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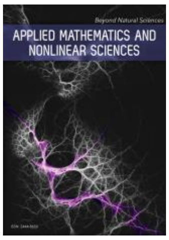

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Optimization of Innovative Talent Cultivation Mode of Tourism Management Major Combined with Multiple Intelligences Theory

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Abstract

This paper first proposes the talent cultivation model of industry-academia integration on the basis of multiple intelligence theory and constructs the mathematical model of knowledge base expansion based on the three dimensions of coupling compatibility, interaction intensity and interaction time. Secondly, based on the knowledge transformation theory, it constructs the information and knowledge transformation model of industry-academia organizations and conducts the existence test of the Matthew effect. Finally, the tourism management major of University J as a research object is selected to analyze the operational development trend of the industry-academia integration talent cultivation model combined with multiple intelligences by analyzing the role relationship between system variables derived from the data. The results show that in 100 simulations, the coupling compatibility of the industry-academia fusion system of tourism management majors rises by 1.286 gradients for every 1.286 gradients, and the Matthew effect of the incremental knowledge of colleges and universities rises by one grade, indicating that the model, which has a more significant effect on the success rate of innovative talent cultivation in tourism management majors, has a more significant effect on the enhancement of the success rate of innovative talent cultivation.

Keywords: Multiple intelligence theory; Coupling compatibility; Knowledge transformation model; Matthew effect; Industry-academia integration.
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1 Introduction

At present, people's living standards are also improving rapidly, and more and more people are choosing to travel abroad, which leads to the rapid development of tourism. In the future, tourism will be a rapidly developing service industry, which will have a great role in promoting the economy [1]. However, there are many problems in the cultivation of innovative talents in tourism management in colleges and universities. Most tourism management graduates from undergraduate colleges and universities and universities are unable to adapt to the current tourism market, resulting in a “mismatch between supply and demand”, so that the cultivation of tourism professionals in undergraduate colleges and universities and universities can not adapt to the needs of the market. The loss of its basic objectives, and can not provide undergraduate colleges and universities with universities to adapt to the needs of the market [2].

From the current situation, tourism will be the fastest-growing tertiary industry in the next few years, and the current tourism market is in urgent need of a group of grassroots tourism management practitioners to meet the needs of the tourism market [3]. The development momentum of the tourism industry is very good. The tourism market is in urgent need of a group of graduates of higher vocational colleges and universities, and the research on the cultivation of innovative talents in tourism majors of undergraduate colleges and universities and universities is the main work of the tourism majors of undergraduate colleges and universities and universities at present, in order to adapt to the needs of the current development of the tourism market and to promote the sustained development of the tourism industry.

This paper constructs the talent cultivation model of industry-teaching integration on the basis of Gardner's theory of multiple intelligences. A knowledge base expansion mathematical model will be constructed based on the three dimensions of coupling compatibility, interaction intensity and interaction time in order to further study the coupling-interaction role mechanism. Secondly, taking the physical system, knowledge base, management system and cultural values as the basic conditions for realizing knowledge innovation, the information and knowledge transformation model of industry-academia organization will be constructed according to the knowledge transformation theory, and the existence test of hierarchical Matthew effect will be conducted. Finally, the tourism management program of University J and the industry-academia cooperation organization with University J were selected as the system dynamics research objects. By analyzing the role relationship between system variables derived from the data, the system simulation method is applied to analyze the operational development trend of the industry-academia integration talent cultivation model combined with multiple intelligences.

2 Literature review

According to Gardner's in-depth study of multiple intelligence theories in psychology, multiple intelligence theory has now been widely used in the field of education and other fields [4]. Bao, Y. constructs a computer training teaching model based on multiple intelligences theory in the Internet of Things environment, the main goal of which is to make the individual's superior intelligence value and development, find out their inferior intelligence, and strive to strengthen their deficiencies, so that individuals can lead to success through education [5]. Nce, E. Y. and Nce, M. used the fuzzy analytic hierarchy method (FAHP) to e-rank the PLE and ALE systems, and in the course, based on the theory of multiple intelligences, individual students were evaluated and evaluated, and the multi-dimensional evaluation was carried out on a more comprehensive evaluation dimension [6]. Xie, X. Research on the multi-intelligence Internet innovative computer training platform believes that every individual is moldable, and in the process of students' vocational education, which way to cultivate students' professional qualities and which way to cultivate talents are the main questions that should be considered now [7]. Ferrero, M. believes that with the rapid development of society and science and technology, human beings are likely to discover more new intelligence, which puts forward higher and stricter requirements for the comprehensive quality of talents in various industries [8].

It is found that due to the lack of attention paid to tourism management professional education in undergraduate colleges and universities, funds cannot be received in time, which affects the normal professional practice training of tourism management students [9]. Kim, E. J. and Pomirleanu, N. believe that tourism crisis management is a vocational skill that tourism management students must have, but due to the lack of practice, this will inevitably lead to a disconnect between theory and practice, which will eventually affect the improvement of students' crisis management ability [10]. Kharel, S. et al. found that the lack of local tourism management teaching resources, multimedia and computer networks leads to poor practical ability of tourism management students, resulting in the local tourism industry is not competitive internationally [11]. Lima Muniz et al. believe that practical teaching is an important part of cultivating innovative talents in the tourism profession, and teachers in undergraduate colleges and universities must pay attention to the cultivation of students' practical ability; otherwise, it will directly cause poor employability of tourism students in undergraduate colleges and universities [12].

The above study concluded that insufficient practice is the main factor affecting tourism management education students in the job market, and the teaching mode of industry-teaching integration is precisely one of the most effective ways to improve students' practical ability [13]. Bodrunov, S. D. believes that tourism management students have not adjusted the curriculum accordingly to the current changes in the market and the characteristics of the times and that the professional teaching materials used are out of touch with market needs to be out of touch, resulting in the lack of professionalism of tourism students in undergraduate colleges and universities [14]. Qian, Y. believes that the current reform of higher undergraduate education in China is facing a new situation, the need to explore the integration of industry and education as the basis for talent training strategy, but also need to take advantage of the faculty of the enterprise, and jointly cultivate applied talents in line with the needs of the enterprise [15].

3 Talent cultivation model of industry-teaching integration based on multiple intelligences

The theory of multiple intelligences emphasizes that school teaching should be taught for the purpose of cultivating students' practical abilities and that teaching should be taught for the purpose of cultivating students' multiple intelligences and through multiple intelligences. It is not only a goal but also a concept of setting school curriculum. The curriculum of tourism courses in colleges and universities should be set up on the premise of market demand, with the starting point and ultimate goal of cultivating students' practical ability and multiple intelligences, and the courses should be able to effectively improve students' practical ability, and the most effective way to improve students' practical ability is the integration of industry and education teaching mode.

