authenticity and operability, which can enhance students' perception and participation but it also has obvious limitations. For example, field trips are costly and limited by time and geography, while the interactivity and innovativeness of traditional situational simulation are insufficient to meet the needs of complex tourism education [21]. Therefore, how to introduce modern educational technology to enhance the effect of experiential learning has become a key direction of research in recent years. The rapid development of educational engineering technology has brought new opportunities for tourism education. Virtual Reality (VR) and Augmented Reality (AR) technology have become an important tool to enhance the teaching effect [22]. Through VR technology, students can virtually visit museums, cultural sites, or natural scenic spots, thus obtaining an immersive learning experience, while AR technology can superimpose digital information into real scenes, providing students with dynamic and instant learning support. In addition, big data and artificial intelligence are increasingly used in tourism education [23].

Current related research has accumulated rich experience in tourism education model innovation. For example, tourism education emphasizes the in-depth combination of industry practice and education and utilizes the MOOC platform to offer tourism courses and provide flexible learning modes [24]. Other studies focus on cultural and sustainable tourism education, integrating cultural awareness and ecological protection concepts into curriculum design. In contrast, some studies pay more attention to the regional balance of educational resources and localized practices, such as developing courses that incorporate unique tourism resources and cultural backgrounds. With the advancement of smart tourism and education modernization, tourism education research is rapidly developing in the direction of digitalization and intelligence.

In the literature review of educational engineering and tourism education, this study utilizes visual analysis, focusing on keywords and links to related nodes in the relevant research areas [25]. The four core keywords are "educational engineering", "tourism education", "interactive teaching" and "experiential learning". In addition, these core words are associated with some secondary core words, such as "higher education" and "tourism". The details are shown in Fig. 1.

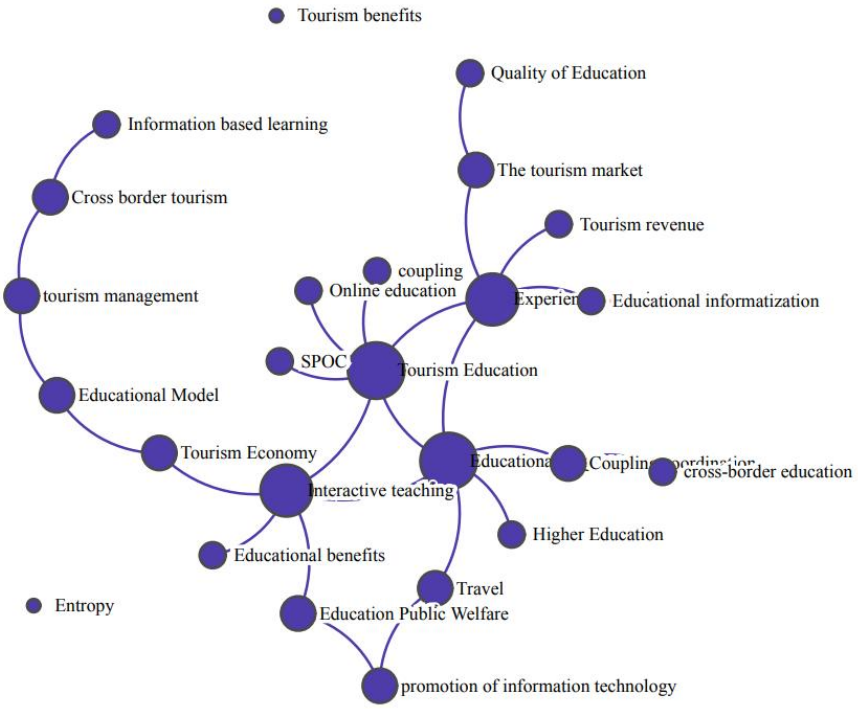

Fig. 1. Visualization and analysis of educational engineering and tourism education.

III. Research Methods

A. Coupled Coordination Theory

The theory of coupled coordination first originated in the field of physics and is used to describe the interaction between two or more systems and their overall dynamic behavior [26]. The concept of coupling was initially used to explain the interaction of different elements in natural systems, such as vibration between molecules, energy exchange, and other phenomena, emphasizing the dynamic equilibrium state formed between systems through energy or information transfer. With the rise of cross-disciplinary research, this theory has gradually been extended to other fields, such as ecology, economics, and social sciences. In these fields, coupling theory is mainly used to analyze the interactions between complex systems and reveal how different subsystems can achieve common development through coordination [27]. In particular, in the field of regional development and resources and environment, coupling theory has been used to explore the systemic relationships among economy, society, resources, and environment, to provide theoretical support for sustainable development strategies.

