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A Study on the Maturity Evaluation System of Local Universities' Smart Campus Environment Based on Fuzzy

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Abstract:

The purpose of this paper is to promote the development of a smart campus using the fuzzy comprehensive evaluation method. The method discusses and analyzes three aspects of a university's smart campus environment construction, including infrastructure, support platform and institutional mechanism, and determines the weights of each dimensional index by combining the method of expert consultation, calculates the fuzzy affiliation degree of each dimension by using the fuzzy comprehensive evaluation method, establishes the matrix and analyzes the evaluation results. As a result, 17% of the affiliation degree of the intelligent environment construction of a university was calculated as "budding stage", 39% as "integration stage", 23% as "integration stage", 21% are in the "innovation stage". According to the maximum affiliation degree, the comprehensive evaluation level of a university's intelligent campus environment construction can be determined as the "integration stage". Conclusion The evaluation model of smart campus environment construction built by multi-level fuzzy comprehensive evaluation method is relatively objective and reasonable, and the evaluation results can better guide the construction and improvement of smart campus development.

Keywords*: smart campus; environmental construction; maturity model; evaluation system.*

I. INTRODUCTION

In recent years, the informatization construction of higher education institutions in China has made great progress, from the initial stage of computerization characterized by a stand-alone information system to the stage of campus network construction, and then to the stage of digital campus construction. In the last two years, the informatization of colleges and universities began to enter the stage of intelligent campus construction [1]. Each stage is led by the development of the computer hardware environment, which subtly changes our campus informatization environment [2], therefore, the establishment of this model can effectively evaluate whether the development stage and level of the digital campus environment in which a university is located is in line with the orderly promotion of the smart campus construction.

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II. SMART CAMPUS ENVIRONMENT BUILDING MATURITY RATING AND CHARACTERISTICS

In the process of construction, the smart campus revolves around service informatization, and there is no clear guiding document to rely on [3], in order to help universities correctly understand the development stage and development level of their smart campus environment construction, this paper, based on the models of CMM and SCCMM and combined with the actual situation of [4]information construction of a local university, carries out 3 dimensions from infrastructure, support platform and institutional mechanism Evaluation, the construction of smart campus environment is divided into 4 stages. As shown in Table 1.

TABLE I. Building a Smart Campus Environment

Level	name (of a thing)	Phase Description	Key Features
1	germinal stage	Some of the wisdom-based technologies are used in a few business areas, in isolation from each other.	Spontaneous, individual, isolated
2	integration phase	Multiple smart class technologies are used at scale in multiple business areas and are already interconnected with each other for system integration.	Organized, scaled application, integrated whole station
3	integration phase	There are deep applications of smart class technology in all business areas, where business and technology converge.	Various business areas, deep applications, convergence
4	innovation phase	With IT support, the school's education and teaching model, research and collaboration model, and management and decision-making model have all been innovated with a significant IT contribution.	Deep integration and model innovation

III. METHODOLOGY FOR THE ESTABLISHMENT OF EVALUATION INDICATORS

The construction of a university's smart campus is a complex system project, and the architecture of a smart campus is the design reference for the construction of a smart campus, and the framework model for the design of a smart campus environment is shown in Figure 1 below. In order to make a local university have a clear understanding of the development status of its smart campus environment construction, we need to establish uniform rules to establish the determination model from 3 dimensions: infrastructure, support platform, and institutional mechanism.

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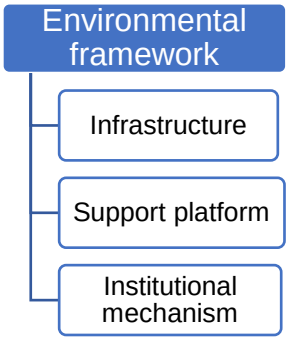

Fig 1: Framework model of a smart campus environment in a university

3.1 Infrastructure

Campus network construction: college campus weak electrical pipe network, integrated wiring to meet the needs of intelligent campus applications and other observations [5].

Datacenter construction: Datacenter room construction standards and architecture, data center reliability and utilization, use of cloud computing, meeting business system usage requirements, and other observations [5].