3.1 Mechanisms for expanding the knowledge base of industry-academia-research institutes

3.1.1 Coupling compatibility based on knowledge perspective

Industry-university-research knowledge base expansion requires close coupling and continuous interaction among the partners, and this process cannot be separated from two basic elements, i.e., knowledge base coupling and close interaction. In this section, a mathematical model of knowledge base expansion will be constructed based on the three dimensions of coupling compatibility, interaction intensity and interaction time to further the coupling-interaction mechanism [16].

Assuming that the eigenvalue of the knowledge base of the university is represented by x_u and the eigenvalue of the knowledge base of the enterprise is represented by x_i, the distance of the knowledge base between the two subjects can be expressed in several ways [17]:

The first one is expressed $x_u - x_i$ by the difference in eigenvalues between the two subjects.

The second is expressed x_u / x_i in terms of the ratio of the two eigenvalues.

The third is expressed in logarithmic form $\ln \frac{x_u}{x_i}$.

Because the knowledge base coupling compatibility degree and knowledge base distance have opposite meanings in the quantitative representation, this paper uses $\left(x_u - x_i\right)^{-r}$ to indicate the coupling compatibility degree of the knowledge base between two subjects of tourism enterprises and tourism management majors in colleges and universities, where r is a constant greater than 1 [18]. The closer the characteristic values x_u and x_i of the knowledge base between the two subjects are, the greater the degree of coupling compatibility is.

3.1.2 Intensity of interaction based on a knowledge perspective

The intensity of interaction between universities and enterprises at a given moment in an industry-university-research cooperative organization satisfies the functional form:

$$\omega_{ui} = \alpha_u e^{\beta\left(x_u - x_i\right)^{-r}} \tag{1}$$

Where, ω_{ui} represents the weight of the interaction between universities and enterprises, α_u represents the relative size of the knowledge production capacity of universities. β represents the magnitude of the force between universities and enterprises, x_u and x_i represent the eigenvalues of the knowledge base of universities and enterprises, respectively. $\left(x_u - x_i\right)^{-r}$ represents the coupling compatibility degree of the knowledge base of universities and enterprises, where r is a constant greater than 1.

3.1.3 Knowledge Base Expanded Mathematical Modeling

This is because in a knowledge network, the evolution law of the node state is that the state of node p at moment t is the result of the sum of the products of the states of all the nodes at the previous moment and the corresponding weights as varied by the active function, i.e., [19]:

$$x_p(t+1) = \varphi\left(\sum_{q=1}^{n} \omega_{qp} x_q(t)\right) \tag{2}$$

So in the industry-university-research coupling-interaction innovation system structure, $(t+1)$ moment the total value of university knowledge is:

$$x_u(t+1)=\alpha_u(t)e^{\beta(t)(x_u-x_i)^{-r}}x_i(t)+x_u(t) \tag{3}$$

Then the incremental knowledge of the college in moments t to $(t+1)$ is:

$$\Delta x_u=\alpha_u(t)e^{\beta(t)(x_u-x_i)^{-r}}x_i(t) \tag{4}$$

Similarly, the total value of the firm's knowledge at moment $(t+1)$ is:

$$x_i(t+1)=\alpha_i(t)e^{\beta(t)(x_u-x_i)^{-r}}x_u(t)+x_i(t) \tag{5}$$

Then the incremental knowledge of the firm in moments t to $(t+1)$ is:

$$\Delta x_i(t+1)=\alpha_i(t)e^{\beta(t)(x_u-x_i)^{-r}}x_u(t) \tag{6}$$

From the analysis of formula (4) formula (6), it can be seen that in the process of university and enterprise coupling an interactive knowledge base expansion, the greater the degree of knowledge base coupling compatibility, the better the compatibility, the higher the intensity of interaction, then the value of knowledge innovation in a certain period of time is also also greater.

When the industry-university-research cooperative organization is in an open environment, Equation (4) Equation (6) can be amended to respectively:

$$\Delta x_u=\alpha_u(t)e^{\beta(t)(x_u-x_i)^{-r}}x_i(t)+\theta(t) \tag{7}$$

$$\Delta x_i=\alpha_i(t)e^{\beta(t)(x_u-x_i)^{-r}}x_u(t)+\varphi(t) \tag{8}$$

Where, θ and φ denote the stimulus from outside the University-Industry-Research Cooperation (UIC) system to universities and firms, respectively, in a decision made by the government when it regulates the policy of the UIC organization.

3.2 Multiple Intelligence-based Innovation Model of Industry-University Coupling and Interaction

The physical system, knowledge base, management system and cultural values are the basic conditions for realizing knowledge innovation. According to the theory of information and knowledge transformation, the information and knowledge transformation model of the organization can be constructed as the information and knowledge transformation model of the university-industry organization shown in Figure 1 [20]. Where $I(t)$ represents the external stimulus information to the academic-industrial organization, $K(s)$ represents the original knowledge base of the academic-industrial organization, and $P(S)$ represents the knowledge operator of the academic-industrial organization under the influence of the physical system and knowledge base.

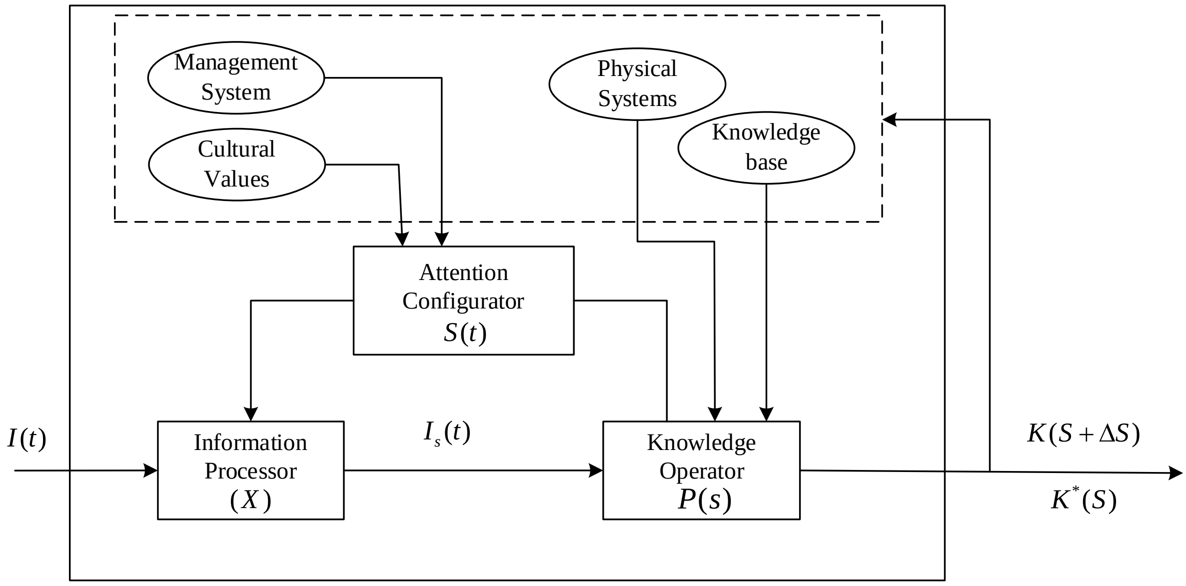


Figure 1. Information and knowledge transformation model

According to the theory of multiple intelligences, in order to transform $I_s(t)$ to $K(S+\Delta S)$, it is known by the principle of Fourier transformation that the information and knowledge transformation model of the industrial-academic organization must have the following functions:

1) The industrial-academic organization selects the external information stimuli and forms a sample sequence of information $I_s(t)$:

$$I_s(t)=I(t)S(t) \tag{9}$$

2) Formation of a new knowledge spectrum sequence $I_s(S)$, whose key operation is:

$$I(S)*S(S)=I_s(S) \tag{10}$$

3) Formal formation of the new knowledge base, i.e., the convolution of the knowledge spectrum sequence $I_s(S)$ with the original knowledge spectrum to create a new knowledge spectrum and realize the expansion of the knowledge base:

$$I(S)*K(S)=K^*(S) \tag{11}$$

The ability of an industrial-academic organization to process information is influenced by its physical systems, knowledge base, management systems, and cultural values. For analytical convenience, the sampling switch $S\left(t\right)$ is set to be a modified rectangular pulse sequence of amplitude 1 and sampling width τ, also known as the modified switching function, i:

$$S(t)-\sum_{-\infty}^{+\infty}\left[gr(t+\tau-nTs)-gr(t-nTs)\right] \tag{12}$$

Let the sampling sequence $I_s(t)$ be the convolution of $I(t)$ with the improved switching function $S(t)$:

$$I_s(t)=I(t)*S(t)=\int_{-\infty}^{+\infty} I(\eta)S(t-\eta)d\eta \tag{13}$$

Fourier transform to $S(t)$:

$$F\{S(t)\}=\int_{-\infty}^{+\infty} S(t)e^{-j\omega t}dt=\frac{4\pi\tau}{T_s}(e^{-j\omega t}-1)\sum_{-\infty}^{+\infty} S_a\left[n\omega_s t\right]\delta(\omega-n\omega_s) \tag{14}$$

The knowledge spectral function for the sampling sequence $I_s(t)$ is then obtained by the convolution theorem:

$$\begin{aligned} I_s(j\omega)&=F\{I_s(t)\}=F\{I(t)*S(t)\} \\ &=\frac{4\pi\tau}{T_s}(e^{-j\omega t}-1)\sum_{-\infty}^{+\infty} S_a\left[n\omega_s t\right]I[j(\omega-n\omega_s)] \end{aligned} \tag{15}$$

The schematic of information sampling and its knowledge spectrum is shown in Fig. 2. Through the above analysis, we basically understand the process of integrating information with the original knowledge base of the industry-academia organization, and the conversion of information into knowledge has changed the original knowledge base. The knowledge spectrum of the original knowledge base is equal to the internal spectrum of the knowledge computing system, so there is:

$$\begin{aligned} K(S)&=F\{I_s(t)\}=\int_{-\infty}^{+\infty} S(t)e^{-j\omega t}dt \\ &=\frac{4\pi\tau}{T_s}(e^{-j\omega t}-1)\sum_{-\infty}^{+\infty} S_a\left[n\omega_s t\right]\delta(\omega-n\omega_s) \end{aligned} \tag{16}$$

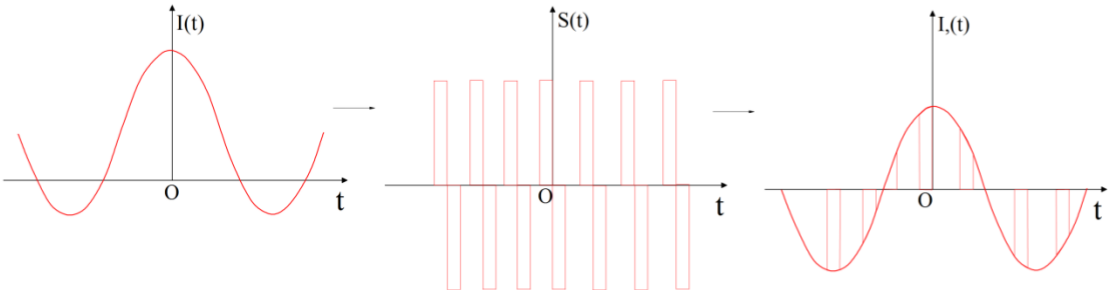


Figure 2. Transformation between knowledge and information

According to Equation (16), the knowledge spectrum of the knowledge base of an industry-academia organization motivated by external information is:

$$\begin{aligned} K(S+\Delta S)&=I_s(jw)=F\{I_s(t)\}=F\{I(t)*S(t)\} \\ &=\frac{4\pi\tau}{T_s}(e^{-j\omega t}-1)\sum_{-\infty}^{+\infty} S_a\left[n\omega_s t\right]I[j(\omega-n\omega_s)] \end{aligned} \tag{17}$$

4 Systematic power mechanism for the cultivation of innovative talents through industry-academia integration

4.1 Causal Flow Diagram Construction of Industry-University Integration to Cultivate Innovative Talents

From the perspective of system theory, university-industry cooperation is by no means a simple superposition of the functions of industry and academia but a systemic, holistic function in that they interact with each other and thus manifest [21]. Meanwhile, as a subsystem belonging to different systems, its external demand and endogenous power have their characteristics and goals, and in the triple helix model of industry-academia-research, the cooperative relationship among universities, enterprises and research institutes is emphasized [22]. All three can become the organizers, leaders, and participants of the innovative talent cultivation system, and they are not independent of each other. Rather, in the operation process, they also participate in the role of other subjects. The three work together for mutual benefit.

All three subsystems can independently cultivate innovative talents in tourism management, but the core of the work of industry-academia research lies in the common cooperation between the three or both of them. Therefore, according to the overall structure of the industry-university-research cooperation system, the construction of industry-university cooperation to cultivate innovative talents mainly involves the following feedback loops [23].

1) Through university-industry cooperation, universities make students not only obtain rich practical results, but also improve their practical ability, and the improvement of students' comprehensive quality directly promotes the improvement of their employment competitiveness. The causal relationship between colleges and universities, as shown in Figure 3, as an important indicator of the comprehensive strength of the discipline, also makes colleges and universities increase their competitiveness so that more human and material capital is injected into the cultivation of college and university talents, forming a virtuous cycle. Ultimately, colleges and universities have established a positive feedback causal network based on talent cultivation.