On this basis, coupling theory further developed the concept of "coupling coordination" to measure the efficiency and coordination of interactions between different systems [28]. The coupling coordination theory emphasizes that the coupling relationship is not only about the strength of the interaction between systems but also about whether the results of the interaction reach a synergistic development state. The introduction of this concept marks the extension of the theory from pure coupling mechanism research to coordination and optimization practice. In recent years, the coupling coordination theory has been widely used in urban planning, industrial restructuring, and education-industry relationship research [29]. For example, in the study of the interaction between tourism education and the tourism industry, the coupling coordination theory has been used as an analytical tool to reveal the dynamic law of matching the allocation of educational resources with industrial demand. With the development of data technology, the quantitative analysis ability of the coupled coordination model is increasing, which makes the practical application of the theory more accurate and provides a scientific basis for cross-field systematic research [30].

Using the coupled coordination model, it is necessary to establish two corresponding evaluation index systems, namely the "tourism industry efficiency index system" and "tourism education engineering index system", as shown in Table I and Table II.

TABLE I. TOURISM INDUSTRY BENEFIT INDICATOR SYSTEM

System	*Evaluation*	*Unit of measurement*	*Indicator direction*
Benefits of the tourism industry	Total output value of the tourism industry	Billion	+
	Employees in the tourism industry	Person	+
	Number of travel agencies	unit	+
	Number of star-rated hotels	unit	+
	Number of tourist attractions	unit	+
	Travel agency revenue	Billion	+
	Revenue from star-rated hotels	Billion	+
	Revenue from tourist attractions	Billion	+

TABLE II. TOURISM EDUCATION PROJECT INDICATOR SYSTEM

System	*Evaluation*	*Unit of measurement*	*Indicator direction*
Tourism education level	Number of higher tourism institutions	unit	+
	Number of students in higher tourism institutions	unit	+
	The proportion of higher tourism institutions to the total number of regular higher education institutions	%	+
	The proportion of students from higher tourism institutions to students from regular higher education institutions	%	+
	Secondary Vocational Tourism School	unit	+
	Number of students in secondary vocational tourism schools	unit	+
	Proportion of secondary vocational tourism schools to secondary vocational schools	%	+
	Proportion of students in secondary vocational tourism schools to students in secondary vocational schools	%	+

B. Mechanisms for the Coordinated Development of Educational Engineering and Tourism Education

Educational engineering is a systematic and engineering mode of educational resource allocation and management, which aims to improve the operational efficiency and overall effectiveness of the educational system through scientific planning and optimization of educational resource allocation [31]. In the field of tourism education, education engineering is oriented to industrial demand, precisely matching educational resources to the talent cultivation demand of the tourism industry, and building a synergistic system between education and industry. The core of the project is to integrate the tourism industry's demand for complex and innovative talents into the education system through curriculum design, teacher training, and school-enterprise cooperation, to improve the quality and appropriateness of talent training [32]. At the same time, the education project also focuses on enhancing the efficiency of education management through informatization and intelligent means, for example, applying big data technology to analyze the regional tourism market demand and adjusting the investment of education resources accordingly to form a dynamic mechanism for coordinating the supply and demand of education. This mode of education engineering, led by industrial demand, provides strong support for the efficient development of tourism education.

The key to the coordinated development mechanism of education engineering and tourism education lies in realizing the

in-depth integration of education and industry, and forming the coupling and synergy between the two [33]. Firstly, through policy guidance and resource integration, the education project incorporates the government, institutions, enterprises, and other parties into the cooperation framework to form an education system centered on the needs of the industry. Second, in the coordinated development mechanism, the two-way promotion relationship between theory and practice is emphasized. On one hand, the education project promotes multi-level cooperation between tourism colleges and enterprises through deepening the integration of industry and education, such as internship practice and joint projects between industry, academia, and research, etc., to ensure that the training of talents meets the actual needs of the industry [34]. On the other hand, the development of the industry also provides feedback for the education project, which constantly adjusts the curriculum content and teaching mode through the changes in the industry's demand for talent. In addition, the coordinated development mechanism also pays attention to the differences in regional characteristics. For example, in regional tourism resource-rich areas, the education project can formulate personalized education strategies according to the focus of the development of the local tourism industry, and promote the characteristic development of local tourism education. This mechanism of multi-level and multi-body synergy not only enhances the service industry capacity of tourism education but also promotes the continuous optimization and upgrading of the regional tourism industry.