Public terminal construction: campus network access mode and coverage, campus bandwidth per capita, degree of wireless coverage, deployment of intelligent security systems, and other observations [6].

3.2 Support platform

Construction of a basic service platform: a unified framework of information standards and norms within the school has been built, and data exchange and sharing systems and other observatories have been built using data centers [7].

Construction of basic business platform: realize cross-platform unified and integrated identity authentication for different business systems and support single sign-on and other observation points.

3.3 Institutional mechanisms

Organizational safeguards: standardized management structure, rules and regulations, and other observations

Mechanism security: Observations such as funding and talent security for information technology construction.

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According to the evaluation indicators in different dimensions, we set the weight benchmark scores and set relatively fixed observation points for each secondary indicator, but with the construction of smart campus and the update and iteration of information technology and dynamic enhancement, the weight scores can be adjusted accordingly [8-9].

Ⅳ. INTEGRATED EVALUATION APPLICATION PROCESS

4.1 Fuzzy comprehensive evaluation of smart campus environment construction

First, the decision set, i.e., the evaluation rating set v = {budding stage, integration stage, convergence stage, innovation stage} and the evaluation indicators for the rating dimensions were determined as $U = \{u_{1,}u_{2,} \ldots u_3\}$, and then the expert leaders of the computer information center filled out the maturity survey form for the construction of the smart campus environment (see Table 2).

$$R = \begin{Bmatrix} r_{11} & r_{12} & \cdots & r_{1m} \\ r_{21} & r_{22} & \cdots & r_{2m} \\ \vdots & \vdots & \cdots & r_{3m} \\ r_{n1} & r_{n2} & \cdots & r_{4m} \end{Bmatrix} \#(1)$$

TABLE II. Smart Campus Environment Building Maturity Surve

Primary evaluation index	Primary weight	Secondary evaluation index	Secondary weight	Three level evaluation index	Three level weight	Embryonic stage	Integration phase	Fusion stage	Innovation stage
Infrastructure	0.60	campus network construction	0.13	wired network coverage	0.20	0	0.1	0.1	0.8
				wireless network coverage	0.20	0.5	0.4	0.1	0
				campus network operation	0.20	0.1	0.2	0.4	0.3
				campus network exit	0.20	0.2	0.2	0.1	0.5
				campus network technology	0.20	0.1	0.2	0.3	0.4
		data center 8 construction	0.15	data center machine room	0.17	0	0.1	0.2	0.7
				server configuration	0.33	0	0	0.3	0.7
				memory	0.33	0	0.1	0.5	0.4

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				configuration					
				cloud service construction	0.17	0.1	0.3	0.1	0.5
		public terminal 5 construction	0.12	Multimedia Classroom	0.30	0	0.1	0.1	0.8
				Smart Classroom	0.20	0.4	0.5	0.1	0
				safety monitoring system	0.30	0	0.1	0.3	0.6
				energy saving and emission reduction system	0.20	0.1	0.1	0.3	0.5
Support platform	0.27	basic service platform construction	0.13	domain name service system	0.20	0.1	0.2	0.1	0.6
				website group management system	0.30	0.2	0.2	0.2	0.4
				e-mail system	0.20	0	0.1	0.4	0.5
				information release system	0.10	0.2	0.2	0.2	0.4
				unified messaging system	0.10	0.3	0.3	0.4	0
				virtual community	0.10	0.4	0.5	0.1	0
		basic business platform construction	0.12	unified identity authentication and management	0.20	0.5	0.5	0	0
				unified information portal	0.20	0.4	0.5	0.1	0
				unified information service interface	0.20	0.5	0.5	0	0
				campus one card system	0.40	0	0	0.3	0.7
Institutional mechanism	0.13	organizational support	0.18	leading organization for informatization	0.29	0.3	0.5	0.2	0
				informatization functional management organization	0.28	0.7	0.2	0.1	0
				technical support service system	0.29	0.5	0.2	0.3	0
				think tank system construction	0.14	0.6	0.2	0.1	0.1