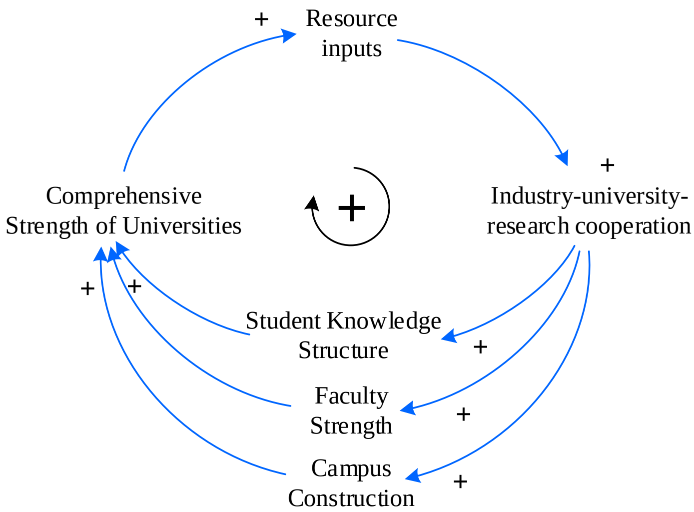


Figure 3. Causality diagram in Colleges and Universities

2) Enterprises acquire new technologies and high-quality talents through university-industry research Cooperation, thus enhancing their R&D capability and comprehensive

competitiveness. The causal relationship of enterprises is shown in Figure 4, which shows that enterprises will increase the cooperation between industries, universities and research institutes, and the improvement of cooperation between industries, universities and research institutes further deepens and consolidates the strength of enterprises, forming a virtuous circle. Eventually, the enterprise forms a positive feedback causality network based on the enterprise's new technology.

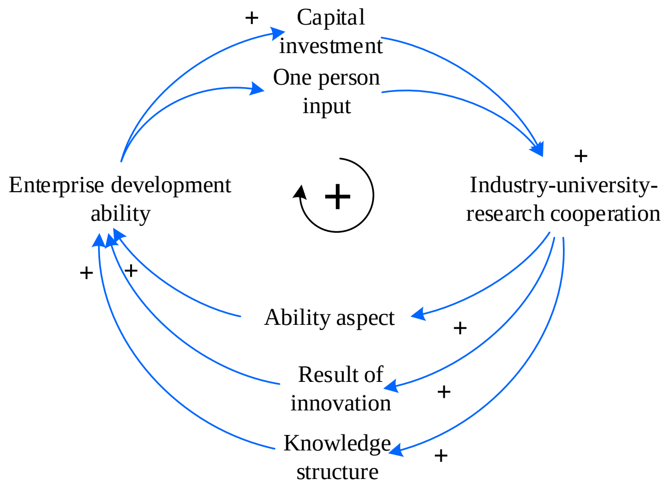


Figure 4. Causality diagram in enterprises

3) Through the combination of the causal relationship diagram of the three subsystems of the university tourism major training innovative talent system, the enterprise training tourism innovative talent system and the scientific research institute training tourism innovative talent system, the overall causal relationship of the industry-university-research system can be obtained, as shown in Figure 5. It can be seen that the capital investment of industry-university-research cooperation not only refers to capital but also includes the investment of personnel. Cultivate innovative talents in scientific research institutes, and the ability to cultivate innovative platforms is manifested through the scientific research level of scientific research institutes and the comprehensive quality of scientific research personnel.

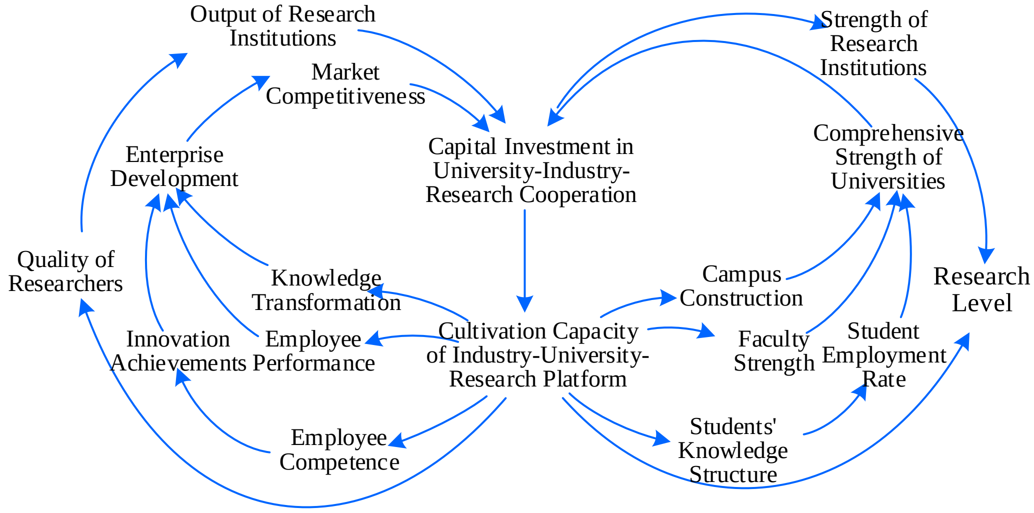


Figure 5. Causality diagram in industry-university-research cooperation

Through the causality diagram of University-Industry-Research cooperation as above, it can be learned that University-Industry-Research is a complex system in which multiple variables are involved, and there is a certain relationship between many variables [24]. Among them, the cultivation capacity of the industry-university-research platform, as the starting point and the end point of each complex circuit, is the core variable in the whole industry-university-research causality diagram.

4.2 Multiple Intelligence-based Talent Cultivation System for Tourism Professionals

4.2.1 Flow chart of industry-academia integration and innovative talent cultivation system

The information feedback closed structure of tourism management innovative talent cultivation system is used to express the change causality of the whole system, which is defective in that it cannot indicate the individual quantitative change mechanism of the whole quantitative change process [25]. This paper further clarifies the role of the influencing factors, applies the system dynamics method to construct an explicit dynamics model, and utilizes the decision-making feedback mechanism to clarify the above problems. Through the level variables, rate variables, constants and other factors, the system dynamics method can construct the flow chart of the relationship between the behavior of each factor, which comprehensively and specifically reflects the organizational structure of the overall system, the role of the mechanism and other issues [26]. According to the design of the flow chart of the role and influence relationship between each influencing factor in the industry-academia integration innovative talent cultivation system of the multiple intelligence theory, combing the characteristics of the variables that cannot be revealed in the single causal influence relationship, revealing the role mechanism of individual elements in depth, and realizing the purpose of the simulation of industry-academia-research cooperation innovative talent cultivation system.