IV. Results and Discussion

A. Coupled Coordination Model

The coupled coordination model is derived from the coupling theory in physics and is mainly used to study the degree of interaction and coordination between different systems or subsystems. In the social sciences, the coupled coordination model is commonly used to assess the development of synergy between two or more systems [35]. The key indicator of the model is the degree of coupling coordination.

The coupling degree reflects the strength of the interaction between systems and takes a value ranging from 0 to 1. The closer the value is to 1, the stronger the coupling between systems. The coupling coordination degree combines the coupling degree and the comprehensive development level of the system to reflect the coordinated development state between the systems. In the field of tourism education, the coupling coordination model is applied to analyze the relationship between the benefits of the tourism industry and education engineering. By constructing the coupling coordination model, the relationship between these two subsystems can be quantified, revealing the following: how the improvement of tourism industry efficiency affects the development and implementation of the innovative model of education engineering, how the progress of education engineering provides specialized talent support for the tourism industry, and thus enhances industrial efficiency [36]. The potential for synergistic development of the two subsystems and possible obstacles.

The corresponding evaluation index system has been constructed above. Therefore, next, the data needs to be standardized. The data in this paper comes from the China Tourism Statistical Yearbook. The specific standardization process is as follows:

$$Y_{ij} = \frac{x_{ij} - \min x_{ij}}{\max x_{ij} - \min x_{ij}} \tag{1}$$

$$Y_{ij} = \frac{\max x_{ij} - x_{ij}}{\max x_{ij} - \min x_{ij}} \tag{2}$$

Eq. (1) and Eq. (2) are the processes of forward indicator processing and reverse indicator processing, respectively, where x_{ij} is the specific value in the original data matrix. max and min are the specific maximum and minimum values of a column and a row, respectively. Next is the calculation of the entropy value, Eq. (3):

$$E_{ij} = \ln \frac{1}{n} \sum_{i=1}^{n} \left[(y_{ij} / \sum_{i=1}^{n} y_{ij}) \ln(y_{ij} / \sum_{i=1}^{n} y_{ij}) \right] \tag{3}$$

where, E is the entropy value and n represents the year of the data. Next is the weight Eq. (4):

$$W_{ij} = (1 - E_{ij}) / \sum_{j=1}^{m} (1 - E_{ij}) \tag{4}$$

m is the number of indicators, and W is the specific weight.

Therefore, it can be obtained that the specific weights of the two indicator systems with the corresponding entropy value are given in Table III.

TABLE III. Weights of Tourism Industry Efficiency Index system

Evaluation	E_{ij}	d	W_{ij}
Total output value of the tourism industry	0.974	0.014	0.248
Employees in the tourism industry	0.917	0.0254	0.142
Number of travel agencies	0.874	0.145	0.361
Number of star-rated hotels	0.687	0.254	0.054
Number of tourist attractions	0.671	0.361	0.364
Travel agency revenue	0.997	0.001	0.036
Revenue from star-rated hotels	0.64	0.364	0.074
Revenue from tourist attractions	0.364	0.364	0.967

In Table III, the entropy value is to be calibrated, and the calibration result, if between 1 and 10, indicates that the range of entropy value meets the basic requirements of the entropy weight method, otherwise, further differencing is required.

The data in Fig. 2 is the result after standardization using Eq. (1) and Eq. (2), and the results are carried out, which involve a total of data from 2018 to 2022, and after the multidimensional data have been processed by the NMDS for downscaling. The results are shown in the figure in which the values are colored, the square of R in its results is 0.4328, the P-value is less than 0.05, which is in line with the entropy weighting method on the processing of the expectations, then the weights and standardized data can be used. The details are shown in Table IV.