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				construction planning	0.21	0.4	0.5	0.1	0
		Mechanism guarantee	0.17	management system	0.21	0.1	0.6	0.3	0
				decision making mechanism	0.14	0.4	0.5	0.1	0
				financial support	0.30	0.2	0.5	0.2	0.1
				assessment and incentive	0.14	0.5	0.2	0.2	0.1

where v is the set of evaluation ratings, m is the number of elements in v, u is the set of evaluation indicators, and p is the number of elements in u [10]; determine the weight vector of evaluation indicators u as $A = (a_1, a_2, a_3 \cdots, a_p)$, then the fuzzy affiliation of this rating dimension

$$B_i = A_i \circ R = (a_1, a_2, a_3 \cdots, a_p)\begin{Bmatrix} r_{11} & r_{12} & \cdots & r_{1m} \\ r_{21} & r_{22} & \cdots & r_{2m} \\ \vdots & \vdots & & \vdots \\ r_{n1} & r_{n2} & \cdots & r_{nm} \end{Bmatrix}, (i = 1, \cdots, s)\#(2)$$

The fuzzy matrix for the single-factor secondary evaluation of each dimension is.

$$R_{\textbf{Infrastructure}} = \begin{Bmatrix} 0.18 & 0.40 & 0.20 & 0.22 \\ 0.02 & 0.57 & 0.32 & 0.10 \\ 0.10 & 0.52 & 0.20 & 0.18 \end{Bmatrix}\#(3)$$

$$R_{\textbf{Support platform}} = \begin{Bmatrix} 0.17 & 0.38 & 0.23 & 0.22 \\ 0.28 & 0.28 & 0.14 & 0.30 \end{Bmatrix}\#(4)$$

$$\mathrm{R}_{\textbf{Institutional mechanism}} = \begin{Bmatrix} 0.51 & 0.01 & 0.19 & 0.29 \\ 0.29 & 0.04 & 0.19 & 0.48 \end{Bmatrix}\#(5)$$

The experts gave the following weights to the secondary evaluation indicators for each dimension.

$$A_{Infrastructure} = (0.28 \quad 0.44 \quad 0.28)\#(6)$$
$$A_{Support\ platform} = (0.17 \quad 0.28)\#(7)$$
$$A_{Institutional\ mechanism} = (0.5 \quad 0.5)\#(8)$$

B1, B2, B3, B4, B5 Construct a composite evaluation matrix based on the set of evaluation factors$U = \{U1, U2, U3, U4\}$using the composite evaluation matrix of single factors, and C is the composite evaluation result.

$$\mathrm{A} = (0.6 \quad 0.26 \quad 0.14)\#(9)$$
$$\mathrm{C} = \mathrm{A}^{\circ}\begin{Bmatrix} B_1 \\ B_2 \\ B_3 \end{Bmatrix}\#$$

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$$= (0.6 \quad 0.26 \quad 0.14)^{\circ}\begin{Bmatrix} 0.09 & 0.51 & 0.25 & 0.16 \\ 0.23 & 0.33 & 0.19 & 0.26 \\ 0.40 & 0.03 & 0.19 & 0.38 \end{Bmatrix}\#$$

$$= (0.17 \quad 0.39 \quad 0.23 \quad 0.21)\#(10)$$

4.2 Analysis of evaluation findings

By calculating the fuzzy synthesis of the overall set of R, we analyzed the comprehensive evaluation results of smart campus environment construction: the proportion of those belonging to the "budding stage" was 17%, the proportion of those in the "integration stage" was 39%, the proportion of those in the "integration stage" was 23%, and the proportion of those in the "innovation stage" was 21%. The proportion of the "integration stage" is 23%, and the proportion of the "innovation stage" is 21%. It can be seen that the comprehensive evaluation grade of the university's intelligent campus environment construction is in the "integration stage".

Ⅴ. CONCLUSION.

In summary, the analysis and research of the fuzzy-based maturity evaluation system of wisdom campus environment construction, the model is in line with the actual situation of wisdom campus development, can better reflect the next step of wisdom campus development construction and improvement goals, and has the promotion and guidance significance to guide the systematic construction and evaluation of wisdom campus. Bibliography.

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