From the previous variables and combined with the causality diagram, the role relationship between the variables, and then form the industry-university fusion innovative talent cultivation system flow diagram as shown in Figure 6, in the constructed system flow diagram of industry-university fusion, including 4 state variables, which are university capital, talent cultivation capacity of cooperation platform, institutional capital, student quality index, and enterprise capital. In addition, the constructed flow diagram includes 6 rate variables, 8 auxiliary variables, and 12 constants. In order to simplify the parameter estimation of the model, certain variables that do not change significantly are fixed as constant values in the text, such as governmental inputs, results conversion rate, enterprise capital inputs, and capacity building.

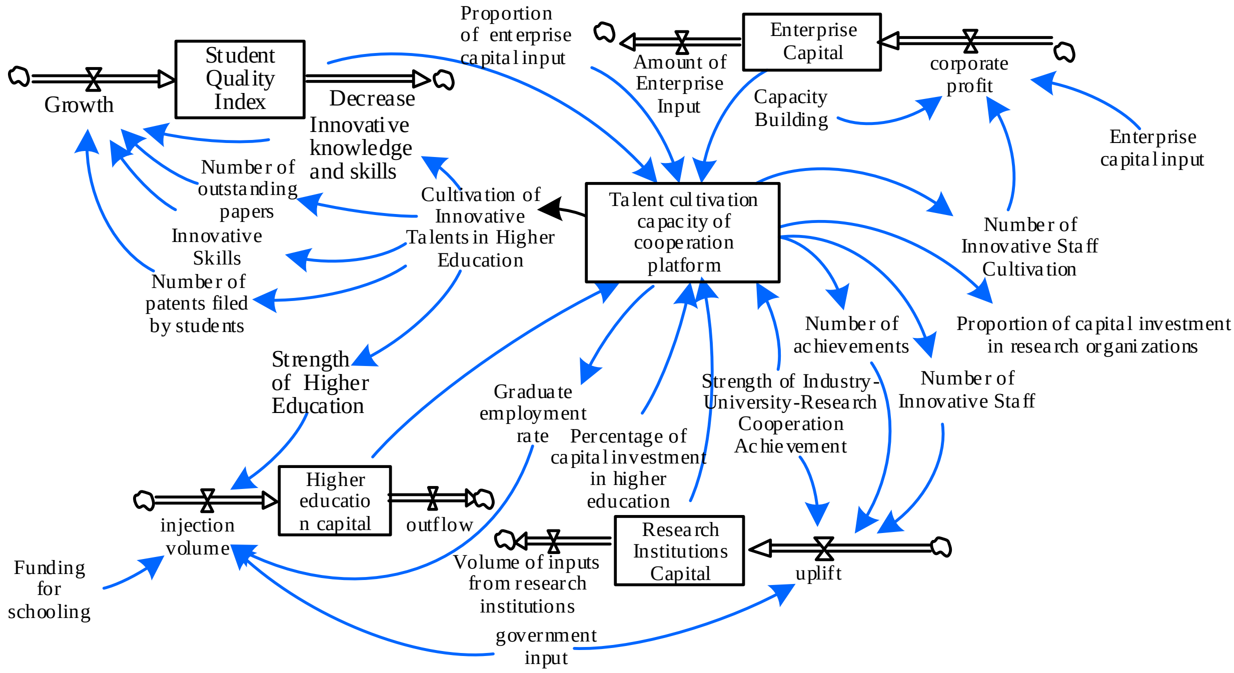


Figure 6. Flow diagram of talents training for industry-university integration

In addition, table functions are extensively used in this model to deal with numerous nonlinear problems. For variables with linear relationships, the parameters are determined by linear regression analysis.

4.2.2 Empirical tests of the hierarchical Matthew effect

First of all, the criteria for class division are determined, and innovative talent cultivation subjects are classified into high level (H), medium-high level (MH), medium-low level (ML), and low level (L) according to the full-time equivalents of R&D personnel and the high level of R&D funding of the innovative talent cultivation subjects. If the input level of the year is high, it means that it is above 200% of the average level. Medium-high level means that the input level is between 150% and 200% of the average level, medium-low level means that the input level is between 50% and 150% of the average level, and low level means that the input level is below 50% of the average level.

Secondly, the probability of knowledge transfer between different standard levels of each tourism innovative talent training subject is evaluated. The knowledge transfer probability for a step length of d year is denoted as:

$$P_{ij}^{t,t+d} = P\left\{X_{t-d} = j \middle| X_t = i\right\} \tag{18}$$

Where $P_{ij}^{t,t+d}$ denotes the one-step knowledge transfer probability that a subject whose knowledge level is at type i in year t transfers to type j after d years.

Combining all subjects and possible knowledge transfers over the entire examination period, the Markov transfer probability P_{ij}^{d} for the examination period is obtained as:

$$P_{ij}^{d}=\frac{\sum_{t=t_n}^{t_n-d} n_{ij}^{t,t-d}}{\sum_{t=t_n}^{t_n-d} n_i^t} \tag{19}$$

Where n is the sum of all subjects that belonged to type i in year t and shifted to type j in year $t+d$ for the entire examination period, and n denotes the total number of subjects whose level of R&D resources belonged to type i in year t.

The estimation leads to the d-year time-length Markov transfer probability matrix, i.e:

$$\begin{bmatrix} \frac{n_{11}^d}{n_1^d} & \cdots & \frac{n_{1j}^d}{n_1^d} & \cdots & \frac{n_{14}^d}{n_1^d} \\ \frac{n_{21}^d}{n_2^d} & \cdots & \frac{n_{2j}^d}{n_2^d} & \cdots & \frac{n_{24}^d}{n_2^d} \\ \cdots & \cdots & \cdots & \cdots & \cdots \\ \frac{n_{41}^d}{n_4^d} & \cdots & \frac{n_{41}^d}{n_4^d} & \cdots & \frac{n_{44}^d}{n_4^d} \end{bmatrix} = \begin{bmatrix} p_{11}^d & \cdots & p_{1j}^d & \cdots & p_{14}^d \\ p_{21}^d & \cdots & p_{2j}^d & \cdots & p_{24}^d \\ \cdots & \cdots & \cdots & \cdots & \cdots \\ p_{41}^d & \cdots & p_{4j}^d & \cdots & p_{44}^d \end{bmatrix} \tag{20}$$

Where the diagonal elements of the matrix represent the probability of maintaining the status quo for each type of level subject at d year length during the examination period, i.e., the probability of level curing. Finally, the existence test of the level Matthew effect is carried out. It includes two steps:

The first is to examine whether rank solidification exists.

The second is to examine whether rank curing increases over time. If the phenomenon of solidification between high and low levels is significant and shows a degree of intensification over time, it indicates the existence of the phenomenon of the hierarchical Matthew effect.