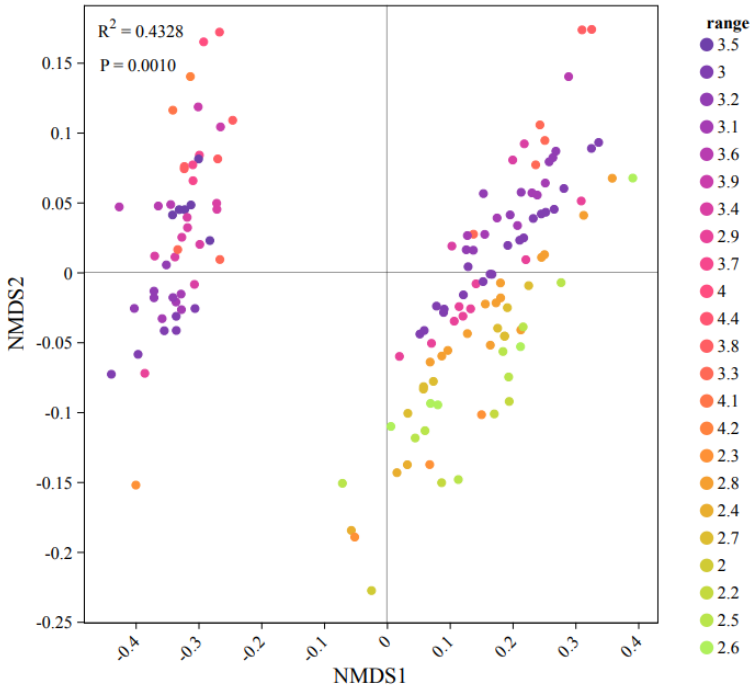

Fig. 2. Basic statistical results after data normalization.

TABLE IV. TOURISM EDUCATION PROJECT INDICATOR SYSTEM WEIGHTS

Evaluation	E_{ij}	d	W_{ij}
Number of higher tourism institutions	0.974	0.047	0.148
Number of students in higher tourism institutions	0.361	0.062	0.362
The proportion of higher tourism institutions to the total number of regular higher education institutions	0.528	0.817	0.051
The proportion of students from higher tourism institutions to students from regular higher education institutions	0.687	0.364	0.047
Secondary Vocational Tourism School	0.847	0.635	0.263
Number of students in secondary vocational tourism schools	0.967	0.057	0.148
Proportion of secondary vocational tourism schools to secondary vocational schools	0.889	0.687	0.187
Proportion of students in secondary vocational tourism schools to students in secondary vocational schools	0.947	0.036	0.045

After the weights in Table IV are calculated, the coupled coordination model needs to be established. The coupled coordination model is mainly used to study the degree of interaction and coordination between different systems or subsystems. In the field of social sciences, the coupled coordination model is often used to assess the synergistic development between two or more systems [see Eq. (5)].

$$C = \left\{ f(x)g(x) / \frac{f(x)+g(x)}{3} \right\}^{\frac{1}{2}} \quad (5)$$

where, C is the coupling coordination degree, where $f(x)g(x)$ is the comprehensive evaluation value of tourism industry benefits and tourism education engineering, respectively.

The research object of this study is the coupling of education engineering and tourism education, in which the entropy value of the indicators in the tourism benefit and education engineering is judged, out of the original indicator system, to ensure the accuracy of the data, the data cited "smaple1" and "smaple2" sample data, the results of the entropy value are in line with the range of 0~1 (10 times the entropy value in the figure), as shown in Fig. 3.

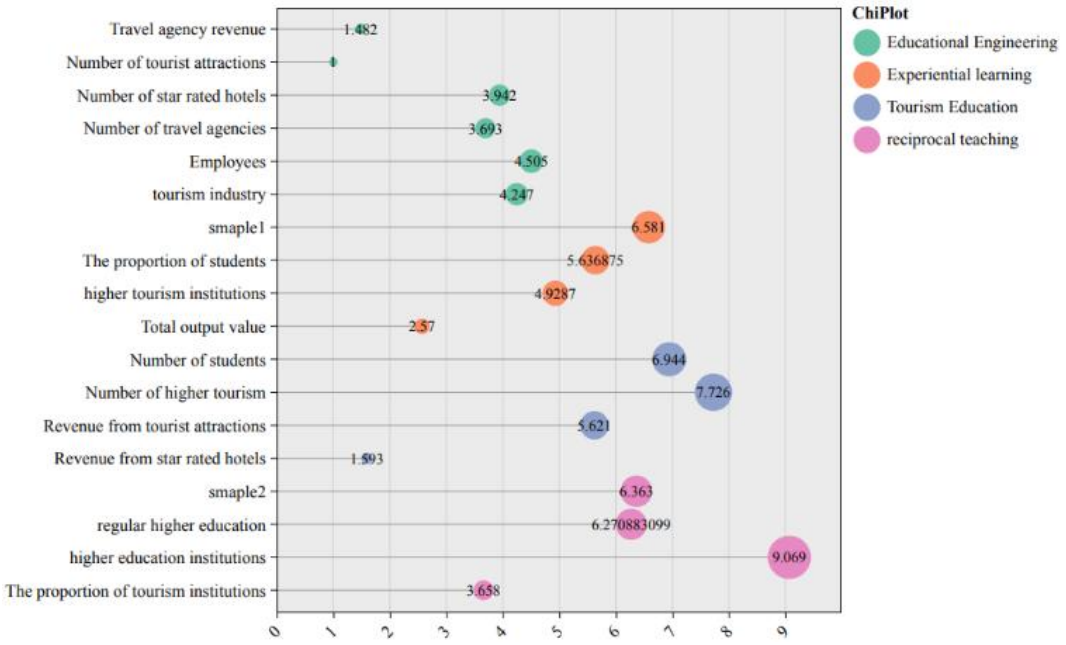

Fig. 3. Information entropy judgment of coupling educational engineering and tourism education.

B. Discussion of Results

In this study, we assess the two systems by constructing the "tourism industry efficiency index system" and "tourism education project index system", and analyze the coupling and coordination relationship between them through the coupling coordination model. According to the results of the model, this study draws the following conclusions: the coupling and coordination degree of tourism industry efficiency and tourism education project is at a medium level, indicating that although there is a certain degree of interaction between the two, there is still room for improvement in their coordinated development. The following will be discussed in detail from the evaluation results of the two indicator systems and the results of the coupling coordination analysis, respectively.

The dynamic changes in the tourism industry's efficiency indicators from 2018 to 2022 show that analyzing these indicators reveals the general trends, key influencing factors, and possible problems in the development of the tourism industry. These indicators cover four dimensions: economic efficiency, employment, infrastructure development, and industry revenue, reflecting the comprehensive performance of the tourism industry. The following is a detailed analysis of each indicator:

The total output value of the tourism industry amounted to 150.32 billion yuan in 2018 and grew to 180.43 billion yuan in 2022, with an average annual growth rate of 4.6%. This growth is mainly attributable to the steady development of the domestic economy and the continuous increase in tourism demand. In recent years, the government has actively promoted the policy of "regional tourism", encouraging localities to create distinctive tourism destinations, which has contributed to the expansion of the tourism market. In addition, the obvious trend of upgrading tourism consumption and the increasing demand for medium- and high-end tourism products also became the core driving force for the growth of the total output value. The impact of the epidemic caused the total output value to fall to RMB 141.27 billion in 2020, but it quickly recovered to RMB 170.58 billion in 2021, indicating that the tourism industry possesses strong market resilience. In the post-epidemic era, people's travel consumption methods have gradually diversified, driving a sustained increase in total output value. However, the growth of this indicator has also revealed certain shortcomings, such as the over-reliance on scenic spot ticket revenues in some regions, which has led to a single industrial structure and limited risk resistance.

The number of people in the industry will grow from 2.004 million in 2018 to 2.315 million in 2022, with an average annual growth rate of 3.7%. With the expansion of the tourism industry, the demand for occupations such as tour guides, hotel service personnel, and scenic spot managers has increased significantly. Meanwhile, tourism-related secondary and tertiary industries such as transportation, catering, culture, and entertainment also absorb a large number of laborers. The number of people in the workforce declined sharply to 1.827 million during the 2020 outbreak, reflecting the industry's high sensitivity to public health events. However, the number of employees rebounded rapidly from 2021 onwards, indicating that the tourism industry has a strong capacity to absorb employment and is an important pillar industry in regional economic development. It should be noted, however, that some employees in the industry still face problems such as high labor intensity, insufficient vocational skills, and weak social security, which pose a potential threat to the long-term development of the industry.