5 Analysis of the dynamic mechanism of industry-academia integration for the cultivation of innovative talents

According to the system dynamics simulation analysis method, and combined with the actual situation of the current tourism industry-academia integration of innovative talents training, as well as the mastery of the relevant data of J University. Therefore, this paper chooses the tourism management program of University J and the partner institutions that have industry-academia cooperation with University J as the system dynamics research object of this paper. By analyzing the relationship between the system variables derived from the data, it applies the system simulation method to analyze the operational development trend of the industry-teaching integration talent cultivation model combined with multiple intelligences. Based on the research results, it tries to provide optimization suggestions for the scientific practice of cultivating innovative talents in tourism management.

5.1 Initial Value Setting and Parameter Assignment

Through the network platform of undergraduate colleges and universities J and field research, we can get the data survey of the tourism management program of undergraduate colleges and universities J and the X enterprise, which is the object of industry-university-research cooperation with undergraduate colleges and universities J, and get certain values of the enterprise and the undergraduate colleges and universities in the past three years, as shown in Table 1. It can be seen that the university's academic revenue increased from 5.35 million yuan in 2019 to 7.5 million yuan in 2022, and the enterprise's revenue increased from 2.83 million yuan in 2019 to 3.56 million yuan in 2022, and the industry-academia integration constituted by the undergraduate colleges and universities and the enterprise realizes a win-win situation.

Table 1. Variable assignment

	2019	2020	2021	2022
Amount of funds injected into running schools	535,0000	650,0000	720,0000	750,0000
Graduate employment	96.15%	97.38%	94.74%	93.26%
Excellent publications	103	92	114	128
The fresh graduate student Numbers	3724	3581	3314	3526
Students' academic works are published	23	29	15	37
Corporate earnings	283,0000	225,0000	336,0000	356,0000
The technology of conversion	10.87%	11.34%	12.86%	12.55%
Platform to cultivate employee number	0.3155	0.6826	0.7534	0.7808

In the innovative talent cultivation model of industry-university-research teaching in this paper, the simulation time of the knowledge value-added system dynamics model of students is selected as 2008-2022, with one year as a unit simulation time, totaling 14 years. Therefore, the initial value of the knowledge stock of the knowledge population in this paper refers to the amount of publication of academic works of each knowledge subject in 2008, so the initial values of the knowledge stock of the knowledge producer, i.e., University J, the knowledge consumer, i.e., Enterprise X, and the knowledge disaggregator are set to be 3,214, 4,085, and 2,379, respectively.

5.2 Analysis of empirical test of model Matthew effect

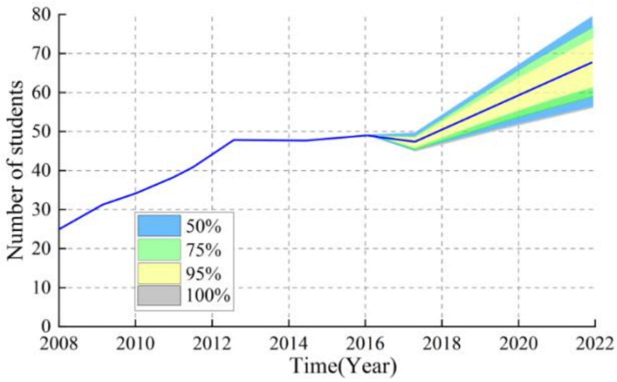
Matthew effect analysis is a method of studying uncertainty for evaluating and predicting the benefits of developing innovative talents in university tourism, which means that after determining the control and observation quantities, we can judge whether the parameters are sensitive or not by adjusting the values of the control quantities to observe the changes in the behavior of the model when the observation quantities change in a certain range, i.e., we can observe the changes in the magnitude of the sensitivity graphs.

Vensim DSS provides a function for analyzing the Matthew effect, also known as Monte Carlo simulation. It can not only provide univariate Matthew effect analysis but also multivariate Matthew effect analysis, and at the same time, it can also analyze the Matthew effect of multiple variables at the same time. In this paper, the parameters of the Matthew effect analysis are set as shown in Table 2, and the Matthew effect of the number of students of industry-academia integration of tourism management majors on the expected incremental increase in knowledge of universities and the increase in the contribution rate of enterprises, which are the three uncertainties, is selected.

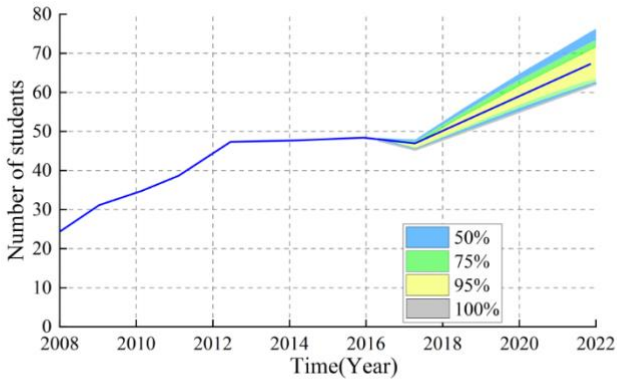
Table 2. Matthew effect analysis parameter list

Observed quantity		Simulation times		Noise seed
Number of students		500		1315
Control variables	Current	Distribution type	Value range	
			Minimum value	Maximum value
Teach the student proportion in production	0.05	RANDOM UNIFORM	0.02	0.07
Knowledge increment, expected to colleges and universities	1.50	RANDOM UNIFORM	1.2	2.0
Increase in the contribution rate of enterprises	0.0051	RANDOM UNIFORM	0.0025	0.0081

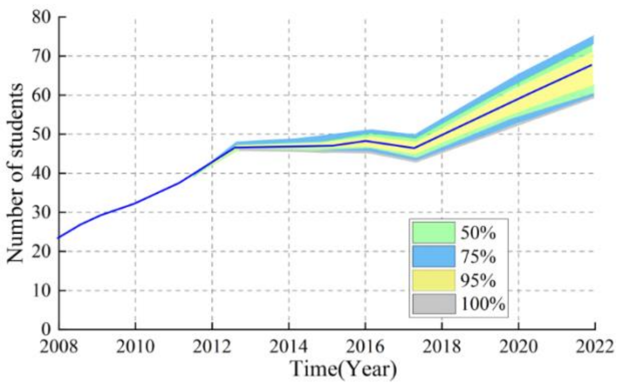
The initial values of the previous parameters and the analysis of the Matthew effect set the parameters into the model, and the basic output analysis results of the three variables are obtained, as shown in Figure 7. Figure 7 (a) and Figure 7 (b) present the confidence intervals of 50%, 75%, 95%, and 100% for the number of personnel participating in the innovative teaching model of industry-teaching integration in a 100-times simulation and the larger the confidence intervals indicate that the range of the increase in the knowledge of the students participating in the innovative teaching model of industry-teaching integration in Tourism Management majors is the larger, and the stronger the Matthew effect on the variables is. Figure 7(c) and Figure 7(d) present the analysis of the Matthew effect and the simulation trajectory of the students participating in the innovative teaching mode of industry-teaching integration of tourism management majors under the simultaneous changes of the two variables, respectively.