The number of travel agencies grew from 5,002 in 2018 to 5,610 in 2022, at a CAGR of 2.8%. In recent years, the increasing demand for free and customized travel in the country has driven the diversification and specialization of travel agents' business. Many travel agencies have begun to transform to digitalization to attract customers through online booking and customized services. In addition, the government has introduced

relevant policies to support the development of small and micro tourism enterprises, creating favorable conditions for the establishment of small and medium-sized travel agencies. The growth in the number of travel agencies has provided tourists with more choices, but competition in the industry has also become more intense. During the pandemic, many small and medium-sized travel agencies were forced to close due to the sudden drop in market demand, and the number of travel agencies dropped to 4,821 in 2020. However, this volatility gradually recovered after 2021, reflecting the industry's resilience. In addition, travel agents with strong digital transformation capabilities stood out from the competition, and market concentration increased.

The number of star-rated hotels grew from 802 in 2018 to 872 in 2022, at a CAGR of 2.1%. With the development of the tourism industry, the demand for high-quality accommodation has been increasing year after year, and the number of star-rated hotels has been rising steadily. Some local governments have introduced high-end hotel brands through investment while accelerating the renovation of old hotel facilities to provide tourists with a better service experience. Although the number of star-rated hotels has increased, their growth rate is slower compared with that of B&Bs and budget hotels. This phenomenon reflects the limited growth in market demand for high-end accommodation, especially during the pandemic, when tourists preferred more cost-effective forms of accommodation with lower contact density [37]. The challenge for star-rated hotels is to balance costs and market demand while adapting to diverse consumer preferences.

The number of scenic spots grew from 1,001 in 2018 to 1,104 in 2022, with an average annual growth rate of 2.5%. The country is vigorously promoting the development of regional tourism and encouraging localities to tap local cultural and ecological resources to create unique scenic spots. For example, some regions have attracted tourists by creating cultural theme parks and upgrading the infrastructure of natural scenic spots. Although the number of scenic spots has steadily increased, the problem of homogenization of scenic spots is more prominent, with some regions focusing on quantitative expansion and neglecting the management and service quality of scenic spots. The distribution of new scenic spots is concentrated in the eastern and coastal developed regions, and the development of scenic spots in the western region still needs to be strengthened. The coordinated development of the region needs to be further promoted. Table V shows the evaluation data of tourism industry efficiency indicators.

TABLE V. EVALUATION DATA OF TOURISM INDUSTRY EFFICIENCY INDICATORS

	2018	*2019*	*2020*	*2021*	*2022*	*Average rate%*
Total output value of the tourism industry	1503	1602	1412	1705	1704	4.6
Employees in the tourism industry	200	211	182	223	231	3.7
Number of travel agencies	5002	5103	4821	5520	5610	2.8
Number of star-rated hotels	802	823	798	856	872	2.1
Number of tourist attractions	1001	1053	1027	1089	1104	2.5
Travel agency revenue	501	521	482	553	580	3.8
Revenue from star-rated hotels	201	210	192	222	233	3.6
Revenue from tourist attractions	804	851	801	902	953	4.4

According to the data in Table V, the eight indicators of the benefits of the tourism industry show a steady growth trend between 2018 and 2022, with the average annual growth rate remaining between 2% and 4.6%. The total output value of the tourism industry increased from 150.32 billion yuan in 2018 to 180.43 billion yuan in 2022, with an average annual growth rate of 4.6%, especially in the period of post-epidemic economic recovery (2021 to 2022), which demonstrated that the industry is economically resilient. From 2.004 million in 2018 to 2.315 million in 2022, with an average annual growth rate of 3.7%. This shows the continued growth of the tourism industry in terms of employment absorption, but the number of people employed declined during the epidemic (to 1.827 million in 2020). The number of travel agencies and the number of star-rated hotels both showed a slow growth trend, with average annual growth rates of 2.8% and 2.1%, respectively. Despite the low growth rate, the increase in absolute numbers provides a guarantee to meet the growing demand of tourists. The average annual growth rates of travel agency revenues, star-rated hotel revenues, and scenic spot revenues were 3.8%, 3.6%, and 4.4% respectively, reflecting the continuous enhancement of the level of tourism consumption and tourists' spending power. The overall performance of the tourism industry's efficiency was solid, but the dampening effect of the epidemic on short-term growth was evident, while there were problems of uneven regional development and insufficient collaboration upstream and downstream of the industry chain within the industry.