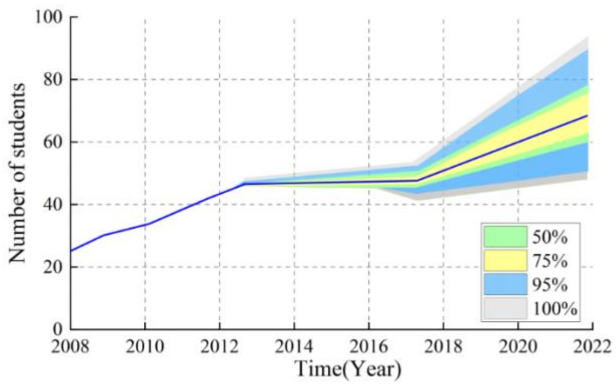
(a) Matthew effect analysis of student numbers



(b) The Matthew effect of expected knowledge increment in universities



(c) Matthew effect analysis of students participating in innovative teaching modes



(d) Matthew effect analysis of students who do not participate in innovative teaching mode

Figure 7. Matthew effect analysis of students with innovative teaching mode

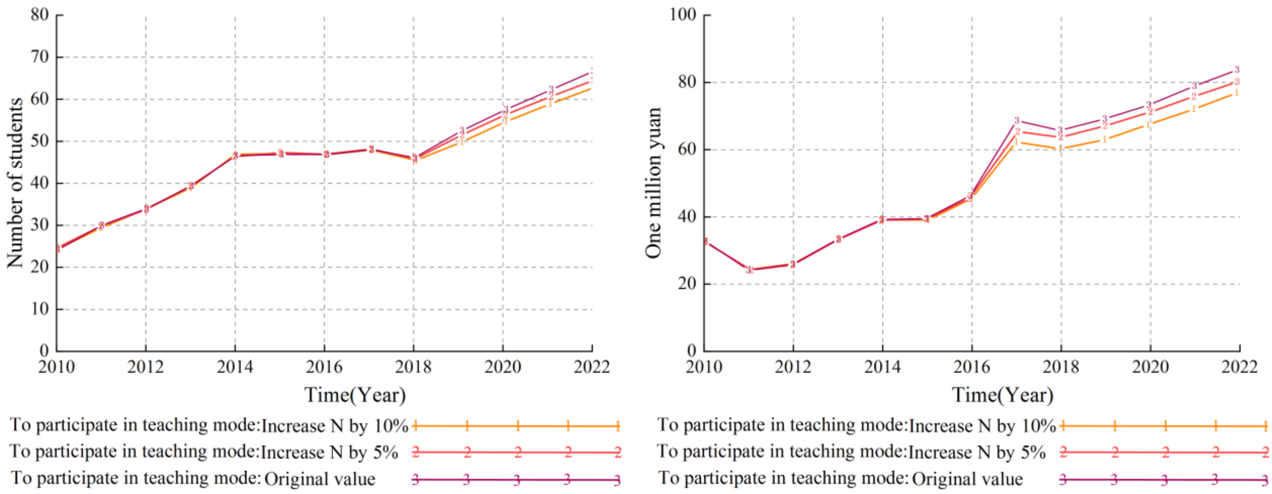
The analysis of the Matthew effect of the influence of each of the above three variables on students participating in the innovative teaching model of industry-teaching integration in tourism management majors shows that the 95% confidence interval has the largest percentage, and in 2016, the Matthew effect was generated. Participating in the innovative teaching model, students have a greater elasticity to the expected incremental knowledge of higher education, and the Matthew effect is stronger, that is, as in the evolutionary trend of Figure 7 (a). Side by side with the evolutionary trend of Figure 7 (b) and (c), the Matthew effect was generated in 2016 and 2012, respectively. In particular, the Matthew effect on the increase in local revenue and enterprise efficiency by students participating in the innovative teaching model is relatively weak. The expected enterprise contribution rate is the least affected by the Matthew effect. Meanwhile, the Matthew effect of students participating in the innovative teaching mode of industry-teaching integration of tourism management majors on the joint influence of the three variables is the strongest, i.e., the evolutionary trend in Figure 7(d).

In summary, the results of the evolution can be seen that teachers can not be limited to the ivory tower and should have extensive contacts and exchanges with industries and trades outside the campus. Teachers as a whole should have a wealth of practical experience, an understanding of the operating mechanism of enterprises, an understanding of market demand and development trends, and be able to introduce students to changes in a timely manner and adjust the content of education and teaching in a timely manner on this basis. At the same time, there should be different academic voices in the university. It is because of the different academic voices and academic thinking in universities and colleges that continue to mingle and collision will have a different view of the problem, will produce innovative thinking, will promote innovative thinking of tourism management students continue to burst.

5.3 Analysis of simulation results of industry-academia collaborative system dynamics

In order to examine the impact of changes in the level of innovation resource location in tourism management on various innovation factors, simulation results are generated by making changes in the initial value of innovation resource location level in enterprises and universities. Using VensimPLE software, we simulate the impact of a 10% increase or a 10% decrease in the initial value of the innovation resource location level of enterprises and universities on the key factors of collaborative innovation, such as the number of cooperative published academic works and the success rate of collaboration. In the following, we focus on the two dimensions of cooperative published academic works and collaborative success rate to analyze the different impacts of the changes in the resource position of enterprises and universities, as well as the changes in the policy factors of both sides.

The sensitivity test results are shown in Fig. 8. From the dimension of cooperative published academic works, the impact of changes in the resource level of enterprises, universities, academics and researchers on the number of cooperative published academic works is shown in Fig. 8(a). When the resource level of enterprises or the resource level of universities and research institutes increases or decreases by 10%, it will bring about corresponding changes in the number of cooperative published academic works, which in turn affects the transformation rate of local achievements, innovation revenue and other corresponding collaborative innovation links. From the perspective of collaborative success rate, Figure 8(b) illustrates the impact of changes in the level of enterprise, academic, and research resources on collaborative success rate. The impact is more significant. The level of enterprise and academic and research resources increased by 10%, the success rate of synergy has a more significant enhancement, that is, the coupling compatibility degree of the university-industry fusion system of tourism management majors rises by 1.286 gradients, and the Matthew effect of the incremental knowledge of colleges and universities rises by one level.



(a) Co-published academic works dimension (b) Success dimensions together

Figure 8. Sensitivity test results

That is to say, if the level of resource level of innovation subject is reduced due to various factors, its negative impact on the establishment of collaborative innovation relationship and collaborative results is relatively large, which is unfavorable to the development of university-industry-university-research collaborative innovation. Therefore, while promoting the improvement of the level of resource level of innovation subject, it is more crucial to avoid the negative impact on the resource level of innovation subject from innovation incentives, innovation services and other fields.