Table VI shows the dynamic changes in the indicators of tourism education engineering between 2018 and 2022, covering the number and scale of higher tourism education and secondary vocational tourism education, as well as their share in the education system. The in-depth analysis of these data can reveal the current situation, trends, and problems in the development of tourism education.

The number of higher tourism colleges and universities increased from 100 in 2018 to 116 in 2022, with an average annual growth rate of 3.7%. This growth is attributed to the country's dual policy support for tourism and education. In recent years, as the importance of the tourism industry has gradually increased, many regions have increased their investment in tourism talent training by establishing or expanding higher tourism education institutions to meet the market demand for high-level tourism talent. The increase in the number of tertiary tourism institutions has provided more students with learning opportunities and delivered a large

number of talents to the industry. However, some of the newly established institutions are still inadequate in terms of professional development and faculty strength, which may lead to the improvement of education quality lagging behind the growth in quantity.

The number of students in higher tourism colleges and universities increased from 203,000 in 2018 to 234,000 in 2022, with an average annual growth rate of 3.6%. With the development of the tourism industry, social demand for professional skills such as tourism management, tourism planning, and tourism marketing has increased significantly, attracting more students to enroll in tourism-related majors. Many higher education institutions have responded positively to the industry's demand by expanding their enrollment. Despite the steady increase in the number of students, the share of tourism majors remains low compared to the total number of students in higher education as a whole, at only 5% in 2022. This reflects that the status of tourism education in the higher education system needs to be upgraded. In addition, some graduates reflect a low degree of employment and professional fit, indicating that there is still a gap between the training system and actual demand.

The share of higher tourism institutions in the higher education system grew from 5.0% in 2018 to 5.6% in 2022, with a CAGR of 2.8%. With the increase in the number of higher education institutions in the country, the share of tourism institutions has also increased. In particular, some local institutions have contributed to the growth of this percentage by establishing tourism colleges or tourism programs. Despite the upward trend in the proportion, the growth in the share of tourism education is more limited compared to other sectors (information technology, engineering management). This indicates that tourism education is still not prioritized high enough in the higher education system, and its resource allocation and policy inclination need to be strengthened.

The share of students in higher tourism institutions increases from 4.5% in 2018 to 5.0% in 2022, with a CAGR of 2.7%. The growth in the ratio is mainly attributed to the expansion strategy of higher tourism institutions and the increased attractiveness of the tourism industry to professionals. However, the rapid growth in the total number of tertiary students has also limited the magnitude of the increase in the proportion. This proportion has increased but is still at a low level, reflecting that tourism education has failed to attract more high-quality students to enroll, and the industry's attractiveness is limited. At the same time, with the lack of resources following the expansion of some institutions, the quality of education may be affected, requiring further optimization of the match between enrollment scale and training resources.

The number of secondary vocational tourism schools increased from 301 in 2018 to 332 in 2022, with an average annual growth rate of 2.5%. The development of secondary vocational tourism schools is mainly driven by national policies. For example, in recent years, the government has advocated the alignment of vocational education with industrial demand and accelerated the construction of vocational schools [38]. In addition, the growth in demand for tourism service jobs has made secondary tourism schools an important part of vocational education. Although the number of schools has been growing steadily, its share has grown more slowly relative to the overall size of the nation's secondary schools, rising only from 6.0% to 6.5%. Some schools have problems such as single specialization and insufficient practical teaching equipment, making it difficult to effectively meet market demand.