6 Conclusion

The research in this paper is mainly based on the relevant research results of the theory of multiple intelligences, based on the basic characteristics of innovative talents in tourism management majors in colleges and universities and the current demand for talents in tourism enterprises as an entry point, puts forward the innovative talent cultivation mode of industry-teaching integration of tourism management majors in colleges and universities based on the theory of multiple intelligences.

1) In the industry-academia-research teaching innovative talent cultivation mode, University J participates in the strongest Matthew effect of the increase in knowledge of the students of the industry-teaching fusion innovative teaching mode of tourism management majors, indicating that the cultivation of innovative talents is largely dependent on the quality of students in colleges and universities and the practice of the enterprise.

2) The increase in the level of enterprise and academic and research resources by 10% has a more significant effect on the success rate of synergy, i.e., for every 1.286 gradient increase in the coupling compatibility degree of the industry-academia fusion system for tourism management majors, the Matthew effect of the knowledge increment in colleges and universities rises by one grade relatively.

3) The current research on the innovative talent cultivation mode of tourism with multiple intelligences is relatively weak, and most of them adopt decentralized research, and the research on the innovative talent cultivation mode of tourism in colleges and universities is also relatively small. There is still a great research prospect for the research of innovative talents training in college tourism, and the ultimate goal of the research is to make the

cultivated college tourism professionals able to use the knowledge they have learned to complete the relevant tourism work tasks and to realize the most fundamental purpose of vocational education, i.e., to apply what they have learned to what they need to do.

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References

[1] Jing, Z. (2023). Construction and application of piano to intelligent teaching system based on multi-source data fusion. Journal of circuits, systems and computers.

[2] Yuan, Z. (2021). Interactive intelligent teaching and automatic composition scoring system based on linear regression machine learning algorithm. Journal of Intelligent and Fuzzy Systems, 40(2), 2069-2081.

[3] Klein, R., & Celik, T. (2021). The wits intelligent teaching system: detecting student engagement during lectures using convolutional neural networks.

[4] Hadi, A., Suwidagdho, D., & Ningsih, R. (2021). The role of multiple intelligences: for career guidance and counselling services for vocational high school teachers. KONSELI : Jurnal Bimbingan dan Konseling (E-Journal).

[5] Bao, Y. (2021). The construction of innovative computer practical training education model in the environment of multiple intelligences internet of things. Journal of Intelligent and Fuzzy Systems(5), 1-11.

[6] Nce, E. Y., & Nce, M. (2021). Automatic e-content sequencing system for personalised learning environments by using fuzzy ahp based on multiple intelligences:. Journal of Information Science, 47(6), 821-837.

[7] Xie, X. (2021). Construction of innovative computer training education mode under the environment of multiple intelligences internet of things. Journal of Intelligent and Fuzzy Systems(13), 1-11.

[8] Ferrero, M., Vadillo, M. A., & Samuel P. León. (2021). A valid evaluation of the theory of multiple intelligences is not yet possible: problems of methodological quality for intervention studies. Intelligence, 88(June 24), 101566.

[9] Liu, Z. (2022). Retraction note: mountain soil characteristics and agrotourism management optimization based on distributed collaboration. Arabian journal of geosciences.

[10] Kim, E. J., & Pomirleanu, N. (2021). Effective redesign strategies for tourism management in a crisis context: a theory-in-use approach. Tourism Management, 87(77/78), 104359.

[11] Kharel, S., Anup, K. C., Devkota, N., & Paudel, U. R. (2022). Entrepreneurs' level of awareness on knowledge management for promoting tourism in nepal. Journal of information & knowledge management(2), 21.

[12] Lima Muniz, Emerson CleisterDandolini, Gertrudes AparecidaBiz, Alexandre AugustoRibeiro, Alessandro Costa. (2021). Customer knowledge management and smart tourism destinations: a framework for the smart management of the tourist experience - smartur. Journal of knowledge management, 25(5).

[13] Liao, X., Fu, Z., Huang, Z., Li, Z., & Li, X. (2021). Exploration and practice of "integration of production and education, integration of science and education and integration of theory and practice" in medical talent training. Advances in Applied Sociology, 11(6), 308-314.

[14] Bodrunov, S. D. (2018). Convergence of technologies as a new basis for integration of production, science and education. Economics of Contemporary Russia.

[15] Qian, Y. (2020). Research on the integration of production and education with china's occupation education.

[16] Garg, S., & Roy, D. (2022). A birds eye view on knowledge graph embeddings, software libraries, applications and challenges.

[17] Gupta, S., Justy, Théo, Kamboj, S., Kumar, A., & Kristoffersen, E. (2021). Big data and firm marketing performance: findings from knowledge-based view. Technological Forecasting and Social Change, 171.

[18] Khan, I. U., Usoro, A., & Crowe, M. (2021). Is organisational culture a hurdle in online knowledge sharing a conceptual view. International Journal of Business Information Systems, 37(3), 336-.

[19] Scuotto, V., Le, L. L. S., Magni, D., & Maalaoui, A. (2022). Extending knowledge-based view: future trends of corporate social entrepreneurship to fight the gig economy challenges. Journal of Business Research, 139.

[20] Tran, L. T. T. (2021). How coopetition-driven innovation model works: a closer look at inlearning and absorptive capacity from a knowledge-based view. European Journal of International Management, 1(1), 1.

[21] Costa, D., Favero, E., & Cunha, W. (2022). Baiuka – an educational kids game based on the multiple intelligences theory that narrates amazonian legends.

[22] Peterlin, J., Dimovski, V., Meko, M., & Roblek, V. (2021). Cultivating management education based on the awareness of students' multiple intelligences. SAGE Open, 11(1).

[23] Murad, O. S. (2021). Multiple intelligences in light of gardner's rating and the extent of their consistency with academic disciplines for the students of al-balqa applied university. Universal Journal of Educational Research, 9(2).

[24] Cichocki, A., & Kuleshov, A. P. (2021). Future trends for human-ai collaboration: a comprehensive taxonomy of ai/agi using multiple intelligences and learning styles. Computational Intelligence and Neuroscience, 2021(3), 1-21.

[25] Yahay Mohammed Bani Abduh Raafat Abd-el baast Kabil. (2021). Analyzing the reality of the education process at najran university in light of the theory of multiple intelligences among faculty members. Psychology (Savannah, Ga.), 58(1), 5842-5863.

[26] Sarayreh, A., & Sarayreh, A. M. (2021). The effect of a training program based on multiple intelligences on developing environmental awareness and achievement motivation among primary school students in jordan. Journal of Educational and Social Research, 11(3).

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