TABLE VI. EVALUATION DATA FOR TOURISM EDUCATION PROJECT INDICATORS

	2018	*2019*	*2020*	*2021*	*2022*	*Average rate%*
Number of higher tourism institutions	100	105	103	111	116	3.7
Number of students in higher tourism institutions	20.3	21.1	20.7	22.5	23.4	3.6
The proportion of higher tourism institutions to total regular HEIs	5.0	5.2	5.1	5.4	5.6	2.8
Proportion of students from higher tourism institutions to regular HEI students	4.5	4.6	4.6	4.8	5.0	2.7
Secondary vocational tourism schools	301	312	308	323	332	2.5
Number of students in secondary vocational tourism schools	10.2	10.7	10.4	11.2	11.7	3.5
Proportion of secondary vocational tourism schools to all secondary schools	6.0	6.2	6.1	5.4	6.5	2.0
Proportion of students in secondary vocational tourism schools to all secondary students	5.5	5.6	5.6	5.8	6.0	2.2

Table VI reflects the dynamics of tourism education engineering in terms of the number of schools, size of students, and the proportion of education, with an average annual growth rate remaining between 2% and 3.7%. The number of higher tourism institutions increased from 100 in 2018 to 116 in 2022, with an average annual growth rate of 3.7%; the number of students increased from 203,000 to 234,000, with a growth rate of 3.6%. Despite the increase in numbers, the share in the overall size of higher education grew by only 0.6 percentage points (from 5.0% to 5.6%). The number of vocational tourism schools increased from 301 to 332, with an average annual growth rate of 2.5%, slightly lower than the growth in higher education. The number of students grew more significantly, from 102,000 to 117,000, with an average annual growth rate of 3.5%. Whether it is higher education or vocational education, its share in the overall education system has been on a slow upward trend (with an average annual growth rate of between 2% and 2.8%), but the level of the share is still relatively low, unable to fully meet the growing demand for talents in the tourism industry [39]. Although the development of tourism education engineering has been steadily increasing, its development speed has not been able to fully match the growth of the tourism industry, especially in the distribution of educational resources and the input of practical teaching, there are still significant shortcomings.

Table VII presents the coupling coordination model calculations.

TABLE VII. COUPLING COORDINATION MODEL CALCULATIONS

Year	*Coupling (C)*	*Degree of coupling coordination (D)*	*Coordinated state*
2018	0.681	0.548	Initial coordination
2019	0.702	0.563	Initial coordination
2020	0.651	0.521	sue for harmonization.
2021	0.733	0.624	Moderate coordination
2022	0.756	0.646	Moderate coordination

Table VII reflects that the coupling degree between the benefits of the tourism industry and the education project is always at a high level, reflecting the strong correlation between the two. The coupling degree rises significantly after 2021, suggesting that the recovery of the education project is in step with the rebound of the tourism industry. The degree of coordination increases from 0.548 in 2018 to 0.646 in 2022, showing a gradual increase in synergy between the systems. However, during the epidemic (2020), the degree of coordination declined to 0.521, indicating a certain lag between industry and education development, especially the failure of the education system to quickly adapt to industry changes.

These are the following suggestions for improvement: adjust the curriculum design according to the needs of the tourism industry, increase the number of practical skill courses, and solve the problem of the disconnection between education supply and market demand [40]. Encourage colleges and universities to build practical training bases with enterprises, to realize resource sharing and complementation through school-enterprise cooperation, and to enhance the actual effectiveness of educational projects. Increase the investment of educational resources in the central and western regions to narrow the gap between regional educational developments, thus enhancing the overall degree of coordination.

V. CONCLUSION

This study takes the tourism industry benefits and tourism education project as the research object, constructs the evaluation framework based on the index system, and empirically analyzes the coordination relationship between the two by using the coupling coordination model. The study shows that with the common development of the tourism industry and tourism education, their coupling coordination degree has been improved year by year, which is manifested in the following aspects: the steady growth of tourism industry benefits, the gradual improvement of tourism education project, and the coupling coordination level of tourism industry and education project has gradually moved from the primary coordination stage to the moderate coordination stage, reflecting the benign cycle relationship between the two in the interactive development.

However, this study still suffers from the following shortcomings: the data in this study mainly focus on 2018 to 2022, which fails to fully reflect the late stage of the epidemic and future trends. Some of the data sources have limitations, which may lead to limited applicability of the conclusions. Only the coupled coordination model was used in the study to analyze the relationship between the two, and other dynamic models (system dynamics modeling, structural equation modeling) were not combined to explore the intrinsic mechanism in more depth. Therefore, future research should continue to make efforts in the areas of "optimizing the indicator system", "exploring regional differences", "expanding research methods", and "focusing on industry innovation". Therefore, future research should continue to make efforts in "optimizing the indicator system", "exploring regional differences", "expanding research methods" and "focusing on industry innovation".

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